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# PROFILES OF CALIFORNIA BRUSH
## Targeted Grazing to Reduce Fire Fuel Loads in California Chaparral Series Part 1

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**This publication aids in identifying** selected brush species found in the California chaparral community and also presents nutritional content and toxin presence for these plants to help livestock producers develop timing and supplementation protocols for targeted grazing. In addition to photographs of the plants, the publication contains information on the level of crude protein (CP) and acid-detergent fiber (ADF) during the growing season for many plants. ADF is a measure of fiber content in a feed; as ADF increases, digestibility decreases. Table 1 provides the seasonal variation of annual grass, forbs, and clover in the chaparral and valley areas of California. Some plant descriptions in this publication contain a browse rating from *California Range Brushlands and Browse Plants* (Sampson and Jepperson 1963, 45). Some graphs in this publication display total condensed tannins (TCT). High tannin levels can reduce feed consumption and digestibility and decrease production efficiency (Cornell University 2015). However, ingesting low to moderate amounts of tannins can help cattle and sheep retain nitrogen. Overall, brush species have low nutritional value and present challenges to targeted grazing management.

*Table 1.* Crude protein and crude fiber content of annual grasses, fliaree, and bur clover at seven stages of maturity.

| Stage of maturity | Crude protein (%) | | | Crude fiber (%) | | |
|---|---|---|---|---|---|---|
| | Annual grass | Filaree | Bur clover | Annual grass | Filaree | Bur clover |
| Early vegetative | 18 | 27 | 28 | 24 | 12 | 16 |
| Late vegetative | 15 | 25 | 27 | 25 | 14 | 17 |
| Early flowering | 15 | 22 | 26 | 26 | 16 | 19 |
| Late flowering | 10 | 16 | 22 | 29 | 21 | 23 |
| Mature | 6 | 10 | 19 | 33 | 26 | 26 |
| Dry | 5 | 7 | 18 | 34 | 28 | 28 |
| Dry, leached | 3 | 5 | 17 | 35 | 30 | 29 |

*Source: Hart et al. 1932; Gordon and Sampson 1939.*

## How Browse Plants are Rated

An overall browse rating of excellent, good, fair, poor, or useless is given in the discussion of each prominent species or variety for cattle, horses, sheep, goats, and deer. These ratings are based on the following.

- Degree of cropping within easy reach, taking into account season of the year.
- Abundance and distribution of the species and its nutritional value.
- Abundance of twigs and leaves and whether the plant is deciduous or evergreen.
- Reproductive capacity, whether solely by seed or also vegetatively by sprouting, as when cut or burned.
- Objectionable anatomical structures such as spines or prickles that are annoying or injurious to grazing animals.
- Whether the plant is poisonous to grazing animals at any season of the year.

Although this publication uses the best current source of browse ratings for California, more research in this area is needed in the future. If further information is desired regarding plant secondary compounds, toxic plants in California, or supplementation to alleviate toxic effects review Part 2, "Targeted Browsing of California Brush," in press.

## Non-Poisonous Brush Species

Several brush species may have poor palatability and digestibility; some are also quite high in protein and are desirable to livestock.

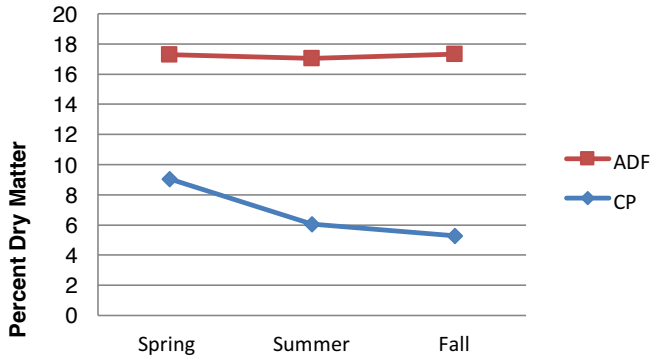
### California yerba santa (*Eriodictyon californicum*)

**Plant family:** Boraginaceae, Waterleaf Family.
**Toxic compounds:** None.
**Signs:** NA
**Treatment:** NA
**Time to graze:** Spring, CP = 9%.
**Management:** NA

California yerba santa is a fragrant, erect shrub, 2 to 8 feet tall, that keeps its leaves year round. The branches are smooth and sticky. Leaves are 2 to 6 inches long and are smooth and gummy on top with finely toothed edges. The flowers are lavender, pale blue, or sometimes nearly white, with dense hairs on the outside and grouped in loose clusters that bloom from May to June.

The name "yerba santa," or "holy plant," was given by the Spanish, as it was a major medicinal herb used in the Spanish missions.

California yerba santa has a browse rating of fair to poor for deer and poor for sheep and goats. Deer consume California yerba santa moderately in the spring. Crude protein is highest in the spring and drops below 6% in summer and fall (Narvaez 2007). However, the oils and compounds that create its distinctive scent may decrease palatability.




**California yerba santa plant.** *Photo:* © 2013 Margo Bors.

**California yerba santa flowering stem.** *Photo:* © 2013 Margo Bors.

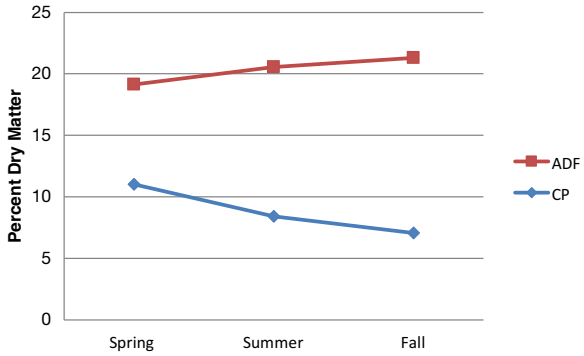
## Coyote brush (*Baccharis pilularis*)

**Plant family:** Asteraceae, Sunflower Family.
**Toxic compounds:** None.
**Signs:** NA
**Treatment:** NA
**Time to graze:** Spring, CP = 11%.
**Management:** NA

Coyote brush is a common shrub found in lower-elevation open hills and mountain slopes. It is upright and compact, 2 to 10 feet tall. Its dark green, round leaves, ½ to 1½ inch long, are leathery and coarsely toothed.

Coyote brush has a browse rating of fair to poor for sheep and goats and poor to useless for cattle. Coyote brush does provide forage and vitamin A in dry grass areas. The Eastern variety, *Baccharis cordifolia*, contains alkaloids, but coyote brush is not known to be toxic.

Coyote brush has its highest protein level in the spring and maintains 7% CP even in fall. Occasional burning followed by sheep and goat grazing destroys the sprouts and seedlings.




**Coyote bush flowering stem.** *Photo:* © 2011 Aaron Arthur.

**Coyote bush flowering stem.** *Photo:* © 2009 Margo Bors.

**Coyote bush stem.** *Photo:* © 2002 Lynn Watson.

## Blackberry (*Rubus* spp.)

**Plant family:** Rosaceae, Rose Family.
**Toxic compounds:** None.
**Signs:** NA
**Treatment:** NA
**Time to graze:** Summer or year round. Supplementation may be needed in winter.
**Management:** NA

There are eleven species of blackberry (native and introduced) in California, of which four are considered weeds on grazed rangelands: thimbleberry (*R. parviflorus*) and California (*R. ursinus*), Himalayan (*R. armeniacus*) and cutleaf (*R. laciniatus*) blackberry. Thimbleberry has round, smooth stems and simple leaves. Himalayan blackberry, the most problematic, has five leaflets that are toothed and oval. Cutleaf blackberry has five deeply lobed leaflets. California blackberry has three leaflets. In general, blackberries lose their leaves in fall; however, many keep some leaves year round. Blackberries have white or pink flowers in large clusters. They can reproduce from regrowth, rhizomes (underground shoots), and seeds.

Goat and sheep are the preferred species for browsing blackberries. Goats prefer blackberries any time of year and consume them more readily than do sheep. They also readily consume early-season growth and blackberry seedlings. One browsing strategy for

**Cutleaf blackberry.** *Photo:* UC ANR.

**California blackberry.** *Photo:* UC ANR.

controlling blackberry is browsing year-round with a stocking rate of three to four sheep per acre. This strategy may require supplemental feeding of hay during the winter to maintain body condition (Launchbaugh et al. 2006). Another strategy is to concentrate a larger number of animals in both spring and summer to deplete blackberry root reserves.

Himalayan blackberry has about 15% CP and 63% total digestible nutrients (TDN) year round (Peters, Filley, and Hulting 2010). In early summer, plants use root reserves for new growth and after midsummer begin to store sugar in the rhizomes. Browsing in this window may best deplete root reserves. Some studies are concerned with the tannin content of blackberry and raspberry fruit and have reported tannin levels from 2 to 6% dry matter (Gudej and Tomczyk 2004). However, these studies used cultivated varieties and a different method of evaluating them than did studies such as that cited above.

**Thimbleberry.**
*Photo:* UC ANR.

**Himalayan blackberry.**
*Photo:* UC ANR.

## Poison oak (*Toxicodendron diversilobum*)

**Plant family:** Anacardiaceae, Sumac Family.

**Toxic compounds:** Urushiol, an oily organic allergen found in plants.

**Signs:** Not toxic to livestock. In humans, red skin, watery blisters, and itching occurs 1 to 5 days after exposure.

**Treatment:** Wash with cold water within 15 minutes of exposure or use dish soap or over-the-counter poison oak products within 2 hours. Some people are not sensitive.

**Time to graze:** When leaves are not oily (Peischel 2003); CP is high in early spring.

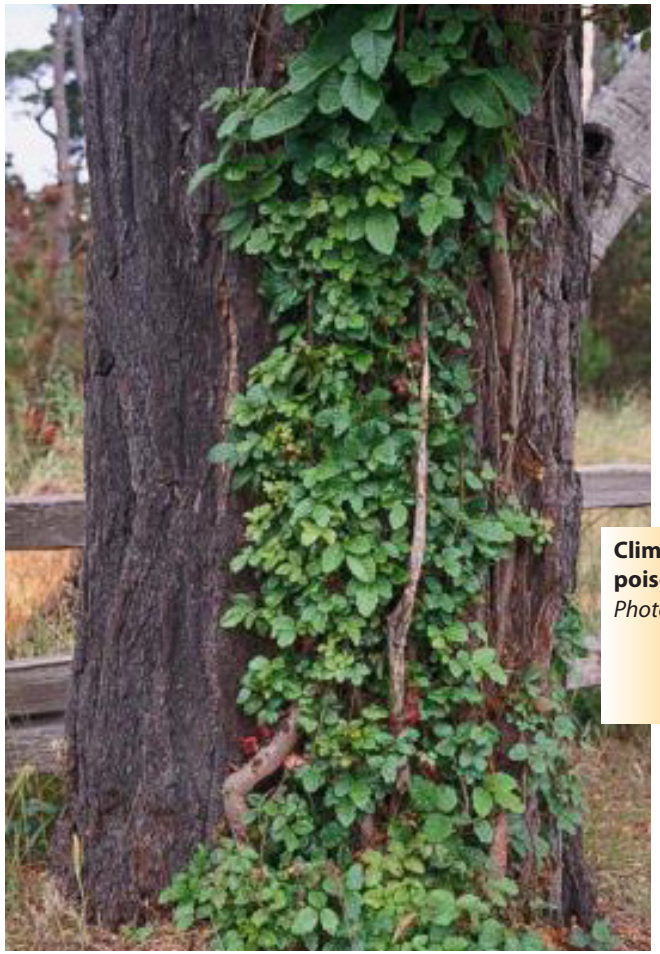
**Management:** NA

**Poison oak plant.** *Photo:* UC ANR

**Poison oak fruit.** *Photo:* UC ANR.

Poison oak is a 1 to 6 foot shrub, or a vine that grows up trees. Leaves have three leaflets that turn red to orange in the autumn and fall off in winter. It has small white flowers and produces small white to green fruit in late summer. Urushiol is a mixture of compounds; allergic reaction to it requires direct contact with the plant or oil on animal fur or objects. Poison oak is not poisonous to livestock. It has a browse rating of good to fair for horses and deer and fair to poor for cattle, sheep, and goats. It is quite nutritious, with CP in young foliage around 35% and 8% when the leaves change color in autumn (Sampson and Jespersen 1963). Livestock prefer poison oak to many other brush species. Sheep and goats like the very young new shoots on second-year growth. Goats prefer to graze in late winter to early spring or late summer to early fall (Peischel 2003).

**Poison oak leaves.** *Photo:* UC ANR.



**Climbing poison oak.** *Photo:* UC ANR.

## Deerbrush (*Ceanothus integerrimus*)

**Plant family:** Rhamnaceae, Buckthorn Family.
**Toxic compounds:** None.
**Signs:** NA
**Treatment:** NA
**Time to graze:** Spring, CP = 27%.
**Management:** NA

Deerbrush grows between 1,000 and 7,000 feet and is most abundant in the ponderosa pine belt. It loses its leaves in the winter. It is a shrub 3 to 12 feet tall, with long green or yellowish drooping branches. The flowers are white to dark blue in clusters 2 to 6 inches long that bloom from May to July.

Deerbrush is an important summer browse species. Samples have shown that CP averaged 27% in April and about 13% in August. It has a browse rating of excellent to good for sheep, goats, and deer, and good to fair for cattle.

**Deerbrush plant.** *Photo:* © 1995 Saint Mary's College of California.

**Deerbrush inflorescence.** *Photo:* © 1995 Saint Mary's College of California.

## Brush That Contains Tannins

Tannins can cause harmful conditions such as oak poisoning, which is more common in cattle than in sheep and goats. It causes constipation, dehydration, edema in the neck, and eventual kidney damage. Tannins bind to protein in the rumen, making them indigestible. Therefore, protein supplementation will help reduce the harm caused by browsing brush that contains tannins. Goats have tannin binding proteins in their saliva that allows them to tolerate higher levels of tannin. Calcium also binds with tannins, so calcium supplements may prevent intoxication. Tannin concentrations above 4% in the diet cause animals to eat less.

**Blue oak tree.** *Photo:* © 2009 Keir Morse.

## Blue oak (*Quercus douglasii*)

**Plant family:** Fagaceae, Oak Family.

**Toxic compounds:** Tannins.

**Signs:** Anorexia, rumen stasis, constipation, diarrhea, increased urination, subcutaneous (s.c.) edema of the neck, brisket, abdomen, perineum, weakness, and recumbency (Burrows and Tyrl 2013).

**Treatment:** Provide fluid and electrolytes (Burrows and Tyrl 2013).

**Time to graze:** Spring.

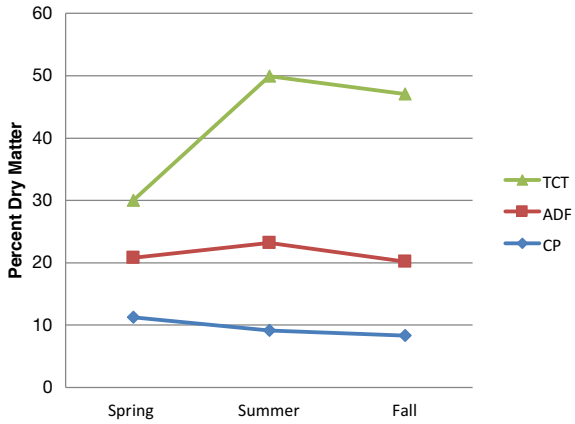
**Management:** Protein supplement; watch toxicity in cattle.

Blue oak trees grow from 20 to 60 feet tall. The leaves are generally 1 inch to 3 inches long, bluntly toothed, blue green above, and pale beneath. The trunk has white bark that is shallowly checked into small, thin scales.

Blue oak has a browse rating of excellent to good for deer, fair to poor for sheep and goats, and poor for cattle. Young sprouts and acorns are palatable to all types of livestock. One study found that during fall, blue oak made up 15% of black tail deer diet in Tehama County (Sampson and Jespersen 1963). Mature acorns are distinctly low in CP but high in fat, fiber, and oils.

In 1985, during a heavy snowfall of 6 to 9 inches in the northwestern Sacramento valley, cattle had nothing to eat for 3 days but young sprouts and leaves from fallen blue oak branches; on sixty ranches, over twenty-five hundred cattle died (Fuller 1988).

Blue oak tannin content is 20% lower in the spring than in the summer and drops only slightly in the fall. The best time to graze blue oak is in the spring, when CP is highest as well.




**Blue oak acorns.** *Photo:* © 2008 Keir Morse.

## Leather oak (*Quercus durata*)

**Plant family:** Fagaceae, Oak Family.

**Toxic compound:** Tannins.

**Signs:** Anorexia, rumen stasis, constipation, diarrhea, increased urination, s.c. edema of the neck, brisket, abdomen, perineum, weakness, and recumbency (Burrows and Tyrl 2013).

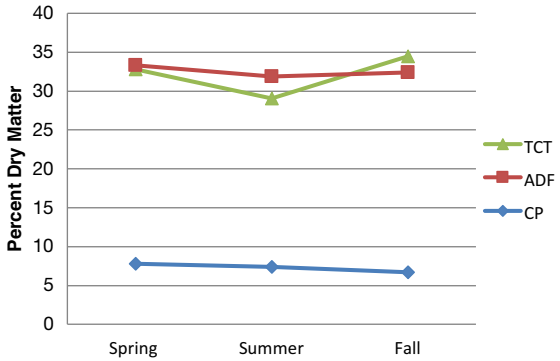
**Treatment:** Provide fluid and electrolytes (Burrows and Tyrl 2013).

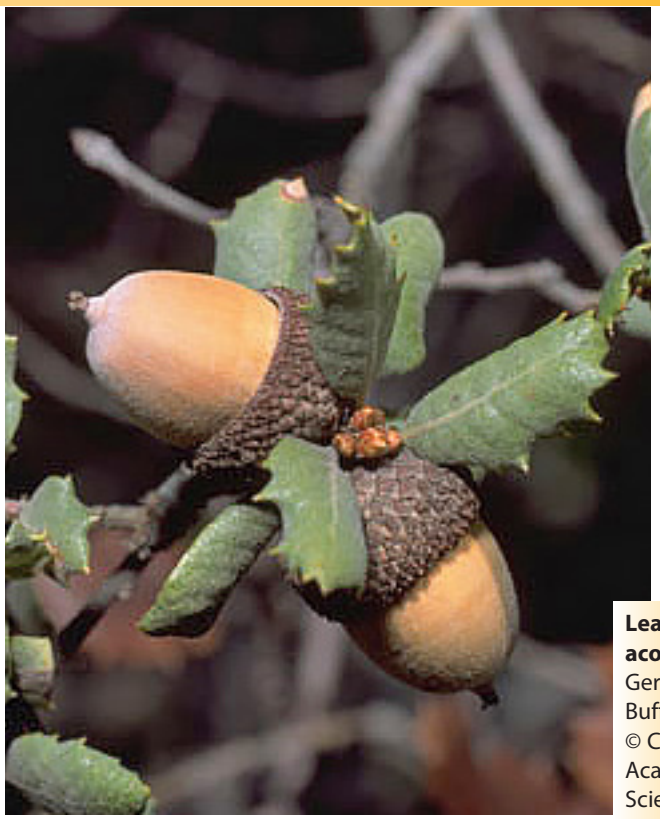
**Time to graze:** Any.

**Management:** Protein supplement.

Leather oak is found in the North Coast ranges, Sierra Nevada Foothills, San Francisco Bay Area, and San Gabriel Mountains. It is a shrub that is 3 to 9 feet tall and keeps its leaves year round. The leaves are spiny and the edges roll under. The acorn matures in 1 year, with a cup about ½ to ¾ inch wide and a nut about ⅝ to 1 inch long.

Tannin and CP content change very little by season in leather oak; they tend to be slightly lower in summer. Compared with blue oak, leather oak maintains lower levels of tannin year round but also has lower levels of CP.



**Leather oak acorns.** *Photo:* Gerald and Buff Corsi © California Academy of Sciences.

**Leather oak tree.** *Photo:* © 2002 Timothy D. Ives.

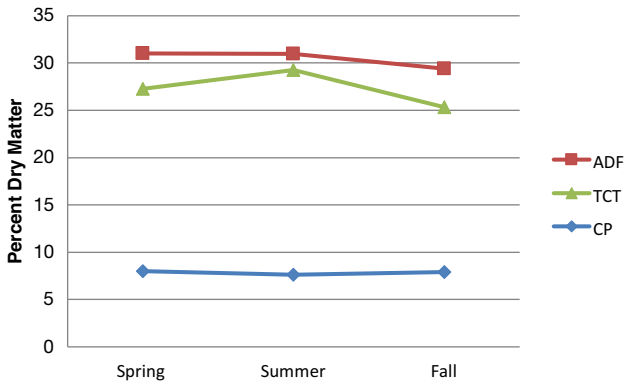
## Interior live oak (*Quercus wislizeni*)

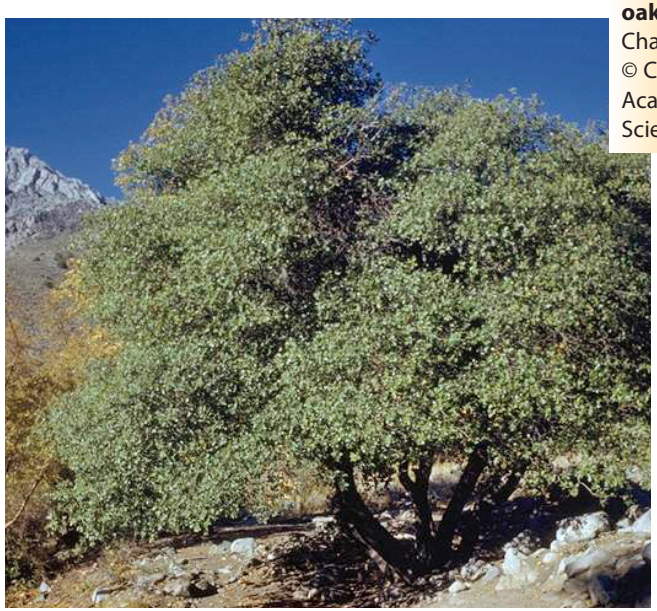
**Plant family:** Fagaceae, Oak Family.
**Toxic compound:** Tannins.
**Signs:** Anorexia, rumen stasis, constipation, diarrhea, increased urination, s.c. edema of the neck, brisket, abdomen, perineum, weakness, and recumbency (Burrows and Tyrl 2013).
**Treatment:** Provide fluid and electrolytes (Burrows and Tyrl 2013).
**Time to graze:** Any.
**Management:** Protein supplement.

Interior live oak is a shrub 3 to 8 feet tall that keeps its leaves year round. The leaves are stiff, dark green, shiny, and ¾ to 2 inches long. The acorns mature the second autumn and are sharply pointed.

Interior live oak has a browse rating of excellent to good for deer, fair to good for goats, fair to useless for sheep, and poor for cattle. The first 2 years of growth are desired by deer, especially in the spring and summer because they are more digestible at that stage of growth.

Tannin and CP levels change very little by season; tannins tend to be slightly higher in summer. Interior live oak is very similar to leather oak.



**Interior live oak tree.** *Photo:* Charles Webber © California Academy of Sciences.

**Interior live oak acorn.** *Photo:* © 2008 Keir Morse.

## Manzanita (*Arctostaphylos* spp.)

**Plant family:** Ericaceae, Heath Family.
**Toxic compound:** Tannins.
**Signs:** Lower body condition due to weight loss.
**Treatment:** Protein supplement and possibly energy supplement if there is little other forage to consume.
**Time to graze:** Summer or fall.
**Management:** Protein supplementation.

Manzanita is a bush or small tree that keeps its leaves year round. The tree usually has very crooked branches with smooth purplish or reddish-brown bark that may become shredded with age. The small flowers are white or pinkish, bell-shaped, and in clusters. The fruit are round and berrylike.

### Hoary manzanita (*Arctostaphylos canescens* ssp. *canescens*)

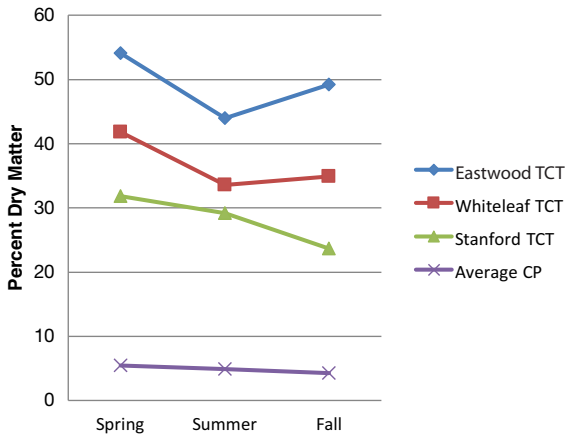
Hoary manzanita can be distinguished from other manzanita species by having no burl at the base of the stem, stems covered in fine hair, and pale gray-green leaves.

### Eastwood manzanita (*Arctostaphylos glandulosa*)

Whiteleaf manzanita is found in the dry chaparral areas of lower elevations in the Coast Range south to the mountains of southern California. It can be identified as having a burl at the base of the stem, stems covered in coarse hair, and sticky fruit.

### Stanford Manzanita (*Arctostaphylos stanfordiana*)

Stanford manzanita is found along the north coast of California. Its leaves are oblong and bright green to shiny.




Manzanita has a browse rating of poor to useless for goats and deer and useless for cattle and sheep. Experiments 100 years ago to eradicate manzanita in northern California using goats failed because the goats nearly starved to death after eating everything other than manzanita (Sampson and Jespersen 1963). While all species have similar CP levels, the concentration and timing of tannins is different, so grazing should occur in the summer or fall, when tannins are at their lowest level. ADF is similar for all species, ranging from 20 to 25%.

**Hoary manzanita.** *Photo:* Walter Knight © California Academy of Sciences.

**Eastwood manzanita.** *Photo:* Charles Webber © California Academy of Sciences

**Stanford manzanita.** *Photo:* Charles Webber © California Academy of Sciences

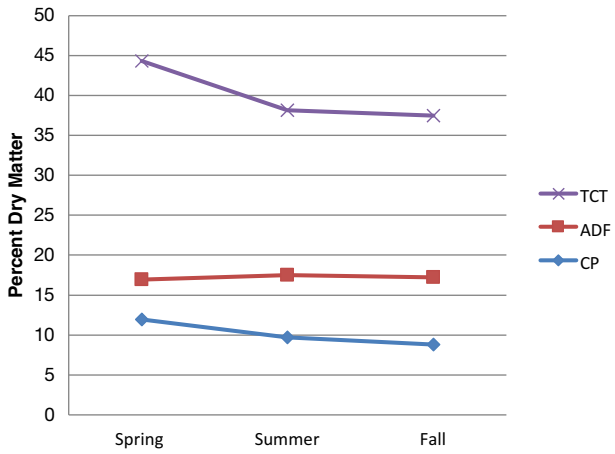
# Wedgeleaf ceanothus (*Ceanothus cuneatus*)

**Plant family:** Rhamnaceae, Buckthorn Family.
**Toxic compound:** Tannins.
**Signs:** Lower body condition due to weight loss.
**Treatment:** Protein supplement and possibly energy supplement if there is little other forage to consume.
**Time to graze:** Any. Winter is the preferred time of grazing for goats.
**Management:** Protein supplement.

Wedgeleaf ceanothus, commonly referred to as buckbrush, is an erect shrub 3 to 8 feet tall that keeps its leaves year round. The leaves are ¼ to 1 inch long, dull green, and attached to spurlike stems. The flowers are white, lavender, or bluish, in short round clusters that bloom from March to April. Seeds, which are contained in a capsule with horns on the back, mature in September and October. Wedgeleaf ceanothus is fast growing and fixes nitrogen, so it establishes quickly in new areas.

Wedgeleaf ceanothus has a browse rating of good to fair for sheep and goats, fair for deer, and poor for cattle. In a digestion trial with deer, it was found that wedgeleaf ceanothus was similar to good hay in TDN. However, it was noted that protein digestibility was low, which is now known to be due to tannins (Hagerman et al. 1992).

Tannin levels do not change significantly by season but tend to be slightly higher in spring. Protein does not change, remaining above 7% year round. The best times to graze is in the summer or fall.




**Wedgeleaf ceanothus inflorescence.** *Photo:* © 2002 Lynn Watson.

**Wedgeleaf ceanothus plant.** © 1995 Saint Mary's College of California.

## Brush that Contains Cyanogenic Glycosides

Cyanogenic glycosides are not toxic themselves, but they break down into toxic cyanide gas when consumed. Several species of the Rosaceae (Rose) family contain cyanogenic glycosides. The clinical signs of cyanide poisoning include apprehension, distress, weakness, ataxia, labored breathing, collapse, seizures, and death within an hour. If caught quickly, recovery is likely with treatment of 30 to 40% sodium thiosulfate administered intravenously. The best prevention to poisoning is to avoid grazing during the mid to late summer (the period of highest risk) and supply alternative forage. Also avoid grazing plants with cyanogenic glycosides during droughts, for 2 weeks after non-killing frosts, or until the vegetation has dried after killing frosts (Arnold et al. 2014). Consumption of 200 ppm of cyanogenic glycosides is dangerous, and signs of poisoning will show in 15 minutes.

## Chamise (*Adenostoma fasciculatum*)

**Plant family:** Rosaceae, Rose Family.

**Toxic compound:** Tannins and cyanogenic glycosides causing cyanide poisoning and poor digestibility.

**Signs:** See introductory paragraph.

**Treatment:** See introductory paragraph.

**Time to graze:** Fall, winter, or spring, not mid to late summer (Peischel 2003).

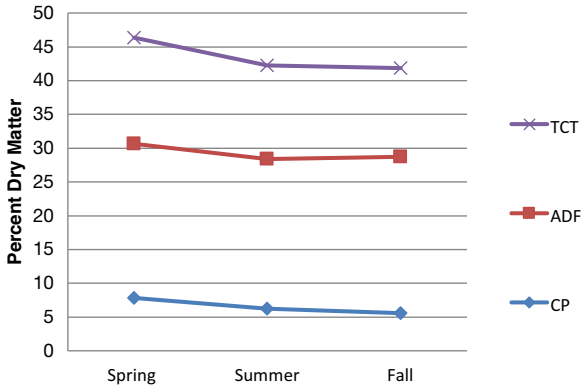
**Management:** Protein supplement and alternative forages.

Chamise is a shrub that keeps its leaves year round. It is about 2 to 12 feet tall, with slender, dense branches that have gray or dark bark. The leaves are needlelike, ¼ to ½ inch long, in alternate clusters. Seeds mature from midsummer to fall. Chamise probably has the widest range and produces more volume of growth than any shrub in California (Sampson and Jespersen 1963).

**Chamise inflorescence.** *Photo:* © 2009 Keir Morse.

Chamise is not highly palatable to livestock or deer and has a browse rating of good to fair for deer, sheep, and goats and poor to useless for cattle. After a fire, chamise sprouts are palatable for about 3 years; therefore, previous management techniques included burning every 3 years. Chamise can be controlled by spraying 2, 4-D in the spring and burning that fall. However, application of 2, 4-D increases cyanide levels in chamise, so livestock should not have access after its application.

Levels of tannins and ADF change very little by season, but CP is slightly higher in the spring, reaching about 7%. Cyanide poisoning can occur in consuming the leaves, stems, and fruit.




**Mature chamise plants.** *Photo:* © 2010 John J. Kehoe.

**Chamise stems.** *Photo:* © 2009 Barry Breckling.

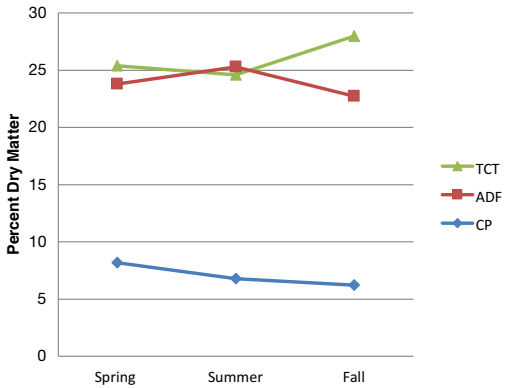
## Toyon (*Heteromeles arbutifolia*)

**Plant family:** Rosaceae, Rose Family.
**Toxic compounds:** Tannin and cyanogenic glycosides.
**Signs:** Difficulty breathing, convulsions, bloody nose, bloating, and death (Fuller and McClintock 1986).
**Treatment:** See introductory paragraph.
**Time to graze:** Before flowering and berry development (Peischel 2003); cyanide levels are higher in young growth in spring.
**Management:** Protein supplement, alternative feed; watch for cyanide poisoning.

Toyon is a large shrub, 6 to 10 feet tall, that keeps its leaves year round. It has thick, leathery leaves that are dark glossy green above and lighter beneath, with bristly, toothed edges. The flowers are small and white in clusters that bloom from June to July. The berrylike, red fruit is present from November to January.

Toyon has a browse rating of good to fair for goats and deer, poor to useless for sheep, and useless for cattle.

Cyanide levels are highest in new leaves during spring, drop in the fall, then rise again once it rains. In one case, goats fed trimmings died within 4 hours; however, the plant is not always a problem because feral goats have heavily grazed it near Baja California (Burrows and Tyrl 2013).




**Toyon fruit.** *Photo:* © 2003 Michael Charters.

**Toyon inflorescence.** *Photo:* © 2003 Christopher L. Christie.

The pulp of immature fruit contains cyanide; once mature, the seeds contain cyanide, but the pulp does not.

Tannin content is slightly higher in the fall. CP is highest in spring. The best time to graze toyon may be in summer prior to flowering; however, later in the fall, before it rains, the risk of cyanide poisoning from leaves diminishes.

## Western chokecherry (*Prunus virginiana* var. *demissa*)

**Plant family:** Rosaceae, Rose Family.

**Toxic compounds:** Cyanogenic glycosides.

**Signs:** Difficulty breathing, convulsions, bloody nose, bloating, and death (Fuller and McClintock 1986).

**Treatment:** Use 20 cc of a 10% solution of sodium thiosulfate mixed with 10 cc of a 10% solution of sodium nitrate (Panter et al. 2011). Seek advice from a veterinarian.

**Time to graze:** Avoid grazing chokecherry in spring (Panter et al. 2011).

**Management:** Animals usually avoid chokecherry if there is plenty of forage available. Avoid grazing in areas with chokecherry during drought or other times when little other forage is available (Panter et al. 2011).

Chokecherry is a shrub 3 to 8 feet tall that loses its leaves in the winter. It has white flowers on stalks 2 to 5 inches long that bloom from April to May, producing red or dark purple fruit ¼ to ½ inch in diameter that mature in September and October.

Western chokecherry accounts for more sheep losses than any other species in the rose family. This plant is palatable to deer, sheep, and goats, with CP ranging from 15% in midsummer to 12% in the fall. It is very poisonous at certain growth stages; however, usually only a few animals become ill or die. Toxicity depends on the amount consumed, cyanide content variation by season, amount of moisture in the leaves, size of the animal, amount of forage in the stomach, and how quickly the foliage was consumed.

**Western chokecherry fruit.** *Photo:* © 2007 Mary Winter.

## Bitter cherry (*Prunus emarginata*)

**Plant family:** Rosaceae, Rose Family.
**Toxic compounds:** Cyanogenic glycosides.
**Signs:** See introductory paragraph.
**Treatment:** See introductory paragraph.
**Time to graze:** Avoid grazing sheep in fall (Sampson and Jepperson 1963).
**Management:** See introductory paragraph.

Bitter cherry is similar to chokecherry, but it has flowers in short, rounded clusters and produces fruit that is oval, ½ inch long, and turns from red to black when ripe.

Bitter cherry has occasionally caused poisoning in sheep in the fall. Its CP levels are similar to those of desirable plants, and it has a browse rating of excellent for deer, fair for cattle and goats, and fair to poor for sheep.

**Bitter cherry inflorescence.** *Photo:* © 1995 Saint Mary's College of California.

## Serviceberry (*Amelanchier alnifolia*)

**Plant family:** Rosaceae, Rose Family.
**Toxic compound:** Cyanogenic glycosides.
**Signs:** See introductory paragraph.
**Treatment:** None.
**Time to graze:** Also avoid grazing during droughts, for two weeks after non-killing frosts, or until the vegetation has dried after killing frosts.
**Management:** Avoid grazing during the early growing season when toxin levels are high.

Serviceberry is a rigid shrub, 3 to 10 feet tall, with gray or reddish brown bark. The flowers are in roundish white clusters 1 to 2 inches long that bloom from April to June and produce a bluish or purple berrylike edible fruit that is ¼ inch wide. It has a browse rating of good for goats and good to fair for cattle, sheep, and deer. In samples collected in Northern California, the CP content of leaves and stems ranged from 13% in June to 4% in November.

## Birch leaf mountain mahogany (*Cercocarpus betuloides*); Curl-leaf mountain mahogany (*Cercocarpus ledifolius*)

**Plant family:** Rosaceae, Rose Family.

**Toxic compound:** Cyanogenic glycosides.

**Signs:** Toxicity of plants from this genus can cause difficulty breathing, convulsions, bloody nose, bloating, and death (Fuller and McClintock 1986).

**Treatment:** See introductory paragraph.

**Time to graze:** Avoid grazing after early-autumn frosts (Burrows and Tyrl 2013).

**Management:** See introductory paragraph.

Plants in the *Cercocarpus* genus contain cyanogenic glycosides. While Western mountain mahogany and curl-leaf mountain mahogany are not specifically listed as toxic to livestock, other species in this genus can cause harm, particularly *C. montanus* (alder-leaf mountain mahogany) (Burrows and Tyrl 2013). Signs, treatment, time to graze, and management for toxic species within this genus are listed. Found along the mountain ranges of California, western mountain mahogany inhabits elevations of 400 to 5,000 feet; curl-leaf mountain mahogany inhabits 4,000 to 8,500 feet. Western mountain mahogany can be identified as having wedge-shaped leaves with smooth edges below the middle and sharply toothed above. Curl-leaf mountain mahogany has leaves that are leathery, sticky, smooth above, and white-hairy beneath, with smooth edges.

Mahogany is a valued browse species, with a browse rating of excellent for deer, excellent to good for sheep and goats, and good for cattle. In a nutritional study in California, mountain mahogany contained CP levels averaging 7% in January and February; 14 to 15% in April, May, and June; 12% in July, August, and September; and 9% in October, November, and December. Cyanide is potentially present in the leaves, especially in the fall after the first frost.

**Birch leaf mountain mahogany stem.** *Photo:* Charles Webber © California Academy of Sciences.

**Curl-leaf mountain mahogany stem.** *Photo:* ©2007 Dr. Mark S. Brunell.

## Browse with Higher Toxicity

### Ponderosa pine (*Pinus ponderosa*)

**Plant family:** Pinaceae, Pine Family.

**Toxic compounds:** Terpenes.

**Signs:** Early vulvar swelling and mammary development; blood-tinged discharge from the vulva, delivery of dead or weak calves; placental retention, metritis, flaccid uterus (Burrows and Tyrl 2013).

**Treatment:** Remove retained placenta; treat metritis; provide good feed (Burrows and Tyrl 2013).

**Time to graze:** Avoid grazing in winter when little other forage is available (Panter et al. 2011).

**Management:** Avoid grazing pregnant animals.

Ponderosa pine is found throughout California in dry, mountainous sites. It can be identified by its orangeish bark with large grains and needles 5 to 10 inches long in clusters. Consumption of more than 2.5 pounds of dry or green needles in the last 2 months of pregnancy can cause abortion in cattle (Pfister 2008). Deer, sheep, and goats are not as susceptible as are cattle.

**Ponderosa pine.** *Photo:* Charles Webber © California Academy of Sciences.

## California buckeye (*Aesculus californica*)

**Plant family:** Sapindaceae, Soapberry Family.

**Toxic compounds:** Aesculin, saponins; in all, more than thirty compounds.

**Signs:** Sawhorse stance, trembling, reluctance to move; lasts 12 to 48 hours.

**Treatment:** Rarely fatal, usually not necessary.

**Time to graze:** Goats prefer buckeye in fall, when leaves are dry (Peischel 2003), although CP is very high in spring. Seasonal content of toxin is unknown.

**Management:** Supplementing diet with cholesterol may help but has not been studied. Supply alternative forage.

California buckeye is a 15- to 40-foot-tall tree that loses its leaves in fall. It has smooth gray bark and leaves that have 5 to 7 oblong, toothed leaflets that are 3 to 6 inches long. The flowers are large, pinkish, and fragrant in erect cylindrical clusters 6 to 10 inches long that bloom from May to July.

Palatability varies by season; deer feed on new leaves in the winter and fallen leaves in August. Its browse rating is excellent to good for deer, fair to poor for sheep and goats, and poor for cattle. Sheep and goats browse buckeye, but cattle rarely do. Goats graze once the leaves dry and will also remove bark from the tree.

The CP of young leaves can be exceptionally high, sometimes 39%, dropping to 24% before flowering, 17% in late bloom, and 13% when leaves change color and drop.

The fruit and leaves are poisonous to domestic livestock if large amounts are ingested. Buckeye plants are poisonous to all livestock; the nectar and pollen are poisonous to honey bees. In 1960, after a late-April snowstorm in Tehama County, a number of cattle died from eating California buckeye leaves.

**California buckeye fruit.** *Photo:* © 2011 Neal Kramer.

## Scotch broom (*Cytisus scoparius*)

**Plant family:** Fabaceae, Legume Family.

**Toxic compound:** Alkaloids.

**Signs:** Clinical signs have not been confirmed but are most likely to consist of abrupt onset of diarrhea, ataxia, tremors, and possible fetal deformities.

**Treatment:** Unknown.

**Time to graze:** Before flowering and in fall dieback (Peischel 2003). Leaves and stems have higher CP in spring.

**Management:** Remove adult females from areas with Scotch broom 3 weeks prior to blooming and do not return until after kidding. Remove doelings at least 6 months before breeding.

Several species of *Cytisus* grow in California, two of which have become invasive weeds: French broom and Scotch broom. Scotch broom is a 3- to 10-foot-tall shrub with sharply angled branches and bright yellow flowers that bloom from March to June, before leaves emerge. Young branches have five ridges, are green and hairy, and become smooth and brown as they age. Leaves are small and oblong, with three leaflets. The flowers are single or paired along the branches and resemble pea flowers.

The leaves contain several alkaloids, including lupanine, anagyrine, sparteine, and cystisine. These alkaloids bind to receptors and affect the nervous system and the digestive tract. Alkaloids cause the plant to taste bitter and therefore may affect palatability to animals, limiting intake. The plants also contain flavonoids, which may cause reproductive problems in livestock. Scotch broom has a browse rating little to no value.

**Scotch broom plants.** *Photo:* © 2005 Louis-M. Landry.

**Scotch broom stem.** *Photo:* © 2008 Neal Kramer.

**Scotch broom inflorescence.** *Photo:* © 2008 Neal Kramer.

## California azalea (*Rhododendron occidentale*)

**Plant Family:** Ericaceae, Heath Family.

**Toxic compounds:** Diterpenoids, grayanotoxins.

**Signs:** Anorexia, profuse salivation, swallowing, vomiting, retching, colic, irregular respiration, and bellowing that lasts up to 24 hours.

**Treatment:** No specific antidote; 10 to 20 mg atropine sulfate and 15 to 20 mL 10% camphorsulfate given subcutaneously. Oral administration of charcoal limits absorption of toxins after ingestion.

**Time to graze:** Never.

**Management:** Plant is unpalatable but may be eaten in high amounts when no other green forage is available.

California azalea can be found in the north Coast Ranges, Sierra Nevada, and the mountains of southern California along streams and wet places. California azalea is a shrub that loses its leaves, is 3 to 16 feet tall, with bright yellow-green leaves 1½ to 3½ inches long. Flowers form in clusters of 5 to 20 and are very fragrant, tube shaped, and white to pink with a yellow stripe.

Sheep have been lost when pastured in an area with a large amount of azalea for a long period of time. In 1979, 15 to 20 goats became ill in Shasta County from eating California azalea. They were vomiting and showed diarrhea, and two goats died. All parts of the plant, including the nectar, is toxic. The toxins bind sodium channels, which has effects on many cells, especially neurological, cardiac, and muscular.

**California azalea inflorescence.** *Photo:* © 2011 Neal Kramer.

**California azalea plant.** *Photo:* © 2013 Aaron Arthur.

## Tree tobacco (*Nicotiana glauca*)

**Plant Family:** Solanaceae, Nightshade Family.

**Toxic compound:** Alkaloids.

**Signs:** Excitement, salivation, and tremors of short duration; later, depression, ataxia, labored breathing, and birth defects.

**Treatment:** Induced vomiting and activated charcoal.

**Time to graze:** Never. All plant parts are toxic year-round.

**Management:** Unpalatable. As with other alkaloids, supply alternative feed. In cows, ingestion of 0.07% of body weight of dried leaves caused intoxication, while in sheep, ingestion of 0.13% of body weight produced clinical signs and higher dosage caused birth defects.

Tree tobacco is a shrub or small tree that can reach 25 feet tall. The leaves are 1 to 4 inches long and are bluish-gray or appear to be covered in a waxy white substance. The yellow, tubular flowers are 1¼ to 2 inches long at the end of branches. The plant blooms from April to November.

Tree tobacco has caused human poisoning in California. The species is unpalatable to livestock, yet poisonings have been reported from tree tobacco as well as coyote tobacco and desert tobacco. Cleft palates occurred in goats exposed to tree tobacco at 35 to 40 days of gestation.

**Tree tobacco inflorescence.** *Photo:* © 2009 Thomas Stoughton.

**Tree tobacco stem.** *Photo:* © 2005 Steven Perkins.

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