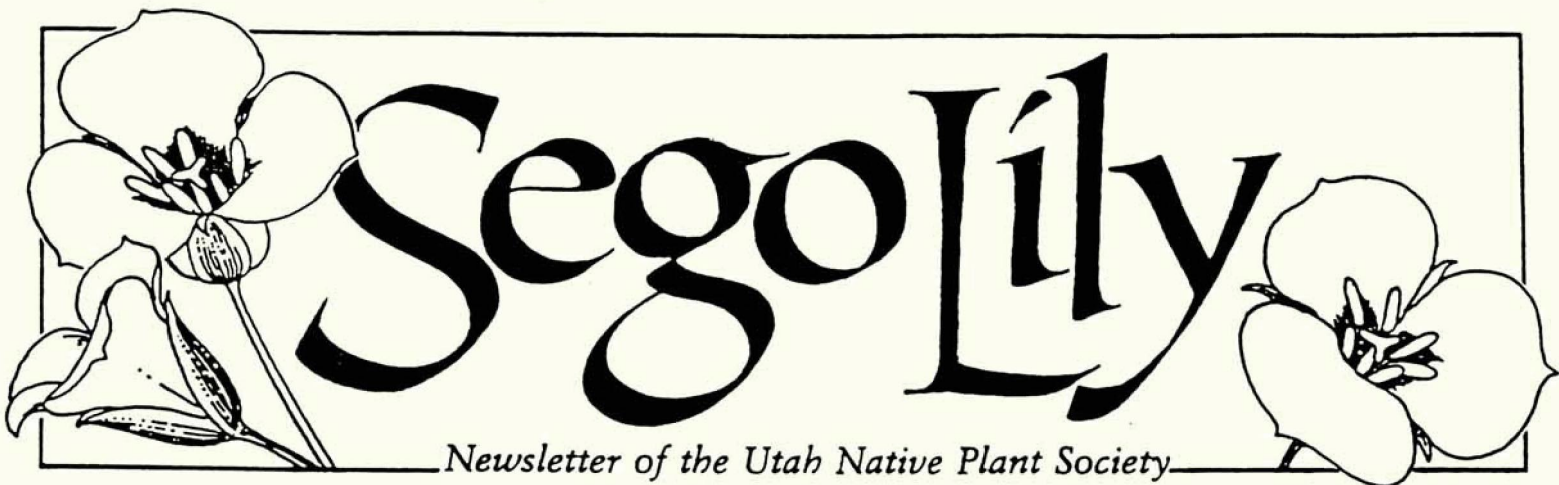




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Toxic Plants: Native and Introduced Hazards to Horses

by Jeannette Glover

Poisons, essentially those produced by plants, have been recognized since antiquity. They were usually discovered by observing the reactions of birds and animals to the foods they ate.

Poisons fall into five categories: nerve poisons, internal organ poisons, irritants, allergy producers, and minerals.

Nerve poisons affect the nervous system and are further classified by which part of the nervous system they attack. Those attacking the somatic system interfere with nerve control of the striated muscles causing symptoms in consciously controlled parts of the body such as the legs. Poisons attacking the autonomic nervous system interfere with smooth muscles functioning unconsciously such as the heart, stomach and lungs. Finally, there are the poisons which interfere with the central nervous system. Three well known poisons of each preceding kind are curare, scopolamine, and opium.

Internal organ poisons affect organs such as the liver, kidneys and stomach and range from mild reactions such as stomach upset to deadly reactions such as liver destruction or prevention of oxygen assimilation in body cells.

Irritants are substances which can burn the skin and mucous membranes causing mild to severe damage as in the case of blister beetles when swallowed.

Allergy producers affect only those individuals who have developed or are inclined to develop an allergy to them. The reactions may be as mild as a runny nose or result in anaphalactic shock which can be fatal if not treated quickly.

Mineral poisons in plants are due to the absorption by plants of large quantities of a potentially lethal mineral such as lead or selenium.

Blister Beetles

One of the most interesting and frightening poisons found in feed is due to the blister beetles which live in clusters in growing alfalfa. These may be inadvertently baled with the hay, especially if a swather is used instead of a sickle mower which allows the insect to escape rather than crushing it as a swather does.

This beetle produces cantharadin which causes blisters wherever it touches a horse's tissues; so that when a horse eats the contaminated alfalfa, the entire digestive tract is severely irritated. The chemical is absorbed and excreted through the kidneys causing irritation of the kidneys, urinary bladder and urethra as well. Calcium levels may plunge causing destruction of heart muscle, body tremors, and a peculiar breathing pattern of periodic jerking contractions of the diaphragm in unison with the heart beat (synchronous diaphragmatic flutter).

Symptoms include colic, diarrhea, bloody bowel movements and urine, ulcers of the mouth, frequent and painful attempts to urinate, hanging the muzzle in water without drinking, congestion of the mucous membranes, elevated temperature, dehydration, increased pulse, quickened breathing, depression, and shock. Sometimes an animal will die suddenly from heart failure without showing any symptoms.

It has been determined, through research, that it takes as little as five grams of blister beetles to kill a horse. It is a very difficult poisoning to diagnose, so it is very important to check all bales of hay for any sign of these beetles before feeding it to horses.

In addition, first or fifth crop alfalfa hay may be used because it is much less likely to contain beetles due to their life cycle. Also, Brome may be used as an alternate feed.

[Ed.note: The blister beetle can also cause blisters in humans, commonly under clothing where the beetle crawls. An extract of the beetle is used to remove warts.]

Poisonous Plants

Poisonous plants are ubiquitous in our environment, many of them prized for their beauty and medicinal qualities. They grow in pastures, on range land, and down roadsides, we encourage them to grow in our yards and gardens. Fortunately, not many poisonous plants are palatable and usually will not be eaten when there is plenty of proper feed available. Unfortunately, bored or curious horses are likely to sample anything within reach and a gleeful escapee is likely to indulge on anything and everything within reach.

Less than one percent of the known plant species are poisonous; and most of these vary in toxicity depending on growth conditions (temperature, moisture), the season, the amount eaten, the stage of development, the type of soil, and the size and sensitivity of the victim. It is a rare poisonous plant that is always extremely poisonous.

Editor's Note of Thanks

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Listed below are some of the more common poisonous plants, their geographical location, a brief description, symptoms of poisoning, and other data as available.

Aspergillus. Aspergillus is a genus of molds sometimes observed in stored hay. Moldy hay is easily identified by the "moldy" odor and "dusty" look when a bale is opened. Although not all mold in hay is Aspergillus, it is better to discard all such hay because of the threat of respiratory disease caused by Aspergillus Fumigatus and the carcinogenic and highly toxic secondary metabolites called "aflatoxins" produced by A. flaves and A. parasiticus. These molds are ubiquitous in our environment.

Bluegreen Algae. Not all bluegreen algae are poisonous, but of those that are, the most important ones grow in fresh water lakes, ponds, and reservoirs where the poison produced may contaminate drinking water. Usually this is not a problem because of the small number of algae; but when they "bloom" (a condition where the algae multiply at such an accelerated rate that they cover the entire surface of the water coloring it a pale blue-green), the poison level in the water may be high enough to harm animals drinking it, and many animal deaths from this have been documented.

These algae require generous amounts of phosphorus, nitrogen and other nutrients found in water, especially water containing fertilizers washed out from agricultural fields or contaminated with sewage.

Algae are cyanobacteria; the three species most commonly associated with poisonous blooms are Anabaena flos-aquae, Aphanizomenon flos-aquae, and Microcystis aeruginosa referred to by many biologists as "Annie, Fannie, and Mike".

Black Locust (Robinia pseudo-acacia). This deciduous tree is a legume and may reach a height of 80 feet. The bark is deeply furrowed and brown with 1/4 to 1/2-inch thorns. The sweet-scented, white, pea-like blooms hang in clusters 4-8 inches long later developing into 3-4 inch bean like pods which turn brown and dry. Alternate leaves are compound; the leaflets are smooth margined, opposite, oval 1-2 inches long, and number seven to nineteen.

It is common in the eastern United States, a native of the central states and a transplant in the West. It is also called yellow locust and false acacia.

All parts of the plant are poisonous and cause diarrhea, stupor, depression, colic, weak and irregular heartbeat, and death. Symptoms appear within a few hours after eating any part of the tree.

Black walnut (*Juglans nigra*). This is a tall deciduous tree cultivated throughout the United States for its fruits, which are edible after being shelled.

Wood shavings used for bedding may cause colic and laminitis in horses nibbling at them; also horses chewing on the bark or branches of trees within their reach may become ill. In addition, the pollen from the blossoms may cause an allergic respiratory reaction.

Bracken Fern (*Pteridium aquilinum*). This plant is a large perennial herb growing throughout the United States on moist but well-drained sites, burned-over areas, woods, and shady places with dry, sandy or gravelly soil. Fortunately it is unpalatable, but horses may feed on it when other food is scarce or if it is mixed in the hay. It has a cumulative effect.

This fern bears its sori (clusters of spores) along the margins of its broad leaf blades which are rolled back over the sori. The plant contains the enzyme thiaminase which inhibits the absorption of vitamin B1 (thiamine) in the intestine by destroying the vitamin before the horse can absorb it.

The symptoms include weight loss, lack of coordination, deterioration of nerve function, depression, and muscle twitching. Signs of poisoning are slow to appear and an untreated horse will eventually die.

Treatment consists of taking the horse off the contaminated feed and giving intravenous injections of thiamine hydrochloride.

Buttercup (*Ranunculus acris*). This perennial herb grows in moist fields, pastures, meadows and gardens throughout the U.S. It has light yellow flowers and deep green leaves divided into three segments which are again divided into three segments.

The plant contains a bitter tasting oil which produces blisters and inflammation around the mouth. Symptoms include, colic, diarrhea, jerking spasms. In severe cases it may cause extreme damage to the digestive system, temporary blindness and convulsions.

Castor Bean (*Ricinus communis*). Castor bean, also known as Castor oil plant and palma Christi, grows throughout the U.S. as an ornamental in yards or as a cultivated crop in California and the Southwest to produce castor oil. It is a native of Africa.

This shrub-like plant with branched, green to reddish or purple stems grows from 4-15 feet tall depending on the climate. The leaves are alternate, long-stalked, up to three feet wide with 5-11 lobes which have saw-toothed margins. The flowers form in a dense terminal cluster 1-2 feet high. The glossy seeds are mottled with a pattern of thin white, brown, and black lines and encased in a spiny pod. The seeds look like a fat, blood-filled tick which is

where its scientific name *Ricinus* (also the scientific name of the tick it resembles) comes from.

The foliage of young seedlings is toxic, but the greatest amount of the poison called ricine is found in the fleshy part of the mature seeds. The processed oil is not poisonous.

Ricine poisoning may be mild, producing a burning sensation in the mouth, throat, and stomach with mild colic; or, depending on the amount ingested, it may produce more severe symptoms such as colic, diarrhea, sweating, thirst, trembling, weakness, a "thundering" heartbeat, violent convulsions and death due to failure to breathe. Only a few ounces of beans can be fatal.

Poisoning may be prevented by clipping off the seed heads before they mature; but it is best to eliminate the plant entirely from your horse's environment.

Chokecherry (*Prunus virginiana*, *demissa*, & *melanocarpa*). This shrub or small tree is distributed in the eastern and western states, mostly in seasonally wet sites in valley bottoms and on hillsides. It has oval or egg-shaped, sharply-toothed, dark green leaves; yellow-white flowers in dense clusters; and red or red-purple berries. The leaves contain hydrocyanic acid which is released as cyanide when ingested causing death due to asphyxiation by interfering with the ability of the body's cells to absorb oxygen. It takes as little as 0.25 percent of body weight ingested as fresh green leaves to be lethal if consumed in a period of an hour or less. Drinking water intensifies the reaction.

Toxicity declines as the plant matures and it is not a very palatable plant. The main problem occurs in early spring before adequate preferred forage is available; so it is best to avoid grazing in areas with chokecherries at this season. This shrub is also deadly when the leaves are wilted from frost.

Symptoms appear soon after leaves are eaten and include rapid breathing, gasping, nervous excitement, agitation, staggering, convulsions, coma, and death unless treated immediately.

Other commonly found trees which also poison by way of hydrocyanic acid contained in their leaves, fruit pits, and bark are peach, cherry, apricot, and plum; so it is best to keep horses out of orchards.

Cocklebur (*Xanthium strumarium*). Cocklebur is a common annual weed found in lake beds, river bottoms, and disturbed soil of fields, pastures, and roadways. It is most dangerous to horses in the spring when they eat the young leaves.

Symptoms include rapid and weak pulse, labored breathing, and spasmodic contractions of leg and neck muscles.

Crotalaria (*Crotalaria agatiflora*). This evergreen shrub of the pea family is grown in the warmer areas of California and Florida as an ornamental because of its showy 14-inch flower spikes. alternate leaves are grey-green and divided into three, inch long leaflets. The loose seeds in the

roundish pod contain pyrrolizidine alkaloids that destroy the liver. Since the liver is a large organ able to function normally until about 60 percent of it is destroyed the symptoms are not immediately apparent making the onset of liver failure sudden and fatal within three to five days.

Daffodil (*Narcissus* spp.). This bright spring bloomer is widely grows in gardens everywhere. It is a bulb whose basal leaves usually grow the length of the flower stalk. The flowers are predominantly yellow or white with many variations.

These plants contain alkaloids with the greatest concentration in the bulb. The amount eaten dictates the severity of the symptoms which are colic, diarrhea, trembling, stupor, and possibly death.

Death camas (*Zigadenus venenosus*). This perennial, basal-leaved bulb grows early in the spring below 8,200 feet on foothills, in meadows and pastures from Canada to Florida to California, in the West, and the plains states.

The leaves are long, narrow, and grass-like around the base of the stem bearing branched clusters of white to yellow-white flowers. All parts of the plant are toxic containing alkaloids. It is considered one of the most poisonous plants in the western U.S. It is relatively unpalatable.

Symptoms include difficulty breathing, excessive salivation, weakness, coma, and death when even less than 10 pounds is eaten.

Delphinium (*Delphinium* spp.). The Delphiniums, also called larkspurs, comprise a genus of over 250 species of herbs from 2-6 feet tall; all of which contain alkaloids in varying quantities which act as poisons. While there are more than 80 native species growing across the U.S. they are more common in the West.

Leaves are lobed or divided finger-like on long stalks. The flowers are usually in a long terminal cluster, the prevailing color being blue.

The two most common western range varieties are low larkspurs and tall larkspurs; 0.5 to 3.0 percent of body weight ingested is lethal.

Several species of low larkspur are poisonous. They are generally between 6-24 inches tall and are found on grass or shrub-grass ranges in plains, dry meadows and foothills depending on the species. They are one of the earliest growing plants on spring ranges and the young growth is the most poisonous. It is palatable and matures early losing some toxicity. Sheep are not affected by these plants so part of range management for this plant problem is to graze sheep during the early part of the season and delay grazing horses or cattle. It may also be controlled with 2 pounds 2, 4 D ester/acre in its early growth stage.

Tall larkspurs grow 3-6 feet tall in tree or shrub shaded areas in mountains. These are large, erect plants relatively late maturing and poisonous at all times. They are palatable. This plant may be controlled by first grazing with sheep; but spot

chemical control or hand grubbing may often be the only feasible approach except for fencing off the worst areas.

Signs of poisoning include colic, bloating, muscle twitching, nervous symptoms, paralysis, and death.

Ergot (*Claviceps purpurea*). Ergot is a fungus which grows on several species of wild grass, rye, wheat, barley and other cereals in the U.S., Canada, and Europe.

The poisonous stage of the life cycle of this fungus is a dark, hard, "resting", structure called a sclerotium which matures at the same time the grain ripens. The characteristic alkaloids which act as poisons are produced only during sclerotia formation.

These various poisons act in several different ways. One form causes the smooth muscle to contract (miscarriages) and the blood vessels to constrict (gangrene due to insufficient blood supply). But some of the alkaloids inhibit the hormones adrenalin, noradrenalin, and serotonin causing the veins to dilate resulting in decreased blood pressure. Yet another alkaloid-lysergic acid amide (LDA)-is a precursor for lysergic acid diethylamide (LSD) which causes psychotic delusions in human victims and who-knows-what in a horse.

Animals may be poisoned either from grazing on infected wild grasses or by eating feed made from ergotty grain. Symptoms include convulsions, miscarriages, gangrene, and possibly death.

An historical note of interest here is that ergotism in people during the Middle Ages was named Saint Anthony's Fires and was believed to be caused by possession of the victim by the Devil, until a group of French physicians discovered the true cause in 1597. Since doctors during this time could do little to relieve their patients suffering, many victims who were able would make a pilgrimage to the shrine of Saint Anthony in Egypt in hopes his special powers would "drive out the demons".

Fescue (*Festuca arundinacea*). Fescues, specifically tall fescue, are not poisonous; but the fungus *Acremonium coenophialum* which grows within this grass produces an alkaloid which is poisonous.

This alkaloid poison causes abortion, retained placenta, lactation difficulties, and sometimes interferes in the growth rate of yearlings.

Some researchers believe interseeding with red clover helps offset the problem through dilution of the fescue plants; but most believe prevention is the best medicine. Keep pregnant mares away from the infected area 90 days before foaling; certainly no less than 30 days, and some recommend a full year off the contaminated fescue.

This particular grass is common in the Southeast but not the Intermountain West.

Fiddleneck, fireweed, tarweed, buckthorn, and yellow burr weed are a group of weeds common in

wheat and other grain crops in the West and Midwest, plus fiddleneck may also be found in hay fields and pastures.

This group of weeds contain pyrrolizidine alkaloid which causes liver damage when ingested. A single large dose, or several small doses eaten over days or weeks will cause poisoning.

Fortunately these weeds are not very palatable, but since a horse may be poisoned by eating small amounts over a period of time they pose a definite threat. In addition, since it is a liver poison, symptoms may not appear until it is too late.

Foxglove (*Digitalis purpurea*). This is a beautiful biennial herb growing 2-5 feet tall along roadsides, in open fields and in gardens from British Columbia south throughout the western U.S.

Its alternate leaves are simple, hairy, and toothed. It is the source for the drug digitalis used to treat congestive heart failure. Its flowers are tubular, 2 inches in length, purple or white-lavendar, and grow in 12-24 inch long clusters.

Leaves, flowers, and seeds are toxic, causing increased heart rate, skipped heart beats, bloody diarrhea, trembling, lack of appetite, convulsions, and eventually a complete cessation of the heart beat resulting in death.

Hemlocks. There are three kinds of hemlocks which grow in the U.S.. One is a tall evergreen tree which is not at all poisonous; and the other two are deadly flowering herbs.

Poison hemlock (*Conium maculatum*), also called deadly hemlock and spotted hemlock, is a 2-10 foot tall biennial herb belonging to the carrot family. It has hollow, jointed, multi-branching stems which are often marked with reddish purple spots. The alternate leaves are dark green with finely divided, fern-like toothed leaflets; the leaf veins terminate at the tips of the leaf "teeth". When the foliage is crushed, it has an offensive odor described by some like cat urine, mouse, or parsnip. Small white flowers grow in umbrella-like clusters at the tips of branches, and the small seeds are flat and ovate with notched edges.

It is found throughout the U.S., Canada, and Europe growing along roadsides, field edges, creeks, and ditches. All parts are poisonous due to at least five different alkaloids it produces; the most important of these is coniine. The lethal dose of hemlock is 0.1 to 0.5 percent body weight of ingested plant materials.

Poisoning is most common in the spring when the succulent young leaves appear before the better forage plants have become plentiful. It is wise to delay grazing until adequate amounts of preferred forage are available since it is not palatable but is eaten if it is the only food available. Symptoms include loss of coordination, staggering, drooling, slow heart rate, and respiratory failure leading to death. There is no successful treatment of this poison.

It is possibly the most famous poison in the entire world due to its use in the murder of the great Greek philosopher Socrates by his political enemies.

Water hemlock (*Cicuta maculata*) and western water hemlock (*Cicuta douglasii*) is a stout, erect, 3 to 7 foot herb with tuberous, thickened roots and small white flowers in umbrella-like clusters. The leaves are divided into 2 to 3 leaflets with sawtoothed edges but not the fern-like leaves of poison hemlock; additionally, the veins of its leaves terminate between the leaf teeth rather than at the tips. When the stem is cut, the yellow liquid which drips from the cut smells like raw parsnip giving it one of its common names, poison parsnip. Several other common names are: cowbane, snakeweed, wild carrot, beaver poison and spotted hemlock.

Different species of water hemlock grow in most of the U.S. and Canada along streams, ditches, and in bogs, swamps, and marshes. This plant must have its roots in water or extremely wet soil.

Water hemlock is probably the most poisonous plant growing in the U.S. due to a substance called cicutoxin which is an alcohol chemically. All plant parts are poisonous, but the roots are the worst; a walnut-sized piece of root will kill a cow.

Within 30 minutes of consuming a poisonous dose of water hemlock the victim will start drooling; this is followed rapidly by muscle tremors, violent convulsions, and death due to failure to breathe. There is no known cure.

Prevention includes grubbing out the plants, with special care given to removing all roots; delaying use of range or pasture until preferred forage is abundantly available; and treating chemically (possibly repeatedly).

Horsechestnut (*Aesculus* spp.). Horsechestnut, also called buckeye, is a widely planted deciduous ornamental shade tree growing up to 100 feet tall. The leaves are opposite on long stems with 5-9 leaflets arranged in a finger-like fashion. Clusters of snowy white, yellow, or dark pink blossoms appear with the leaves at the ends of branches. The fruit consists of 1-2 shiny brown seeds encased in a spiny capsule. All parts of the tree are poisonous due to a glycoside aesculin which causes colic, diarrhea, weakness, muscle twitching, lack of body control, mood swings, stupor, dilated pupils, and sometimes paralysis and death.

Horsetail (*Equisetum arvense*). This weed grows in flood plains, meadows, or any moist area with a high water table throughout the U.S.. It is a jointed, hollow-stemmed, green plant having no true leaves nor bearing any flowers. It can easily find its way into meadow hay; and since its poisoning is cumulative, horses may sicken after eating small portions over a period of time or after feeding on large portions when good forage is not available.

The poison produced by this plant is the vitamin B1 destroying enzyme thiaminase. With early

diagnosis, massive doses of thiamine and removal of the contaminated food can effect a cure.

Symptoms include excitement, muscle weakness, trembling, staggering, diarrhea, and loss of conditioning and death if left untreated.

Hydrangea (*Hydrangea macrophylla*). This particular species, of the 35 species in the U.S. is listed as being extremely poisonous. It is also called hortensia and is a commonly planted ornamental shrub which can reach up to 12 feet in height. It has bold, dense, clusters of pink, white, or blue flowers. The leaves are simple, 3-8 inches long, broadly oval, coarsely toothed, shiny, green above and lighter green below.

The buds, leaves, and branches contain a cyanide compound which produces colic, bloody diarrhea, nervous excitement, staggering, rapid breathing, gasping, convulsions, and possibly death due to asphyxiation.

Kentucky Coffee Tree (*Gymnocladus dioica*). This large, rough-barked tree is a member of the pea family growing up to 80 feet tall in moist woods from Canada to Alabama, Oklahoma, and Tennessee. It has twice-compound leaves arranged in 3-7 pairs of 2-4 inch oval leaflets without marginal teeth. The fruit is a thick, flat pod containing 4-7 broad seeds.

The leaves, seeds and pulp are poisonous if eaten, but apparently only mildly so for horses.

Lantana (*Lantana camara*). Lantana is a common ornamental flowering shrub found in yards, along roadways, or growing naturally in the dry woods of the southeastern U.S. or in the Southwest.

The dark green leaves are ovalish with toothed margins, roughish above, hairy below; and grow opposite or whorled along the main stem. The small tubular flowers show yellow first, then orange, then red, or all three colors at once in a single cluster. Sometimes the flowers are white or lavender. The two-seeded, fleshy berries are 1/4 to 3/8 inches across and turn blue-black when ripe.

All parts are toxic with symptoms of diarrhea and low blood sugar. Twenty to thirty pounds of Lantana will kill a horse.

Lily of the Valley (*Convallaria majalis*). This fragrant spring bloomer grows from a horizontal rootstock on a small upright rootstock called a pip containing a bud and many roots with two broad basal leaves which are oblong to oval, smooth and shiny dark green. The tiny flowers are bell-shaped, waxy, white or pale pink.

All parts are poisonous containing convallarin and convallamarin which are glycosides that work on the heart producing irregular pulse, irregular heartbeat, colic, mental confusion, extreme weakness, depression, collapse of the circulatory system and death.

Locoweed (*Astragalus* spp.). *Astragalus* species are found throughout the world and vary from non-poisonous to very poisonous. The

locoweed, also known as milkvetch, crazyweed, or poison vetch, is one of the most common poisonous plants in the West. It is a low-growing perennial herb belonging to the pea family with alternate, pinnate leaves consisting of leaflets arranged in feather-like fashion. The flowers are white to purple, pea-like blossoms and the seeds resemble garden peas encased in a dry leathery pod. These plants are "accumulators" growing on dry plains and slopes in soils rich in selenium which they accumulate from the soil and concentrate in their bodies making them poisonous for grazing animals. They are not palatable, but will be eaten in the absence of better forage. An exception to this is the timber milkvetch which poisons by nitro compounds contained in the plant which is a palatable plant growing in better sites, such as forested areas. Some locoweeds, once eaten, are addictive. The effects of this poison are cumulative and damage brain cells.

Symptoms include nervousness, weakness, emaciation, insatiable appetite, lack of coordination, impaired vision, impaired judgement (locoism), difficulty breathing, and sometimes death from heart failure or respiratory paralysis. Even if the victim survives, it may never fully recover due to the brain damage.

A horse will show symptoms or perhaps die after ingesting 600 pounds or more of locoweed over a period of a month and a half; whereas cattle must consume twice that amount in the same period to show symptoms.

Locoweed may be managed with chemicals, but are often too sparse to warrant their use so that provision of adequate preferred forage through good grazing management is generally the best alternative.

Lupine (*Lupinus* spp.). There are about 100 species of this hardy flowering plant throughout the U.S. in gardens, fields, on ranges, and mountainsides. The plants may be shrubby, from 4-8 feet tall. The alternate leaves are narrow, finger-shaped, and covered with fine hairs on both sides. The pea-like blooms form upright columns at the ends of branches and may be blue, purple, yellow, pink or white. Fruits are blackish, flattened pods containing 5-6 brown kidney-shaped seeds.

Most of these plants are not poisonous, but a few species contain toxic alkaloids throughout the entire plant which causes congenital deformities (teratogenic) and a few direct poisonings. The three main teratogenic-causing species are: silky (*L. sericeus*), spur (*L. laxiflorus*), and tailcup (*L. caudatus*) which is the most poisonous and one of the most abundant.

Alkaloid concentration is highest in early growth stages and in the mature seeds. Pregnant animals eating as little as 1 1/2 pounds per day during gestation produce deformed offspring. Symptoms of poisoning vary with the amount of poison in different lupine species; but generally, there are breathing

difficulties, muscle twitches, convulsions, sometimes unconsciousness and even death.

Milkweed (*Asclepias* spp.). These coarse, erect weeds grow in dry gullies, woods, on hillsides, and along roadsides throughout the U.S.. Most of the 60 species are very poisonous. The oblong to narrowly egg-shaped leaves are opposite or whorled with thick yellowish veins containing a milky juice. The small white, pink, or rose-colored flowers are usually in close, round clusters. The large, flat, rough seed pods are filled with many seeds, each with a tuft of long, silky hairs.

The poison is concentrated in the stems and leaves giving rise to symptoms within a few hours after ingestion. Symptoms include staggering, labored breathing, elevated temperature, perspiring, enlarged pupils, muscle spasms, and weakness.

It is a very unpalatable plant which is most poisonous when green but retains toxicity when dry.

Monkshood (*Aconitum* spp.). These beautiful perennials grow to 6 feet high and are found in woods, along creeks, in moist areas on mountain slopes, and in gardens throughout the U.S.. The leaves are basal and divided into 3 to 9 lobes finger-fashion. The flowers are usually borne on terminal clusters with the upper part of each resembling a hood; they are usually blue or purple, but there are a few white or yellow species.

All parts of all species are poisonous when eaten due to the substance aconitine which acts to slow down the heart.

Symptoms are: burning sensation followed by numbness of lips and tongue, dizziness, colic, diarrhea, slowed and weakened heart beat, muscle weakness, convulsions, and death. A relatively small amount of juice can be fatal within hours.

Nightshades. The members of the nightshade family are poisonous because of the alkaloids they contain such as atropine, scopolamine (hyocyamine), nicotine, and solanine.

The symptoms of poisoning by these plants are similar because all their poisons interfere with the nervous system producing digestive disturbances, rapid heartbeat, dry mouth (except Jerusalem cherry which causes drooling), weak pulse, trembling, dilated pupils, fever, weakness, depression, drowsiness, unconsciousness, and finally death due to heart failure or failure to breathe.

Not all parts of all species are poisonous; for example: Tomato (*Lycopersicum esculentum*) fruits are most enjoyable and nutritious, but the foliage and vines contain solanine. Irish potato (*Solanum tuberosum*) tubers are a food staple in many areas around the world, but the leaves, sprouts, and vines contain solanine; potato peel is poisonous for horses.

Eggplant (*Solanum Melongena esculentum*) has edible fruit, but the foliage and stems contain solanine.

Tobacco (*Nicotiniana*) species all have a high content of nicotine, especially in the leaves which are deadly when eaten and not particularly healthy when dried, cured and smoked (something our horses would never do).

The sinister reputation of the nightshades is based on such members as belladonna, henbane, deadly nightshade, black nightshade, and jimsonweed

(Angel's trumpet or Moon Lily) whose poisons are contained throughout the entire plant.

Belladonna (*Atropa belladonna*), also called deadly nightshade or poison cherry is a native of southern Europe and the Middle East, but is also a transplant to the United States where it is seen in gardens and occasionally in the wild. This herb, containing atropine, grows to a height of 2 to 5 feet on a stem covered with short hairs. The leaves are smooth-margined and about 6 inches long. The flowers are about 1 inch long having 5 petals, yellowish at the base and dull purple at the top. The fruit is dark purple and the size of a small cherry.

Deadly nightshade (*Solanum dulcamara*) is also known as European bittersweet, woody nightshade, blue nightshade, or climbing nightshade. It is a woody plant which climbs like a vine, at times reaching a length of 6 feet. The leaves are pointed with smooth margins. The flowers are white, purplish white, or deep blue. The fruit is a bright red berry. It grows wild in the woods throughout North America but was a native of Europe originally.

Black nightshade (*Solanum nigrum*) is known as American bittersweet, poison berry, and also deadly nightshade. The leaves and flowers (white with long yellow anthers) are similar to European bittersweet, but it is a smaller plant growing from 6 inches to 3 feet high with a green (not woody) stem and a dark purple to black berry. It is most common in waste places, cultivated fields, and yards in the eastern states but grows throughout the U.S.. Another species *S. americanum*, is a native nightshade growing wild along roadsides and in undisturbed areas; but it is essentially the same plant as *S. nigrum*. Wilted leaves are especially toxic. One to ten pounds of black nightshade can kill a horse.

Black Henbane (*Hyoscyamus niger*), alias stinking nightshade, fetid nightshade, and stinking roger, is an herb about 2 feet tall with toothed, hairy leaves 3-8 inches long. The flowers are 1-2 inches in diameter with yellow petals and purple veins. The fruit is green and less than an inch in diameter. As you may have assumed, it has a very unpleasant odor. It is an European transplant that is most common in the Rocky Mountain states.

Jimsonweed (*Datura stramonium*) is commonly called thornapple and stinkweed. It grows 3-5 feet tall and has a very unpleasant odor. It is found in open areas of foothills, dry pastures and vacant city lots throughout most of the U.S.. The smooth, broad, coarsely-toothed, alternate, 5-6 inch leaves grow from stems on a thick, multibranched central stock. The white or pale-violet flower are erect, five-pointed trumpet-shaped and about 4 inches long. The fruits are spiny, 2 inch, egg-shaped structures. The entire plant contains hyocyamine.

Jerusalem cherry (*Solanum pseudo-capsicum*) is an annual herb or evergreen shrub grown as an ornamental especially for Christmas time.

The leaves are deep green, shiny, waxy, oblong, and about 4 inches long. It has 1/2 inch wide white flowers borne in clusters; its fruits are scarlet globes resembling miniature tomatoes.

Southwestern thornapple (*Datura wrightii*) is 1-5 feet tall with large, 6 inch, trumpet-shaped flowers

protruding from oval, pointed, rank-smelling leaves up to 6 inches long, and covered with spines. The fruits of this plant hang down, while Jimsonweed fruits do not hang.

It is found in gullies and on plains from central California east to Texas and into Mexico.

Oak (*Quercus* spp.). There are approximately 80 species of oak distributed throughout North America. They vary from 3 foot shrubs to 150 foot trees; there is some variation in leaf shapes, but they are all identifiable by the seeds (acorns) which are borne in a basal cup.

Oak contain large amounts of gallotannin in the foliage, buds, and acorns and a little less in the bark. Signs of poisoning appear after several days or weeks of the relatively large amounts of poison-containing food that must be ingested before the horse is affected.

Symptoms include colic, constipation followed by bloody diarrhea, extreme thirst, frequent urination due to kidney involvement, rapid but weak pulse, liver damage, intravascular blood clotting and death.

Oleander (*Nerium Oleander*). Oleander is an ornamental shrub originally from Southern Europe but now found throughout the southern states, Hawaii, and California. Its 3-10 inch leaves are opposite or in whorls of three and tend to be thick and oblong with a prominent mid-rib on the underside of the dark green surface. The flowers occur in clusters and range in color from white to deep pink; the fruit is a cylindrical pod.

All parts are poisonous due to the glycoside named oleandrin which causes digestive upset, bloody diarrhea, irregular heartbeat, fleeting pulse, drowsiness followed by coma, lung paralysis, and death within hours or even minutes depending on the amount eaten. Only one half pound, or less, of oleander can be lethal for a horse.

Point locos (*Oxytropis* spp.). Point locos or point vetches are low-growing herbs with white to purple (purple vetch) pea-like flowers in dense spires rising just above the foliage on long stalks. They are often confused with *Astragalus* locoweeds, but this species keel (lower most) petals narrow to a point whereas *Astragalus* blossom's keel petals are rounded.

They are found on open plains and grasslands from Canada to Texas, and in the West to the eastern base of the Rockies in Montana and Wyoming and mountains of central Utah and Arizona.

Not all *Oxytropis* species are poisonous, but some of them are selenium accumulators and poison in the same fashion as *Astragalus* locoweeds with identical symptoms.

Rayless goldenrod. This bushy, 2-4 foot tall, shrub with yellow flowers grows in the Southwest and is also called rosea or jimmyweed. It contains the alcohol tremolol which causes depression, muscle tremors, stiff gait, and weakness. Lactating mares who have eaten this plant can poison their foals through their milk.

Red maple (*Acer rubrum*). This extremely poisonous maple tree, also called swamp maple is native to the eastern U.S.. A horse can die within a day or two after eating small amounts of wilted leaves or fallen autumn leaves which contain a chemical causing

the breakdown of blood giving rise to brown urine, rapid breathing, weakness, depression, and very dark blood.

Rhubarb (*Rheum raphaniticum*). Rhubarb is a deep-rooted, perennial herb frequently grown in gardens for its pleasantly acid leafstalks used in pies and sauces. It is also the most dangerous of all plants in a vegetable garden because of the lethal amounts of oxalic acid concentrated in the large (12-30 inch) basal leaves growing on long green or red stalks.

The oxalic acid crystalizes in the kidneys causing severe damage and the following symptoms: severe abdominal pain and cramping, weakness, labored breathing, internal bleeding, reduced urine formation, convulsions, and coma rapidly followed by death.

St. John's - wort (*Hypericum perforatum*). St. John's-wort (Klamath weed, goat weed) is a perennial plant growing from a woody base with 1/2 to 1 inch long leaves attached directly to the stem without a leaf stalk. These leaves have tiny, dark resin spots which are translucent when the leaf is held up to the light. The flowers are yellow, 5 petal, star-shaped, and about 1 inch across forming a round-topped cluster near the tops of branched stems. It is found throughout North America but is most common from California to Washington.

St. John's wort contains hypericin which is a chemical causing animals to develop severe sensitivity to light (photosensitivity) so that any unpigmented areas of their body will sunburn and develop red, swollen, sore, itching skin which peels off in sheets leaving skin lesions. This "sunburn" is generally not the cause of death, rather, most animals starve to death because their mouths are so severely burned they can not eat.

This plant is unpalatable and toxic at all stages but animals will eat it in early spring when the shoots are young and tender and preferred forage is unavailable. It is also a threat in stored hay.

A poisoned animal should be housed out of the sunlight and its lesions treated to avoid infection and promote healing.

St. John's wort is an imported plant and was first documented in the U.S. in 1793. It appeared near the Klamath River in northern California about 1900 and spread rapidly making a quarter of a million acres of rangeland worthless by 1940. In 1945-46 a small beetle with very specific appetite for St. John's wort and a few related species, but no other plant was introduced into California with a very impressive effect - in less than 10 years, 99% of the St. John's wort had disappeared and is now a minor problem.

Senecio spp. This genus includes groundsel, ragwort, tansy ragwort, and stinking willie, all of which contain the alkaloid pyrrolizidine which attacks and destroys the liver.

These weeds grow in pastures and meadows everywhere and may also cause problems in hay. A horse eating these plants will show signs of liver failure and may die if the dosage is high enough to destroy the liver.

White snakeroot, Richweed (*Eupatorium rugosum* or *Eurticae folium*). This 2-4 foot tall perennial herb grows in shaded fields, pastures, roadsides, and woodlands from Canada to Georgia, west to

Minnesota, and south to Texas. It has opposite, long stalked, smooth, thin, sharply-toothed ovalish leaves that are 3-5 inches long. The snow-white blooms appear in loosely branched clusters at the terminal ends of the branching stem. The entire plant is toxic due to the presence of trematol which passes into the milk of lactating mares and poisons their foals.

Two to ten pounds of white snakeroot can kill a horse due to heart failure and/or liver damage. The symptoms include weakness, lethargy, stiffness, and loss of coordination.

Yellow star thistle. Yellow star thistle is an abundant and unfortunately tasty range weed commonly found in abandoned cropland in the Southwest, the South, and along the Pacific Coast. Some horses become so fond of it they will eat it to the exclusion of better forage. It takes 35 to 40 days of eating this thistle before symptoms appear; these include foaming at the mouth, lip twitching, tongue flicking, inability to close the mouth, inability to grasp food and chew, and difficulty drinking even though the animal can swallow. Death is usually due to starvation and dehydration. This poison causes permanent brain damage as well. There is no known cure at this time, so it is kinder to have the victim euthanized. Applications of the herbicide 2,4-D (not toxic for horses at required levels) will eliminate this weed and its close relative "Russian knapweed" which causes similar symptoms when eaten over several weeks.

Yews (Taxus spp.). A common name for Yew is ground hemlock although they are no relation to the true hemlocks. The two most common yews are English and Japanese.

The yews are evergreen trees or shrubs with flat, pointed, needlelike leaves and thin, flaking, scaled bark. They produce a fleshy, scarlet, cup-shaped fruit which has one stony seed. Yews are much prized as ornamentals for landscaping and are found throughout the U.S..

Unfortunately they are very poisonous due to taxine, an alkaloid found in the foliage, seeds, and bark. As little as 3 ounces of yew can kill a horse suddenly from heart failure within minutes after ingestion. Horses exhibit muscle tremors, difficulty breathing, convulsions, and collapse.

[Ed. note: The poison in the yew is also extracted to be used as an anti-cancer drug for humans, taxol. It is now used for breast and ovarian cancer.]

Grasses. Several grasses are toxic to horses under unique conditions as with tall fescue and the cereal grasses previously mentioned. Torpedo grass, a lush pasture grass in the South, can cause anemia and death when ingested, Sorghum and Sudan grass, commonly found in Southwest and Southeast, are also harmful at certain stages. Drought and frost tend to intensify the glycosides in these plants causing normally beneficial plants to become poisonous. The animal dies from oxygen deprivation due to the action of the cyanide produced from the glycosides. Sorghum, in large amounts, can also cause prussic acid poisoning.

Dealing with poisoning. If you suspect your horse has eaten something toxic, call the veterinarian. Have a sample of the suspected food available so that the veterinarian has some idea of the kind of poison to

be treated. Although some types of poisoning are untreatable and fatal, others can be cured with fast treatment. It is even better if you can prevent the poisoning in the first place by observing a few precautions.

Do not feed shrub and tree trimmings to horses.

Do check all pastures, ranges, paddocks, and fence lines for poisonous trees, shrubs, and herbs. Be sure your horse can't reach over, under or through the fence and reach toxic plants.

Do take samples or parts of unknown plants to your county extension agent or garden center expert for identification. Your county extension agent can tell you the best way to eradicate problem plants.

Do inspect hay for poisonous plants and blister beetle before feeding, and discard any that is contaminated.

Do inspect bedding carefully for dangerous weeds before placing it in the stall; avoid using wood-shavings from the fore mentioned trees and shrubs.

Do graze to maintain and improve range or pasture conditions.

Do not graze beyond capacity as this will favor the increase of poisonous plants present in the environment.

Do not graze too early in the season; allow preferred forage plants to become well established.

Do not turn animals onto unfamiliar areas without checking first for poisonous plants.

Do be sure that adequate water is available at all times.

Do not make hay from areas with poisonous plants.

Do be aware of special environmental conditions such as drought, frost, unseasonable snow, and extreme moisture as these conditions may enhance the toxicity of some poisonous species.

Do not plant poisonous species on horse property.

Do be sure all orchards and garden areas are properly fenced to prevent horses from entering or reaching into them.

When poisonous plants are present in the environment control them either with chemicals, alternate stock grazing (sheep and larkspur), hand grubbing, or biological enemies (St. John's-wort and the beetle).

Be alert, be wary, be happy with a healthy horse.

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- Raven, Peter, Ray, F. Evert, and Eichhorn, Susan E., "Biology of Plants", Fourth Edition, Worth Publishers, Inc., New York, New York, 1986

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Tellez, Guilanme, "Blister Beetles: One Supplement A Horse Doesn't Need", The Chronicle of the Horse, February 18, 1994
Thomas, Heather S., "Beware of Poisonous Plants", The Chronicle of the Horse, June 9, 1995

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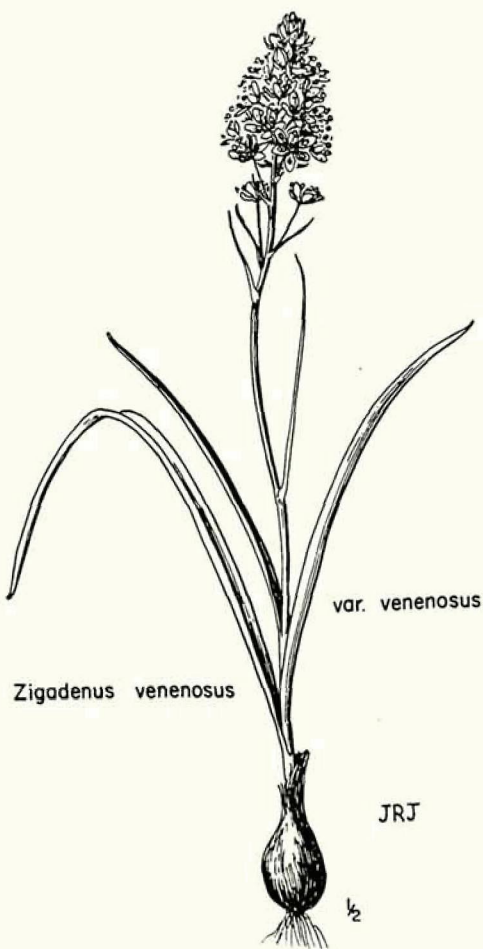
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Death Camas, *Zigadenus venenosus*

Illustration by Jeanne R. Janish. From Intermountain Flora by Cronquist, et. al., 1977.



VOL. 20 No. 2

MAR/APR 1997

CALENDAR OF EVENTS

Spring Talks Salt Lake Chapter, and Red Butte Garden

March 19, 7:00 p.m.
Utah Dept. Nat. Resources
1594 West N. Temple

Pam Poulson, Red Butte Garden and Arboretum
Everything You Wanted to Know About Wildflower
Identification but Were Afraid to Ask!

Mar 27, noon
Red Butte Visitor Ctr.

Robert Johnson, Great Basin Nursery
Native Perennials for the Garden
call 581-4747 for information

Apr. 16, 7:30 p.m.
U of U Fine Arts Museum

Dr. P Northington, National Wildlife Research Center
Nativescaping

Apr. 17, noon
Red Butte Visitor Ctr.

Sherman Brough & Ardean Watts
Common Mushrooms in Your Garden

STATUS OF KNOWLEDGE of Astragalus holmgreniorum and A. eremiticus var. ampullaroides

by Kimball T. Harper
Professor Emeritus, Brigham Young University

NOMENCLATURAL HISTORY

Astragalus holmgreniorum Barneby and A. eremiticus var. ampullaroides Welsh are two of the rarest plants in Utah. Like so many unusual taxa in the Utah flora, they are denizens of Washington County. Both are rather recently recognized taxa: A. holmgreniorum (the specific name is the plural form for Holmgren) was named in 1980 by Rupert Barneby, the reigning authority on North American locoweed species. The specific name honors Noel and Pat Holmgren, who with Barneby collected the specimens from which the species was named. Barneby's common name for the species, Paradox Milkvetch, similarly honors Noel and Pat, the "pair of docs". Although the species was first collected in Utah in 1941 by Melvin Ogden and has the overwhelming part of its small range in Utah, the specimen from which it was named was taken in Mohave County, Arizona on 26 May 1979, some 8 miles south of St. George.

Dr. Duane Atwood collected A. eremiticus var. ampullaroides (but unnamed at the time) on May 4, 1976 from Chinle shale on the Shivwits Indian Reservation, Washington Co., Utah. The population was recollected from that site by Stan Welsh and Atwood on 21 April 1982 and the species was named from that collection by Welsh in 1986. The common name (Shivwits Milkvetch) commemorates the site of collection. The varietal name indicates the similarity of the fruits of this taxon to those of another Chinle Shale locoweeds endemic (A. ampullarius Wats.) that occurs farther east in Washington Co. and more commonly on Chinle outcrops in Kane County. These two taxa share similarities in fruits but are quite different in other ways: A. ampullarius has blue flowers and prostrate to ascending growth habit, while A. eremiticus var. ampullaroides has ochroleucous flowers and strictly erect, very tall (< 3 ft) stems. A. eremiticus var. eremiticus Sheldon differs from the variety ampullaroides by having the caudex at or close to the soil surface, solid stems, and cylindric, elongated pods, while variety ampullaroides has a deeply subterranean caudex, fistulose (hollow) stems, and short, inflated ovoid pods. The var. ampullaroides occurs only on Chinle Shale, an unusual and harsh environment that few species can tolerate, while var. eremiticus seems never to occur on pure Chinle Shale.

RECENT COLLECTIONS

During the past 2 or 3 years, several new populations of both of these rare locoweeds have been discovered, primarily by Bob Douglas, a sharp-eyed botanist in the Dixie Area office of BLM, St. George. Previously unknown populations of A. holmgreniorum have been discovered just south of Santa Clara, near Stucki Spring, and in Purgatory Basin south of Quail Creek Reservoir. Although the 2 new populations south of Santa Clara may occasionally have pollinators move between them, they almost certainly are genetically isolated from the population complex near the historic town of Atkinville near the freeway into Arizona. The small Purgatory Basin population is even more disjunct from the Atkinville populations.

New populations of A. eremiticus var. ampullaroides have been discovered on BLM land west of the Shivwits Indian Reservation but on a disjunct outcropping of the Chinle Shale. Many years ago, Valori Armstrong, a BLM botanist working out of the Richfield office, discovered another population of A. eremiticus var. ampullaroides on Chinle Shale just east of I-15 along Utah Highway 9. She later discovered a very small, struggling population of the variety between the lanes of the freeway near Harrisburg. In 1996, Douglas found 2 other populations of the variety on either side of the freeway near Harrisburg. Both are on isolated

outcrops of Chinle and on land managed by BLM. Prior to construction of the freeway, the Harrisburg area population of A. eremiticus var. ampullaroides probably exchanged genes occasionally, but the freeway and its constant flow of traffic has, no doubt, stopped or greatly restricted movement of pollinators and seed dispersers between those populations.

GEOLOGIC RELATIONSHIPS

As noted above, A. eremiticus var. ampullaroides occurs only on Chinle Shale. This substrate is high in clay minerals that expand greatly on wetting and shrink in equal proportions on drying. The substrate is of a loose, grainy texture that is soft and puffy when dry and slick and gluey when wet. This combination of characteristics makes for an unstable surface that bulges up into small mounds when wetted and contracts to form deep, wide cracks when dry. Those qualities tend to destroy root systems so effectively that few perennial plants can persist on the Chinle. Roots are broken as the clays swell and bulge and again as they contract and open large cracks in the surface. Those qualities also make it difficult to mark individual plants for monitoring. Marking pegs are pushed from the soil as it swells or may drop into 3 inch wide, 3 feet deep cracks as the clays dry. Such marking pegs as are relocated may be several inches from the plant they initially identified, but even worse, a high percentage of the pegs are never relocated, apparently because they fall into deep crevices.

A. holmgreniorum is found primarily on the Virgin Limestone member of the Moenkopi Formation (6 of 9 known populations). Two other populations occur on the Upper Redbed of the Moenkopi Formation. A final population upsets any hypothesis of a neat plant-parent material relationship: it occurs on Chinle Shale.

ECOLOGICAL RELATIONSHIPS

Both of these locoweeds are short-lived (less than 5 years) and both are sensitive to droughty winters such as occurred on their habitats in 1995-96, a year in which neither species set any fruits. Flowers and fruits of both are also damaged by late frosts. Their persistence seems to be ensured primarily by their moderately large, hard-coated seeds. When suitable moisture and temperature conditions occur, seedlings appear in profusion. Mortality among seedlings is high for both species, but some individuals survive to flower in the year following germination.

There appears to be little physical difference among the clay surfaces where A. eremiticus var. ampullaroides grows. In contrast, significant

variation exists among sites that support the Holmgren locoweed. Sites that have greater than average density of the species averaged across several years tend to have deeper soils with a well developed erosional pavement of small rock fragments and to occur near intermittent drainage channels and at the base of slopes. Such sites probably have better than average growth water relations due to "run on" water, good infiltration rates, and slower than average physical evaporation from soil surfaces protected by the stony surface mulch.

ASSOCIATED SPECIES

The Shivwits locoweed has few reliable shrub associates other than the Gutierrezia microcephala. Associated herbs include species such as Eriogonum annual species, Hilaria rigida (sparse), Lotus humistratus, Monolepis nuttalliana, Plantago patagonica, Calochortus flexuosus, and the weedy red-brome (Bromus rubens). Species richness is low and vegetational dominants are annuals.

The Holmgren locoweed always occurred with two shrub-species: Acamptopappus sphaerocephalus and Lycium andersonii. Species richness is great on sites occupied by this locoweed with an average of about 41 species per site of occurrence (species encountered in 15 4.0 m² quadrats placed at random in the habitat of the locoweed). At the average site, 8 or 9 shrub species can be expected and about that many perennial dicot herbs. Native grasses are few (1 or 2), but species of native annuals are profuse with almost 20 being observed per sample. On average, 4 or 5 alien, annual weedy-plant species were also found per study site. In good years, living plant cover averages about 20% with shrubs contributing about 17% of that total, perennial grasses about 14%, and perennial dicot herbs about 5%. A whopping 40% of the living cover in 1993 (which was a good year for the warm desert communities of concern) was contributed by alien annuals. In contrast, native annuals contributed only 10 or 12% of the total living cover on Holmgren locoweed sites.

THREATS TO THESE SPECIES

Unfortunately, every population of Shivwits locoweed is threatened in one or more ways. This species is highly palatable to wild rabbits and domestic livestock. At all known sites, we have seen this species reduced to essentially no seed producing plants in at least one year by grazing animals in the last 5 years. A housing tract is being built across the street from the site just off the freeway along Utah Highway 9. That will greatly increase stress on that population. The population on the Indian Reservation is annually heavily grazed by cattle: few plants set

any seed at all. The newly discovered site on BLM land west of the Reservation is also grazed by cattle but less heavily than on the reservation. It is also handicapped by small population size. The population between freeway lanes is quickly being swamped out by vigorous populations of alien annuals. Apparently, the aliens are better adapted to traffic air pollution, regular disturbance due to road work and spraying for "weeds", and the incessant wind generated by speeding vehicles. The two new populations on either side of the freeway at Harrisburg are grazed each spring by cattle and both probably are too small to resist damaging genetic erosion from drift for very many decades. In summary, there isn't much positive to be said for the future of any known population of A. eremiticus var. ampullaroides.

The Holmgren locoweed has a smaller total geographic range than the Shivwits Milkvetch, but its populations are much larger. Nevertheless, the species is being pressed on every side by burgeoning human populations and immensely successful alien annual weeds. The population on the South Hills near Santa Clara is very near a proposed housing development as is a portion of the larger population in the Atkinville area.

The populations near the freeway are vulnerable to disturbances associated with freeway traffic, road maintenance activities, and conditions that favor success of the highly competitive alien annuals. The single Arizona population is situated near a historic watering place for domestic livestock (no longer so used). Areas adjacent to the locoweed habitat have been so abused by heavy livestock use that the better soils support only alien species. Such nuclei of alien weed seed keeps adjacent areas sown with aliens that can hardly fail to compete with Holmgren locoweed seedlings for space and resources.

The last discovered population of Holmgren Milkvetch is adjacent to a massive development that will become the new fairgrounds for Washington County. The site occupied by the locoweed closely parallels a dirt road that is now receiving unparalleled use and already had a heavy ingrowth of alien annuals. Road dust may foul stigmas and reduce reproductive success of this obligately outcrossed species.

In conclusion, we are again not optimistic about the future health of this very attractive locoweed. It, like the Shivwits locoweed, is palatable to grazing animals, but grazing seems a minor threat when compared with human alterations of its habitat.

The Rediscovery of the Yellow Ladyslipper

by
Keith J. Wallentine

The yellow ladyslipper orchid is an erect and stately pouched flower that once was found fairly widely in the U. S. but now is threatened with extinction by building development and by its own beauty, which has encouraged collectors, despite the fact it cannot be propagated successfully in captivity.

Utah once was home to thousands of yellow ladyslippers, and as late as the 1940s botanical textbooks noted the flower was present in Salt Lake Valley and could be found readily in the wet meadows where Millcreek emerged into the valley way out at 39th South.

By the 1960s Utah appeared to be down to one population of the orchid, known as Cypripedium calceolus by some botanists, parviflorum by others. That population was on the outskirts of Logan, where it had been watched over by that crusty and beloved botanist, the late Dr. Art Holmgren of Utah State University. In the mid 60s residential development reached the orchid's home ground, but Dr. Holmgren lost no time persuading the buyers of the homesite to treat them as royalty, which the owners were proud and happy to do. The plants prospered with only a few minor mishaps and remain although they've migrated a bit and some now are in the midst of the yard's landscaping.

Over the years wildflower enthusiasts continually kept an eye out for other yellow ladyslippers in the valleys and mountains but without success. It remained for the Utah Native Plant Society in 1993 to score a victory. The Society offered a reward to anyone finding the flower. Researchers from University of Utah working in Red Butte Canyon were stimulated to wonder if the flower possibly was one they had noted while working on another project. It seemed plausible inasmuch as the canyon had been closed to general traffic since the Army took it over more than a century ago.

Thus, on the afternoon of June 10, 1993, a small group from UNPS accompanied the two researchers to the canyon site to view the plants, which indeed were the yellow ladyslipper, yielding the \$200 reward. The boggy area containing the flowers may be the only place in the canyon it grows, but it's more likely there are other sites. The abundant presence of rattlesnakes in that particular area tends to slow foot by foot exploration.

In addition to the Red Butte site it still seems likely there are other places along the Wasatch as well as elsewhere in Utah that the yellow ladyslipper remains even now, and it's well worth keeping an eye out for the flower during spring and summer months. Stream banks and well watered meadows are good places to look.

However, in some parts of the country the flower is found on relatively well drained hillsides, such as both in New Jersey and in Virginia. The New Jersey site, possibly one of the last few remaining in an area once well known for the flower, is in a wildflower preserve under conifer trees. The area has been so heavily used the orchid plants now are protected by a cage of steel bars covered with mesh to assure their safety.

As with other rare wildflowers, anyone finding ladyslippers should enjoy them, take their pictures, then leave them and let them live.

Utah Native Plant Forum a Success

The Utah Native plant forum was held at Utah Valley State College in February. There was a large turnout of enthusiastic participants. Many people were involved in the commercial propagation of native plant species for both revegetation and private landscaping.

Thursday afternoon consisted of short presentations from several experts. Dr. Kimball Harper of Brigham Young University showed slides of representative floristic communities of Utah and set the enthusiastic tone of the meeting. Teresa Prendusi of the U.S. Forest Service outlined the challenges faced by the people of Utah, and in particular the land management agencies, in protecting the diverse flora of the state. She pointed out that in the United States there are 436 animals on the Threatened and Endangered Species list, and 613 plants on the list, yet only ten percent of the budget funds go to plant related conservation research, and the other 80% goes to the animals.

Pam Poulson of Red Butte Garden gave an inspirational presentation about her work with students and teachers, and gave us some ideas about how to connect with young people about our relationship with plants and the natural world. Bill Varga of Utah State University talked about edible plants, with humorous anecdotes about the inedible ones as well (such as the edible but unpalatable, fishy tasting glacier lily mush which he served up on one camping trip.)

Robert Johnson of Great Basin Natives, Mark Lawson of Porter-Lane Nursery, Ron Stevenson of Stevenson Intermountain Seed, Stan Young of USU, Richard Stevens of Utah Division of Wildlife Resources, and Glen Beagle of Lone Peak Nursery talked about the production end of the native plant nursery business, and about seed collection for nursery production or for reseeding in reclamation projects, with insights into how they make decisions about what to collect, how to grow the plants, and what the potential markets are.

Conley Thompson of Utah Department of Transportation, Rebecca Bonebrake of the Bureau of Land Management, and Steve Monsen of US Forest Service spoke on the subject of land management agencies' utilization of native species for revegetation and reclamation and about the challenges the agencies face in trying to enhance areas by revegetating with native plants while at the same time protecting the seed source habitat from overcollection.

Peter Lassig, landscaper for the Salt Lake LDS Temple Square for many years, gave a demonstration of how he plans, lays out and times the plant growth cycles for the various gardens and beds. He must take into consideration the soil types, the shade patterns cast by surrounding buildings, and the flowering periods of the many species and varieties used in his plantings.

Friday the participants broke into workshop groups to gather ideas for future actions to enhance knowledge and appreciation of our native plant heritage. Some of the ideas that emerged were:

- create a web-page for native plant enthusiasts to keep informed of developments and events.
- compile an information booklet to organize a service project utilizing native plants
- develop standards for native seed collectors to protect ecosystems from degradation.

The meeting was a huge success, and our hats are off to Dr. Susan Meyer from the U. S. Forest Service shrub research lab, Dr. Phil Allen of BYU, and Janett Warner of Wildland Nursery for organizing the meeting.

UTAH COUNTY CHAPTER ORGANIZED

Following the Utah native plant forum, the enthusiasm spilled over to create a new Utah County chapter of the Utah Native Plant Society. Susan Garvin and Dea Nelson of American Fork and Salem are organizing a chapter. Susan can be reached at 377-5717 at the U. S. Forest Service shrub research lab.

YELLOWSTONE INSTITUTE FIELD COURSES NATURE STUDY VACATIONS 1997

Some classes in which our members may be interested are listed below. For more information or a catalogue of all the courses offered write or call: The Yellowstone

Association, PO Box 117, Yellowstone National Park, WY 82190, tele: 307-344-2294.

Jun 20-22 Wild Edible Plants & Medicinal Herbs

Jul 18-19 Wildflowers of Yellowstone

Jul 20-24 Wildflowers Llama Trek

Jul 22-24 Wildflower Art

Jul 25-27 Alpine Wildflowers

Aug 30-Sept 1 Wild Edible Plants & Medicinal Herbs

RED BUTTE GARDEN & ARBORETUM Upcoming Activities (581-4747 for information)

Mar 27 Native Perennials for the Garden

Robert Johnson, Great Basin Nursery

Apr 17 Common Mushrooms in Your Garden

Sherman Brough & Ardean Watts

NEW BOOKS

The Alpine Flora of the Rocky Mountains, vol. 1: The Middle Rockies
by Richard W. Scott

This is a flora of all flowering plants and vascular cryptogams known to occur above timberline, as well as timberline conifers. This monumental volume, the first in a projected three-volume set, covers all mountain ranges in Wyoming, including the Medicine Bows, plus the Wasatch and Uinta ranges in Utah and the Beartooths in southern Montana. It includes information on 611 species, each with a distribution map and illustrations. The volume also contains discussions of the alpine environment and geomorphic processes, plant adaptation at altitude, descriptions of the various ranges and basins and their geologic histories, as well as botanical keys, glossaries of alpine and botanical terms and indexes of common and Latin names.

Available from University of Utah Press
\$110

Flowers of the Canyon Country by Stan Welsh
photographs by Bill Ratcliffe

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c/o Jo Stolhand
Utah Native Plant Society
P.O.Box 520041
Salt Lake City, UT 84152-0041

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Illustrated in color one hundred species of flowering plants and includes information on distributional range, habitat, size and flowering time.

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University of Utah Press is allowing UNPS members to buy these books at 40% discount with a minimum purchase of 11 books. Call Jo Stolhand at 801-521-0069 if you are interested in purchasing one of these books.

Guide to Flowering Plant Families
by Dr. Wendy B. Zomlefer

130 families common to the temperate zone are represented in 165 pen and ink drawings with 22 charts comparing related families and an illustrated glossary.

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VOL. 20 No. 3

MAY/JUNE 1997

CALENDAR OF EVENTS

May 28th, Wednesday
6:30 P.M.

Wildflower Walk in the Hills
Elaine Barton and Therese Meyer lead.
Meet at 6:30 at the new Huntsman headquarters, top of
Research Park.

May 31, Saturday
10:00 A.M.

Celebrate Wildflowers Hikes in Provo Canyon; all welcome
Dr. Kim Harper and others lead. Sponsored by Forest
Service and Utah County Chapter, UNPS. Meet at Rock
Canyon Park.

June 21 and June 22,
Saturday and Sunday,
8:00 AM

**RARE PLANT FIELD TRIP IN DINOSAUR NATIONAL
MONUMENT** (in cooperation with Colorado Native Plant
Society) Leader: Tamara Naumann
Meeting Location: see inside

PARTIAL FOR PENSTEMONS by Robert L. Johnson

For those already familiar with penstemons, their allure is unmistakable. Whether observed in the wild or in the garden, it is nearly impossible to walk past a flowering specimen without pausing to pay homage and offering a well deserved token of appreciation for something so heavenly. While many of the flowers seen in cultivation today (like annual bedding plants) have larger blossoms, brighter colors, or even longer bloom time, few if any capture the "wild essence" while still embracing spectacular beauty as does a penstemon. It is no wonder that penstemons in the garden are the envy of both amateur and seasoned gardeners alike.

CULTURE:

While some people apparently have good success with this group of plants, others struggle to establish and reproduce what seemingly is so easy for nature to cultivate. For those despairing over past failures growing this plant, or simply interested in giving penstemons a try, there are ways to improve your chances of success. Understanding the ecology of this diverse genus will allow you to better select the proper species for your growing conditions or assist you in altering your garden site to better meet specific growing requirements.

Overall, penstemons are relatively easy, not-so-fussy creatures. The problem most often encountered is their tendency to be short-lived. After waiting three years to enjoy a spectacular display of creamy-pink conchs ascend the three foot flower spikes of my *Penstemon palmeri*, I was dismayed to watch it fade, wither and die following anthesis. Such an event has often been labeled as "blooming itself to death" for lack of better understanding, but is most often due to other factors unrecognized. Number one on the list for fingering blame is certainly unsuitable soil conditions. I prefer to use unsuitable as opposed to poor soil conditions because even rich, organic soils may lead to problems. Most penstemons grow naturally in well drained, gritty soils and find it difficult to adjust to heavy soils that remain damp over extended periods of time. Penstemons that do grow naturally in heavier soils usually experience only a short period of moisture during which they grow, flower, and set seed, followed by drought induced dormancy.

My own over-eagerness to put penstemons in the garden without proper soil conditioning has been responsible for the demise of several plants. All did tremendously well the first year or two but eventually succumbed to crown rot. Crown rot can occur any time of the year but most often strikes during winter thaws when cool temperatures and excess soil moisture combine to promote disease on winter-stressed plant tissue. Besides wilting and yellowing of leaves, the most definitive symptom of crown rot is when upon examining a stressed plant, a slight tug separates the top leafy portion of the plant from the decaying roots at soil level. Exposure to the open air in freezing weather coupled with thawing and repeated cycles of freezing and thawing may also lead to plant desiccation, producing entry sites for plant pathogens.

DRAINAGE: If you want to improve the drainage in your own garden, try spading in pea gravel or builders sand. The common aeolian sand forming the sand dunes in many parts of Utah is generally too fine grained to provide adequate drainage for most species. Grit ranging in 1/8" to 1/4" yields desirable results. I have found that a raw mix of gravel ranging from sand size particles to large

gravel is adequate and creates a more natural look especially if you use the gravel also as a mulch layer. Some gardeners find perlite useful, but extensive use of perlite may not be cost effective and does look somewhat artificial. Since crown rot occurs where the leafy part of the plant connects to the root, the top few inches of the soil are most critical for providing good soil drainage, though 10-12 inches is best. When adequate drainage has been achieved, a mulch layer will help cool the soil and prevent soil moisture from excessive evaporation. Both gravel and bark mulch can be used effectively. The large, chunky, red lava rock, however, is definitely gaudy, unless of course you have a matching brown polyester jump-suit for your leisure garden wear. At such extremes, you are making a statement, and statements are not subject to opinions on style or decor. When using a mulch, however, the soil is able to retain more moisture, so be careful not to overwater.

WATER: Water requirements for penstemons can be highly variable. If you have a mix of native plant species, trial and error may be your best bet. If you have incorporated plants from the southwest, then it is important to realize that their flower season may correspond to the monsoon weather of late summer. If you have plants from the Great Basin and Rocky Mountains, then spring through early summer is the flower season for the majority of species. Arid desert penstemons often flower in spring and then are dormant throughout the remaining summer months. Watering once a week has provided satisfactory results. Though a weekly watering may not be a truly xeric application, there are some benefits. A little extra water can go a long way in extending the bloom time of many native species, including some penstemons. Also, if you have a large mix of species ranging from high to low elevations, a weekly watering during the hot summer months keeps those thirstier species happy while the more xeric species are able to keep their reservoirs full. Once again, opting for a weekly watering necessitates proper soil drainage. With a good mulch layer, watering can be postponed for larger intervals. For those attempting for a more xeric condition, remember that the flowering spikes of most penstemons will dry

and appear dead excepting for a few basal leaves near the plant's crown.

Also extra water is extremely important the first year until the plant becomes established and expands its root zone.

EASY PENSTEMONS: Don't let the possible difficulties, however, deter your attempt to try a sampling of penstemon species. The reward of one success far outweighs several failures, and there are even some penstemons that seem fail proof. Perhaps the most reliable penstemon to grow is the Rocky Mountain penstemon, *Penstemon strictus*. It grows fairly well even in heavier soils. It is also long lived, increasing its width yearly to form a large clump. There are also other penstemons which fare better in heavier, wetter soils. Most of these can be found growing naturally in mountain meadows where they are better adapted for both increased moisture and competition. Such penstemons are suitable in border planting where they share their space happily with other plants of similar heights. *P. strictus*, *subglaber*, *procerus*, *rydbergii*, *parvus*, and *whippleanus*, all do okay in such conditions. The only other factor to consider is iron availability. Some penstemons such as *P. whippleanus* often develop iron chlorosis when planted in slightly alkaline soils that are excessively moist. Decreasing the pH by adding organic matter, improving drainage, and watering less will assist in healthier plants. You can also apply chelated iron to the plant and soil to alleviate iron chlorosis when symptoms become serious.

LONG LIVED PENSTEMONS: Other species which do well in most soils and are long lived are those that tend to be somewhat shrubby, at least at the base. These species generally like a nice sunny spot somewhat to themselves, shying away from excess competition. *P. leonardii*, *sepalulus*, *linarioides*, *venustus*, and the southwest U.S. *pinifolius* are good examples. The more evergreen types like *P. cardwellii*, *montanus*, and *alpinus*, also grow well but are more susceptible to winter desiccation (primarily leaf dehydration) and are thus best placed in a sheltered sight, protected from wind and excessive freeze-thaw cycles.

PENSTEMONS REQUIRING GOOD DRAINAGE: The penstemons requiring particular attention in their cultivation are primarily desert species as well as mountain species that inhabit talus slopes, roadcuts, crevice communities, and/or gravely substrates. When driving the mountain roads in spring enjoying the wildflowers, you are certain to encounter *P. eatonii*, *palmeri*, or *cyananthus* growing on a road cut. This should provide you a clue that good drainage is certainly not detrimental to the survival of their species. Likewise, providing good drainage in the garden will promote plant health and longevity. I have witnessed the same flowering clump of Eaton's penstemon for several years in the wild, but have watched my own cultivated specimen give up the ghost after flowering during its third year. Of course I provided no special soil amendments to improve drainage like I should. Too often, I must admit, I simply put in plants, never having quite enough time for soil preparation. My hope is that eventually a plant will fall in love with a particular site and perform beautifully despite my neglect or best intentions.

FROM THE DESERTS: There are several desert species worth mentioning. *P. confusus* has thick, glaucous leaves and charming pink flowers. Likewise *P. pachphyllus* has similar leaves but striking blue flowers. *P. speciosus* offers green leaves with large purple-blue flowers. For the lovers of miniatures, *P. nanas* may fit the bill, only growing a few inches tall but with attractive violet-blue flowers. Another miniature that is a real traffic stopper is *P. petiolatus*. It can be seen growing on the limestone cliffs along the gorge between Saint George and Littlefield, Arizona. I guess most people don't really notice it because I haven't yet seen traffic stopped on I-15. If the species were a little larger, people probably would take notice. It has glaucous blue leaves that are somewhat holly like in appearance with intense magenta flowers. Northern gardeners will have to test the limits of its cold tolerance however. To the exclusion of many other species *P. brevicaulis*, *cleburnei*, *doliis*, *goodrichii*, *immanifestus*, *marcusii*, *moffattii*, *scariosus*, and *tidestromii* are noteworthy examples of Utah species inhabiting arid regions that require at least some cultural attention to

bring out their best form. I use "attention" in general terms only because most of these species either haven't been grown in cultivation or by few individuals only. There is still a lack of knowledge regarding specific growing requirements for many individual species.

FOR THE ROCK GARDEN: Other species which are small in stature and hence excellent for rock or alpine gardens include *P. humilis* (particularly var. *brevifolius*), *P. hallii*, *rupicola*, *acaulis*, *caespitosus*, *thompsoniae*, *grahamii*, and *bracteatus*. Rock garden penstemons perform beautifully when grown in scree, especially when placed next to rocks and boulders. Large stones act to moderate the environment by acting as wind breaks and heat sinks. They also provide a permanent mulch where roots can explore for deep moisture and receive protection during winter freezing.

PENSTEMONS FOR THE HUMMINGBIRDS: Another reason to grow penstemons is to attract hummingbirds. The red or magenta colored penstemons are hummingbird magnets. Of the red penstemons, *P. eatonii*, and *barbatus* are the most common. Not from Utah but certainly beautiful and similar in function is *P. pinifolius*, *clutei*, *cardinales* and *alamosensis*. One of my favorites is *P. rostriflorus*. Unlike the more subdued deep red of *eatonii*, this penstemon is a flamboyant red/orange. When viewing the two red heads together, it is like comparing a regular red head versus a carrot top. In pinker shades *P. pseudospectabilis*, and *utahensis* are large, ornamental species that are surely garden worthy.

PENSTEMONS FOR SANDY SOILS If sandy soil is a factor in your garden, then you are in luck, many penstemons are natural components of dune vegetation. Among the sand loving penstemons you'll find *P. leonardii* var. *patricus*, *ambiguus*, *ammophilus*, and *acuminatus*. Sandy soil will avail the lucky gardener with the ability to grow many penstemon species far better and to the envy of gardeners with plain 'ol' regular soil.

TAKE THE PENSTEMON PLUNGE: Beside the species mentioned thus far, many, many others which despite their beauty are rarely

encountered in a garden setting. This is certainly related to the plants own rarity or seclusion in nature well as a lack of availability at local nurseries and mail order catalogs. With over 275 U.S. species, (not counting varieties and subspecies) to choose from, choosing can be somewhat daunting. If the extensive variety of penstemon species also seems somewhat overwhelming, and you find it difficult to locate a starting point, don't panic. The vast majority of outstanding penstemons are still not commonly available in the horticulture trade, and that narrows the list significantly. Also, many penstemons are similar in form and color. Unless you are a penstemon collector, having a dozen different species, that from a distance look the same, may not be your objective.

There are essentially two color schemes prevalent on the penstemon palette: 1) flowers in the blue, blue violet, violet blue, violet, and purple range, and 2) flowers in the pink, magenta, and red tones. There are also neutral white flowers and a very few yellow penstemons. Leaves also take on unique colors ranging from bright green to a powdery blue-green. A careful examination of pictorial guides and plant descriptions will help you decide which penstemon has the flower and leaf color you desire.

There are also several penstemon cultivars on the market that have been bred for larger and brighter flowers, and even red leaves as found on *P. digitalis* 'Husker Red'. In fact, the Midwest 'Husker Red' was the 1996 Perennial Plant of the Year. A yellow form of *P. pinifolius* has been selected and coined 'Mersea Yellow'. Even though the foliage is exactly the same as the regular red *P. pinifolius*, the striking yellow flowers make it hard to believe the plant truly is a penstemon. *P. confertus* also has yellow flowers.

Since there is not adequate space to take each penstemon species individually and scrutinize its horticultural merits, I have neglected to detail individual species in length. What I hope to have accomplished is to illustrate the existence of exceptional penstemon diversity, diversity in form, color, cultural conditions, and subsequent potential garden application. Surely there are several good choices to enliven everyone's garden. My

personal approach is even more basic. If I like it I try it. This shotgun approach may be responsible for unnecessary plant suffering and demise, but occasionally I learn something that can only be ascertained through stubborn trial and error. Regardless of a plant's title, you may find yourself designating your own native penstemon as your personal perennial plant of the year, this year and for years to come.

Sources of Penstemons:

High Country Gardens
2902 Rufina Street
Department: MGA97 Santa Fe, NM 87505
phone: 505-438-3031
fax: 505-438-9552
Catalog Cost - Freeplants only

Great Basin Natives
P.O. Box 114 Holden, UT 84636
gbn@sisna.com
plants only- free price list

Plants of the Southwest
Agua Fria, Rt.6, Box 11A
Santa Fe, NM 87501
Telephones: Orders: 800-788-SEED
Customer Service: 505-471-2212
Fax: 505-438-8800

Alplains
32315 Pine Crest Ct.
Kiowa, CO 80117
seed only

RECENT WORK ON THE ARIZONA WILLOW (*Salix arizonica* Dorn)

Kimball T. Harper
Professor Emeritus
Brigham Young University
Provo, UT 84602

The Arizona willow was described as a new species in 1975 by Robert Dorn from material collected on the White Mountains of east-central Arizona by Carl-Eric Granfelt. In 1992, U.S. Fish and Wildlife personally proposed to list the species as endangered, because of the combined stresses of big game

browsing, cattle grazing, and increased peat accumulation on habitats occupied by the species. Decreased overland flow of water (due to greater evapotranspiration from conifers invading forested slopes above the meadows that supported the willow) appears to have permitted water courses to fill with peat from aquatic plants. In the process, sites occupied by the willow became progressively less well drained and less suitable for its growth. Undrained soil also seems to have favored devastating out-breaks of the *Melampsora* rust, which has severely depleted several populations of the willow in Arizona.

As part of the listing process, all known specimens of the Arizona willow were again examined by experts in 1993. In that process, Robert Dorn discovered a specimen at the University of Wyoming, Laramie, that had been collected in 1913 on the "Sevier Forest, Utah" at 10,000 ft elevation. The specimen had been filed as *Salix pseudomvritinensis*, but Dorn himself had annotated it as *S. arizonica* in 1988. Although a Sevier National Forest no longer exists, older Forest Service employees recalled that portions of the current Dixie National Forest east of Cedar City, Utah, had once been designated as the "Sevier Forest". Since the original label described the species as being "abundant in places", an immediate search for it was launched on the Markagunt Plateau of Utah. Efforts in 1993 failed to locate the species, but in 1994, Dr. Duane Atwood and Ron Rodriguez of the U.S. Forest Service relocated the species on June 30th at Rainbow Meadows on the headwaters of Mammoth Creek at 10,400 ft elevation. Their specimen was later verified by Robert Dorn and George Argus. Subsequent work by Dr. Atwood turned up populations of the species at several locations on the Markagunt Plateau, the East Fork of the Sevier River, on 7-Mile Creek just north of Fish Lake on the Fish Lake National Forest, and on U-M Creek to the northeast of Fish Lake. In August of 1995, Atwood, Stan Welsh, and Bob Thompson collected the species on the Wasatch Plateau, SanPete County (Manti-LaSal National Forest) on wet, limestone rubble some 2 miles North of White Mountain.

The Arizona willow thus occurs at several locations in southwestern Utah. As its

original collector (unfortunately, he didn't record his name) noted, the species is locally abundant. In retrospect, it's surprising that the species went uncollected for so long. It is locally abundant and is a genuinely distinctive willow. In fact, local summer-home residents on the Markagunt Plateau recognized the species and had even given it a common name, that being manzanita willow. The common name locally used is indeed appropriate, since plant size and shape, stem color, and leaf size and color are all reminiscent of *Arctostaphylos patula*. The care of the Arizona willow in Utah is illustrative of how poorly known our flora is. It also says something about the error in avoiding collection of specimens of genera that the general botanical community perceives to be "difficult". Willows have "cowed" several generations of botanists, but as Sherel Goodrich and Wayne Padgett have shown, they can be identified quite adequately once well designed keys are prepared by the "initiated".

In 1995, an interagency team consisting of representatives of the U.S. Forest Service, the U.S. Park Service, the U.S. Fish and Wildlife Service, and the Fort Apache Indian Reservation jointly approved and released a conservation agreement and strategy plan for conservation of the Arizona willow throughout its range. All partners to the plan have committed to conserve the species on all lands managed by their agencies. The plan is longterm and calls for prevention of habitat degradation through grazing management, construction of fences to exclude domestic and wild ungulates, and enlightened management of riparian areas. The plan calls for regular monitoring of known willow populations and annual review of monitoring results. Management of areas where the willow grows will be annually evaluated in light of monitoring results and adjusted as needed to achieve the desired objectives.

As part of the longterm monitoring program for Arizona willow on the Dixie and Fish Lake National Forests, two master's thesis research programs were initiated at BYU in summer 1994. Leroy L. Mead described the abiotic and biotic habitat of Arizona willow at 25 different locations throughout the species' range in Utah in a master's thesis completed

at BYU in 1996. Vickie Taylor will complete a masters degree at BYU in April 1997: she is emphasizing stem growth and longevity, seed production and viability, and the effects of exclosure of domestic and wild ungulates on growth and mortality of stems of the willow.

Mead documented the geographical distribution of this willow in Utah (occurrences in Kane, Iron, Garfield, and SanPete Counties) and over an elevational range between 10,465 and 8,320 ft. The species occurs primarily on mineral parent materials derived from volcanic deposits, but at four sites, soils are derived from Claron limestone. Perhaps perennially available water and cold soil conditions are more important than the mineral parent material, since the species always occurs on deep peaty deposits or moist, organically enriched mineral soils (mollisols) along stream courses.

Mead showed that the species associated with the willow are components of moist meadows throughout the mountains of the state. Commonly associated herbs are *Aster foliaceus*, *Caltha leptosepala*, *Deschampsia caespitosa*, various *Carex* species, *Achillea millefolium* and *Aconitum columbianum*. The most common associated shrubs are *Salix planifolia* and *Potentilla fruticosa*. Watertable depths are almost always within 3.0 ft of the surface but at over 2/3 of the sites watertable is within 1.5 ft of the surface, and at several sites it fluctuates between the surface and within six inches of the surface. Site pH values are universally acid (5.8 - 6.4). Summer time soil temperatures at 1.5 ft depth ranges between 6° and 10° C.

Mead found that cattle browsed the Arizona Willow significantly more heavily than did sheep. Cattle preferred Arizona to planeleaf willow, while sheep preference were reverse to those of cattle. Mead also concluded that willow growth was negatively affected by warmer soil temperatures, deeper peat deposits, and shallower watertable depths.

Vicki Taylor has documented that while the Arizona willow forms long-lived clones no stems are known to have survived above ground for more than 20 years. Growth rates of surviving stems do not differ significantly among sites, but percentage survival of

stems does differ significantly from site-to-site. The species does produce viable seed that germinates immediately after dispersal when wetted. Nevertheless, seedlings of the species have never been observed in nature. The inference is that seed rarely finds a safe site for germination and survival in the dense cover of meadows in which the species persists. Since genetic variation among sexually reproduced offspring is known to pose an obstacle to epidemic spread of microbiotic pathogens (bacterial and fungal diseases) and small, short lived insect pests (such as aphids), some thought should be given to creation of microsites suitable for willow seedling establishment in the habitats in which the Arizona willow flourishes.

Although ungulate exclosures had been in place for only one year in the 1996 growing season, Taylor is finding some favorable responses of the willow to protection from browsers. However, that analysis is not yet complete.

TREE DISTRIBUTION IN UTAH: PINYON AND FIR

by Robert Weiss

Over time, distribution of tree species can expand or recede in their natural geographic range. Sometimes, relict or remnant stands of some species can be found many miles from where they naturally occur. My discussion involves relict stands of two coniferous tree species. The first species involves the discovery of a small population of single needle pinyon (*Pinyon monophylla*). It is most commonly found in the Great Basin, throughout Nevada and western Utah, growing with Utah juniper. In the past, several scattered individuals have been identified near the mouth of the Logan River Canyon, east of Logan, Utah. In March, 1995, at least five new individuals of single needle pinyon were found growing up above Right Hand Fork Road, right off Highway 89. This is about ten miles up Logan River Canyon. They are somewhat spread out, but in close proximity to each other. Out of the five trees, two are producing cones and one of the cone producers is around forty feet tall. They are located at approximately 6000 ft. elevation on a southerly aspect on steep rocky terrain. They are growing in association with curl-leaf mountain mahogany, Utah juniper, Rocky mountain juniper, Douglas fir, and limber pine. This find has not been documented until now and is considered the northernmost population of single needle pinyon found in this part of Utah.

The second species is white fir (*Abies concolor*), a true fir common in central and southern Utah. This stand of relict white firs is growing right across the drainage from the five single needle pinyons. There are at least twenty white fir individuals of various

sizes growing close together. They are located on a north aspect near a ridge at around 6400 ft. elevation. This population of white fir has been documented by USFS in Logan. This group of trees may be the northernmost reproducing population of true white fir (not including hybrids with grand fir in southern Idaho) in the Rockies.

It takes off-trail hiking to reach either population. Due to the nature of the rugged terrain where they are both found, there have probably not been very many hikers in the past. Even though there is a National Forest Campground and popular rock climbing wall within a half mile, I have never seen any one up these slopes where the relict stands are found. In April, 1996, several more single needle pinyon were discovered on a southwest aspect on steep rocky terrain in Card Canyon. This area is about a mile southwest of the other pinyon population. Overall, the Logan River Canyon is a unique area in which several other tree species are near their northern or southern geographical limit. There may be more relict stands out in the northern Wasatch Range of Utah just waiting to be found.

RARE PLANT FIELD TRIP DINOSAUR NATIONAL MONUMENT

In cooperation with Colorado Native Plant Society
Leader: Tamara Naumann

Meeting Location: see below

Date: Saturday and Sunday, June 21 and June 22,
8:00 AM

This is a working field trip. We will attempt to find and map populations of *Erigeron wilkenii* (Dieter's fleabane) and *Habenaria* (*Platanthera* or *Limnorchis*) *zothecina* (alcove bog orchid). New information on these species will be used by the National Park Service to better protect these rare plants. [Note that the type locality for *Erigeron wilkenii* is only 2.5 km east of the Utah state boundary: although not yet known from our state it is expected here. Here's your chance to find a new state record for Utah for an extremely rare plant!] The spectacular scenery of the Yampa and Green River canyon country will add to the experience. We'll also have an opportunity to see some Fremont rock art. Ability to read and interpret a topographic map is necessary for at least some members of the group.

Meet in the parking lot at Dinosaur National Monument Headquarters (two miles east of the town of Dinosaur, Colorado, on US Hwy 40) at 8:00 AM on Saturday, June 21. We will try to consolidate vehicles (choosing high-clearance four-wheel-drive types as much as possible) for the trip to the search sites on the Yampa Bench. For those who are interested, Tamara and Peter will host a pot-luck

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c/o Jo Stolhand
Utah Native Plant Society
P.O.Box 520041
Salt Lake City, UT 84152-0041

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dinner on Friday evening at their home near the park headquarters (ask for directions ~~when you call to~~ register). Camping is on your own on Saturday night. If there is enough interest, we'll reserve the group site at Echo Park, but primitive camping on BLM land might be more pleasant (i.e., fewer mosquitos). The trip will conclude midday on Sunday.

Primitive camping is available on BLM land approx. 6 miles from the park headquarters. The campground at Echo Park in the Monument is about 35 miles from the headquarters on rough roads; the cost is \$5 per night (the mosquitos exact an additional toll). Ask about other camping/motel options when you register.

Bring food, water, sun screen, rain gear and sturdy shoes. Days will be warm to hot, evenings will be cool. Bring a compass, if you have one. Mapping materials, a checklist of the flora of Dinosaur National Monument and copies of Uinta Basin Flora will be available from the trip leader. Hiking conditions range from moderate to difficult. The road to Echo Park/Yampa Bench usually requires four-wheel drive and may not be passable if conditions are wet. Dogs are not allowed in the back country in Dinosaur National Monument.

To register, call or send E-mail to:
Tamara Naumann, (970) 374-2504 (h)
(970) 374-2501 (w)
Tamara_Naumann@NPS.gov.
Trip limit is 20 persons.

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Newsletter of the Utah Native Plant Society

VOL. 20 No. 4

JUL/AUG 1997

August Wildflower Blooming

**Pam Poulson
Red Butte Garden**

The 1997 Wildflower season is a beautiful one. Heavy snows and a cool wet spring provided a fantastic desert bloom and verdant mountain wildflower bloom. Also as a result of the wet winter, there have been many reports of biting ticks, mosquitoes and deer flies from all across the state, even from backyards of homes. Wet weather means more insects, more snails, more birds, more snakes and so on, right on up the food chain. It also means that if conditions are good the wildflower season for 1998 will be incredible from all the seeds that were produced this year.

We've been getting rave reviews on mountain wildflower bloomings all over the state.

Check out the wildflowers above 8,500 ft. No need for an altimeter or topo map; just look for the presence of aspens as you rise in elevation. Jump in your car and head for Snowbird, Millcreek Canyon, the Alpine Loop road on the back side of Mount Timpanogos, the Logan Canyon to Bear Lake road, along the Mirror Lake road out of Kamas, The north slope of the Uintas, The Nebo Loop road above Nephi, The LaSal Mountain Loop road, Great Basin National Park, The Boulder to Torrey Road, the Skyline Drive (both the Farmington Canyon and the Fairview Canyon), Bryce Canyon National Park, Cedar Breaks National Monument and the North Rim of the Grand Canyon. As usual, the display in Albion Basin above Alta is fantastic. The road has been improved into a graveled road and the Basin is accessible to anyone willing to drive the dusty road. However, weekend traffic is bumper to bumper, and the Forest Service may limit access by car this year, with either a quota or a user fee.

Hikers and other off road explorers can find special treats in the upper reaches of the mountains at 9,500 feet and above, especially in some of Utah's Wilderness Areas, such as Lone Peak, Twin Peaks, Mount Naomi, Mount Timpanogos and the High Uintas. Wherever you explore, be gentle with the landscape and look in various habitats and exposures for a wide variety of wildflowers:

In wet areas and along streams, look for Monkshood (Aconitum columbianum), Elephant Head (Pedicularis groenlandica), Western Bog Orchid (Habenaria dilatata), Case's Fitweed (Corydalis caseana), Western Bistort (Polygonum bistortioides), Shooting Star (Dodecatheon ssp.), Monkeyflower (Mimulus ssp.), Cow Parsnip (Heracleum lanatum), Bluebells (Mertensia ssp.), Bittercress (Cardamine cordifolia), Western Jacob's Ladder (Polemonium occidentale), Blue Gentian (Gentiana ssp.), Rose Crown Sedum (Sedum rhodanthum), Richardson's White Geranium (Geranium richardsonii), Grass of Parnassus (Parnassia fimbriata) and Golden Columbine (Aquilegia chrysantha). Look for the native Yellow Pond Lily (Nuphar polysepalum) on the shallow lakes of the Uintas.

In dry meadows and on south facing slopes look for Wild Rose (Rosa ssp.), Lupine (Lupinus ssp.), Showy Golden Eye (Viguiera multiflora), Mountain Arnica (Arnica ssp.), Indian Paintbrush (Castilleja ssp.), Western Coneflower (Rudbeckia occidentalis), Yarrow (Achillea millefolia), Senecio (Senecio ssp.), Penstemon (Penstemon ssp.), Tansy Aster (Macheranthera ssp.), Sulphur-flowered Buckwheat (Eriogonum umbellatum), Wyeth's Buckwheat (Eriogonum heracleioides), Skyrocket Gilia (Gilia aggregata), Fireweed (Epilobium angustifolium), Ivesia (Ivesia jamesia), Sticky Geranium (Geranium viscosissimum), Valerian (Valerian ssp.), Golden Aster (Heterotheca villosa), Elk Gentian (Frasera speciosa), Gumweed (Grindelia squarosa), Horsemint (Monardella odoratissima), Giant Hyssop (Agastache urticifolia), Pearly Everlasting (Anaphalis margaritacea), Leafy Jacob's Ladder

(Polemonium occidentale), Mountain Hollyhock (Iliaena rivularis), Yellow Stonecrop (Sedum ssp.) and Bluebells (Campanula ssp.). Mountain Bikers: Please preserve our fragile meadows by staying on designated trails.

On rocky slopes above timberline look for Mountain Sunflower (Hymenoxys grandiflora), Valerian (Valeriana ssp.), Nuttall's Gilia (Gilia nuttallii), Lemon Drops (Eriogonum grayi), Fleabane Daisy (Erigeron ssp.), Wind Flower (Anemone multifida), Moss Campion (Silene acaulis), Parry's Primrose (Primula parryi), Diamondleaf Saxifrage (Saxifraga rhomboidea), and Rock Penstemon (Penstemon humilis).

Along the edges of the woods and just under the trees look for Wild Clematis (Clematis ssp.), Utah White Columbine (Aquilegia caerulea), Parrotbeak (Pedicularis ssp.), Coralroot Orchid (Coralorhiza ssp.), and Dwarf Jacob's Ladder (Polemonium pulcherrimum).

In deep shade and in acidic soils under conifers watch for our tiny native Wintergreens (Pyrola ssp.), Twinflower (Linnea borealis) and Pipsissewa (Chimaphila umbellata).

In the valleys of Utah, the middle of summer will soon be marked by the blooming of Sunflower (Helianthus annuus), Thistle (Cirsium ssp.), Gumweed (Grindelia squarosa), Rocky Mountain Beeplant (Cleome serrulata), Rabbitbrush (Chrysothamnus nauseosus) and Sagebrush (Artemisia ssp.). The last two flowers on that list are notorious for causing August Hayfever which should be very common this year because of the abundance of winter moisture, which developed more flowers and consequently more pollen.

Lawn and garden weeds are wildly robust at this time of year. Take a closer look at them as you fight them: Redroot Pigweed (Amaranthus retroflexus), Common Mallow or Cheeseweed (Malva neglecta), Sunflower (Helianthus annuus), Yellow Sow Thistle (Sonchus arvensis), Prickley Lettuce

(Lactuca scariola), Chicory (Cichorium intybus), and Teasel (Dipsacus sylvestris) all demand closer inspection, especially the Teasel. Some of the most tenacious weeds lie flat against the ground: various milky sapped spurges (Euphorbia spp.) and the spiny seeded Puncture Vine (Tribulus terrestris.) The two horned seeds of Puncture Vine will easily penetrate a bare foot or paw and will pop bicycle and wheelbarrow tires with little effort. Throw young Dandelion (Taraxacum officinale) greens and Purslane (Portulaca oleracea) leaves into your next salad.

While weeding, beware of two weedy vines: Deadly Nightshade (Solanum camara) and Morning Glory (Convolvulus arvensis). Check your bushes for the pretty purple flowers and red berries of the highly poisonous Nightshade, which is relatively easy to conquer with hoeing. On the other hand, Morning Glory may seem easy to eradicate, but don't be fooled. Its roots can penetrate up to 20 feet into the ground. Pulling up ten inches worth merely serves to prune underground stems into branching.

In the outback, watch out for Stinging Nettle (Urtica dioica), and Poison Ivy (Toxidendron rydbergii.)

Origins of A Shade Garden: A Shady Past

by Richard Hildreth

For over a year we have pondered the potential for a neglected space on the west side of our house in Sandy. The site measures eight feet wide by twenty seven feet long, bordered on the north and west by a six-foot wood fence, on the east by the windowless two-story white wall of the house, and it opens on to the rear yard that is densely shaded by natural stands of Gambel Oak. The new site receives about two hours of direct sunlight each day, with high shade provided the remainder of the day by our neighbor's trees adjacent to the fence: silver

maple, cottonwood (subsequently removed) and Siberian elm.

The previous history of this site is a mystery. The stratigraphy of the soil profile rivaled any in Canyonlands. We began by disposing of the foot or more of broken concrete pieces (a former patio, perhaps), underlain by another foot of the indigenous round cobble stones common in this part of Sandy. Beneath the rubble and stone was a layer of 6 mil black plastic, covering a six inch layer of clay-loam "topsoil" (imported, no doubt), and finally a second layer of black plastic (presumably to curtail the spread of nearby aspen.) The parent soil of this garden-to-be is a well drained quartzite derived from the rocks of Little Cottonwood Canyon and carried to our garden as part of the alluvial outwash fan. The crowning piece of this layered dilemma was a row of full-grown, although straggly Pfitzer Junipers, strategically placed to hide the whole mess. A hint for anyone faced with removing a juniper with a major trunk: kill the plant by cutting back severely the previous year, or, alternatively, treat the trunk with glyphosphate (Roundup or other brands) and extract the stump after the roots die. The job is relatively easy with a shovel, loppers and heavy crowbar.

In order to access this side yard and to provide traffic circulation to the rear garden, it was necessary to construct a gate in the north fence, where none previously existed. A creative copper panel of a branch of maple leaves now decorates this new entry, thanks to the artistry of Sue's father. Numerous cobble stones were used to define a meandering soft bark chip path through the garden and beyond. In this replacement phase of construction, two functioning sprinkler heads were uncovered.

What next to do? With junipers and rubble removed, paths and beds defined, and a functioning irrigation system, the next step was to prepare the soil in the beds. The bottom of the strata was parent soil permeated by a variety of vigorous tree roots from the neighbor's trees (more about these jewels later.)

Rather than endanger the trees by disturbing the roots, a better solution was to create elevated beds. The choices were to purchase a topsoil (the easier approach) or to work with materials at hand (a tedious but eminently successful method.) These included ten cubic yards of tree chips from a branch of the neighbor's tree dropped (on top of our oaks) in a winter storm. Other potential soil-building materials at hand included composted sod (from the median strip conversion project to low water-use perennials); shredded and composted oak leaves; composted steer manure (a bargain at Home Depot, especially the broken bags at half price!); some surplus sand, all blended with love, sweat and tears. The trick is to pre-blend all these ingredients and then add them to the roughed up surface of the bed. Conversely you could add multiple layers of each item, but carefully mix each new layer with the previous layers to avoid creating interfaces, that might impede root growth and water penetration. Now everything is ready for planting, but what to plant?

If you are really organized, you probably have a plan on paper of the bed layout to scale, sprinkler placement, slopes, sun and shade patterns, wind currents, and other pertinent design details. Other gardening types simply buy a bunch of plants and stick them in the ground. I do both, except the plan evolves in my head (tempered by budget, effort and other contingencies) along with the plant list. Adjustments to the list are made at the nursery or from catalogs. As an inveterate collector, the tendency is to have one of everything! Fortunately Sue, a more sensible gardener, quells these tendencies.

One last point to remember: a garden that starts out as a sun or shade site, may change as trees around continue to grow. A sunny site may become shady. In our case a still-in-progress shade border, suddenly became exposed when the neighbor suddenly removed the source of shade - a large cottonwood (hurrah!).

Now if only the Siberian elm and silver maple would meet the same fate, gardening on our

side of the fence would be much easier. In the mean time an arbor of saran screen or lathe will be necessary to protect the new shade tolerant plants. The less desirable option would be to move these plants to available shade and replace them with sun tolerant plants.

NATIVE PLANT SOURCES AND SEED SUPPLIERS

List compiled by Red Butte Garden and Arboretum, University of Utah
390 Wakara Way
Salt Lake City, UT 84108
(801) 581-5322

Alpine Plants
P O Box 345
Tahoe Vista, CA 95732
(916) 546-5578
(seeds and plants)

Applewood Seed Co.
5380 Vivian Street
Anvada, CO 80002
(303) 431-6283
(wildflower seeds and mixes)

Arkansas Valley Seed
P O. Box 270
Rocky Ford, CO 81067
(grasses, forage and reclamation seed)

Bernardo Beach Native Plant Farm
Star Route 7, Box 145
Vequita, NM 87062
(dry-land plants and flowers)

Bitterroot Native Growers, Inc.
P.O. Box 566
Hamilton, MT 59840
(plants)

Clyde Robin Seed Co
P.O. Box 2366
Castro Valley, CA 94546
(415) 785-0425
(wildflower seeds)

Curtis & Curtis
Star Route, Box 8A
Clovis, NM 88130
(grass seed)

James Ranch
33800 Hwy. 550
Durango, CO 81426
(plants)

Lamb Nurseries
Easl 101 Sharp Ave.
Spokane WA 99202
(plants)

Moon Mountain
P.O. Box 34
Morro Bay, CA 93442
(805) 772-2473
(wildflower seed & mixes)

Mountain States Nursery
P O Box 33982
Phoenix, AZ 85067
(lower-elevation natives)

Mt. Tahoma Nursery
2811 112th Ave. East
Graham, WA 98338
(206) 847-9827
(plants)

Northern Nevada Native Plant Society
Mail Order Seed Service
P O Box 8965
Reno, NV 89507

Plants of the Southwest
1812 Second Street
Santa Fe, NM 87501
(505) 983-1548
(wildflower, grass & vegetable seed, plants)

Porter Lane Wholesale Nursery
262 West, 400 South
Centerville, UT 84014
(801) 298-2613
(wholesale container plants)

Colorado Alpines, Inc.
P O Box 2708
Avon, CO 81620
(303) 949-6464
(wildflower seeds)

Environmental Seed Producers, Inc.
P O Box 2709
Lompoc, CA 93438
(805) 735-8888
(wildflower seeds)

Fjellgarden
P.O.Box 1111
Lakeside, AZ 85929
(alpines, especially AZ natives)

Forestfarm
990 Tetheroe Road
Williams, OR 97544-9599
(woody plants and flowers)

Granite Seed Co.
P.O. Box 177
Lehi, UT 84043
(801) 768-4422
(seeds, wholesale & retail)

Greenlee Nursery
301 East Franklin Ave.
Pomona, CA 91766
(ornamental grasses only)

High Altitude Gardens
P.O. Box 4619
Ketchum, ID 83340
(800) 874-7333, (208) 726-3221
(wildflower seed and mixes)

J.L. Hudson, Seedsman
P.O. Box 1058
Redwood City, CA 94064

Prairie Moon Nursery
Rte. 3, Box 163
Winona, MN 55987
(plants and seed)

Prairie Nursery
P.O. Box 365
Westfield WI 53964
(seed and plants)

Plants of the Southwest
930 Baca Street
Santa Fe, NM 87501
(505) 983-1548
(Rocky Mt. Wildflower mix)

Progressive Plants
9180 South Wasatch Blvd.
Salt Lake City, UT 84093
(801) 942-7333
(wholesale container plants)

Rocky Mountain Rare Plants
P.O. Box 20483
Denver, CO 80220-0483
(alpine and rock garden plants and seed)

UNPS SEGO LILY
c/o Jo Stolhand
Utah Native Plant Society
P.O.Box 520041
Salt Lake City, UT 84152-0041

Address Correction Requested

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Russell Graham
4030 Eagle Crest Road, N W
Salem, OR 97304
(plants)

Siskiyou Rare Plant Nursery
2825 Cummings Road
Medford, OR 97501
(plants)

Southwestern Native Seeds
P.O. Box 50503
Tucson, AZ 85703
(wildflower and shrub seeds)

Texas Star Gardens
P.O. Box 663
Abilene Tx 79604
(wholesale and retail over \$100)

The Wild Garden
P O Box 487
Bothell, WA 98011

Wild and Crazy Seed Company
P O Box 895
Durango, CO 81302

Wildseed
P.O. Box 308
Eagle Lake, Tx 77434
(800) 848-0078
(wildflower seed)

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| ☐ Household | \$20.00 |
| ☐ Sustaining | \$35.00 |
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VOL. 20 No. 5

SEPT/OCT 1997

CALENDAR OF EVENTS

Garden Tour
10 am, September 20

Meet at Ensign Elementary School (770 E. 12th Avenue in Salt Lake), See details inside.

Fish Springs National
Wildlife Refuge Open House
Sat. Sept. 20

Air Boat rides, Pony express talks, Native Am. history speakers, Native plant tours, Bird tours, Geology talks Conservation group info. booth, food concessions, Call 522-5353 for more information.

Annual Meeting
Oct. 29

The traditional New World Pot Luck. Watch for announcement of place.

UTAH- AN HISTORIC, SCENIC AND FLORISTIC WONDERLAND

Dr. David Joyner

Utah was inhabited prehistorically by Fremont (eastern Utah), Sevier Fremont (western Utah), and Anasazi cultures (south), and more recently (1300 + A.D.) by nomadic Shoshone, Utes, Paiutes and Goshutes. European encroachment began with the arrival of the Dominguez-Escalante expedition of 1776, involving Franciscan priests Atanasio Dominguez and Silvestre Velez de Escalante. Their expedition entered northeastern Utah near the present day town of Jensen. They travelled due west to Utah Lake, then south along the current route of Interstate 15 to the Arizona border. As early as 1818, Canadian fur trappers Donald MacKenzie and Michel Bourdon visited the Bear River Valley in northern Rich County; however, it wasn't until the early 1820's that Utah was used extensively for rendezvous by the legendary mountain men Jedediah Smith, Jim Bridger, Peter Skene Ogden, John Weber, and Etienne Provost. Fur trappers in turn were succeeded by government sponsored explorations lead by John Fremont (1843), Howard Stansbury (1849), John Wesley Powell (1870+) and others. Utah was settled by pioneers in 1847. One year earlier, the ill-fated Donner party left their mark in Utah: wagon tracks leading out from the mouth of Emigration Canyon in the Wasatch Range west through the Salt Lake Valley and into the barren Great Basin Desert. Utah was granted statehood in 1896, 49 years after the original Mormon immigrants arrived in the Salt Lake Valley.

The Utah landscape originally encountered by early explores and pioneers has been modified dramatically during the past 150+ years. Exotic plants and animals introduced for food or sport now compete with or have replaced many native species. Farming and the ever-menacing urban sprawl continue to modify or deplete native habitats, displacing or even eliminating native species such as grizzly bears and bison. Contemporary events unquestionably have had a major impact on Utah's flora and fauna, although it remains to be seen whether man's influence will ultimately rival the large-scale environmental wrath brought about by glaciation, mountain building and erosion, or by climatic changes. Entire mountain ranges with their respective floral and faunal

communities have come and gone, or have been modified dramatically by the onslaught of Pleistocene glaciers. Rivers changed course or disappeared completely. Lush forests and wetlands became deserts, and deserts were replaced by seas. Each event has influenced directly or indirectly the topography and biodiversity of Utah. Collectively their combined forces have defined the landscape you now visit.

GEOLOGIC HISTORY: Utah's geomorphology reflects a landmass historically subjected to repeated floodings, faulting, stretching and erosion. Sandstones, quartzite, and fossil-rich limestones visible throughout the state attest to the repeated floodings by shallow seas, from early Paleozoic into the late Mesozoic Era (570 to 150 million years ago). By the early Tertiary, some 50+ million years ago, fresh-water lakes dominated the scene, as exemplified by Lake Uinta in the Uinta Basin. This body of water represented Utah's share of the Green River Lake, an interconnecting waterway extending into Wyoming and Colorado. And more recently, between 30,000 and 10,000 years ago, Pleistocene Lake Bonneville played its part in defining western Utah's morphology. As Lake Bonneville receded, shrinking into the present-day Great Salt Lake, residual minerals pilfered from the surrounding mountains saturated previously inundated soils. The result, plant communities dominated by halophytes (Chenopodiaceae), species able to cope with the severe osmotic stresses associated with hypersaline soils.

The seismic history of Utah is also well known. As William Stokes (1986) noted: "Several of the longest normal faults in North America have been mapped along the Wasatch Line (eastern edge of Basin and Range). From north to south, they are the 225-mile-long Wasatch Fault, the equally long Sevier Fault that begins near the center of the state and terminates near the southern border; and the Hurricane Fault, beginning near Richfield, Sevier Co., and leaving the state southeast of St. George, Washington Co." He continued: "ordinary normal faults abound; one study charted more than 3,000 mappable faults in Utah's Great Basin." Those of you intimately familiar with Montana's Madison River as it flows from Hebgen Lake into and beyond what is now Quake Lake can readily appreciate the impact seismic activity can have on a landscape. Fortunately, there is an upside to every geologic event, and in this case, it's the formation of mountains, whether through faulting, folding, or volcanic activity. Several major mountain building episodes affected Utah during the past 100 million years. The first, centered along western Utah during the early Cretaceous (105 million years ago), was the Sevier Orogeny. Soon after (geologically speaking) came the Laramide Orogeny (late Cretaceous to early Eocene; 88 to 66 million years ago) or, as it is more commonly referred to, the Rocky Mountain Orogeny. One consequence of the Laramide uplift was the formation of the Uinta Mountains, but other equally notable formations also attributed to this period of mountain building include Utah's San Rafael Swell,

the Kaibab, and the Uncompahgre Uplifts. Peter Harley gave a fluent account of the mountain building process in his contribution to the Alpines '86 publication Rocky Mountain Alpines; if you are unfamiliar with the geologic history of the western U.S., or are intimidated by the geologic literature, you might consider reading his rendition "Geologic History of the Rockies".

Erosion is perhaps the most consistent and universal modifier of Utah's landscape, producing large scale effects through glaciers, floods or channel-cutting by river systems, or small-scale impacts brought about by the freezing and thawing of water in soil (nivation) or in the cracks of rocks (frost-wedging), or by wind-scouring. Erosional events have produced some of Utah's most cherished sceneries - the arches, natural bridges, canyonlands and badlands of our national parks and monuments. Erosion, solifluction, and frost creep also produce microhabitats dear to the heart of every rock gardener, the screes, talus slopes, and moraines which support our cherished alpine plants.

The significance of these geologic forces and their accumulative short-term and long-term impacts on Utah and its people was defined eloquently by Genevieve Atwood (Utah Geological and Mineral Survey) in her Introduction to the text Geology of Utah written by William Stokes. She wrote: "Utahns have a unique opportunity to appreciate their geologic heritage. An unusually large segment of earth's history is recorded in over 250 formations that crop out in different areas of the state and virtually every geologic influence that shaped the earth - lakes, glaciers, wind, igneous action, tectonic forces, and erosion have left unmistakable impressions. Utah's economy is more closely linked to geology than most other states. In the past, the state relied upon the mining and energy industries and now tourism, based mainly on geologic attractions, is a major source of income. National and state parks related to geology and rocks have been set aside in many areas of the state. Also, the design and construction of nearly every major structure in Utah should consider geology because few other states have Utah's vulnerability to the geologic hazards associated with earthquakes, landslides, rockfalls, unstable soil conditions, high ground water, floods, liquefaction, and shifting lakes."

GEOMORPHOLOGY: Utah's topography can be delineated into four major Provinces: (1) Middle Rocky Mountains; (2) Colorado Plateau; (3) Basin and Range; and (4) the Colorado Plateau/Basin and Range Transition Zone. The Middle Rocky Mountain Province, occupying the northeastern portion of the state, includes the Wasatch Range, the physiographically distinct Bear River Range, and the aberrant Uinta Mountains. These three mountain ranges, which have played a dominant role in the evolution of northern Utah, appear cartographically as a tilted wishbone or "Y" shaped assemblage. The Uinta Mountains form the right arm, extending on an east-west plane from Colorado on the east to the Wasatch Range on the west. The northern Bear River

Range becomes the upright left arm of the wishbone and, along with the Uinta Mountains, frame the northeastern "notch" of Utah, an indentation representing the southwestern corner of Wyoming. The Wasatch Range, which extends 100+ miles south into central Utah, serves as the base of the wishbone.

Immediately west of the Bear River/Wasatch mountain assemblage, along a line delineated coincidentally by Interstate 15, is the Basin and Range Province, referred to by many as the Great Basin Desert. Drab and dull to some, this Province is actually a kaleidoscope of ecosystems, communities and habitats. Formed by the expansion of the earth's crust, the 35 fault ranges and their corresponding basins extend from the western half of Utah west to the Sierra Nevadas, and from southern Oregon southeast to Arizona and New Mexico. The northeastern segment of this Province, now confined principally within the boundaries of Utah, was inundated by Lake Bonneville which, at its peak, covered approximately 20,000 square miles.

To the east of the Basin and Range Province and south of the Uinta Mountains lies the Colorado Plateau, Utah's "Canyonlands" and "Color Country". Sparsely vegetated and composed primarily of continental sandstones and shale, this exciting and colorful landscape is dominated by plateaus, mesas, high cliffs and deep canyons. This Province is home to some of Utah's most exciting plant species, including such notable endemics as *Astragalus iselyi* and *Penstemon navajoa*.

Unbeknownst to many, the southcentral Colorado Plateau/Basin and Range Transition Province forms the fourth physiographic unit in Utah. This zone, where the two broad physiographic units merge and overlap, is made up of eight high plateaus ranging in elevation from 8,000' to 11,000'. If the names "Aquarius Plateau", "Paunsaugunt Plateau", and "Markagunt Plateau" are not familiar, perhaps *Castilleja aquariensis*, *Townsendia jonesii* var. *lutea*, or *Astragalus serpens* might be.

Individually and in combination, these physiographic provinces define Utah. With an elevational range of over 11,000' (from 2,200' in southwestern Utah to 13,528' at King's Peak in the Uintas), you can explore five Life Zones (Lower Sonoran to Alpine) without leaving the boundaries of the state. Is it any wonder Utah supports over 3,000 species of indigenous vascular plants, a number of which are endemic?

Visit Utah's scenic wonderlands and explore the flora and geology. Consider Garfield County in the southcentral part of the state. Home to Bryce National Park, the Henry Mountains, and the Aquarius Plateau, Garfield County supports an array of interesting and attractive plants, including *Astragalus malacoides*, *Penstemon bracteatus*, and *Ivesia sabulosa*. How about Uinta and Daggett Counties in eastern Utah? These are the only counties in the state where *Hymenoxys torreyana*, *Balsamorhiza hookeri*, and *Penstemon acaulis* occur. Are you a buckwheat (*Eriogonum*) fancier? If so, Washington County in the

southwestern corner of the state should be on your agenda. Look for *Eriogonum brachypodum*, *davidsonii*, *fasciculatum*, *heermannii*, *insigne*, *phamaceoides*, and *thomasii*, only seven of the 26 buckwheats whose ranges extend into Washington County. A real buckwheat enthusiast might wish to locate all 57 *Eriogonum* species occurring within the state of Utah. Utah is also home to 63 species of *Penstemon*, a whopping 111 species of *Astragalus*, and 17 species whose distributions are so limited as to warrant federal threatened or endangered species status, including *Townsendia aprica*, *Arctomecon humilis*, and *Primula maguirei*.

Bald Mountain, on the western edge of the Uintas, and the Albion Basin, at the top of Little Cottonwood Canyon in the Wasatch Range, are two areas each of which typifies its respective mountain range and thus, serves as a "window" through which you can view some of Utah's finest mountain floral communities.

WASATCH RANGE, LITTLE COTTONWOOD CANYON AND THE ALBION BASIN.

(Modified after Gilson 1977)

The Wasatch Range, rising 6,000 - 7,000' in elevation above the valley floor, extends from the Bear River Range in northern Cache County south to Mt. Nebo, near Nephi (Juab County). Little Cottonwood Canyon is situated approximately mid-way in the 120-mile-long by 20-mile-wide range. Included within the Wasatch are seven federally designated wilderness areas: 1. Mt. Olympus (9,026'; 15,856 acres); 2. Twin Peaks (11,330'; 11,796 acres); 3. Lone Peak (11,253'; 30,088 acres); 4. Mount Timpanogos (11,750'; 10,750 acres); 5. Mount Naomi (9,980'; 44,964 acres); 6. Mount Nebo (11,877'; 28,170 acres); and 7. Wellsville Mountain (9,372'; 23,750 acres). North of Mt. Olympus, but within the Mt. Olympus Wilderness Area, is Neffs Canyon, containing one of the nation's deepest caves (1,170'). Twin Peaks arise on the north side of Little Cottonwood Canyon, whereas Lone Peak, a granitic intrusion complemented with Mississippian limestone and quartzite, is on the south side. Mount Naomi and the Wellsville Mountains are north of Salt Lake, while Mount Timpanogos and Mount Nebo are to the south.

The date of origin of the Wasatch Range, as one element of the Middle Rocky Mountains, is uncertain, since its formation cannot be attributed to the Sevier Orogeny (early Cretaceous), or the Laramide (late Cretaceous), the two principal mountain-building episodes affecting Utah. Regardless, the morphology of the Wasatch is principally a product of the last 10-20 million years. The Central Wasatch, which includes Little Cottonwood Canyon, extends from the Weber River near Ogden south to the American Fork River near Mt. Timpanogos. During its orogenic episode, this portion of the range was tilted, warped, folded and faulted, the impact of which is clearly visible along the Hellgate Cliffs in Little Cottonwood Canyon, in which the strata are tilted 25 degrees to the

east. Furthermore, at least four prominent thrust faults are visible on the north side of Little Cottonwood Canyon, the most obvious being the Alta overthrust which runs between Superior Mountain and Cardiff Pass.

Although a majority of the exposed rock in Little Cottonwood Canyon is sedimentary in origin, having been deposited 90 million to 1 billion years ago, there also are conglomerate deposits and massive intrusions of granitic rock (granodiorite stocks). These granitic intrusions are most evident at the lower end of the canyon, and between the communities of Alta, located at the top of Little Cottonwood Canyon, and Brighton, situated near the top of the neighboring Big Cottonwood Canyon. Gilson described these two granitic stocks: "the larger (Little Cottonwood Stock) runs down the north side of the canyon starting just below Superior, crosses to the south side at about Red Pine and continues to form the Pfeifferhorn and Lone Peak. It is the largest and youngest stock in the Salt Lake area. The other stock called Alta Stock runs roughly east to west in the Albion Basin under the Sugarloaf and Albion ski lifts.

The upper realm of Little Cottonwood Canyon, forming the Alta and Albion Basins, is rich in very old rocks: Precambrian quartzites and shale, plus limestones from the Cambrian (570 million years ago) and Carboniferous Periods (370 to 250 million years ago). Many of these light-colored Paleozoic limestones are rich in fossils, as typified by the upper Flagstaff area on the north side of the canyon. The darker colored formations in the Alta and Albion Basins are primarily shale, quartzite, or at high elevations, younger limestone (e.g., Hellgate and Peruvian cliffs).

As you ascend from the mouth of Little Cottonwood Canyon to the Alta and Albion Basins at the top, stark reminders of recent (18,000 to 3 million years ago) glacial events are clearly evident. The canyon profile changes from a river-derived "V" shape at the mouth to a glacially-scoured "U" at higher elevations. Morainal deposits are present at the mouth of the canyon adjacent to Bell's Canyon and at Hokum Fork, while glacial hanging valleys, such as Albion Basin, Germania and White Pine, occur at higher elevations on the south side of the canyon. Also at higher elevations and on the south side are small hanging lakes such as Cecret, White and Red Pine. Add to these the striations caused by glacial ice grinding over rock surfaces, as evident in the Albion Basin and the sharp glacially-derived profile of the Pfeifferhorn, and there is little doubt of the impact alpine glaciers have had on the morphology of Little Cottonwood Canyon.

Geology, elevation, orientation and climate collectively have influenced the floral and faunal compositions of Little Cottonwood Canyon. Little Cottonwood is within the Northern Mountain Climate Zone and, at alpine elevations, may receive up to 500" of snowfall yearly (60" of precipitation, the most precipitation of any area in Utah). The average annual precipitation along the extreme lower slopes is 16" per year. According to Gilson, the climatic conditions of

Alta are influenced primarily by a rapid elevational change and by orientation - the canyon runs east and west. Consequently, the canyon acts like a flue, directing moisture-laden frontal air up the canyon where the air mass is cooled and slowed by the upper canyon ridges. This intensifies and then extends the dropping of moisture. Winter precipitation results from middle latitude cyclonic storms originating out of the northwest, while rainfall in summer comes from high-intensity thunderstorms. Precipitation in May and October is generally attributed to the low-aloft. Mean annual temperature is 43° (F) at 7,200', 38° at 8,200', and 32° at 10,000'. At 8,200' the mean summer temperature is 53° and the mean winter temperature is 27°.

Elevational changes in temperature and moisture levels in concert with local edaphic factors delineate Little Cottonwood's plant communities. As you enter the mouth of the canyon, at an elevation of 5,000' (Upper Sonoran), the sun-baked southfacing slope is dominated by "Foothill Community" species such as *Quercus gambelii* (Gambel Oak), *Cercocarpus ledifolius* (Mountain Mahogany), *Juniperus osteosperma* (Utah Juniper) and *Bromus tectorum* (Red Brome Grass), whereas the shaded northfacing slope, comprised primarily of sheer cliffs, supports *Abies concolor* (White Fir), *Picea pungens* (Blue Spruce), and *Pseudotsuga menziesii* (Douglas Fir). Streamside vegetation includes maples (*Acer grandidentatum*, Bigtooth Maple; *A. glabrum*, Rocky Mountain Maple; and *A. negundo*, Box Elder), *Prunus virginiana* (Chokecherry), cottonwoods (*Populus fremontii*, Fremont Cottonwood; *P. angustifolia*, Narrowleaf Cottonwood), and *Alnus incana* (Mountain alder). With a gain in elevation from 7,000 to 10,000' (Lower to Upper Montane), Blue Spruce is replaced by *Picea engelmannii* (Engelmann Spruce), White Fir by *Abies lasiocarpa* (Subalpine Fir), and the cottonwoods by *Populus tremuloides* (Aspen). At alpine elevations, subalpine conifers, willows, alders and grass-sedge meadows are replaced with talus and alpine tundra.

Gilson (1977) and Arnow et. al. (1980) provided an abbreviated list of the shrubs and trees of Little Cottonwood Canyon, including those in proximity to the Snowbird Ski Resort. Flowering shrubs found throughout the canyon include: *Actaea rubra* (Baneberry, white flower); *Artemisia tridentata* and *A. ludoviciana* (Sage, green flower); *Ribes aureum* (Golden Currant, golden flower); *Arctostaphylos uva-ursi* (Manzanita, white flower); *Sorbus scopulina* (Mountain Ash, white flower); *Pachistima myrsinites* (Mountain Lover, red flower); *Berberis repens* (Oregon Grape, yellow flower); *Potentilla fruticosa* (Shrubby Cinquefoil, yellow flower); *Symphoricarpos oreophilus* (Snowberry, pink flower); *Ribes cereum* (Squaw Currant, white/pink flower); *Lonicera involucrata* (yellow flower); and *Rosa woodsii* (Woods Rose, pink flower). As you approach the Snowbird Ski Resort, you should find *Sambucus caerulea* (Blue Elderberry, white flower); *Prunus virginiana* (Chokecherry, white flower); *Amelanchier*

alnifolia (Serviceberry, white flower); *Rubus parviflorus* (Western Thimbleberry, white flower); and *Rubus idaeus* (Wild Raspberry, white/pink flower). Above Snowbird, you might encounter *Ribes montigenum* (Gooseberry Currant, white/pink flower), *Rosa nutkana* (Nootka Rose, pink flower), *Sambucus racemosa* (Red Elderberry, white flower), *Ceanothus velutinus* (Snowbrush, white flower), or *Lonicera utahensis* (Utah Honeysuckle, white/yellow flower). Conifers consist of *Pinus contorta* (Lodgepole Pine), *P. flexilis* (Limber Pine) plus Engelmann and Blue Spruce, White and Subalpine Fir, Douglas Fir, and Juniper (*Juniperus communis* and *J. osteosperma*). Broadleaf trees include maple, alder, cottonwood, aspen, *Salix* spp. (willow), Boxelder, Gambel Oak, *Betula occidentalis* (Western Water Birch), and Mountain Mahogany.

On your way to the Albion Basin, as you leave the Snowbird Resort and enter the small community of Alta (8,500' elevation), scan the hillsides and mountain peaks on both sides of the road. On your right is Collins Gulch. Immediately above Collins Gulch is the broad, glacially-derived Germania Bowl. The prominent peak forming the southwest corner of Germania is the 11,068' Mount Baldy. The southeastern flank of Germania is ridged by Sugarloaf Pass, which obscures your view of the 11,051' Sugarloaf. Sugarloaf, Devils Castle (10,920'), Point Supreme (10,595') and Mount Wolverine (10,600') delineate the Albion Basin.

On your left, behind the town hall and police station, is the trail head for the Alta/Brighton trail. This popular pathway leads to Cardiff Pass which overlooks Big Cottonwood Canyon. The two peaks flanking Cardiff Pass are Superior and Flagstaff; both approximately 10,500' in elevation. Further east and overlooking Grizzly Gulch is Davenport Hill.

Immediately following snow-melt, *Dicentra uniflora* (Steer's Head), the logo for the Wasatch Rock Garden Society, is surprisingly abundant along the Alta/Brighton trail, although generally restricted in distribution to east-facing exposures. *Claytonia lanceolata* (Spring Beauty) and *Ranunculus* spp. (buttercups) literally cover these barren slopes. As spring progresses, masses of vegetation emerge, turning these hillsides into a glorious display of paintbrushes, lupine, composites, Leafy Jacobs Ladder (*Polemonium foliosissimum*), and willows. The REAL floral display, however, occurs among the numerous rocky outcrops visible to the left of the trail. Diminutive *Penstemon humilis* ssp. *brevifolius* bloom by the thousands. The bright red-orange of *Castilleja applegatei* clashes, then blends harmoniously with the blue floral tubes of *brevifolius*. If you search in the right locations, the blue-flowered *brevifolius* is joined by a vivid pink-flowered variant, but only four or five pink-flowered penstemons can be found. These rocky outcrops are a rock gardener's dream: crevices packed with mats of *Eriogonum*, *Petrophytum caespitosum*, and even the carpet-forming *Juniperus communis*, perhaps hundreds of years old. Blue and white-flowered *Erigeron eatonii*, only 1-2" high, emerge

from hairline cracks in the lichen-encrusted rock, as does *Ivesia gordonii*, *Phlox pulvinata*, and *Sedum debile*. Even yarrow (*Achillea millefolium*) is attractive in this setting, with white flower clusters atop 3-4" stems. And to make the scene complete, overlooking the display is the occasional scraggly Limber Pine (*Pinus flexilis*).

As you travel further up the canyon, past the Snowpine and Alta Day lodges, you will enter a gravel roadway leading to your final destination: the Albion Basin. While meandering throughout the basin, look for *Heuchera rubescens* and *Erigeron compositus* on the north and east sides of the large boulders bordering the Cecret trail. *Polemonium pulcherrimum* can be found growing along the shady baselines of some of these boulders. *Primula parryi*, another classic alpine plant that also prefers a cool, shady substrate, can be found along the base of nearby cliffs. The Albion Basin is also a great place for paintbrushes. *Castilleja applegatei* dominates on the dry, granite outcrops (e.g., north of the Cecret campground) while *C. sulphurea* occurs sporadically along the Cecret trail. *C. rhexifolia* is the most widely distributed paintbrush in the basin and also shows the greatest variation in floral color, from vivid pink to fire engine red to purple. Take your time exploring the basin; see how many of the plants on your species list you can locate and, in the meantime, enjoy the scenery.

BALD MOUNTAIN AND THE UINTAS:

(Modified after Grogger 1974; Hansen 1975; Stokes 1986; Bradley 1988)

The Uinta Mountains, perhaps more so than any other mountain range in Utah except the Wasatch, cater to the outdoor interests of Utah's diverse population. Within an hour's drive of the populous Wasatch Front, the rugged peaks, cirques and alpine vistas of the High Uinta Primitive Area attract backpackers and other wilderness enthusiasts seeking solitude and pristine panoramas. Recreationists favoring a more "civilized" outdoor experience flock to the many campgrounds and undeveloped camp sites situated throughout the range. Fishermen hike to glacially-derived lakes in quest of cutthroat and rainbow trout, while hikers traverse alpine meadows and craggy peaks via a webbing of cross-linking trails. Even fossil hunters fulfill their dreams in the fossil-rich Bridger and Uinta Formations of eastern Utah. Traditionally, a trip into the Uintas epitomizes the optimal outdoor experience for every boy and girl raised in Utah.

Geographically, the Uintas are best known for being the longest (160 miles long x 35 miles wide) range in the contiguous 48 states with an east-west orientation. Its western edge flanks the Wasatch Range in north-central Utah, while its eastern perimeter extends into Colorado. To the north are the Green River and Washakie Basins of Wyoming and to the south, the arid Uinta Basin. Along its eastern flank, the Sand Wash, Coyote, and Piceance Basins of western Colorado. Grogger (1974) characterized the Uinta Range as having been "carved from a broad,

open, double-domed, asymmetrical, east-west trending anticline that is overturned and arcuate to the north." Stokes (1986) described this range as "a great east-trending anticlinal fold 160 miles long and about 30 miles wide with numerous secondary structures extending outward in all directions. There are, in effect, two segments to the Uintas, both large oval-shaped elongate domes aligned along the major east-west axis. The East Dome and the West Dome merge at a saddlelike constriction roughly between the towns of Roosevelt, Duchesne County, and Roosevelt, Daggett County. The West Dome is highest near Gilbert Peak. The East Dome has collapsed so that its former high point is now the vicinity of Browns Park." Thus, the Uintas consist of an arch (Uinta Arch) originating 55 to 80 million years ago (Laramide Orogeny) through an upward flexing (anticlinal uplift) of the earth's crust. The summit of the arch is now deeply dissected and eroded into jagged peaks which lead to deep, narrow canyons. The aspen-covered north slope of the Uintas drops sharply into the Green River Basin of Wyoming, whereas the more gently sloping conifer-dominated southern exposure leads first into a series of benches supporting sagebrush and juniper and ultimately into the barren Uinta Basin. All peaks in excess of 11,000' corresponding to timberline occur in the western dome.

The Uinta Range and Basin are derived predominantly from marine sediments deposited in a deep trench (Uinta Trench) 500+ million years ago (Precambrian and early Paleozoic) when the area was inundated by inland seas. Deposition was followed by a period of uplift during the late Devonian (360+ million years ago) which in turn was succeeded by long periods of erosion, eliminating much of the Paleozoic strata. During the Laramide Orogeny, coincident with the formation of the Rocky Mountains, the Uinta Trench was compressed and its contents squeezed upward and outward to form the present Uinta range. Through compaction and metamorphosis, the sandstones, shale and limestones deposited during the Precambrian were transformed into Red Creek Quartzite (named from Red Creek situated between Clay Basin and Browns Park in northeastern Utah; dated to 2.32 billion years old), mica schists and marble. Quartzites predominate in the Uintas and make up a central core approximately 20,000' thick.

Geographic differences in geological structure and rock formations prompted Stokes (1986) to recognize three "significantly different subsections" of the Uinta Range:

1. The High Uintas: "The crestal portion of the Uinta Mountains, specifically that in the western half roughly between Mirror Lake on the west and Fox Lake on the east, is topographically significantly different not only from the lower territory surrounding it but also from the eastward continuation of the range. The High Uintas include the headwaters of the Provo, Weber, Duchesne, Uinta, and Bear Rivers that gather much of the surface water of Utah. Here are many of the state's high peaks including Kings Peak (13,528 feet), the highest. The area shows a distinctive glacial

topography with gently sloping, semi-circular flat-bottomed cirque valleys separated from each other by steepwalled narrow aretes. Hundreds of rock-rimmed lakes have been left by glaciers. Timberline is currently at about 11,500 feet so most of the High Uintas presents a stark barren appearance, especially when covered by snow."

2. The Eastern Uintas: "When compared with the High Uintas the most distinctive surficial character of the eastern part of the range is the scarcity of glacial features. There are, instead, a number of wide shallow valleys that cross the crest of the range. Lakes are almost absent. The basic anticlinal structure has been disrupted by subsidence of an elongate tract known as Browns Hole, only the western part of which is in Utah. This seems to have lowered the former crest of the range several thousand feet and to have created the depression into which the Green River began to flow about 20 million years ago."

3. The Marginal Benches: "The central, higher portion of the Uinta Mountains, especially the eastern subsection, is ringed by benches or shoulderlike remnants of old erosion surfaces between about 7,500 and 8,500 feet elevation. On one side they rise and merge with the higher, more rugged central tracts; on the other they descend rather abruptly toward the adjacent lowlands. From the fact that the benches are mostly covered with gravel debris from the core of the range and stand at about the same general level, it is concluded that they are patch-like remnants of once more extensive surfaces."

The main divide of the western dome (High Uintas), which forms a narrow ridge approximately 60 miles long by one mile wide and may have served as the Continental Divide during Tertiary times, extends from Hayden Peak on the western edge of the High Uinta Primitive Area east to Leidy Peak, situated southwest of Flaming Gorge National Recreation Area. The base of the divide averages 11,000 to 12,000' in elevation, with crests of numerous peaks protruding another 1,000 to 2,000' higher. Reaching out to the north and south of the main divide are secondary ridges which often surpass the main divide in elevation. At least 26 summits in the High Uintas exceed 13,000', only nine of which occur along the main divide.

Bald Mountain is a 11,943' peak immediately west of the High Uinta Primitive Area. Access is gained via State Highway 150 (Mirror Lake Road). As you leave the small farming town of Kamas and travel east and then north on Highway 150, notice the changes in plant community composition. Immediately east of Kamas, the dry, hot exposed hillsides on the north (left) side of the road support Gambel Oak (*Quercus gambelii*), Utah Juniper (*Juniperus osteosperma*), Mountain Mahogany (*Cercocarpus*) and grasses, while the north-facing slopes on the south (right) side of the highway are dominated by oak and maple, with sporadic clumps of conifers and, further up the road, by dense stands of conifers. Look for *Physaria acutifolia* (Twin bladderpod) in fruit along the roadcuts on the left side of the road. As you enter the Uinta

National Forest, Aspen and Yellow Pine (*Pinus ponderosa*) gradually replace the junipers and Mountain Mahogany, which give way in turn to Lodgepole Pine (*Pinus contorta*), the dominant mid-montane to subalpine conifer in the western Uintas. Lodgepole is closely associated with soils derived from quartzite. At the summit, Lodgepole intermingles with, or is replaced by, two subalpine species, Engelmann Spruce (*Picea engelmannii*) and the shorter-statured Subalpine Fir (*Abies lasiocarpa*). The Krummholz midway up Bald Mountain consists predominantly of Engelmann Spruce, but also may contain some stunted Lodgepole Pine.

State Highway 150 as it leaves Kamas initially follows Beaver Creek, which is on the south side of the road. Scan the wet meadows that circumscribe the grass- and willow-lined creek. You should see 3'-tall Green Gentians (*Frasera speciosa*) evenly spaced throughout the drier portions of the meadows. At a distance, the gentians superficially resemble Mullein (*Verbascum thapsus*), a species of similar stature but usually found growing on hotter, drier substrates. *Castilleja miniata* (Scarlet Paintbrush), *Pedicularis groenlandica* (Elephanthead), *Penstemon procerus* (Littleflower Penstemon), and *Veratrum californicum* (Corn Lily) are common throughout the wetter portions of these meadows. *Clematis hirsutissima* (Sugarbowl) and *Hydrophyllum capitatum* (Ballhead Waterleaf) occur along the grassy edge of the road. Soils on the north side of the highway are drier, but still support an interesting flora, including *Lithophragma glabra* (Fringecup Woodlandstar), *Fritillaria atropurpurea* (Leopard Lily), *Penstemon leonardii* (Leonard Penstemon), and *Delphinium nuttallianum* (Nuttall Larkspur). A majority of the yellow composites at this location are either *Wyethia amplexicaulis* (Mules-ear) or *Senecio* spp.

The Beaver Creek meadows with their characteristic moist-soil flora are replaced in the drier Yellow Pine zone by upland meadows dominated by grasses and sagebrush. By early July, many of the grasses have set seed, but most of the wildflowers are still in bloom. The bright red spikes are *Ipomopsis* (*Gilia*) *aggregata*, while the yellow flowers belong to *Wyethia*, *Potentilla*, and *Senecio*. The creme-colored culms are *Eriogonum heracleoides*, a buckwheat particularly common along the Mirror Lake road. *Achillea millefolium*, *Anaphalis margaritacea*, and several species of *Erigeron* produce much of the white evident throughout the meadows.

Approximately half-way to the summit, the dry meadows give way to Lodgepole woodland, with its associated understory. In wet areas, earlier in the spring, the dainty Fairy Slipper Orchid (*Calypso bulbosa*) can be found beneath the Lodgepoles, often in association with *Chimaphila umbellata* (Pipsissewa) and *Pyrola* (Wintergreen). Coralroot (*Corallorhiza maculata*) is also fairly common in the shady understory. By July, in the open, flooded grassy areas, or along streambeds, *Habenaria dilatata* (White Bog Orchid) coexists with Elephanthead, *Zigadenus elegans* (Death camas), and *Geranium richardsonii*

(Richardson Geranium). *Penstemon leonardii* and *P. subglaber* grow along the roadside and, at one location, several white-flowered variants of *P. leonardii* can be found. On drier slopes, the understory remains sparse, although Greenleaf Manzanita (*Arctostaphylos patula*) is common throughout sunny exposed sites. Although Lodgepole Pine forests are not noted for their wildflower displays, you should see a number of attractive wildflowers along this portion of the drive, especially along the edge of the road. *Castilleja miniata* is very abundant throughout this zone, particularly along the wet ditch on the left side of the road; its bright red inflorescence should not be confused with the red trumpets of *Ipomopsis aggregata*. The bright yellow flower clusters nestled among the rocky outcrops are *Sedum lanceolatum*; this species should be near peak bloom in early July.

As you gain in elevation, the mountains close in on the highway. Blocks of quartzite form large boulderfields at the base of cliffs on the left side of the road, while on the right, the edge drops off into a gorge formed by the Provo River. The highway straddles the Provo River for the next 10 miles or so, and you will see the rocky and often dry streambed on either side of the road. Within a mile or two of the summit, you pass by Lilly and Lost Lakes; two popular fishing spots supporting populations of *Nuphar polysepalum* (Yellow Water-lily). Around the next few bends and on the left side of the road is a very large meadow. In a wet year, the meadow generates an unbelievable display of color, whereas in drier years, the greens and browns of sedges and grasses predominate. Immediately beyond and above the meadow is Bald Mountain, a pyramid of rock rising above the horizontal strata that form its base. Highway 150 summits at the base of Bald Mountain, then continues down the north slope, past Mirror Lake and on to Evanston, Wyoming.

In a "normal" year, the roadway over the summit is clear of snow by early June. In 1995, roadcrews were busy removing snow through the 4th of July. Annual precipitation averages 30-40" on the north slope of the Uintas, and 25-35" on the south slope. Winter weather affecting the Uintas originates from middle latitude cyclonic storms over the Pacific Ocean, while summer precipitation is generated primarily by local convective disturbances or by storms from the Gulf of Mexico. Frost occurs during every month of the year and snow may fall at any time during the summer at elevations in excess of 10,000'. Because winds are principally out of the west, snow accumulates on the northeast, east, and southeast facing slopes, whereas western, northwestern, and south slopes often remain snow-free.

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Garden Tour

The Utah Valley Chapter of the Utah Native Plant Society is sponsoring a tour of some public gardens and projects that feature native plants. We will meet at Ensign Elementary School (770 E. 12th Avenue in Salt Lake) at 10 am Saturday, September 20, to see a project established with the help of Mike Alder of NPI. We will then head over to the Jordan River Parkway for a picnic lunch and tours of works in progress with Peter Lassig and Vaughn Lovejoy as our guides. At our last stop, Dave Okleberry will show us around a neighborhood garden project established in west Salt Lake with UNPS assistance. Anyone interested in native plant horticulture is welcome to join us. We are planning to establish a new native plant demonstration garden to inspire people to grow these beautiful plants. Please come and share your ideas.

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