

Poisonous Rangeland Plants in San Luis Obispo County

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California Polytechnic State University, SLO

Photos:
Top Row from Left to Right
Tumble Mustard by Sara Litten, Paso Robles, CA
Purple Starthistle by Amanda Ou, San Luis Obispo, CA
Coastal Fiddleneck by Marc Horney, San Luis Obispo County

Bottom Row Left to Right
Poison Hemlock by Sara Litten, Paso Robles, CA
Lupine by Sara Litten, Paso Robles, CA
Yellow Starthistle by Sara Litten, Paso Robles, CA

Foreword

We have been asked by quite a few people about what generated our interest in poisonous plants and we have to give the credit for that to Dr. Dale Smith, a Cal Poly animal science professor. Our very first year at Cal Poly, we took Anatomy and Physiology together and were assigned to do a project about a topic that affected the nervous system. Dr. Smith gave us quite a few topics that would be of interest and poisonous plants were one of them. We found ourselves very fascinated with the mechanisms of how these toxins elicited their effects. It was at this time our senior project idea was beginning to form. For a year, this idea bounced around in the back of our minds. When we reached our senior year, it was time to determine just what a senior project about poisonous plants would encompass. Our advisor Dr. Marc Horney, another Cal Poly animal science professor, was a blessing when it finally became time to develop and attempt this feat. It has taken many long days and several paper cuts but we feel we have taken the first big steps to encompassing not only information about poisonous plants but the mechanisms and the management strategies that people will need to know into one resource. We hope you enjoy the fruits of our labor. Happy reading!

-Sara and Amanda

Introduction

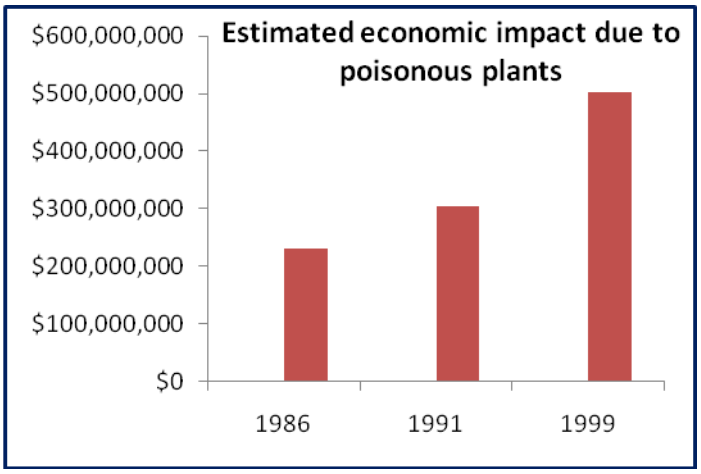
Why is the knowledge of poisonous plants important?

Chronic poisoning, rather than simple mortality, is our main concern because this is what usually produces the greatest economic impact. According to Darwin B. Nielsen, the economic loss due to poisonous plants in 1988 was $234,257,080 and it has just gone up from there. Jerry Holechek, a professor of animal and rangeland science at New Mexico State University, estimated the losses caused by toxic plants to be $340,000,000 in 1991 and in 1999 the estimate went up to $503,000,000. Nielsen organized these losses into three categories:

1) Mortality

2) Reproductive dysfunction

3) Loss of productivity



Graph 1: Estimated economic impact due to poisonous plants

Poisonous plants can affect all biological systems in the animal's body. While most people assume that animals die from acute poisoning, where they have consumed minute amounts of the toxin, this is not always the case. Sometimes a toxic compound needs to accumulate in the body before poisoning the animal. In looking at some the mechanisms for how these toxins affect animals, we hope to widen your understanding of how these problems can occur.

Economic Losses Caused by Poisonous Plants

It is difficult to quantify the economic losses that ranchers suffer when their livestock are affected by poisonous plants. This task is challenging because there are many factors that contribute to the occurrence of poisoning. It is hard to place a dollar amount on a rancher's knowledge or a monetary value on livestock's stress in adverse conditions. Assigning economic

losses from poisonous plants is a complex process. It can be difficult to separate deaths caused by poisonous plants from deaths caused by disease, accidents, and predators. Low reproductive and growth performance of livestock can be attributed to disease and inadequate nutrition as well as poisonous plants. For livestock on rangelands, where animals are not under frequent observation, it can be difficult to connect death or poor performance to poisonous plants. Birth defects caused by poisonous plants can be apparent long after the dam has eaten the plant. In some cases, there is more than one plant that can cause the same type of birth defects.

Agricultural economist Darwin B. Nielsen assigned the impacts of poisonous plants to both direct and indirect losses. Direct losses are any monetary loss felt by the producer due to decreases in their livestock's health or productivity. These losses can include death, decreased performance, and reproductive dysfunction. Indirect losses are generally expenses accrued by a producer who is trying to prevent direct losses. Livestock deaths from toxic plants receive more attention from ranchers and the public than any other loss. Mortality is easy to calculate into economic losses. The producer can count the number of animals that have succumbed to the toxin, and value the losses based on current market prices. Performance losses from poisonous plants include decreased weight gain, emaciation, and neurological damage. Any time an animal goes off feed, the performance of the animal is stunted. An ill animal will not reach market weight when other healthy herd members do. Some plant toxins cause neurological damage. Animals with neurological damage may not be able to function properly and are worth less to the producer due to their imparity. Finally toxins found in poisonous plants can affect reproductive capabilities of livestock in a variety of ways depending on the toxin and stage of reproduction. Plant toxins can affect the following reproductive processes: spermatogenesis, oogenesis, and embryonic and fetal development. They can also cause abortions, lengthen postpartum intervals, and decrease neonatal survival.

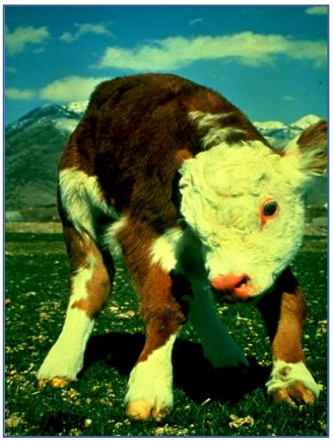


Figure 1: Calf with 'Crooked Calf Disease'

Indirect losses include the cost of building fences to protect livestock and buying supplemental feed when safe rangeland is not available. Producers may have to alter grazing

programs to reduce the incidence of poisoning. This may reduce forage availability or grazing efficiency. If poisoned animals can be treated, medical costs are an additional expense for the rancher.

What is a Poison?

Toxins are found in grasses, forbs, shrubs, trees, and even the vegetables that we consume. The question we should ask ourselves is, are all these toxins seriously harmful to animals most of the time? The answer is no. If this was the case, we would not be able to eat tomatoes, potatoes, spinach, corn, or cabbage. All of these plants have some type of toxin in them. So this brings us to what we need to understand. What is a poison? For our purpose we will define a toxin as *any substance that by entering the body can cause disruptions to the organism's natural processes by producing undesired results*. Other definitions, like this example from Veterinary Toxicology are too narrow "…a poison is a substance which, having entered the body even in minute amounts produces severe physiological disturbances, often leading to death." This definition, while being the most universally accepted, leaves out several economically important compounds such as the glucosinolate toxins found in the mustard family, which can have no visible affect on the animal but can cause serious reproductive effects to the offspring. These can include anything from an abnormally long pregnancy to severe offspring deformities.

Biological Systems Affected by Poisonous Plant Toxins

Affect on Body Systems:

In this section of the guide we are going to focus on how plant toxins can affect three body systems to illustrate the affects these costly plants can have on your livestock as well as some of the mechanisms behind them. Please realize that even though we are talking about these toxins' affects on a single system, they can affect several body systems at once. The three systems we will discuss are: the nervous system, the reproductive system, and the digestive system.

Nervous System:

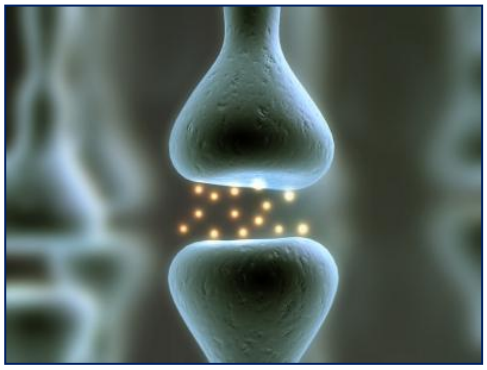


Figure 2: Nerve Synapse

Toxins can inhibit nerve synapse function in three main ways: by mimicking neurotransmitters, by blocking neurotransmitters, and by damaging nervous tissues. To understand how these toxins accomplish this, let's examine how a normal nerve synapse occurs. Before a nerve impulse is triggered, the nerve is in a resting state. A stimulus will trigger a signal that is conducted down the nerve cell in a process known as saltatory conduction. Throughout the myelin sheath there are sections called the Nodes of Ranvier. These nodes are areas that the myelin sheath does not cover and the place where depolarization occurs. These nodes assist the nerve impulse by allowing it to travel down the axon faster and prevent the nerve impulse from leaving the cell. When the signal is transmitted to another cell it is achieved through a chemical synapse. When the axon's signal reaches the synaptic knob, calcium is allowed into the cell which triggers the release of

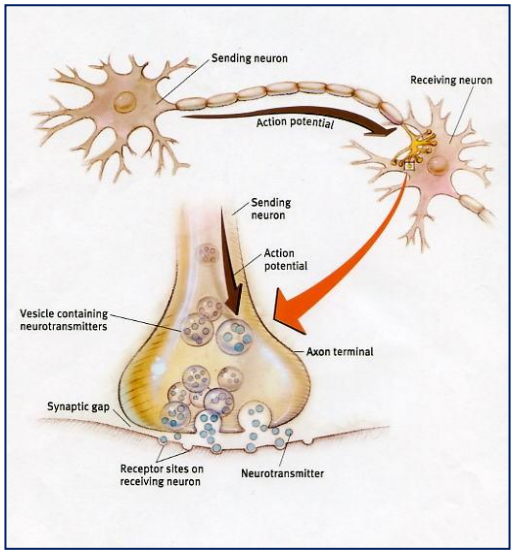


Figure 3: How a Nerve Synapse Occurs

neurotransmitters. These neurotransmitters will then diffuse across the synaptic cleft towards receptors on the postsynaptic membrane. When the neurotransmitter binds this continues the nerve response through the second neuron or to the affected organ.

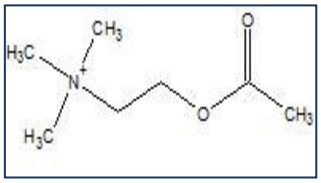


Figure 4: Acetylcholine

Neurotransmitter mimicry occurs when a toxin's chemical structure is sufficiently similar to an active neurotransmitter that it can bind to the neurotransmitter's receptors on the postsynaptic membranes and trigger a neural response. This can lead to an overstimulation of the somatic and autonomic nervous system. Toxins that act in this way elicit symptoms like seizures, muscle tremors, vomiting, elevated heart and respiration rates. An example of this kind of toxin would be the alkaloid Lupanine found in lupines (*Lupinus spp*.). This toxin together with other alkaloid compounds may make up to as much as 2.5% of the Lupine's plants mass. Lupanine's structure is very similar to the neurotransmitter acetylcholine. It will bind to the nicotinic acetylcholine receptor (nAChR) simulating a neural response that cause symptoms such as nervousness, loss of muscular control, and convulsion.

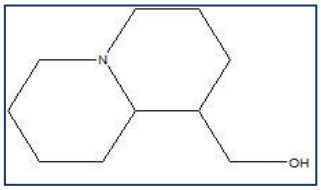


Figure 5: Lupanine

A neurotransmitter blocking toxin also resembles an active neurotransmitter but its binding doesn't generate a neural response. These toxins prevent the natural neural transmitter from combining with the receptors to generate its normal effect. Since this toxin will act as a blocker we will see a suppression of that part of the nervous system. This can result in paralysis. An example of this type of toxin would be Boldine, a toxin found in Bolo leaves as well as Magnolias. It mimics the neurotransmitter epinephrine and acts as an antagonist. It will bind to the neurotransmitter receptors preventing epinephrine from stimulating a normal response such as muscle movement. Symptoms of suppressed neural function such as exaggerated movement, poor coordination, and in high dosages extremely slow breathing are common for this and other neurotransmitter blocking toxins.

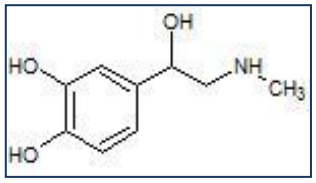


Figure 6: Epinephrine

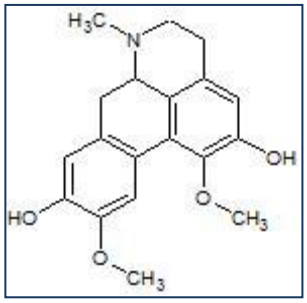


Figure 7: Boldine

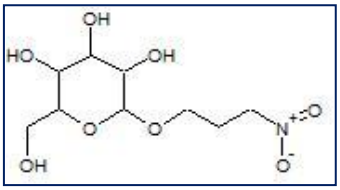


Figure 8: Miserotoxin

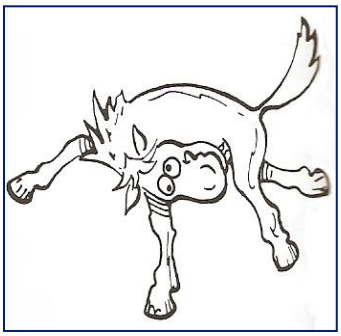


Figure 9: Locoweed Poisoning

These toxins can also affect the nervous system by damaging nervous tissues. The toxins will break down the myelin sheath surrounding nerve fibers. The function of the myelin sheath is to allow nerve impulses to travel faster across neurons. They do this in a process called salutatory conduction. When the myelin sheath is damaged this causes a disruption in this process that slows responses or impedes function altogether. An example of this would be Miserotoxin, a poison found in locoweed. This chemical causes demyelization (damage to the myelin sheath) of the posterior spinal cord by interfering with cellular metabolism. Miserotoxin is hydrolyzed (chemically split apart with water) by microbial enzymes in the rumen to produce nitropropanol. Nitropropanol, in turn, acts as an inhibitor of succinate dehydrogenase, an important Krebs Cycle enzyme. When the Krebs Cycle (which is a critical cellular energy conversion process) no longer functions, nervous system cells lose functionality and die because of insufficient energy (in ATP). This cellular death produces the myelin sheath lesions observed in Locoweed-infected animals. Common symptoms are ataxia (loss of coordination), staggers, and vision impairment. Damages caused from toxins like this are irreversible.

Reproduction:

Figure 10: Cow and calf

Reproduction is the number one factor affecting livestock production. Without a constant supply of offspring most livestock producers would not have any product to sell. Six main factors affecting reproduction are dietary factors, infectious diseases, genetics, management decisions, environment, and ingestion of poisonous plants. While there has been a lot of research on the first five factors, little has been done on combating the effects of poisonous plants on reproduction. Over the past 40 years, researchers have linked hundreds of plants to embryonic death, abortion and

teratogenic effects (birth defects) in livestock. Before this many of these effects went undiagnosed because some producers feared that if these birth defects were acknowledged it could negatively impact the sale of their breeding stock. This was because many people were previously unaware of the relationship between birth defects and plant toxins. The effects of poisonous plants on reproduction can be very diverse. These toxins can cause problems from abortion, low conception rates, decreased libido, severe birth deformities, and weak offspring, among other problems. The mechanisms of action for these toxins are just as diverse as the symptoms. For this reason we will only be discussing the activities of a couple of toxins from plants found in San Luis Obispo County.

Figure 11: 18 month old steer with "Crooked Calf Disease"

Lupine, a plant commonly found in this area, contains two toxins that have a direct affect on reproduction: quinolizidine alkaloids and piperidine. There are at least six different species in this county and not all of them have been shown to contain these toxins. The toxins are in their highest concentrations in the plant during early growth and in the seed pod stage. When this plant is ingested by cattle during the 40^{th} -70^{th} days of gestation, the toxins act like a sedative and prevent the fetus from moving during a crucial part of their development. This is essential for proper palate and limb formation. Studies have shown that when fetal movement is inhibited during this time, cleft palates and limb deformities are much more common. Crooked calf disease is commonly associated with ingestion of this plant.

Figure 12: Horse that is wasting from Locoweed Poisoning

Locoweed contains a toxin known as swainsonine. Swainsonine inhibits α-mannosidase activity which is essential for the production of glycoproteins. Glycoproteins are used in the construction of hormones as well as their receptors so this toxin is basically inhibiting the whole endocrine system. This affects the production of hormones like testosterone and estrogen

and can cause sperm mutations, decrease fertility, ovarian swelling and lower the overall health of the animal. The toxin's half life is very short- only 0.2 hours, but the effects of the toxin can last for days. Bulls affected by swainsonine can take about 70 days to have full reproductive recovery. Steers affected with this toxin can take up to 45 more days to finish in a feedlot than unaffected animals. It is suggested that if you are breeding animals to keep them off infected pastures three weeks prior to breeding to ensure good fertilization rates.

Another plant that has major reproductive effects on horses is mustard. Mustards contain a toxin called glucosinolate which causes congenital hyperthyroid dysmaturity syndrome in foals. The gluosinolate chemical is broken down by the animals into goitorenic compounds that affect the thyroid gland. Mares are most affected when they are bred late and fed mustard-contaminated hay, but placing them into mustard infested pastures can produce similar effects.

Reproductive problems caused by some plant toxics and genetic abnormalities can be easily confused with each other. When some plants are eaten, like mustards or needles of ponderosa pine, the mothers show little if any evidence of poisoning, which can make identifying the toxic agents difficult. There are nine known genera and eleven families of plants that are able to produce compounds that can affect reproduction in animals. There are an additional 12 genera in eight plant families that have some known effect. That is why it is important to know about the plants in your local area.

Digestive System:

Often symptoms of digestive irritation such as diarrhea, vomiting, and weight loss are the result of toxins affecting other biological systems but there are twenty three genera and fifteen families of plants that produce toxins that just affect the digestive system and several more that have secondary effects on it. We will look at a few common to this county.

Castor beans produce some of the most toxic naturally occurring substances known. The main ingested toxin is ricin. Once inside the cells, ricin will deactivate the ribosomes, inhibiting protein synthesis. This kills affected cells, resulting in vomiting and bloody diarrhea, the most common symptoms. This plant is highly toxic and has been used as a poisoning agent throughout history.

Figure 13: Cow with bloat

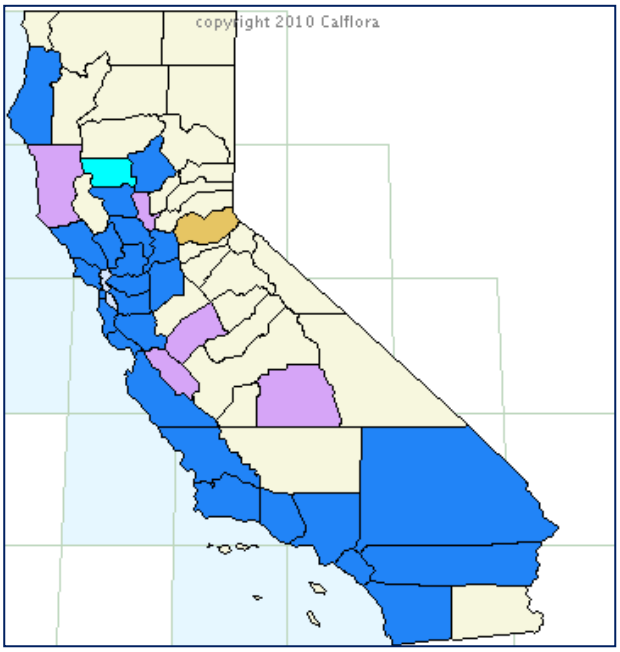
Buttercups (*Ranunculus californicus*) produce a toxin called ranunculoside which are also called volatile lactones. These compounds are hydrolyzed to produce ranunculine and glucose. Runnunculine is then further metabolized to protoanemonine which is an unstable toxic compound. If this plant is ingested in large quantities digestive irritation can follow along with colic, extreme gastro-enteritis and diarrhea. The sap from these plants can cause swelling and blistering of the skin which is probably very similar to what it does to the digestive tract but the exact mechanism of action is unknown.

There are several other plants that produce compounds that have secondary effects on the digestive system but the exact pathways are unknown. An example of this would be Milkweed. This plant produces toxins that belong to the cardenolides chemical family which directly affect ATPase, an enzyme that provides energy for sodium and calcium gradients within the cell. These mainly affect the cardiovascular system but can have secondary effects on the digestive system by producing bloating and gastro-enteritis.

Figure 14: Locoweed
Photo by Marc Horney

This next section of the guide will be dedicated to fourteen poisonous that are found in this area. For each plant, we will discuss its origin, history, life cycle, and description. Also information about the plant's specific toxins will be provided. The last information will be about symptoms, lethal doses, and the animals that are affected by the toxins. Each plant also has a distribution chart courtesy of Calflora (www.calflora.org). The map key is provided below. Enjoy!

Key from Calflora (see example map below)
Dark blue: There are specimen records from this county in an herbarium.
Light Blue: There are documented records, vouchered or confirmed by an expert.
Purple: There are reported records.
Brown: There are reported records available indirectly (eg. in botanical literature).



Coastal Fiddleneck, Fiddleneck, *Amsinckia intermedia*

Annual/Perennial: Winter Annual

Origin: Native to California and Oregon

Where does Coastal Fiddleneck live?

- Overgrazed pastures
- Hay and grain fields
- Roadsides
- Orchards
- Vineyards
- Disturbed areas that are open and dry

Coastal Fiddleneck was named after W. Amsinck, a man who was a patron of the Hamburg Botanic Garden. This plant was eaten by native Californians; the Miwok would roll raw leaves into balls and eat them. The seeds were also ground up to make pinole, a ground meal.

Plant Description and Stages of Growth:

Coastal Fiddleneck is a hairy plant. It can grow up to 2.5 feet tall. Coastal Fiddleneck's leaves are lance-shaped, finely toothed, and hairy. The leaves are alternate. The flowers are yellow, small, and are located in small clusters at the top of the stems. The cluster of flowers forms a fiddleneck like appearance. The fruit of Coastal Fiddleneck is made up of four parts. There is a seed in each section.

Germinate: Fall

Blooms: March through June

Symptoms:

- Liver Damage
- Loss of appetite
- Depression
- Aimless wandering
- Incoordination
- Apparent blindness
- Will lay down
- Photosensitivity
- The toxin will be excreted in the milk, so young are highly susceptible to the toxin.
- The alkaloids can also pass through the placental membrane.

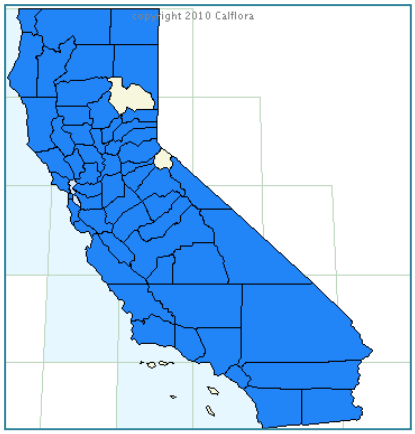
Lethal Dose:

Horses: "Walking Disease", Consume 5% of its body weight over a period of several days or it eats a larger percent of plants for a longer period of time

Cattle and Swine: "hard liver disease"

Seedling Stage
Photo: UC IPM

Mature Flowering Stage
Photo: Marc Horney



Distribution of Coastal Fiddleneck in CA Photo: Calflora

Affected Animals:

- Horses
- Swine
- Cattle

Toxins: Pyrrolizidine alkaloids and nitrates

Toxic Parts: The seed are the toxic portion of the plant. Poisoning of livestock by this plant occurs usually when the seed have contaminated grain or hay. The plant is toxic all year long.

Cocklebur *Xanthium strumarium*

Annual/Perennial: Summer Annual **Origin**: Native to the Americas and Eastern Asia

Cocklebur is a plant with the uncanny ability to get its seed everywhere imaginable. While it's said to be native to the Americas and Asia it can be found just about everywhere. The reason this plant can travel great distances is because of its remarkable seed. It can attach to something and hold on better than gum to your shoe. It can stay viable for years until it can find the right conditions to germinate. The seed can be a big problem for wool growers because it will get stuck in the coat and is very difficult to remove which will lower the wool's value. The plant can also be very toxic to livestock in its seedling state. Cocklebur does have some good uses however, such as its ability to repel army worms and other pests. The most interesting thing about this plant is its seeds' ability to latch onto fabrics which is what inspired the invention of Velcro.

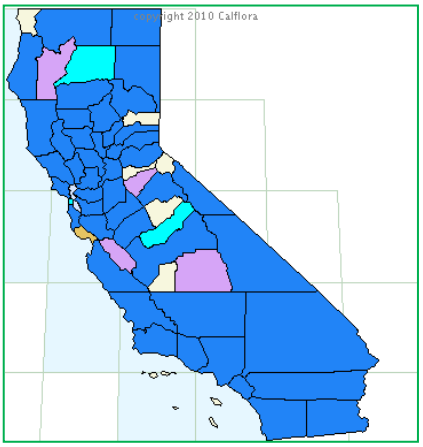
Affected Animals:

- All animals may be affected.
- Cattle, swine, sheep, and poultry are more at risk than horses and pets.

Symptoms:

- Gastrointestinal irritation
- Weakness
- Apnea
- Hypoglycemia
- Cardiac irregularities
- Death

Lethal dose: 1% of the body weight in sprouts.



Distribution in California Photo: Calflora

Plant Description and Stages of Growth: Grows from 1-6 ft tall, has very small green flowers, bush like appearance with oval toothed leaves, and egg shaped, prickly seeds.

Germinates: May or June **Blooms:** Triggered by day length usually in August.

Seedling photo: UC IPM Online

Flowering Plant photo: UC IPM Online

Where does it grow?

- Near river beds
- Meadows
- Grasslands
- Roadsides
- Urban Areas
- Farms

Found in fine textured soils such as clay.

Toxins: Carboxyatractyloside, Sesquiterpene lactones

Toxic parts: The seeds and seedlings contain the highest quantity of toxin, yet the whole plant can be considered toxic. The seed burs can cause mechanical damage.

Death Camas *Zigadenus Venenosus*

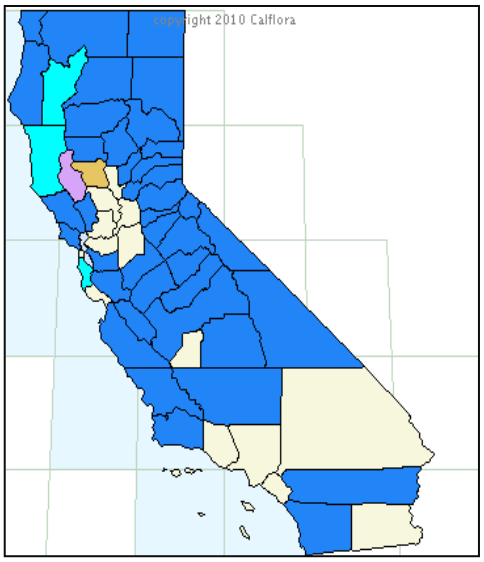
Annual/Perennial: Perennial Herb **Origin:** Native to North America

Death Camas is a plant found in dry meadows or grassy hill sides. It grows from onion shaped bulbs and will look like grass shoots before it flowers. Death Camas flowers between April and July and can be 70 cm high. The Navajo Indians used this plant to treat coyote bites. It is very similar to size and shape of other camases used by the North West Indians for food. The Indians were able to recognize the subtle difference between their bulbs in order to distinguish the two species.

Affected Animals:
- Sheep are the most affected
- Horses
- Cattle

Symptoms:
- Salivation
- Weakness
- Respiration difficulty
- Nausea
- Convulsions
- Coma
- Death

Lethal dose: 2.0-6.0% of animal body weight



Distribution in California Photo: Calflora

Plant Description and Stages of Growth: The death camas stem is usually 20-50 cm tall and protrudes from an oval bulb covered with blackish scales. The leaves are grass like and are 10 to 30 cm tall. The flowers are usually clustered at the top of the steam and form a point.

Germinates: Early spring **Blooms:** April and July

Where does it grow?
- Dry meadows
- Grassy hillsides
- Sagebrush slopes
- Forest areas exposed to sunlight

Bulb Photo: Pacific Bulb Society

Flowering plant Photo: www.bentler.us

Toxins: Steroidal, and glycosidal alkaloids such as zygadenine.

Toxic parts: All parts of the plant are toxic throughout the year, however poisoning is most common is the spring when death camas is abundant.

Field Horsetail, Rushes, Common Horsetail — *Equisetum arverse*

Annual/Perennial: Perennial

Origin: North America

Where does Field Horsetail Grow?

- wet, poorly drained areas of grasslands and fields
- wet meadows, streams and other areas with high water tables: well drained farm fields, orchards, and nursery crops
- roadsides, railroad tracts, and beaches which are sites that have sandy or gravely soil

Its name tells you what it is!
Equis = horse
Seta = bristle, animal hair
Arvum = field

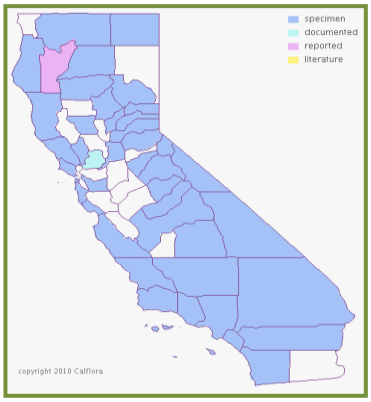
Field Horsetail is a fern that is native to North America. This prehistoric perennial forb dates back to the dinosaur days. Horsetail is the plant material that gave rise to the coal beds in the United States. While field horsetail is toxic to horses, it has been used in human medicine as a diuretic and astringent. The plant has been used to treat bladder and kidney problems as well as stanching a bleeding wound.

Description of Plant and Stages of Growth:

This plant is rush-like with stems that are segmented and hollow. The stems will be eventually topped with spore-producing cones. Common Horsetail has a rhizome system that produces many shoots and tubers. There are two type of stems that grow: reproductive and sterile stems. When the stems are mature they look like miniature pine trees. The sterile stems are vegetative stems that grow later than the reproductive stems. Horsetail does not reproduce by flowers or seed. It reproduces through spores.

Germinate: Reproductive stems: early spring

Seeds: Spores are produced March to July



Distribution of Field Horsetail in CA Photo: Calflora

Seedling Stage
Photo: US Pest

Adult Stage
Photo: © Br. Alfred Brousseau, Saint Mary's

Reproductive Stem
Photo: Calflora

Symptoms:

- Agitation
- Weakness
- Staggering
- Labored breathing
- Rapid heart rate
- Constipation or diarrhea
- Weight loss
- Decreased milk production
- Trembling
- Convulsions and coma prior to death
- Death

Lethal Dose:
Horses: Hay with 20% of dried horsetail can sicken horses in 2-5 weeks.

Toxins: Thiaminase, which is an enzyme that breaks down the vitamin thiamin, aconitic acid, equistitic, nicotin, plamitic acid, and silica.

Affected Animals

- Horses
- Cattle, sheep, and goats are rarely poisoned by horsetail!

Toxic Parts: All parts of the plant are considered toxic.

Jimsonweed *Datura stramonium*

Annual/Perennial: Annual herb **Origin:** Native to Asia. Imported to Europe and the Americas.

Symptoms:
- Dilated pupils
- Agitation
- Increased heart rate
- Trembling
- Delirium
- Convulsions
- Coma
- Death

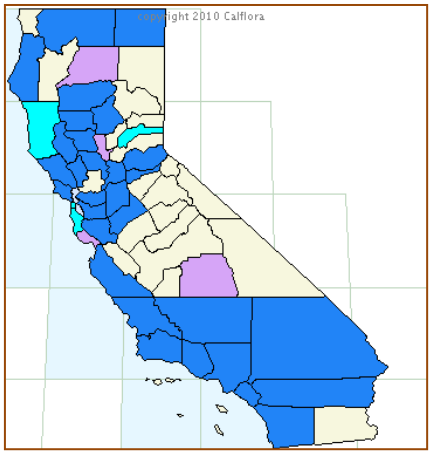
Lethal dose: This is unknown. At least .7% of the leaves are toxic compounds and the seeds contain an even greater amount.

In the United States Jimsonweed is also known as Jamestown weed. It got this name because British soldiers who were trying to suppress Bacon's rebellion boiled this plant to include in one of their evening meals. The soldiers spent the next eleven days appearing to have gone insane. The plant was also used by the Native Americans in sacred ceremonies. Atropine, a toxin found in Jimsonweed, as well as other plants in the night shade family, was used by French women in the 1800's to get their pupils to dilate in a dreamy fashion. It is now used by ophthalmologists to dilate pupils. The most common form of poisoning that occurs with from this plant is in chickens when the jimsonweed seeds get mixed in with other grains.

Affected Animals:
- Cattle
- Sheep
- Horses
- Swine
- Poultry
- People have also been known to get poisoned after eating the berries of nightshade plants.

Plant Description and Stages of Growth: 1-7 ft tall with a 3-4in long white to lavender trumpet like flower. Pointed leaves with coarsely toothed edges, spiny fruits.

Germinates: Late spring to early summer **Blooms:** July to August



Distribution in California Photo: Calflora

Flowering Jimson Weed
Photo: UC IPM Online

Jimson Weed Seedling **Photo:** UC IPM

Toxins: Tropane alkaloids, (atropine, hyoscyamine, and scopolamine).

Toxic parts: All parts of the plant contain toxic doses.

Where does it grow?
- fields
- clearings
- waste places

Larkspur ***Delphinium spp.***

Annual/Perennial: Perennial Forb **Origin:** Native

This member of the Buttercup family is divided into three groups: tall larkspurs, low larkspurs, and plains larkspurs. According to Greek mythology, larkspurs came from the blood of Ajax, a soldier who committed suicide after he could not obtain Achilles' protective covering. This story gave larkspur its nickname "the knight's spur". Larkspur also derives its name from irregular shape and complicated intertwining petals and sepals. Every month has a birth flower; larkspur is July's flower.

Where does Larkspur live?

- Tall larkspur: lives in deep soils that have good moisture content at high elevations.
- Low larkspurs: grow at lower elevations and will complete their life cycle before the soil

Plant Description and Stages of Growth:

This plant has showy blue to purple flowers. The flowers will grow in thick clusters at the end of tall flower stocks. The leaves are almost round and found on the bottom portion of the plant. Larkspur has pod-shaped fruit. One of the risks associated with this plant is that is one of the first plants are green in the season. They reproduce by seeds. They are toxic in the spring, summer, and fall.

Germinates: Early spring **Blooms:** March -September

Flowering Stage
Photo: Calflora

Seedling State
Photo: Christopher Christie

Affected Animals:

- Cattle
- Sheep

Toxins: Diterpine alkaloid.

Toxic Parts: All portions of the plant are toxic whether they are fresh plant material or dried. Toxicity of the plant will decrease over the growing season, but toxic levels can increase in the pods and flowers late in the season.

Symptoms

- Impaired CNS
- Salivation
- Straddled Stance
- Arched back
- Repeated falling
- Constipation followed possibly by diarrhea
- Bloat
- Vomiting
- Mild tremors
- Convulsions
- Coma
- Death 3-4 hours after lethal dose

Lethal Dose:
Cattle: 0.5% of their body weight.

Locoweed *Astragalus/Oxytropis spp.*

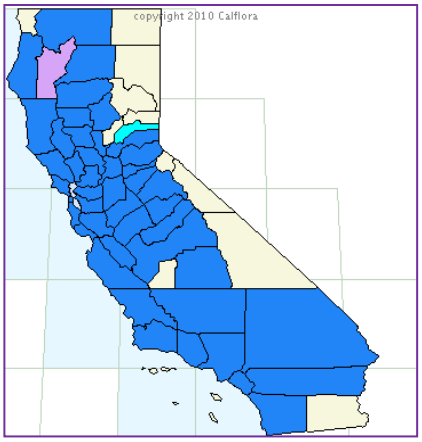
Annual/Perennial: Perennial **Origin:** North America

Affected Animals:
- Cattle
- Sheep
- Horses

Locoweeds are found on mountains, foothills, plains and in desert regions. It stats growing in the fall, winter, or early spring, depending on its location, or species. Locoweeds produce large amount of seeds that can stay viable for up to 50 years in the soil. Animals can develop a taste for it and actually seek it out. Studies have shown that cattle grazing on locoweed infested pastures gain significantly less weight. This loss of gain can continue for up to 50 days after being removed from infected pastures. In China they have developed a vaccine to give cattle in order for them to safely eat locoweed for up to a year. In the U.S, the cost is $1.21 per dose.

Symptoms:
- Depression
- Dull eyes
- Nervousness
- Abortions
- Inability to eat or drink
- May become violent.

Lethal dose: The lethal dose can be as little as two pounds and can affect the animal only hours after being eaten.



Distribution in California Photo: Calflora

Plant Description and Stages of Growth:
This is a low spreading plant with pink, purple, yellowish, or white flowers. Steams can be 8 inches long and flowers range from ½ to 1in long.

Germinates: Fall, winter, or early spring. Usually follows autumn rains.

Blooms: June-August

Immature plant Photo: Alaska Department of Natural Resourses

Flowering plant Photo: Marc Horney

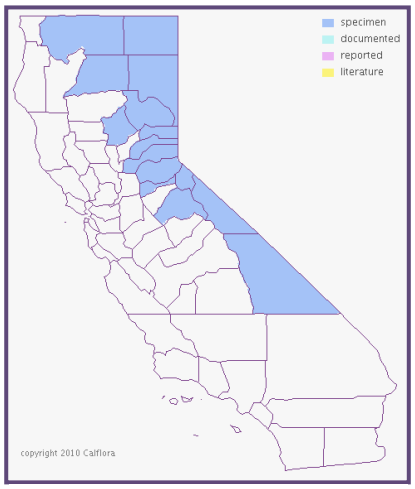
Toxins: Miserotoxin, Swainsonine and Selenium from soil.

Toxic Parts: The whole plant is considered toxic and will remain even after drying.

Where does it grow?
- Dry prairies
- Meadows
- Dry mountain slopes
- Grassy plains

Lupine ***Lupinus spp*.**

Annual/Perennial: Perennial Herb **Origin:** Native to the United States



Lupine Distribution in California
Photo: Calflora

While there are six types of lupine that are associated with "Crooked Calf Disease", there are some sweet lupines that are used for animal forages in other countries. The seed of these sweet lupines are also consumed by humans under certain conditions. Of the six types of lupine that are poisonous and cause "Crooked Calf Disease", three are found in California: Silvery Lupine, Tailcup Lupine, and Velvet Lupine.

Plant Description and Stages of Growth:
Lupines can grow from 0.3 meters to 1 meter tall. Lupine's leaves have 5 to 13 thin, lance-shaped leaflets. The leaflets are arranged around the stem like spokes of a wheel. The flowers of this plant are 3/8-1/2 inches long. They are pea shaped. Assembled along the tops of the stalks, the flowers can be white, yellow, blue, pink, or purple. The fruit of lupines is found in pods.

Where does Lupine grow?
- Foothills
- Mountain ranges in Sagebrush and Aspen areas
- Wooden and open hillsides

Germinates: Spring **Blooms:** June **Seeds Present:** July or August

Seedling Stage
Photo: Annie in Austen

Mature Flowering Stage
Photo: Calflora

Toxins: Quinolizidine alkaloid

Affected Animals:
- Sheep
- Cattle

Toxic Parts: Younger plants are more toxic than older plants. Plants in the seed stage are the most dangerous to livestock in the late summer. This is because their seeds have high levels of alkaloids and they are more palatable than the surrounding dry grasses.

Symptoms
- Nervousness
- Excessive salivation; frothing at the mouth
- Depression
- Reluctance to move
- Lethargy, inappetence
- Difficulty breathing
- Twitching leg muscles
- Hepatic degeneration
- Convulsions
- Coma
- Death

Birth Defects
- "Crooked Calf Disease": cleft palate and distorted or malformed spines in fetus when cattle consume it during their 40^{th} to 70^{th} day of gestation.

Lethal Dose:
Sheep: Consuming 0.1 kg of plant material per day for 3-4 days
Cattle: Consuming 0.5-1.0 kg of plant material every day for 3-4 days

Milkweed *Asclepias spp.*

Annual/Perennial: Shrubbery Perennial **Origin:** North America

Milkweeds are usually found in poor sandy disturbed soils and they can become drought resistant once established. Milkweeds produce larger clumps of flowers when watered and in good soil. The scientific name Asclepias comes from Asklepios, the Greek god of healing. This is because, traditionally, the root of this plant was used to prepare a tea to use as a diuretic for kidney stones, a laxative, and an expectorant. It has also been used treat asthma, bronchitis, to induce sweating and in many Native American cultures a contraceptive. During World War II, children in the United States were asked to collect milkweed pods for the government. The fluffy silk was separated from the pods and used to stuff life vests and flying suits because it was very buoyant and lightweight. Another use for milkweed in World War II was in the production of latex because of the natural rubber shortage.

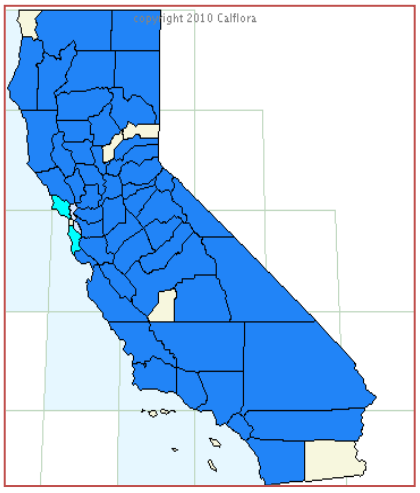
Symptoms:
- Depression
- Weakness
- Difficulty breathing
- Violent spasms
- Bloating
- Gastroenteritis.

Lethal dose: 0.2-1.0% of body weight. Horses are more at risk.

Affected Animals:
- Sheep
- Cattle
- Occasionally horses.
- Most livestock losses the result of hungry animals being concentrated around milkweed infested areas.

Plant Description and Stages of Growth: Stands 1-5 ft tall with a ¼ to ½ flower. Flowers are deep pink to rose star shaped and in dense clusters. Leaves are in pairs and are narrow. Has a white milky sap.

Germinates: Spring after frosts. **Blooms:** May- September



Distribution in California Photo: Calflora


Milkweed seedling Photo: UC IPM


Milkweed flower Photo: UC IPM

Where does it grow?
- Cultivated fields
- Gardens
- Pastures
- Waste places
- Roadsides
- Other disturbed areas

Toxins: Cardenolides and resinoids.

Toxic parts: Leaves and other above ground parts of the plant are poisonous. Milkweed may cause losses at any time, but it is most dangerous during the active growing season.

Redroot pigweed — *Amaranthus retroflexus*

Annual/Perennial: Summer Annual

Origin: Native to North America.

Red root pigweed got its name because pigs like the taste of it. Red root pigweed is a pioneer plant that's likes to grow in bare disturbed areas. In the wild the plant provides cover and food needed for game birds. Historically, the plant's seed also provided food for the early Native Americans who would grind the seed into flour. One red root pigweed plant can produce over 100,000 seeds that are 95% viable and can stay dormant in the soil for up to 40 years. What makes this plant toxic is its ability to accumulate and store nitrogens in its steams and leaves. This level is highest right before it flowers. Its genus name Amaranthus is Greek for "the plant that never fades".

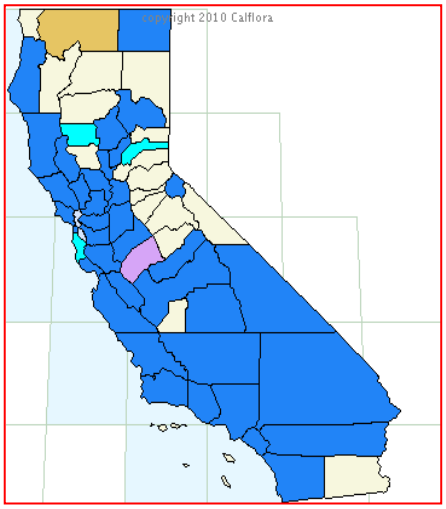
Affected Animals:

- Cattle and swine are the most affected.
- Goats and sheep can also be poisoned.

Symptoms:

- Difficulty breathing
- Sudden death
- Muddy mucous membranes
- Brownish appearance to blood.

Lethal dose: 0.05% of the body weight
Example: .6lbs is toxic to a 1,200 pound steer



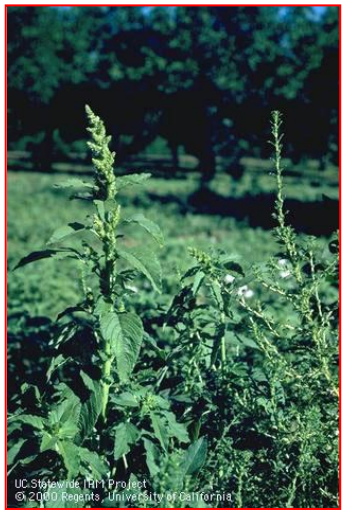
Distribution in California Photo: Calflora

Plant Description and Stages of Growth: This plant can grow from 4"-72" but is normally 20-36" high. The stems near the bottom appear red and smooth but as you move towards the top it becomes green and rough with a dense hairy coat.

Germinates: Usually in late spring to early summer. Influenced by temperature (86-104°F), soil type (pH4.2-9.1) and day length.

Blooms: July to August

Seedling photo: UC IPM Online



Flowering plant photo: UC IPM Online

Where does it grow?

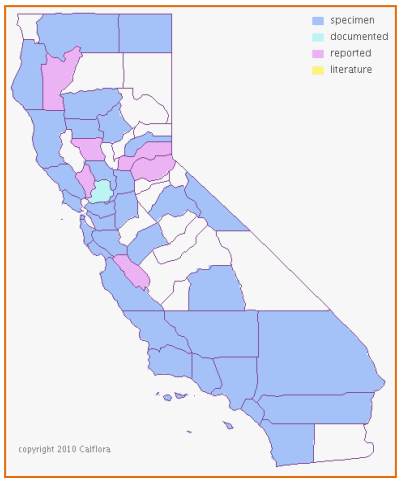
- Cultivated fields
- Gardens
- Pastures
- Waste places
- Roadsides
- Other disturbed areas

Toxins: Nitrate (which is reduced to nitride in the rumen), nephrotoxin, and soluble oxalates.

Toxic parts: Leaves, stems, roots are all toxic. Highest levels are right before it flowers.

Poison Hemlock, Poison Parsnip, Poison Fool's Parsley *Conium Maculatum*

Annual/Perennial: Biennial herb **Origin:** Europe



Concentration of Poison Hemlock in CA Photo: Calflora

This member of the carrot family was introduced in the 1800s from Europe. People thought that its flowers made it an attractive ornamental or garden plant. A biennial plant is a plant that has a life span of two years. People are usually poisoned by hemlock because they mistake it for another plant. Its roots are mistaken for wild parsnips. Poison hemlock leaves are thought to be parsley while the seeds look like anise seeds. Children are sometime accidently poisoned when people make whistles for them out of the hollow stems of the plant. Poison hemlock is thought to be the plant that was used to kill the philosopher Socrates.

Where does this plant grow?

- Stream banks
- Ditches
- Pasture boarders
- Hay fields
- Rangelands
- Roadsides

Description of Plant and Stages of Growth:

Poison hemlock can grow up to 10 feet tall. Its leaves are shiny, alternate, and compound. The leaflets are lacy and fern-like. Poison hemlock has clusters of white flowers that form into green fruit that has several seeds. When the fruit is mature it is grayish brown. Its seeds will germinate April through May. The taproot is fleshy and white. Poison parsnip has two parts to its two year life span. In the first year of its life, the plant is going through its vegetative stage. It is during its second year of life that the plant begins to reproduce. The plant will mature July through August.

Germinates: Late summer to early spring **Flowers:** April through July **Seeds:** April through May

Flowering Stage
Photo: Nature in the City

Seedling Stage
Photo: UC IPM

Affected Animals

- Sheep
- Cattle
- Swine
- Horses

Toxins: Peperidiine alkaloid, conine, and g-coniceine

Toxic parts: All parts of this plant are toxic. The tap root is the most toxic section. The leaves are usually very poisonous through out the season until the time the plant flowers. It is usually only consumed by livestock when there is no other forage available. The animals usually do not want to eat it because it has foul smell.

Symptoms

- Nervousness
- Trembling
- In-coordination
- Dilation of pupils
- Weak heart beat
- Cold extremities
- Coma
- Death from Respiratory failure

Birth defects

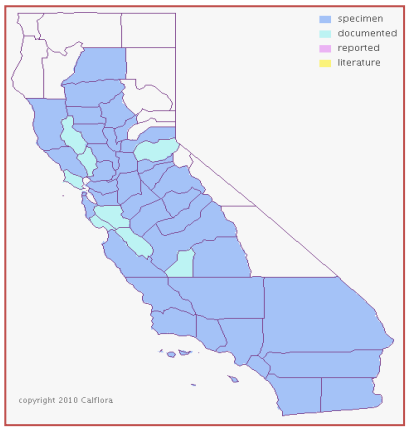
- "Crooked Calf Disease" : skeletal deformities or cleft palette in offspring Cattle: 40-70 days of gestation when Sheep, goats, and hogs: 30-60 days of gestation

Lethal Dose

Sheep: 100-500 grams of fresh leaves
Cattle: 300-500 grams of fresh leaves.
Symptoms occur one hour after eating the plant with death occurring two to three hours later.

Silver Leaf Nightshade, White or Silver Horsenettle, Tomato Weed *Solanum elaeagnifolium*

Annual/Perennial: Perennial Herb **Origin**: United States



Distribution of Silver Leaf Nighshade in CA Photo: Calflora

Silver Leaf Nightshade is not native to California, but it is native to the United States. Native American would use this plant for medicinal purposes. The Navajo Indians would use the plant to cure respiratory problems. Pima Indians would place dried crushed berries in their milk when making cheeses. In modern medicine, the glycoalkaloids found in the plant have been used to slow cancer growth.

Plant Description and Stages of Growth:

Silver Leaf Nightshade grows in patches. It can reach heights of 3 feet. Flowers are purple with yellow centers. The flowers will grow in clusters. Silver Leaf Nightshade's leaves are lanced-shaped and bluish-grey. The fruit produced by this plant is small and yellow. The round berries have seeds and grow in clusters. Flowers are usually purple. The plant will die back in the winter and come back in the spring.

Where is the plant found in Ca?

- Disturbed areas
- Cultivated, waste, or fallow lands
- Roadsides
- Yards
- Perennial fields
- Woods and fence rows
- Grain and hay fields

Germinates: Late March to Early April **Blooms:** May to September
Seeds: June

Symptoms

Gastrointestinal Tract

- Pain
- Constipation or diarrhea
- Inflammation
- Bleeding
- Ulceration of intestinal mucosa

Neurological

- Depression
- Salivation
- Weakness
- Incoordination
- Labored breathing
- Coma
- Death

Reproductive

- Birth defects are possible.

Lethal Dose:
Mild to severe poisoning can occur with the ingestion of 0.1-0.3% of body weight of fresh plants.

Seedling Stage Photo: UC IPM

Mature Plant Photo: Calflora

Toxin: steroidal glycoalkaloid (solasodine)

Toxic Parts: Unripe berries of silver leaf nightshade are the most toxic, but the leaves, stems, ripe berries, and shoots are also toxic. The toxic season of the herb ranges from summer to the fall. Both fresh and dry plants are poisonous.

Affected Animals

- Cattle
- Swine

Tumble Mustard, Tumbling Mustard — *Sisymbrium altissimum*

Annual/Perennial: Winter/Summer Annual
Origin: Europe

Tumble Mustard was introduced to the United States in Philadelphia from ship ballast in 1878. The young leaves and shoots of this plant are edible. Tumble mustard can also be used for medical purposes. The leaves and flowers have properties that cause tissue to contract. Tumble mustard is effective against scurvy.

Where does Tumble Mustard grow?

- Small grain fields
- Rangeland
- Waste Areas
- Roadsides

Plant Description and Stages of Growth:
Tumble Mustard can grow 2-5 feet tall. It has two different types of leaves. There are coarse lower leaves that are lop-shaped and smaller finer loped upper leaves. The fruit of tumble mustard is a slender capsule that has small numerous yellowish seeds inside. The flowers are small and yellow.

Germinates: Spring or late fall **Blooms:** April through September

Mature Stage
Photo: UC IPM

Seedling Stage
Photo: UC IPM

Affected Animals

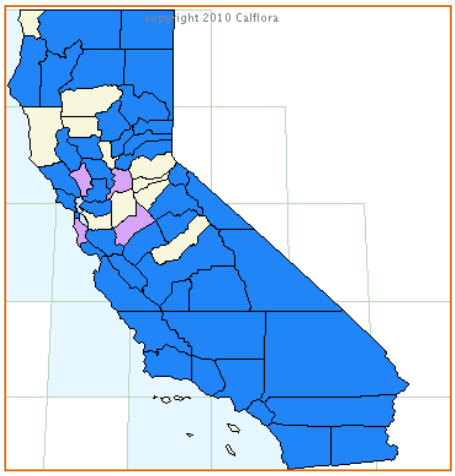
- Horses

Symptoms
Congential Hypothroid Dysmaturity Syndrome

- Longer than normal pregnancies
- Foals are born with facial and jaw deformities.
- Limb deformities are also possible.

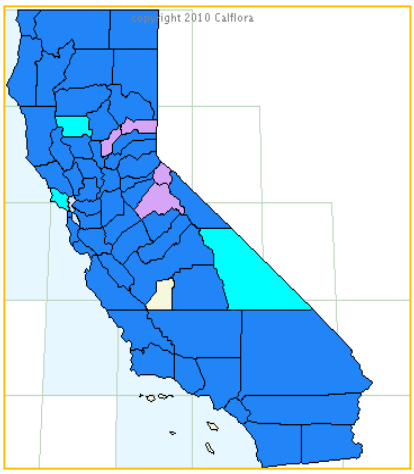
Toxins: Glucosinolates

Toxic Parts: Mares are poisoned by Tumble Mustard when they consume this plant late during their gestation. The toxins act on the mare's thyroid gland. The mares are usually poisoned by being fed contaminated hay.



Distribution of Tumble Mustard in CA
Photo: Calflora

Yellow Star Thistle — *Centaurea solstitialis L.*



Distribution in California Photo: Calflora

Annual/Perennial: Annual

Origin: Eurasia

Yellow star thistle was introduced to the United States in the 1800's in contaminated alfalfa seeds. It has spread rapidly at a rate of 500,000 acres a year and is found in 23 states. When yellow starthistle is eaten by horses it can cause a neurological response very similar to Parkinson 's disease in humans. When eaten chronically it will lead to chewing disease which always results in death.

Where does it grow?

- Disturbed sites
- Grasslands
- Rangeland
- Open woodlands
- Cultivated fields
- Pastures
- Roadsides

Even though the toxic dose for this plant is very, high horses will develop a taste for it and actually seek it out. So it could become a real problem. Its flowers, however, are highly beneficial to the honey industry. In 1959, it was estimated that the value of honey produced from the yellow star thistle flower was between $150,000-$200,000.

Plant Description and Stages of Growth: 1 to 2 meters tall with spiny yellow heads on stem tips. Has a tap root that can penetrate 1m or more. Steam leaves alternate.

Affected Animals

- Horses

Germinates: Germinates after first fall rains. Plants exist as basal rosette until steams grown in late spring-early summer.

Blooms: May-December

Symptoms:

- Inability to swallow
- Drowsiness
- Inability to eat and drink
- Making chewing motions with nothing in the mouth
- Frequent yawning
- Unusual behavior including standing in unusual positions
- Acting as though something is caught in throat
- Chewing food and spitting it out.

Lethal dose: Toxic does is 60-200% of the horse's body weight.

Yellow Star Thistle Seedling
Photo: www.forestryimages.org

Yellow Star Thistle flower
Photo: UC Davis

Toxins: Cardenolides and resinoids.

Toxic parts: Leaves and other above ground parts of the plant are poisonous.

Management of Poisonous Plants on Rangelands

The ruminant portion of the livestock industry depends heavily on grazing. Having access to high quality and inexpensive feed is necessary for producers to raise excellent quality meat and fiber products. In the United States, 42% of land is devoted to pastures and rangeland. Poisonous plants are found throughout these natural environments. Under the correct conditions, these plants can threaten the well-being of animals. Errors made by managers can compromise livestock health and people who are unfamiliar with poisonous plants in their local communities place their animals at a greater risk of being poisoned. If poisonous plants pose a threat to herds, managers should devise grazing plans to minimize those threats.

Figure 15: Grazing Cattle

Figure 16: Cattle grazing dry grasses

Risks to animals can increase when there is inadequate forage. This can be caused by several events. Many poisonous plants have a tap root system which enables them to remain green longer than annual grasses since they can obtain water from deeper in the soil profile. The season of the year and stocking density can affect level of accessible forage. Some poisonous plants become green earlier in the growing season than other forage and others stay green longer. Some grazing management practices will decrease the quantity of good forage while allowing poisonous plants to become more prevalent. Livestock may then be left with larger populations of poisonous plants as their food source. Animals are more likely to consume poisonous plants when they are stressed or hungry. Transporting animals to a new location, driving the animals to a new pasture, penning livestock for extended periods, and changing weather conditions are all circumstances that cause livestock stress.

One of the last places animals are exposed to poisonous plants is in supplemental feed. Producers need to be aware of different plants that might find their way into a feed source. Much of the baled hay is never touched by human hands and it is essential that the rancher knows how to identify toxic species in feed.

Management Strategies to Prevent the Effects of Poisonous Plants

There are various management techniques that a rancher can employ to help reduce or eliminate the threat of poisonous plants. A combination of these strategies is recommended. While some of these strategies are good ideas, they are not practical to use in all circumstances such as trying to hand-pull a whole hillside of coastal fiddleneck. It is important to use the right management techniques for your own circumstances.

Knowledge is Power!

The first step that a rancher should take to protect his livestock from poisonous plants is to gain information about the plants in his area. The manager should learn to visually identify them at the seedling, vegetative, and reproductive stages. Along with recognizing the physical appearance of the plants, ranch managers should educate themselves on the toxins and symptoms that the plants can produce. It is important to understand the times of year that the plants are most toxic to livestock. Being informed of the stages of production that are the most susceptible is critical. Knowing the dose threshold for the plant toxins would also be helpful. Ranchers can become more informed about poisonous plants by contacting their local university, cooperative extension office, local library, or surf the internet. Here are a few websites to refer to:

- USDA Poisonous Plant Research Station http://www.ars.usda.gov/
- Calflora http://www.calflora.org
- USDA Natural Resources Conservation Services http://plants.usda.gov/
- Cornell University Department of Animal Science http://www.ansci.cornell.edu/plants/index.html

Understand Your Animals

Livestock are capable of learning to recognize what plants are poisonous. Animals have a variety of internal responses that enable them to recognize and avoid plant toxins. Their ability to do this is governed by a feedback mechanism from their gut to their brain. A couple of events need to occur in order for the feedback mechanism to become active. If the toxins in a plant make an animal feel nauseous, a signal will be sent to the brain that the animal should not eat that plant any more. Animals must become ill from the plant toxins within twelve hours or less after they consume a new plant in order to learn to avoid it. However, not all poisonous plants appear to produce nausea. In order to trigger the feedback mechanism, toxins must also have a flavor to associate the nausea with. Flavors may allow animals to detect changes in toxin concentrations among forages. If an animal does not detect a change in flavor as the level of toxin concentration changes, it will continue to eat the more toxic plant.

Figure 17: Food, Hooray!

Other behavior can help ranchers monitor livestock susceptibility to poisonous plants. Inexperienced animals are at a much higher risk if being poisoned than animals that are familiar with poisonous plants. Naïve animals without the guidance of experienced grazers are not as prepared to avoid harmful plants as young livestock that have been taught by their dams what plants or tastes to avoid. Animals select their feed based on the nutrients that they need to survive. Poisonous plants can be nutritious. When livestock do not have enough feed or water, they will consume poisonous plant before starving to death. Stress will also increase the likelihood of animals eating poisonous plants and livestock are more susceptible to the toxins when they are stressed. Also when they are placed in a new environment, animals may more likely to consume familiar poisonous plants rather than unfamiliar non-poisonous feeds. Animals that are healthy and eating a nutritionally balanced diet may be less susceptible to toxins, and perhaps better able to break those toxins down. By understanding how livestock act in the presence of poisonous plants, a rancher can be better prepared to protect livestock from poisoning.

Rangeland Health

Increasing grass production can help reduce the likelihood of poisoning. While the logic behind this idea is simple, it is a difficult task to accomplish. If there is more forage available, animals will be less temped to consume poisonous plants. If grass production cannot be greatly increased, producers may need to focus on encouraging the growth of desirable plants and discouraging the growth of undesirable plants. While having some poisonous plants on the rangeland is normal, large populations of some poisonous plants can indicate an unhealthy ecosystem. By having well-functioning ecosystem processes, managers can try to achieve better rangeland health. By changing the quality of the water cycle, mineral cycle, solar energy flow, and the complexity of the organisms living in the rangeland community, a rancher can try to create a healthy rangeland that may have increased grass production. Managing an ecosystem is a complex and difficult job. Even if the ecosystem processes are improved, desired results may not always be obtained. The following sources may be of some help for these projects: "Holistic Management: A New Framework for Decision Making" by Allan Savory (see the sections on ecosystem processes and tools); "Ecologically-Based Invasive Plant Management" website and resources (http://www.ebipm.org/) – for those species that are introduced and invasive; and the University of California Weed Research and Information Center (WRIC;http://wric.ucdavis.edu/).

Type of Livestock

If it is practical the rancher can change the type of livestock he is grazing on rangeland that have poisonous plant infestations. Type of livestock refers to the stage of production an animal is in. For example, in the cattle industry there are three main production phases: cow calf, stockers, and feedlot cattle. Only cow-calf and stocker phases are managed on pasture. If the poisonous plant in question causes birth defects in pregnant cattle, then stockers could be run in that area rather than cows. A rancher could graze species of livestock that are not as vulnerable to the poisonous plant that is a problem before letting a more vulnerable species graze in the area. An example of this would be grazing sheep in lupine infested areas prior to allowing cattle to graze in that area.

An Ounce of Prevention

There are management decisions that can decrease the risk of livestock being exposed to poisonous plants. Breeding schedules can be changed to prevent pregnant livestock from being around poisonous plants during critical periods of gestation. The time that the animals are exposed to poisonous plants can be limited by using intermittent grazing. Grazing plans may also be changed in order to avoid grazing in areas that have poisonous plants at their most toxic stage.

Mechanical and Chemical Control

Mechanical Control: Mechanical control consists of physically removing the plants or disturbing the area that the plants are growing in. There are two mechanical methods that can be used when dealing with herbaceous poisonous plants on the rangeland.

- *Hand-pulling and hoeing:* This method is effective on shallow-rooted weeds growing in loose and shallow soil. These weeds can be killed with the complete removal of the crown. Hand-pulling and hoeing can be used to control small scale infestations or to remove weeds at the edge of an infestation. Another use would be as a follow-up procedure after the bulk of the original infestation has been removed.

Figure 18: Mowing Yellow Starthistle in Yosemite National Park

- *Mowing:* Mowing is used mostly to combat annual weeds, but also for some perennials. Mowing can be helpful in preventing seed production, reducing carbohydrate reserves of plants, and to allow perennial grasses an advantage by setting back the competitive annuals. However the success of mowing depends on the timing of the mowing. Mowing should be done during the flowering stage of the plant prior to seed development. A caution is advised when using this method. Improper mowing practices or mowing a species of plant that responds favorably to being mowed can increase the population of weeds instead.

Chemical Control: This is the primary method used to control poisonous rangeland plants. Timing of application is a critical factor. One of the goals herbicide is to give desirable plants an advantage over undesirable plants. Under some circumstances, control of poisonous plants may allow managers to have longer grazing times, greater pasture productivity, and increased stocking rates. However, once the plant population has been reduced by chemical control, it is vital to implement a program to improve rangeland productivity and health. One downside to the use of herbicides is that some herbicides will actually make the poisonous plant more palatable without decreasing the toxicity.

Biological Control

Figure 19: Poison Hemlock Moth

Biological control is the use of nematodes, pathogens, vertebrates, and arthropods to cause environmental stress for poisonous plants. These organisms can potentially cause enough stress to reduce the population of the targeted poisonous plant. However, the use of biological controls is usually not very successful and can produce unforeseen consequences.

Guide for Management of Specific Poisonous Plants

Coastal Fiddleneck: Coastal fiddleneck can be managed with manual removal of the plants by hand-pulling. Mowing is also an option. Both of these actions should occur before the seeds develop. Manual removal should only be used with small localized infestations. Coastal fiddleneck is out-competed by good grasses or perennial plants. Herbicides are difficult to use on coastal fiddleneck because the hairy leaves and stems reduce its effect. If herbicides are going to be employed then plants must be sprayed before seed development.

Cocklebur: Cocklebur can be managed by manual removal, mowing, and cultivation. These should be completed before the burs develop. Plants that are cut from mowing or manual removal with immature seeds can still produce viable seeds.

Death Camas: Do not allow livestock to graze in areas with high concentrations of death camas in them. Death camas populations can be decreased with herbicides used early in the growing season when the plant has three to six leaves.

Field Horsetail: Field Horsetail can be controlled through quarantine and mechanical methods. Lime and fertilizer can used to encourage an increase in grass growth. Herbicides can also be used to manage field horsetail, but field horsetail can tolerate the treatment.
For more information, please visit the Oregon State University Extension Office:
http://extension.oregonstate.edu/catalog/html/pnw/pnw105/

Jimsonweed: The prescribed methods of control for jimsonweed are manual removal, mowing, and cultivation. These actions should take place prior to seed development.

Larkspur: The early vegetative stage of larkspur is not palatable to livestock. Livestock should be kept away from flowering larkspur until after the seeding stage. Sheep can be used to trample or graze the plant prior to running cattle in the area. Larkspur can be managed with herbicides. Low larkspur should be sprayed during the vegetative stage when the plant is at its

maximum growth prior to flowering. Tall larkspur can be treated throughout the flowering stage. Livestock should not be allowed to graze on herbicide treated larkspur because treated larkspur is more palatable to livestock.

Locoweeds: It is recommended to keep all livestock off of locoweed infested pastures because there is no safe time for livestock to graze this plant. Breeding males should not be allowed near locoweed within 90 days of the breeding season. Pregnant animals should be removed from locoweed infested areas. Breeding females should not to be allow to graze locoweed for more than 2-3 weeks. Herbicides can be used to control locoweed when it is actively growing or budding.

Lupines: Herbicides should be used on lupine when it is actively growing. The plant should reach a height of ten centimeter before it is treated, but it should be treated before it blooms. Sheep can also be used to reduce plant populations before cattle are grazed on the area.

Milkweed: Milkweed can be treated with both mechanical practices and herbicides. This plant can be mowed before the seeds ripen. Herbicides can be sprayed in the spring and summer. If the plants are treated in the spring, they should be at least 12 to 18 inches tall. Application of herbicides in the early to mid-summer is ideal. Milkweed is in bud during this time. Most of its energy is being devoted to reproduction rather than its root system. Treating when buds are present can take advantage of the plant's weakened state and move the herbicides quickly through the plant.
For more information, please visit the US Forest Service Database:
http://www.fs.fed.us/database/feis/plants/forb/ascspe/all.html#MANAGEMENT%20CONSIDERATIONS

Poison Hemlock: Poison Hemlock can be managed a variety of ways. Hand-pulling, grubbing, and multiple close mowing are effective. Plants will not regenerate when they are hand-pulled or cut below the crown. Herbicides can be used. Biological control is a possible method of

control. The larvae of European paleartic moth only feed on the plant tissues of poison hemlock. It was accidently introduced to the United States in the 1970s. Today it is known as the hemlock moth. The hemlock moth can cause defoliation of the plant by consuming plant leaves, young stem tissue, flowers, and seeds.

For more information, please visit Cal-IPC:

http://www.calipc.org/ip/management/ipcw/pages/detailreport.cfm@usernumber=32&surveynumber=182.php

Redroot Pigweed: Cultivation and manual removal prior to seed development is the recommended actions to take when trying to control redroot pigweed. Herbicides can also be used. However, redroot pigweed varieties differ in resistance to certain herbicides.

Silver Leaf Nightshade: Weekly mowing can be used to decrease populations of silver leaf nightshade. Mowing will reduce silver leaf nightshade's carbohydrate reserves by weakening the root system and reduce the quantity of seeds the plant is able to produce. This management strategy works best for small patches of silver leaf nightshade. If livestock are grazed in areas with major silver leaf nightshade infestations, they should be isolated for 6-7 days before being moved to an uninfected area to prevent the spread of seeds in their feces. If herbicide is used, treat silver leaf nightshade when it is in its late bud to early flowering stage.

For more information, please visit CDFA Noxious Weed Gallery:

http://www.cdfa.ca.gov/phpps/ipc/weedinfo/solanum-americanum.htm

Tumble Mustard: Mechanical control is best used when there is a small infestation. Livestock are able to eat young tumble mustard without becoming sick. Herbicides can be used to gain initial control over large infestations of tumble mustard. The plant should be sprayed in the late fall or early spring.

For more information, please visit the US Forest Service Database:

http://www.fs.fed.us/database/feis/plants/forb/sisalt/all.html#IMPACTS%20AND%20CONTROL

Yellow Starthistle: There are multiple methods for livestock producers to use when combating yellow starthistle. Grazing, mowing, burning, and cultivation are all methods that can be used to manage this plant. Timing is a critical factor when using any of these methods to control yellow star thistle populations. High intensity short duration grazing by cattle, sheep, and goats is recommended to take place after the plant has bolted and prior to seed developments. Mowing is also recommended during this time, especially if it is a dry year. Mowing can increase seed population if it is done too early. If a prescribed burn is done, it should occur after other annuals have dried out, but before yellow starthistle is able to produce seeds. If the burn occurs at the wrong time in the season, it can encourage germination in the fall. The best recommendation to control large populations of yellow starthisle is to use herbicides over a period of time and use mowing or grazing as follow up practices to spot treat. Biological control has been tried, but has not been very successful.

For more information, please visit Weed RIC:

http://wric.ucdavis.edu/yst/manage/management17.html

Toxic Plants In San Luis Obispo County

Toxins	Description	Plant cycle	Symptoms	Image
Coastal Fiddleneck *Amsinckia intermedia* **Toxins:** - Pyrrolizidine alkaloids - Nitrates **Toxic dose:** 5% of body weight over a period of several days	A hairy plant that can grow up to 2.5 feet tall. Leaves are lance-shaped, finely toothed, hairy and alternate. The flowers are yellow, small, and located in small clusters at the top of the stems. The cluster of flowers forms a fiddleneck-like appearance. The fruit is made up of four parts and there is a seed in each section.	**Germinates:** Fall **Blooms:** March - June	**Symptoms:** - Liver Damage - Loss of appetite - Depression - Aimless wandering - In-coordination - Apparent blindness - Photosensitivity - Toxin secreted in milk	
Cocklebur *Xanthium* **Toxins:** -Carboxyatractyloside -Sesquiterpene lactones **Toxic Dose:** 0.75% of the body weight.	Will grow from one to six feet tall and has very small green flowers. The plant is bushed with oval toothed leaves. The plant produces egg shaped prickly seeds.	**Germinates:** May or June **Blooms:** Triggered by day length, usually in August.	**Symptoms:** -Gastrointestinal -Irritation -Weakness -Apnea -Hypoglycemia -Cardiac irregularities -Death	
Death Camas *Zigadenus venenosus* **Toxins:** -Steroidal -Glycosidal alkaloids -Zygadenine **Toxic Dose:** 2.0-6.0% of animal body weight	Stem is usually 20-50 cm tall and protrudes from an oval bulb covered with blackish scales. The leaves are grass like and are 10 - 30 cm tall. The flowers are usually clustered at the top of the steam and form a point.	**Germinates:** Early spring **Blooms:** April and July	**Symptoms:** - Salivation - Weakness - Respiration difficulty - Nausea - Convulsions - Coma -Death	
Field Horsetail *Equisetum arverse* **Toxins:** - Thiaminase - Aconitic acid - Equistitic - Nicotin - Plamitic acid - Silica **Toxic Dose:** Consuming a large amount over the period of 30-40 days	This plant is rush-like with stems that are segmented and hollow. The stems will be eventually topped with spore-producing cones. There are reproductive and sterile stems. When the stems are mature they look like miniature pine trees. Sterile stems grow later than reproductive stems.	**Reproductive stems:** Early spring **Blooms:** Spring **Seeds:** Spring to Fall	**Symptoms:** - Agitation - Weakness - Staggering - Labored breathing - Rapid heart rate - Constipation - Diarrhea - Weight loss - Decreased milk production - Trembling - Convulsions and coma prior to death	 © Br. Alfred Brousseau, Saint Mary's College

Jimson Weed *Datura stramonium* **Toxins:** - Tropane alkaloids - Atropine - Hyoscyamine - Scopolamine **Toxic dose:** Unknown.	Grows 1 to 7 feet tall with a 3 to 4 inch long white to lavender trumpet like flower. Pointed leaves with coarsely toothed edges, and spiny fruits.	**Germinates:** Late spring - Early summer **Flowers:** July - Autumn	**Symptoms**: - Dilated pupils - Agitation - Increased heart rate - Trembling - Delirium - Convulsions - Coma - Death	
Larkspur *Delphinium spp.* **Toxins:** - Diterpine alkaloid **Toxic dose**: **Cattle:** 0.5% of their body weight. **Sheep:** 2.0% of their body weight in plant material	This plant has showy blue to purple flowers that grow in thick clusters at the end of tall flower stocks. The leaves are almost round and found on the bottom portion of the plant. Produces pod-shaped fruit. One of the risks associated with this plant is that is one of the first plants that are green in the season.	**Germinates:** Early spring **Blooms:** Summer	**Symptoms** -Impaired CNS -Salivation -Straddled Stance -Arched back -Repeated falling -Constipation -Diarrhea -Bloat -Vomiting -Mild tremors -Convulsions -Coma -Death 3-4 hours after lethal dose	
Locoweeds *Astragalus/Oxytropis spp.* **Toxins:** -Miserotoxin -Swainsonine -Selenium **Toxic Dose:** The lethal dose can be as little as two pounds and can affect the animal only hours after being eaten. *Toxicity varies by species.*	This is a low spreading plant with pink, purple, yellowish, or white flowers. Steams can be 8 inches long and flowers range from ½ to 1in long.	**Germinates:** Fall, winter, or early spring. Usually follows autumn rains. **Blooms:** June-August	**Symptoms**: - Depression - Dull eyes - Nervousness - Abortions - Inability to eat or drink - May become violent.	
Lupines *Lupinus* spp. **Toxins:** - Quinolizidine alkaloid **Toxic dose:** Sheep: 0.1 kg of plant material per day for 3-4 days Cattle: 0.5-1.0 kg of plant material every day for 3-4 days *Toxicity varies by species.*	Lupines can grow from 0.3 meters to 1 meter tall. Lupine's leaves have 5 to 13 thin, lance-shaped leaflets. The leaflets are arranged around the stem like spokes of a wheel. The flowers of this plant are 3/8-1/2 inches long. They are pea shaped. Assembled along the tops of the flower stalks, the flowers can be white, yellow, blue, pink, or purple. The fruit of lupine is found in pods.	**Germinates:** Spring **Blooms:** June **Seeds present:** July or August	**Symptoms:** - Nervousness - Excessive - Salivation - Frothing at the mouth - Depression - Reluctance to move - Lethargy - Difficulty breathing - Twitching leg muscles - Hepatic degeneration - Convulsions - Coma - Death - Birth Defects	

Milkweed *Asclepias californica* **Toxins:** -Cardenolides -Resinoids **Toxic Dose:** 30 – 100 grams for an 'average size' sheep.	Stands 1-5 ft tall with a ¼ to ½ in. flower. Flowers are deep pink to rose, star shaped and in dense clusters. Leaves are in pairs and are narrow. Has a white milky sap.	**Germinates:** Spring after frosts. **Blooms:** May- September	**Symptoms**: - Depression - Weakness - Difficulty breathing - Violent spasms - Bloating - Gastroenteritis	
Redroot Pigweed *Amaranthus retroflexus* **Toxins:** -Nitrate -Nephrotoxin -Soluble Oxalates **Toxic Dose:** 0.05% of body weight.	This plant can grow between 4in-6ft but is normally only 20-36 in high. The stems near the bottom appears red and smooth but as you move towards the top of the plant it becomes green and rough with a dense hairy coat.	**Germinates:** Late spring - Early summer. Influenced by temperature (86-104˚F), soil type (pH4.2-9.1) and day length. **Blooms:** July to August	**Symptoms:** -Difficulty breathing -Sudden death -Muddy mucous membranes -Brownish appearance to blood	
Poison Hemlock *Conium maculatum* **Toxins:** - Peperidiine alkaloid - Conine - G-coniceine **Toxic Dose** Sheep: 100-500 grams of fresh leaves Cattle: 300-500 grams of fresh leaves.	This plant can grow up to 10 feet tall. Its leaves are shiny, alternate, and compound. The leaflets are lacy and fern-like. Poison Hemlock has clusters of white flowers that form into green fruit that has several seeds. When the fruit is mature it is grayish brown. The taproot is fleshy and white. It has two parts to its two year life span. In the first year of its life, the plant is going through its vegetative stage. It is during its second year of life that the plant begins to reproduce. The plant will mature July through August.	**Germinates:** Late summer - Early spring **Flowers**: April – July **Seeds:** April - May	**Symptoms:** - Nervousness - Trembling - In-coordination - Dilation of pupils - Weak heart beat - Cold extremities - Coma	
Silver Leaf Nightshade *Solanum elaeagnifolium* **Toxins:** - Steroidal glycoalkaloid "solasodine" **Toxic dose:** 0.1-0.3% of body weight in fresh plants (wet weight).	This plant can reach heights of three feet. Flowers are purple with yellow centers and grow in clusters. The leaves are lanced-shaped and bluish-grey. The fruit produced is small and yellow. The round berries have seeds and grow in clusters. Flowers are usually purple. The plant will die back in the winter and come back in the spring.	**Germinates:** Late March - Early April **Blooms:** May – September **Seeds:** June	**Symptoms:** -G. I. Tract pain - Constipation - Diarrhea - Inflammation - Bleeding - Neurological - Depression - Salivation - Weakness - In-coordination - Labored breathing - Coma - Death - Birth defects are possible	

Tumble Mustard *Sisymbrium altissimum* **Toxins:** Glucosinolates **Toxic dose:** Unknown	Will grow two to five feet tall. It has two different types of leaves: a coarse lower leaf that is lop-shaped and smaller finely loped upper leaf. The fruit of tumble mustard is a slender capsule that has small numerous yellowish seeds inside. The flowers are small and yellow.	**Germinates:** Spring or late fall **Blooms:** April - September	**Symptoms:** -Congential hypothroid -Dysmaturity syndrome - Prolonged pregnancies -Foals born with facial and jaw deformities. -Limb deformities are also possible.	
Yellow Starthistle *Centaurea solstitialis L.* **Toxins:** -Cardenolides -Resinoids **Toxic dose:** 60-200% of body weight.	Will grow one to two meters tall with spiny yellow heads on stem tips. Steam leaves alternate and the plant has a tap root that can penetrate one meter or more.	**Germinates:** Germinates after first fall rains. Plants exist as basal rosettes until steams grown in late spring-early summer. **Blooms:** May - December	**Symptoms**: -Inability to swallow -Drowsiness -Inability to eat and drink -Making chewing motions with nothing in the mouth -Frequent yawning unusual behavior -Including standing in unusual positions -Acting as though something is caught throat -Chewing food and spitting it out.	

Guide for Control of Poisonous Plants						
	Tool					
Plant	**Mechanical Control**	**Herbicides**	**Grazing**	**Prescribed Burn**	**Cultural Practices**	**Biological Control**
Coastal Fiddleneck	X	X			X	
Cocklebur	X				X	
Death Camus[1]		X				
Field Horsetail	X	X			X	
Jimsonweed	X				X	
Larkspur		X	X			
Locoweed[1]		X			X	
Lupine		X	X			
Milkweed	X	X				
Poison Hemlock	X	X			X	X
Redroot Pigweed	X				X	
Silver Leaf Nightshade	X		X			
Tumble Mustard	X	X	X		X	
Yellow Starthistle	X	X	X	X		X

1. The main recommendation to control locoweed and death camus is to keep all livestock off of infested areas.

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Figure 4: Acetylcholine Drawn by Sara Litten
Figure 5: Lupanine Drawn by Sara Litten
Figure 6: Epinephrine Drawn by Sara Litten
Figure 7: Boldine Drawn by Sara Litten
Figure 8: Miserotoxin Drawn by Sara Litten
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Figure 10: Ironbark Herefords. Cow and calf.
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Figure 12: Poisoning Picasa Web Album. Horse poisoned by Locoweed, AZ 1998.
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