UNIVERSITY OF CALIFORNIA
AGRICULTURE & NATURAL RESOURCES

SIERRA FOOTHILL RESEARCH & EXTENSION CENTER

Presents:

Annual Beef & Range Field Day

Managing Natural Resources on Your Property

APRIL 25, 2009

In Cooperation With:
University of California Cooperative Extension
Dept. of Plant Sciences, UC Davis

Beef and Range Field Day: Focus on Natural Resources
Managing Natural Resources on Your Property
UC Sierra Foothill Research & Extension Center
Saturday, April 25th , 2009

Directions: From Marysville take Hwy 20 east (14 miles) towards Grass Valley, turn north on Peoria Rd. and follow the signs (5 miles). From Grass Valley, take Hwy 20 west (18 miles) to Peoria Rd.

Agenda:

Registration: 9:00 – 9:30 AM -- $15 (includes proceedings, morning refreshments & lunch)

9:30 AM **Welcome and Introductions** – Art Craigmill, Director, SFREC

9:40 AM **Introduction, Grazing Management on Small Acreages** – Roger Ingram, Livestock and Range Farm Advisor, Placer County

Water Quality and Conservation – Ken Tate, Cooperative Extension Specialist, Plant Sciences, UC Davis

Managing Weeds in the Yuba Foothills – Glenn Nader, Livestock and Range Farm Advisor, Yuba-Sutter-Butte Counties

10:40 **Field demonstrations: walking tour near Headquarters –**

Managing grazing, estimating carrying capacity – Roger Ingram
Wetland buffer areas - Ken Tate
Management considerations through soil profile observations – Toby O'Geen
Optimal use of water – Toby O'Geen and Ken Tate

Noon **Tri-tip BBQ Lunch** – Served by the Yuba-Sutter Cowbelles and SFREC Staff

12:20 **Preparing for Wildfire in the Foothills – Why 100 feet?** (during lunch)

The afternoon will all be held in the field

1:00 **Fruit Trees for the Foothills –** Janine Hasey, Farm Advisor, Yuba-Sutter Counties

Native Oak Management and Regeneration – Doug McCreary, Cooperative Extension Specialist, UC Berkeley and SFREC

Land Management to Preserve Wildlife Habitat - Bill Tietje, Area Natural Resource Specialist, UC Berkeley

3:30 **Adjourn**

For more information about the Sierra Foothill Research & Extension Center, go to:
http://groups.ucanr.org/sierrafoothill/

**********NO PRE-REGISTRATION – EVERYONE WILL BE ACCOMMODATED*********

Annual Beef & Range Field Day Proceedings
April 25, 2009

LIST OF CONTENTS

Grazing Management on Small Acreages

Roger Ingram
UC County Director and Farm Advisor
Placer and Nevada Counties

In order for small acreages to maintain a sustainable forage component, the following grazing principles will need to be implemented:

- **Rest period depends on the recovery rate of the plant** – This is the most important grazing principle. During fast growth (spring) on rangeland, a rest period of 25-30 days would be adequate. During slow growth (late spring to late winter) on rangeland, a rest period between 90-120 days would be needed to encourage perennial grasses to increase.

  Fast growth (March-June) on irrigated pasture would need 25-30 days of rest. Hot summer heat slows growth of cool season irrigated forages and rest period would need to be lengthened to 35-45 days for July-October. By November, animals should be off the irrigated pasture to prevent pugging waterlogged soils. During extended winter dry periods, some use of irrigated pasture would be possible. A rest period of 90-120 days would be needed from November – late February.

- **Use the shortest graze period possible while maintaining adequate rest –** The main priority is to get the rest period right. After that, shortening the graze period will increase consumption and improve animal performance. The only way to shorten the graze period is to increase the number of grazing paddocks available per herd. Paddocks can be created through permanent fencing, temporary electric fencing, or herding.

- **Use the Highest Stock Density Possible –** Stock density is calculated by dividing the number of animals by the number of acres they are grazing in their paddock. It is independent of time. The higher the stock density, the greater the uniformity of utilization. A low stock density is visually indicated by over and under-grazed plants side by side. A high stock density on rangeland is more difficult due to the extensive terrain an topography. A goal of 2 animals per paddock acre would be a starting point. On irrigated pasture, a stock density of 20-40 animals per paddock acre would be a goal.

- **Use the largest herd size possible, consistent with good animal husbandry practices –** A larger herd size gives the flexibility to apply herd effect – the concentrated action of animal hooves. The hooves of the animals can act like plows to break up hard capped soils, trom in organic matter and distribute concentrated nutrients from manure, and break up heavy thatch areas associated with medusahead infestations.

- **Match the Stocking Rate to Annual and Seasonal Changes in Carrying Capacity –** Carrying capacity is the forage supply available for grazing. We have no control on that due to its dependence on rainfall and temperature. Stocking rate is the demand we determine to make on the carrying capacity. Low rainfall years mean a low amount of grass. High rainfall years mean a lot of grass.

During low rainfall years, the ability to reduce animal numbers will be needed. This can be accomplished by culling more heavily for reproductive and physical problems, retaining fewer or none replacement breeding females, and weaning early. During high rainfall years, we would need more animals to harvest the forage. During those years, the opposite would occur – cull lightly, retain more replacement breeding females, add in more animals for a short period of time to get paid by the amount of gain they can achieve due to the increased forage (stocker animals).

Another approach would be to have a core number of animals that the land could support in a dry year. In that scenario, you would only need to explore ways to increase animal numbers when forage was in excess. On the rangeland at Hidden Falls, that would be one dry 1000 pound cow on 15-20 acres. The dry cow would the equivalent of 5 sheep or goats. On irrigated pasture, it would be that same 1000 pound cow on 1-1.5 acres.

Seasonal changes in carrying capacity would mean look at strategies that would match the highest demand of the animal (birth – peak lactation) with peak forage supply.

Grazing Management in Detail

The grazing principles described earlier are explained in more detail below. This information was developed by David Pratt when worked for the University of California Cooperative Extension. This paper forms the foundation of the core teaching for the California Grazing Academy, a three-day hands-on course on grazing taught at the Sierra Research and Extension Center, which contains similar habitat to Hidden Falls Regional Park.

GREEN LEAVES CAPTURE SUNLIGHT

Sustainable production in ranching starts with using plants to capture sunlight energy. When sunlight falls on bare soil, rocks, or anything but growing plants, its energy cannot be harvested.

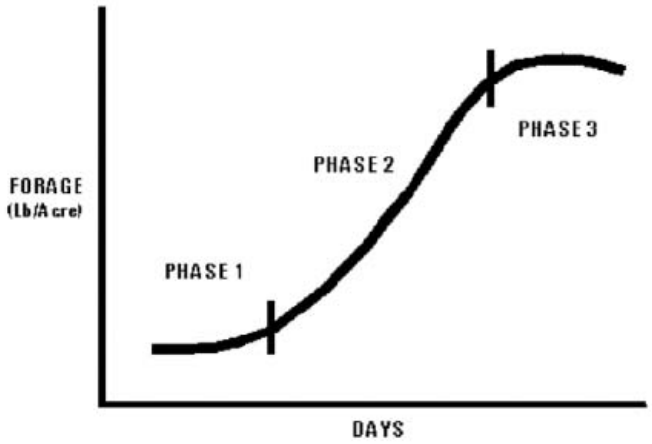
Principle: Maintain 100% green plant cover in pastures for as long as possible.

THE "S" SHAPED CURVE

The efficiency with which plants convert the sun's energy into green leaves and the ability of animals to harvest and use energy from those leaves depends on the phase of growth of the plants.

After grazing, plants go through three phases of growth that form an "S" shaped curve (figure 1). **Phase I** occurs after plants have been severely grazed. After grazing, fewer leaves are left to intercept sunlight and plants require more energy for growth than they are able to produce through photosynthesis. So, to compensate, energy is mobilized from the roots. The roots become smaller and weaker as energy is used to grow new leaves.

FIGURE 1. PLANT GROWTH AFTER GRAZING (THE 'S' SHAPED CURVE)



Plant growth during phase I is very slow but the leaves are extremely palatable and nutritious.

Remember phase I - high quality but low quantity.

When regrowth reaches one fourth to one third of the plant's mature size, enough energy is captured through photosynthesis to support growth and begin replenishing the roots. This is **phase II.** It is the period of most rapid growth. During phase II, leaves contain sufficient protein and energy to meet the nutritional needs of most livestock.

Remember phase II - high quality and high quantity.

As plants continue to grow, leaves become more and more shaded. Lower leaves die and decompose. Leaves use more energy for respiration than they can produce through photosynthesis. This is **phase III.** Phase III material is stemmy and fibrous. Nutrient content, palatability, and digestibility of leaves in phase III material is poor.

Remember phase III - low quality but high quantity.

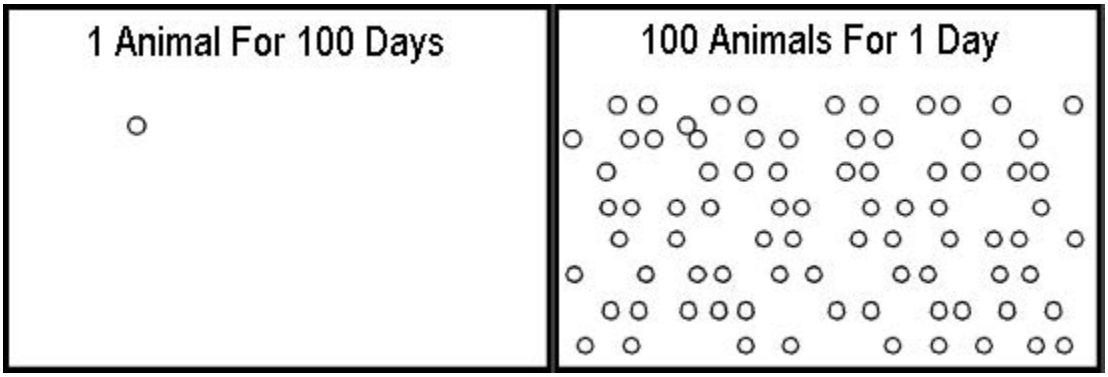
Principle:Adjust grazing and rest periods to keep plants in Phase II,the most rapid period of growth.

Do not graze plants so short that they enter phase I. Phase I regrowth is very slow and will reduce total productivity. Do not allow plants to enter phase III. In phase III, shading and senescence begin to detract from efficiency of photosynthesis. **The harvest of energy from your pastures will be maximized by keeping plants in phase II.**

OVERGRAZING IS A FUNCTION OF TIME

Which would cause more overgrazing: one animal grazing a one acre paddock for 100 days, or 100 animals grazing that same paddock for one day? (figure 2) The stocking rate of both paddocks would be identical: 100 Animal Days per acre. But the effect on the paddocks would be much different.

FIGURE 2. VARYING TIME & NUMBERS WITH CONSTANT STOCKING RATE



In the first case, the animal would keep returning to areas previously grazed because the new growth would be more palatable and nutritious than the older growth of ungrazed plants. In the second case, the animals would probably graze everything in sight but would not have the chance to regraze plants. So, which would cause more overgrazing? To answer we must first know what overgrazing is.

Overgrazing is grazing a plant before it has recovered from the previous grazing.

Overgrazing occurs in two ways: leaving stock in a pasture too long or bringing them back too soon.

It is important to make a distinction between severe grazing and overgrazing. Most people use these terms interchangeably. I define them differently. Severe grazing means removing a lot of the plant, but it does not tell you how long a plant was exposed to grazing. Overgrazing means that a plant was regrazed before it recovered from a previous grazing. By this definition, a severely grazed plant has not necessarily been overgrazed ... but neither extremely severe grazing or overgrazing is good.

Now, let's relate this back to the two pastures. The first case (one animal for 100 days) resulted in regrazing of plants...overgrazing. There would also be many plants that were completely ungrazed. There would be plants in both phase I and III of the S shaped growth curve. Neither overgrazing or undergrazing is desirable.

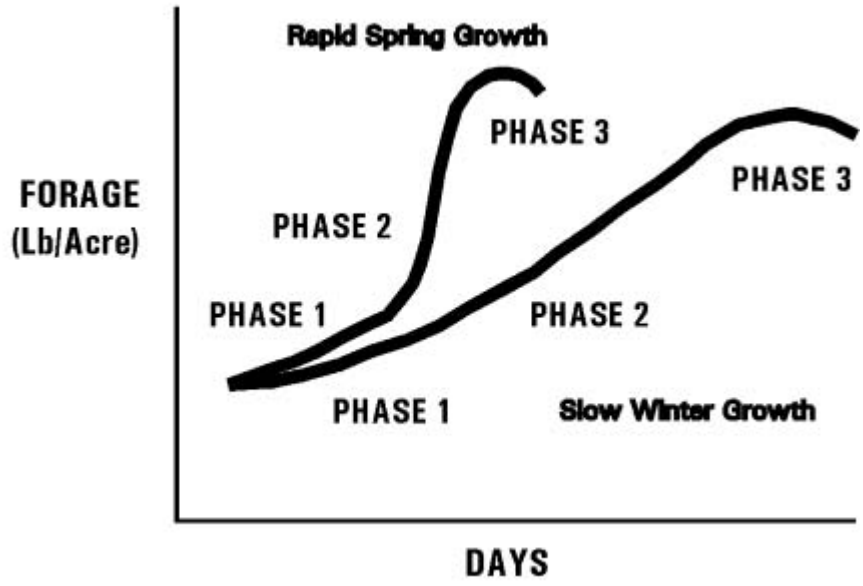
The second case (100 animals for one day) may have resulted in severe grazing, but plants would

not be grazed while they were recovering ... there would be no overgrazing.

PASTURE GROWTH RATES CHANGE

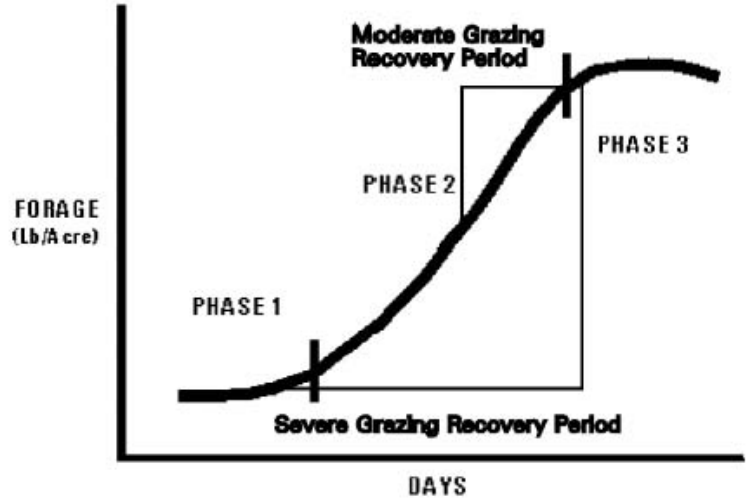
The rate of plant recovery depends on the growing conditions. Plants recover much more slowly during our cool winters than during our warm wet springs (figure 3).

FIGURE 3. PLANT GROWTH AFTER GRAZING DURING RAPID GROWTH & SLOW GROWTH



The growth rate also depends on the severity of grazing (figure 4). When plants are severely grazed their recovery is slow. When grazing is less severe, the recovery is relatively rapid. Increasing grazing severity by 25% may increase recovery time and decrease the productivity of the pasture by 100%!

FIGURE 4. EFFECT OF LIGHT & SEVERE GRAZING ON PLANT RECOVERY



Producers should avoid severe grazing and set rest periods to provide adequate time for plant recovery. During slow growth and dormant periods, rest periods should be long (60 to 120 days). During periods of rapid growth, rest periods should be shortened (30 to 45 days).

Principle: Adjust rest periods to reflect rate of plant growth. Slow growth = longer rest. Fast growth = shorter rest.

COWS ARE GOURMETS

Time is also a critical factor from the animal's standpoint. The forage consumed and the quality of the diet changes during an animal's stay in the pasture.

Cows are gourmets. They graze selectively, eating the best plants and plant parts first, avoiding coarser, less palatable, less nutritious feed. Stock eat most on the first day of grazing (figure 5). As the days pass, the forage gets older and less digestible, and stock spoil more and more grass through trampling and dung and urine contamination, so they eat less.

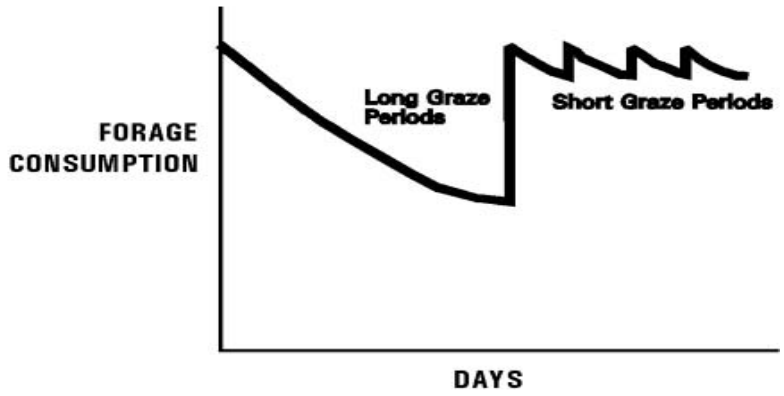
In heavily stocked continuously grazed pastures, regrowth will be grazed as soon as it's available. The phase 1 regrowth is highly nutritious, but there is generally not enough of it to support high levels of animal production.

Lightly stocked continuously grazed pastures consist of plants in phase I and phase III. If animals are forced to eat phase III material, which passes through their gut very slowly, their daily intake will drop because they simply can't fit any more feed in their rumen. The result is poor animal performance.

In contrast, imagine a situation where animals are frequently moved to fresh feed. Forage consumption would remain high. The quality of the diet would also remain high.

Principle: Make graze periods as short as possible while maintaining adequate rest periods

FIGURE 5. EFFECT OF GRAZE PERIOD LENGTH ON FORAGE CONSUMPTION



SUMMER ROTATION ON ANNUAL RANGES

During the dry season annual plants will not be damaged by continuous grazing, after all, they are already dead. But, there are still benefits of controlling the length of the graze and rest periods. They include more total pasture production, more uniform utilization, less forage waste, improved and more uniform nutrition for livestock and better control of the amount of residue left to maintain healthy water and nutrient cycles.
Consider this: we've observed a dramatic increase in the number and vigor of desirable perennial grasses under this type of management. Do you think we'd be seeing the perennials if we grazed continuously through the summer? Perennials can only become established if the land is managed as though they are already present.

STOCK DENSITY

Stock density is the number of animals in a particular area at any moment in time. It is usually expressed in terms of number of head per acre:
STOCK DENSITY = HEAD ÷ ACRE

For example if 50 steers are grazing a 10 acre paddock the stock density is 5 head/acre:

STOCK DENSITY = 50 HEAD ÷ 10 ACRES = 5 head / acre

In his book Holistic Resource Management, Allan Savory says, "Low density, not overgrazing or overstocking, should bear the blame for many serious range and production problems, including trailing, successional shifts toward brush and weeds, pest outbreaks, poor animal performance, and high supplemental feed costs...". To understand why, let's take another look at the two one acre paddocks described earlier (Figure 2).

The two paddocks had identical stocking rates (100 animal days per acre), but they were grazed for different periods of time and the stock densities were drastically different.

In the first paddock, with one animal grazing for 100 days (stock density 1 animal/acre), utilization was uneven, with some plants overgrazed and others undergrazed. In the other paddock, where one hundred animals grazed for one day (stock density 100 animals/acre), utilization was more uniform and there was no overgrazing. Shortening the graze period reduced overgrazing, but it was the increase in stock density that resulted in more even utilization.

Overgrazing is a function of time.

Uniformity of utilization is a function of stock density.

Pastures with low stock density usually appear "patchy" with some patches grazed very short and other patches consisting of rank, "wolfy," phase III vegetation. Some ranchers mow pastures to keep vegetation uniform and palatable. Others use fire to remove old, stemmy, ungrazed material.

What they usually really need is higher stock density.

High stock density increases the uniformity of utilization and maintains forage in a more palatable, nutritious, digestible condition.

Stock density increases as the number of animals in a paddock increase or as paddock size decreases.

Principle: Use the highest stock density possible.

Twenty head per acre is the minimum stock density needed to uniformly graze irrigated pasture. Higher is better. Stock densities of over 50 cattle per acre are not uncommon on well managed irrigated pastures. Two head per acre is a reasonable target on more remote ranges. Again, higher is better.

HERD EFFECT

If you haven't already seen the movie *Dances With Wolves*, get out the popcorn and rent it tonight. When it gets to the scene where they are tracking the buffalo, stop the tape and reread this section. After the buffalo stampeded through, the range literally looked plowed. This is a natural phenomena called herd effect. When animals are spread out and calm, their hooves tend to compact the soil. When they are concentrated and excited, they tend to knock down old standing vegetation and break up the soil.

Herd effect will not happen just by increasing stock density. To achieve this effect it is usually necessary to stimulate animals in some way. It can be done by herding through or feeding on the area where you want this impact.

In addition, would it be easier to achieve herd effect with a group of 2 cows on 20 acres or 200 cows on 2000 acres? You cannot achieve herd effect with small groups.

Principle: Use the largest herd consistent with good animal husbandry practices.

Herds of up to 800 cows or 2500 stockers can be run without behavior problems. Added benefits of combining herds will be to increase the number of paddocks in the rotation and increase stock density.

PADDOCKS

Adequate time control and stock density can be achieved on many ranches with 16 paddocks. However, the "right" number of paddocks will vary and depends on the length of the required rest and desired graze periods and the stock density needed to achieve uniform utilization.
Most ranchers can begin implementing these basic principles without building new fences. By combining herds and closing some gates, there may already be enough fencing to control graze and rest periods and increase herd size and stock density. When fencing is required, consider minimal electric fence designs. Material costs for effective high tensile electric fences usually vary between

$500-$1000 on rangelands.

Stocking Rate and Carrying Capacity

*The **CARRYING CAPACITY** is* the number of animals that a paddock or cell can accommodate without overgrazing. Simply put, the carrying capacity is how much grass you have. ***STOCKING RATE*** is the feed demand. It is the amount of forage your stock are going to eat. Another way of thinking about this is:

Carrying capacity is what nature gives us.
Stocking rate is what we take from her.

The next principle of controlled grazing is:

FLUCTUATE STOCKING RATE TO MATCH CARRYING CAPACITY

If we knew how much grass our paddocks would produce, or if we started the year with a fixed amount of feed it would be a relatively simple process to ration it out over the course of the year. But we don't know what production will be until the season is over. Forage production, and therefore carrying capacity, varies greatly from month to month and year to year. It depends on the weather and our grazing management.

Adjusting stocking rate as carrying capacity changes
is fundamental to good grazing management.

There are really two concerns here: 1) fluctuating the stocking rate to reflect seasonal changes in carrying capacity; and 2) adjusting stocking rate to match annual changes in carrying capacity.

1. ADJUSTING THE STOCKING RATE SEASONALLY

We may not be able to precisely predict <u>how much</u> grass will grow, but in most environments we can predict when it will grow. For example, we know that winter growth on California's foothill rangelands is slow. The green grass is high quality but there simply isn't much there. In spring growth is fast and there is a lot of high quality grass. In summer and early autumn there is very little growth. We generally expect feed quantity and quality to decline through this period. In controlled grazing, graziers must anticipate and plan for the spring "boom" and autumn "bust" of these foothill rangelands.

Just as carrying capacity changes with the seasons, nature is also constantly adjusting stocking rates. We all know that when cows calve, lactate, get bred and wean their calves their feed requirements change. For example, a cow in heavy lactation requires about 60% more energy than a dry cow. The stocking rate of a one acre paddock grazed for one day with 100 lactating cows is 60% higher than that same paddock grazed for one day by 100 dry cows. *By matching our animals' production cycle to our pasture's annual production cycle we can synchronize stocking rate with carrying capacity.*

2. ANNUAL STOCKING RATE ADJUSTMENTS

Stocking rate can be adjusted down in poor feed years by weaning calves or lambs early, or culling more heavily than usual. The earlier you make a decision to destock, the less severely you'll need to cull. (Every mouthful an animal doesn't eat today is a mouthful left for another animal tomorrow).

In good feed years stocking rate can be increased by culling lightly, retaining more replacements, carrying calves over as stockers or contracting to graze more stock.

The enterprise mix should reflect the drought risk. Ranches in environments where drought is common, should probably be stocked conservatively with cows. Surplus forage in good years can be used by stockers. Cow/calf producers in drought prone environments facing destocking decisions every few years should reevaluate their enterprise mix.

There are several methods for estimating stocking rate. But keep in mind that the numbers you calculate are only estimates. It is important to monitor actual production, utilization and livestock performance during the season. Graziers must always be looking ahead at the next paddocks to be grazed to make sure there is enough feed. If there isn't enough feed you are either overstocked, your graze periods are too long, or you are not allowing enough recovery time regardless of what your estimates told you.

DEFINITIONS

CARRYING CAPACITY: The number of animals that a paddock or cell can accommodate without overgrazing.

STOCKING RATE: The feed demand of livestock grazed. The stocking rate can be measured in "stock days" grazed in a paddock.

Starthistle Control

By
Glenn Nader
Butte/Sutter/Yuba Livestock & Natural Resources Farm Advisor

Joseph M. DiTomaso
Extension Weed Specialist, UC Davis

It has been estimated that a stand of starthistle can produce 50-200 million seeds per acre. It only requires about 2 million seeds per acre to repopulate that stand the next year. There is a difference of opinion on the viability of starthistle seed. Idaho researchers found that it persisted for 10 years, while others have found 99.5% germinate in three years. Microbial degradation of the seed by pathogens in a California study appears to account for 40% loss in the seedbank each year. Exposure to increased sunlight causes more germination. This is why disking an area can produce more starthistle seedlings and thatch and heavy litter decreases the number of plants observed. Starthistle's deep tap root allows it to be very effective at harvesting moisture. Research at Sierra Foothill and Extension Center has calculated that eight inches of the available 12 inches of moisture (66%) was used up by starthistle. This means that it will take more rainfall to saturate soils on rangeland site occupied by starthistle. Although the toxic constituent of starthistle for horses is unknown, the entire plant is apparently toxic, either fresh or dried. A large quantity (600 + pounds) must be eaten, typically over a period of 1-3 months before poisoning is evident.

Review of Control Methods

Tillage

Starthistle has a deep (3-6 ft) root. Poor control can occur from tilling too early. When the soil is moist, tillage can increase the sunlight that stimulates new starthistle germination and removes the other competing vegetation. Late and multiple tillage is the most successful.

Mowing

Successful control of yellow starthistle by mowing depends on both proper timing and plant growth form. Branching habit of yellow starthistle is highly variable and is partly dependent upon the level of competition for light with other species. Tall grass or litter will force the branching to occur above the normal mower cutting height, increasing the successful control by mowing. Erect, high-branching plants are effectively controlled by a single mowing at early flowering (2-5% flower), while sprawling low branching plants were not satisfactorily controlled even by multiple mowing. Mowing too early stimulates starthistle growth. Mowing to be effective must cut below the lowest branch of the main stem. Check your starthistle plant to determine if a 4-inch height of the standard mower will cut below any branching. A weed eater can be used effectively in small sites to cut below the branching near the ground at the 2-5% flowering stage. Mowing fails frequently because of the narrow window of time that it can be used. Even under conditions where the effectiveness of mowing is optimal, expect some plants to recover. Retreatment will nearly always be necessary.

Competition

Hardinggrass plantings have been observed to decrease starthistle populations in coastal areas, but this species is also a non-native and can be invasive. Siskiyou County Farm Advisor, Dan Drake, has observed that pubescent wheatgrass and rose clover plantings have decreased starthistle populations. Observation by Craig Thomsen and Fred Thomas at the Sierra Foothill Research & Educational Center in Browns Valley, also indicated that annual clover seedings have decreased starthistle. There was a question of what happened to remaining starthistle in the presence of clover nitrogen enrichment of the soil. Some researchers postulate that there may be fewer but larger plants?

Fire

Researchers have been experimenting with fire to control starthistle at the early flowering stage. A single year (July 7) treatment was unsuccessful at decreasing starthistle. The fire is fueled by the dry annual grasses and girdles the green starthistle plant. After the second year of treatment there was an 85% reduction in starthistle plants coupled with an increase in native forbs. After the third year treatment there was a 96% control of starthistle. One year of absence of burning has allowed the starthistle to greatly rebound. This has illustrated the dynamics of the seed and repopulation by starthistle.

Grazing

Grazing can be an effective way to manage starthistle. When green, starthistle can contain 11-28% crude protein depending on its stage of maturity. Goats are the best control grazers followed by sheep and then cattle. Grazing early (February /March) and allowing late season grazing rest (May -June) can favor starthistle production.

Herbicides

Roundup

Once plants have reached the bolting stage, most effective control can be achieved with Roundup® (glyphosate). The best time to treat with glyphosate is after annual grasses or forbs have senesced but prior to yellow starthistle seed production. Glyphosate is also an important tool in a follow-up control strategy to prevent yellow starthistle escapes from producing seed. Glyphosate provides excellent control of yellow starthistle at all stages of development, even when plants are in the early flowering stage. The use of glyphosate is not recommended when desirable perennial grasses or broadleaf species are present.

Seedlings: Excellent control of seedlings can be achieved at 2/3 qt Roundup Pro per acre or spot application with 1% solution. No additional additives are necessary.

Mature plants: Plants in late rosette or bolting stage can be controlled with 1-1/3 to 2-2/3 qts per acre or complete coverage with 1% solution. No additional additives are necessary. Unlike seedlings, 2/3 qt Roundup Pro per acre will not effectively control large rosettes. Under optimum growing conditions, control of yellow starthistle in the spiny of early flowering (<5% of flower in bloom) stages can also be achieved at 2 qts per acre. All treatments should be made before plants exceed the 5% flowering stage. Beyond this stage, numerous viable seed will already have produced. Control is less effective when older plants show physical signs of drought stress.

Treatment Considerations: Roundup Pro is an ideal treatment for late season yellow starthistle control in annual grasslands. Its use is not advised when perennial grasses or desirable perennial broadleaf species are present, except when used as a spot application. When Transline® has been previously applied, Roundup Pro can be used in a broadcast or spot treatment follow-up program to control escapes before they produce seed, or to prevent the proliferation of potential Transline resistant plants. Early season application of Roundup Pro to seedlings will not provide control of later germinating seeds. Under these conditions, repeated treatments are necessary.

Transline

Transline is a growth regulator herbicide registered for use in non-crop areas, including pastures and rangeland. It has been demonstrated to be very effective for the control of yellow starthistle, as well as other invasive composites (Sunflower family), but does not injure grasses. The increased efficacy of Transline on yellow starthistle can be partially attributed to its postemergence and preemergence activity. A few composites, such as spikeweed (Hemizonia pungens) are not injured by Transline. In addition to composites, Transline injures most legumes, particularly annuals such as burclovers and vetches. Some legumes, including lupines and rose clover are relatively tolerant to Transline. Injury can be avoided on perennial legumes when Transline is applied during their dormant phase. Other plant groups which may be susceptible to Transline include some members of the nightshade family (Solanaceae), the knotweed or smartweed family (Polygonaceae), and teasel (Dipsacus spp.). In contrast, many other broadleaf species, including crucifers and filarees, appear to be relatively tolerant to the herbicide. Transline can be applied both aerially (helicopter or plane) or by ground equipment. Under optimal conditions, 1/4 pt/acre (1.5 oz ae/A) of Transline can provide excellent control of yellow starthistle from December through April. However, under drought conditions, higher rates are necessary. Thus, for consistent control of yellow starthistle, rates between 1/4 and 1/2 pt/acre are preferable. For more information see conversion chart on page 8. Aerial applications should be made with the higher rates. Even when previous years skeletons are present, similar rates will effectively control seedlings. When the desired objective is to enhance rangeland forage quantity while reducing yellow starthistle, earlier applications dates (January to February) are ideal. Although Transline will provide effect control of starthistle to the bolting stage (April or later), the competitive effects of starthistle this late in the season will result in low quantities of grass forage.

Surfactant Use

Use of a surfactant did not improve the control properties of Transline on starthistle until the foliage began to turn bluish, because of the heavy wax production and when the plant begins to produce more hairs or when the temperature increases.

Milestone

Milestone® (aminopyralid) is a new herbicide for use in rangeland, pasture, wildlands, and rights-of way to control broadleaf plants, especially thistles. It controls some important Sacramento valley weeds such as yellow starthistle, Italian thistle, and artichoke thistle. The label rate for the control of most thistles with Milestone is 3 to 5 ounces per acre. The very low amount of material required per acre and the limited movement of the product from the application point has allowed it to be registered under the Reduced Risk Pesticide Initiative of the U.S. Environmental Protection Agency. Research trials conducted from 2000 to 2006 on rangeland sites in California by UC Weed Specialist Joe DiTomaso found that as low as 2

ounces per acre controlled yellow starthistle.

It is made by Dow Agrosciences, the same company that makes Transline. Milestone® is expected to replace Transline for starthistle control because of its lower costs (estimated $9 to $10 per acre for the product at the 3 ounce per acre rate and $6 for the 2 ounce rate), and the fact that it has a broader control spectrum which includes fiddleneck.

Milestone® gives three to four months of preemergence control of starthistle in addition to postemergence control. Starthistle can germinate in the Sacramento valley from October to May. Thus, treatments of Milestone are best applied from December to March. March applications may require a higher rate to be effective. Applications should be made before starthistle bolts or before annual grasses exceed four to six inches in height. Research has shown that the earlier the application, the more grass that is produced on the site.

Long-term control

Any control approach should be continued for at least three years to reduce the yellow starthistle seedbank. Whenever possible, every effort should be made to expose an infested site to high light during the germination period. This will increase the rate of germination and deplete the seedbank more rapidly. Fall or winter grazing, burning, or mowing will provide increased soil surface light during the germination period. By comparison, tillage will bury seeds and prolong the dormancy period. The presence of high populations of biological control agents (weevils and flies) does not appear to significantly impact yellow starthistle populations when used as the sole means of control. However, the presence of these organisms in combination with Transline applications may provide a more long-term or sustainable control. Although no evidence is yet available to support this integrated approach, landowners are encouraged to sustain high levels of the biocontrol organisms.

Precautions

Continuous use of Transline will likely have a long-term detrimental effect on the legume population in a particular area (e.g., burning or mowing). Consequently, other control options should be rotated in the overall yellow starthistle management strategy. In addition, herbicide resistance developed in a Washington population of yellow starthistle exposed to several applications of picloram (Tordon). This population was cross-resistant to Transline. Although, the resistance plants have not spread, the potential exists for the development of resistance to Transline in California if the herbicide is used year after year, with no other method employed. Resistance can be minimized by incorporating other control strategies or by utilizing late season applications of Roundup Pro to control escapes from application skips or resistant plants.

Transline (Clopyralid) Susceptibility Chart.
(N = no control, P = partial control, C = control).

Species or Plant Group	Susceptibility
Grasses (annual and perennial)	N
Chickweed (*Stellaria media*)	P to C
Fiddleneck (*Amsinckia menziesii*)	N
Mustards and other crucifers	N
Common lambsquarters (*Chenopodium album*)	N
Russian thistle or tumbleweed (*Salsola tragus*)	N
Filarees (*Erodium* spp.)	N
Teasel (*Dipsacus* spp.)	C
Puncturevine (*Tribulus terrestris*)	N
Prostrate knotweed (*Polygonum arenastrum*)	N
Smartweed or ladysthumb (*Polygonum* spp.)	P
Red sorrel (*Rumex acetosella*)	C
Curly dock (*Rumex crispus*)	P to C
Jimsonweed (*Datura* spp.)	C
Nightshades (*Solanum* spp.)	C
Annual clovers and other annual legumes	C
Perennial legumes	P or N during dormancy
Lupines (*Lupinus* spp.)	C
Burclovers and medics (*Medicago* spp.)	C
Alfalfa (*Medicago sativa*)	P or N during dormancy
Vetch (*Vicia* spp.)	C
Thistles	C
Knapweed (spotted, diffuse, Russian)	P to C
Tarweeds (except *Hemizonia pungens*)	C
Ragweed (*Ambrosia* spp.)	C
Mayweed (*Anthemis cotula*)	C
Sagebrush (*Artemisia* spp.)	C
Pineappleweed (*Chamomilla suaveolens*)	C
Oxeye daisy (*Chrysanthemum leucanthemum*)	C
Chicory (*Cichorium intybus*)	C
Horseweed and marestail (*Conyza* spp.)	C
Sunflower (*Helianthus* spp.)	C
Prickly lettuce (*Lactuca serriola*)	P to C
Common groundsel (*Senecio vulgaris*)	C
Dandelion (*Taraxacum officinale*)	P to C
Salsify (*Tragopogon* spp.)	C
Cocklebur (*Xanthium strumarium*)	C

The Future of Biocontrol

Many land owners want the same success with starthistle that occurred with the insect that controlled Klamath weed. Presently, there have been five seed head feeding insects released. Given that starthistle is estimated to produce 50 to 200 million seeds per acre and its populations has expanded in California for more than 100 years it may not be realistic to expect biocontrol agents released during the past five years to provide satisfactory control. There are five seed head feeding insects presently released in California. Biocontrol of starthistle should be considered a long term solution. This method may provide the only answer to control on rangelands where of herbicides cost may be too expensive.

Insects

The USDA Ag Research Service conducts the foreign screening of insects that attack starthistle and Calif. Dept. of Food and Ag coordinates the release sites through the county Ag Commissioners. Nursery sites are established and once the starthistle pest increases it is redistribution to other areas. A committee of Ag commissioners decides on the location of the release sites.

Bud Weevil (Bangasternus orientalis)

Introduced in 1988, it has the widest distribution of any yellow starthistle pest. It has been released in 49 counties and has populated all of the sites. Siskiyou and Placer are the counties with the best collection sites. It lays its eggs on the starthistle bracts and the larvae eat the receptacle. They produce only one generation per season, which limits its ability to impact all the different flowering periods. They do not destroy all the seed heads on a plant or all seeds within a seedhead. A private company has been collecting them in Placer County and plans to market them. It is not recommended to purchase these pests, since they have a wide distribution and with time they will increase in number. In addition, the bud weevil is not considered an effective biocontrol agent.

Gall Fly (Urophora sirunaseva)

The gall fly was first released in Placer County in 1984. It is now established in 40 counties. It is a good flyer and can move up to 16 miles per year. Gall flies have increased their populations in Siskiyou and Placer counties. They lay eggs on the seed head, which creates a gall that causes an energy drain on the receptacles. This results in a lower production of viable starthistle seeds. Field surveys have indicated that it is having a limited impact on starthistle. Release sites are on the map below. Like the bud weevil, gall flies are not considered an effective biocontrol agent.

Hairy Weevil (Eustenopus villosus)

It has one generation per year, emerging in May, mating and ovipositing eggs inserted inside closed flowerhead buds in June. It does well in hot dry areas but does not do well in foggy areas. Unlike other yellow starthistle natural enemies, hairy weevil adults also cause extensive damage by feeding on young closed buds. It is now established in 47 counties in California. Thus far, the hairy weevil appears to be more effective in preventing seedhead production in yellow starthistle than both the gall fly or bud weevil.

Peacock Fly (Chaetorellia australis)

It deposits its eggs on the seed head and the larvae hatch it bores inside. They produce three generations per year. This is an added advantage to this pest. One problem is that it emerges early (April) before starthistle flowers. CDFA has had seven releases and seven recoveries. They have found them 100 miles away from the Trinity/Humboldt release site. This species needs cornflower for colonization and establishment and is unlikely to have much of an impact on yellow starthistle control in California.

Seedhead Fly (Chaetorellia succinea)
This fly was accidentally introduced with the Peacock fly in 1991. It has become widespread throughout northern and central California. Chaetorellia succinea produces more than one generation a year. Its larvae can destroy most of the seeds in a head, much like the hairy weevil. Along with the hairy weevil, this fly is the most promising of the natural enemies yet released for yellow starthistle control.

Some of these pests are produced commercially. Below are the names of retail outlets listed in Suppliers of Beneficial Organisms in North America by the Dept. of Pesticide Regulation (1994 edition).

Bangasternus orientalis & Urophora sirunaseva
Bio Collect
5481 Crittenden Street
Oakland, Ca. 94601
Phone (501) 436-8052
Fax (501) 532-0288

Bangasternus orientalis only
Biological Control of Weeds
1418 Maple Drive
Bozeman, Montana 59772
Phone (406) 586-5111
Fax (406) 586-5111
email: biocontrol@montana.campus.mci.net

Peaceful Valley Farm Supply
P.O. Box 2209
Grass Valley, Ca. 95945
Phone (916) 272-4769
Fax (916) 272-4794

Bangasternus orientalis and Eustenopus villosus
Caltec Agri Marketing Services
P O Box 576155
Modesto, CA. 95357
Telephone: 1-800-491-BUGS
Fax: 209-575-0366

TRANSLINE RATE CONVERSION CHART

PRODUCT		ACTIVE INGREDIENT		
FLUID OUNCES	PINTS	OUNCES AE	LB AE	
2.7	1/6	1.0	0.063	
4.0	1/4	1.5	0.095	
5.4	1/3	2.0	0.126	
6.8	2/5	2.5	0.16	
8.0	1/2	3.0	0.19	
9.5	3/5	3.5	0.22	
10.8	2/3	4.0	0.25	California high label rate

Revised 3/13/09

Blackberry Management

Larry Forero, UCCE Livestock Farm Advisor
Joseph M. DiTomaso, Vegetable Crops/Weed Science, UC Davis
Paul Kjos, Shasta County Deputy Agricultural Commissioner/Sealer of Weights & Measures

Blackberry brambles infest many acres of pasture land in northern California. They quietly invade pasture resulting in a reduction of available forage for livestock. Imagine a field 667 feet by 667 feet (ten acres). This field has blackberries along the fence line out into the pasture ten feet along the entire perimeter of the pasture. The area encompassed by the blackberries is 0.60 acres—over 5% of the entire field. At 10,000 lbs/acre production, that is a loss of 6 AUM's in one season.

Understanding the biology of the blackberry plant will help you better manage this pest:

1. The seeds are readily spread by wildlife
2. The plants produce canes from the central cane as well as from rhizomes
3. A single blackberry plant can live 25 years.
4. They may be self-pollinated or pollinated by honey bees
5. First year canes do not produce flowers
6. Second year canes fruit and die
7. Tips of the first year canes that contact the ground form roots at the nodes.

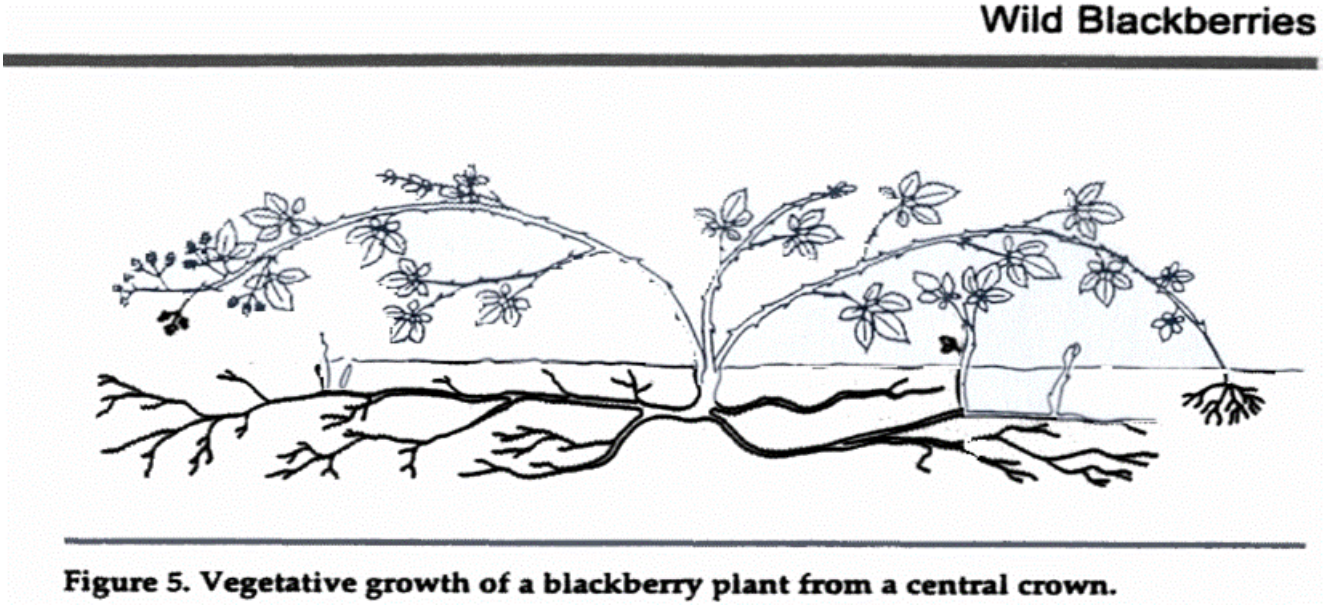


Figure 5. Vegetative growth of a blackberry plant from a central crown.

The tools available to help manage blackberries include:

Burning

A. Burning blackberries can reduce canopy short term. It is not a good long-term strategy because plants will resprout from the base.

Mechanical

A. Wild blackberries can be controlled by REPEATED tillage
B. Bulldozing can cause resprouting and can spread the pest by means of root and stem fragmentation
C. Mowing is not effective because it stimulates formation of suckers from lateral roots and induces branching

Biological Control
A. There is no biological control method available in the US. In Australia, blackberry leaf rust has been released for control of the weed. It is not generally considered successful because the rust does not do significant damage to the host. Although the rust was recently found in Oregon it has had sporadic success. It is also in California, but has not been effective.

Herbicide
A. Common herbicide products include Glyphosate (Round-up®), Triclopyr (Garlon ®4—61.6% Triclopyr) or Triclopyr/2,4-D (Crossbow®—34.4% 2,4-D, 16.5% Triclopyr)

These products behave differently and it is important to apply the product at the right time and at the appropriate rate. Table A summarizes rate and timing, but refer to the pesticide label for specific information.

Table A

Product	Rate	Water	Timing	Application
Round-up	0.5-1.5%	0.6-2 oz/gallon of water	Late summer/early fall	Spray foliage to wet
Garlon	1%	1.25 oz/gallon of water	Mid-summer and later	"
Crossbow	1%	1.25 oz/gallon of water	Mid-summer and later	"

When herbicides are used, it is critical to read and follow all label instructions—understanding the label improves efficacy and assures the product is being applied safely. Some products require a restricted materials permit where others only require an Operator ID. If you have any questions about this—call you local agriculture commissioner's office.

Table B summarizes the products outlined above.

Product	Operator ID	Restricted Materials Permit	Notice of Intent	Use Report
Round-up	Yes	No	No	Yes
Garlon	Yes	No	No	Yes
Crossbow	No	Yes	Yes	Yes

If you are considering spraying blackberries take some time to review and consider the following:

1. Think carefully about the goals for your property/operation.
2. Blackberry control and management requires persistence—be sure you

As a quick review…

2 cups/pint
2 pints/quart
4 quarts/gallon

8 fluid oz/cup
16 fluid oz/pint
32 fluid oz/quart

commit the time it takes.

3. Try to work on projects with measurable objectives that move you along towards your goal.
4. Remember the rules—check with your agricultural commissioner locally to make sure you understand the process for obtaining permits, operator ID and submission of reports.

References

DiTomaso, J.M. *"Pest Notes: Wild Blackberries."* IPM Education and Publications, University of California Statewide IPM Program. UC ANR Publication 7434. http://ipm.ucdavis.edu/PMG/PESTNOTES/pn7434.html.

ESTIMATING CARRYING CAPACITY

Roger Ingram, County Director and Livestock and Natural Resources Farm Advisor, Placer and Nevada Counties

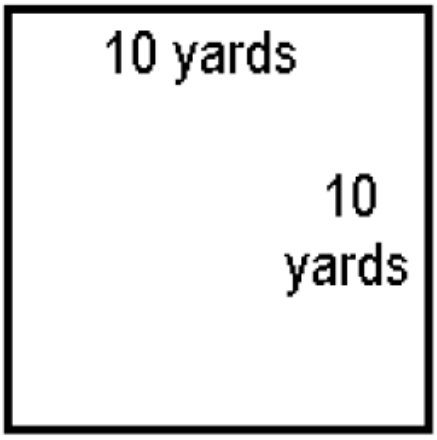
David W. Pratt, former UCCE Farm Advisor and now CEO of Ranch Management Consultants

Several people use and teach the method described in this paper for estimating carrying capacity. I learned it from Dr. Stan Parsons at his *Ranching For Profit School.* It is best applied near the end of the growing season when little additional growth is expected.

PROCEDURE:

1. Pace off an area you think has enough forage to feed an animal for one day. Try to keep your paces one yard long. (This works best with four people, one to stand at each of the paced area. If you don't have enough people you can tap stakes in at the corners.)
2. If the area looks too small, everyone should take a step back. If the area is too big take a step in.
3. Multiply the length of the area (in yards) by the width.

   This gives you the area required by one animal for one day in square yards.
4. Divide the square yards per acre (4840) by the square yards required per animal per day. The result is the number of stock one acre can support for one day (Stock Days per Acre, SDA).



10 x 10 = 100 Square Yards

4840 Sq.Yards/Acre ÷ 100 Sq.Yards/Animal/Day =

48.4 SDA

5. Multiply SDA by the number of acres in the paddock. The result is stock days per paddock. For example, if the square on the previous page is representative of a 12 acre paddock, then:

48.4 SDA x 12 acres = 580 SD in the paddock

6. Since the quantity of forage produced may vary within each paddock, you may have to average several estimates to come up with a reliable assessment of the SD per paddock.

By adding the stock days for each paddock on the ranch you can determine the total days of grazing available on the property.

TEST YOUR ESTIMATE

You'll be surprised at how quickly you can accurately evaluate the carrying capacity of pastures. However, your estimates are likely to be off a bit when you try this for the first time. The accuracy of your estimate can be tested simply by putting a stock in a small paddock to graze.

For example, we estimated that there are 580 stock days of feed available in our 12 acre paddock. If our herd consists of 200 head, there should be almost 3 days of grazing available in the paddock:

580 SD ÷ 200 stock = 2.9 Days

If we check the paddock at the end of the second day and find we are out of feed, then our estimate was too high (we need to make our square larger next time). If we find there is more feed left than we anticipated at the end of the planned three day graze period, then our estimate was too low (we should make our square smaller next time).

You may want to check your estimates on a small area using some temporary portable electric fencing. With experience, simply monitoring the severity of grazing in the paddocks during the graze period is sufficient.

DEFINITIONS

STOCK DAY (SD): The amount of forage required to support one animal for one day.

STOCK DAYS PER ACRE (SDA): The number of animals that can be supported on one acre for one day.

Final Thoughts

While this method works best for the end of the growing season on annual rage, it can be used at anytime. For example, if winter has been dry, you could go and walk the paddocks to assess how many stock days you have left.

Measuring carrying capacity using this method will go quickly once gain experience and confidence in the method. David Pratt and I used to assess carrying capacity in May on part of the Campbell area of the Sierra Foothill Research and Extension Center. The 250-acre Campbell area was being used for a grazing research project. We installed 23 paddocks within the project area in 1996.

Every May, we would assess carrying capacity in all twenty-three paddocks using this method. It would take about two hours to complete the assessment. Once we knew the carrying capacity as expressed in stock days, we were then able to develop a feed budget. The feed budget allowed us to determine how much demand we had on a monthly basis from mid-May through December.

We then compared the stocking rate demand with the carrying capacity supply to determine if we were overstocked, stocked about right, or under-stocked. We knew this in May rather than waiting to see how things would be in September or October. In addition, by factoring the stock demand for November and December, we had a sixty-day drought reserve.

If we were over or under-stocked, we had time in May to determine the best course of action rather than hoping things worked out and having to resort to more drastic actions with few alternatives

On the following page is an example and template you can use to record squares. You can then do the math with a calculator or input into a spreadsheet

Estimating Carrying Capacity Sample

Paddock	Length (yards)	Width (yards)	Area Size of square (square yards)	SDA Stock Days per Acre	Paddock Paddock size (acres)	SD/ Paddock Stock Days
1	5	5	25	193.6	2	387.2
2	7	7	49	98.8	6	592.7
3	6	7	42	115.2	3.6	414.9
4	7	7	49	98.8	4.7	464.2
5	5	4	20	242.0	3.1	750.2
6	7	8	56	86.4	12	1037.1
7	7	7	49	98.8	11	1086.5
8	5	6	30	161.3	15.4	2484.5
9	8	8	64	75.6	7	529.4
10	6	6	36	134.4	13	1747.8
11	7	7	49	98.8	4.2	414.9
12	8	8	64	75.6	12.2	922.6
13	10	10	100	48.4	12.6	609.8
14	7	6.5	45.5	106.4	11.3	1202.0
15	10.5	11.5	120.75	40.1	13	521.1
16	6	8	48	100.8	17	1714.2
17	8	10	80	60.5	25	1512.5
18	16	14	224	21.6	22	475.4
19	13	13	169	28.6	20.4	584.2
20	19	17	323	15.0	15.4	230.8
21	6	6	36	134.4	13.4	1801.6
22	8	5.5	44	110.0	8.8	968.0
23	12	12	144	33.6	34	1142.8
					Total Stock Days	21594.3

Estimating Carrying Capacity Sample

Paddock	Length (yards)	Width (yards)	Area Size of square (square yards) Multiply Length X Width	SDA Stock Days per Acre 4840 / Product in the Previous Column	Paddock Paddock size (acres)	SD/ Paddock Stock Days Multiply SDA X Paddock size in acres
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

Forage Clipping

Roger Ingram, UCCE County Director and Livestock and Natural Resources Farm Advisor, Placer and Nevada Counties

Steps for measuring forage production: Once you have the average production you can compare the production to a known forage production average for your area. For example, the average forage production at the Sierra Research and Extension Center is 2854 lbs/ac

Step 1: Pre-weigh empty bags

Weigh an empty paper bag in grams and write the weight on the bag. This weight will be important for calculations later. Alternatively, you can zero the gram scale while weighing the empty bag. The weight with the filled bag of forage will now be the actual weight without having to subtract out the bag weight.

Step 2: Toss hoop or square foot frame and clip forage.

Randomly toss the hoop or frame and let it land flat on the ground. Clip plants within the hoop to ground level, making sure to sort out all litter, roots or soil. Also discard all weeds or other plants that are not forage species. Clip at least eight to ten hoops or frames per paddock to insure reliable forage production estimates.

Step 3: Weigh clippings.

Place forage clippings in bags and weigh with gram scale. Weights should be marked on each bag. This will be the green weight, which will include water in the forage.

Step 4: Dry the sample

You would next dry the sample in a drying oven, placing it in the sun, or in a microwave. If using a microwave oven, place a small cup of water inside to prevent the forage from burning!

Step 5: Weigh clipping again.

Weigh with gram scale a second time. Weights should be marked on each bag. This will be the dry weight, with little to no water left in the forage.

Step 5: Complete calculations.

Complete the following worksheet using the weights recorded on the sacks and a calculator.

	Green Wt in grams (clipped grass – wt of bag)	Dry Wt in grams (dried forage – wt of bag)	Multiplication factor	Lbs /Ac B X C = D
Sample Number	A	B	C	D
1			96	
2			96	
3			96	
4			96	
5			96	
6			96	
7			96	
8			96	
9			96	
10			96	
Sample Average		Sum of samples 1-10 /10		

Fruit and Nut Varieties for Low-Elevation Sierra Foothills

Janine Hasey, UC Farm Advisor, Sutter and Yuba Counties

Growing fruit and nut trees in the Sierra foothills at low elevations presents many challenges. The opportunity to pick tree ripened fruit is what encourages foothill residents to overcome the obstacles. Knowing what varieties are better adapted to lower elevation foothill conditions and how to manage them can ease some of the home orchardist's frustrations. During a fourteen year demonstration study (1992-2006) evaluating tree fruit and nut variety adaptation at the University of California Sierra Foothill Research and Extension Center in Browns Valley, Yuba County, certain fruit and nut tree species and varieties emerged as able to tolerate and even thrive under foothill soil and climate conditions at 575 feet elevation. As important as knowing what to plant is identifying which tree crops and varieties to avoid planting, which rootstocks performed the best, and which diseases and insects may be most problematic.

Variety and Rootstock Adaptation

Several standard and some newer and antique varieties of apples, peaches, nectarines, apricots, plums, cherries, chestnuts, pecans and walnuts were evaluated. Two to six replications of each variety and at least two trees each for different rootstock/variety combinations were observed. The low elevation foothill site comprised of Auburn-Sobrante Complex gravelly soil has a 7 percent slope. Even the most vigorous rootstocks and varieties when grown on these heavier, shallow foothill soils will be smaller than the same tree growing on a valley loam soil. Our spacing for fruit trees (18' x 18') and for nut trees (25' x 25') was too wide and trees never filled the space. Planting at the closest spacing suggested for the particular variety and rootstock tested at this site is recommended. Key to tree survival in high rainfall years is planting on slopes with good water drainage and avoiding swales where runoff water accumulates since most rootstocks do not tolerate wet, saturated soils. Planting on a hillside or sloping terrain will also aid in avoiding frost damage as cold air drains to lower sites.

Trees should be trained as low as possible for ease of harvest and pest management since homeowners and small commercial orchard operators typically will do most operations by hand. To properly size fruit, peaches, nectarines, plums, apricots, and apples are pruned annually and fruit thinned. Deer will browse on fruit and nut trees which should be protected with an 8-foot deer fence if you're serious about growing a tree that yields fruit. Wild turkeys will eat chestnuts and birds such as crows and other species will eat or damage crops just as they ripen. Cherries, peaches, pecans, and walnuts should be netted to prevent bird damage. Grasshoppers may occur sporadically and can be baited on the orchard border. Gophers may also need to be controlled.

Table 1 lists specific fruit and nut tree varieties that should perform adequately under low-elevation Sierra foothill sites. Also listed for the fruit tree varieties is the average bloom date and for all tree crops the observed spread of harvest dates. Variety specific pest problems or special considerations appear in the last column. Listed in table 2 are varieties or variety/rootstock combinations not recommended for low-elevation Sierra foothills based on poor performance at this site. General observations (and recommendations) on each tree species follows:

Apples
Apple varieties were grafted on either M 7 or M 111 semidwarf rootstock. Generally trees on M 7 were poorly anchored with many requiring staking because of a brittle root system. Most varieties performed better on M 111 with two exceptions (table 2). Most varieties produced adequate crops and flavor is more a personal preference. Codling moth was an ongoing challenge especially when trees were grown organically. During the warm, wet springs of 2000 and 2005, fire blight disease caused extensive dieback in very susceptible varieties (table 1). Fire blight will need managing when environmental conditions are favorable for disease development.

Apricots
The original apricots were on Marianna 2624 and apricot seedling (Royal Blenheim) rootstocks. All six Blenheim (Royal) variety trees on Marianna 2624 rootstock were dead within seven years (table 2) whereas the Patterson variety continued thriving on both Marianna 2624 and apricot seedling rootstocks. Marianna 2624 rootstock suckered profusely however. Three newer apricot varieties on either Citation, Lovell, or Nemaguard rootstock were planted in 2000 and 2001 to replace the Blenheim (Royal) that were not suited to this site. During the wet 2006 spring, trees on Nemaguard rootstock all died as did two trees on Lovell rootstock from waterlogging. Surviving trees were on Citation rootstock or on Lovell rootstock on higher ground. Brown rot (*Monilinia laxa or fructicola*) destroyed the blossoms in the wet spring of 2005 on all varieties.

Peaches
All peach trees were on Lovell peach rootstock. The life span of a peach tree is about 15 years; after thirteen years, the Red Haven variety continued to be the most productive although some trees had sunburn damage and were declining. Overall most varieties of peaches consistently yielded large crops of good quality fruit. The main insect pest was peach twig borer. Even with copper sprays, peach leaf curl can be a problem in wet springs. The varieties most affected were Spring Crest, Flavor Crest, Fay Elberta and Forty Niner; the least affected varieties were Red Haven, Gene Elberta and Nectar (white fleshed). Peaches need heavy dormant pruning and fruit thinning to maintain fruit size.

Nectarines
Like the peaches, nectarines were on Lovell peach rootstock and must be pruned heavily and fruit thinned to achieve good fruit size. Nectarines are very susceptible to thrips damage, which can be expected if a spray is not applied at late bloom. All of the varieties had severe peach leaf curl, more so than the peaches. Some trees declined and died after soil was saturated from El Nino rains in early April 1998. Royal Giant was not affected by waterlogging damage and was less damaged from thrips; however, it did get severe peach leaf curl. All nectarine varieties produced low yields of poor quality fruit overall and appear not to be adapted to this foothill site (table 2).

Plums
The Santa Rosa variety grown on Myrobalan (Myro) 29C rootstock was a consistent producer and well adapted to the site; this variety grown on Lovell rootstock was not as productive. Aphids were the main pest problem, which cause severe leaf curling symptoms. Aphids were very severe on the Elephant Heart variety, less severe on the Simka variety, and not typically a problem on the Santa Rosa variety. Dormant oil sprays alone failed to control the leaf curl plum aphid and usually an insecticide is included with dormant oil commercially to control aphid where they are a problem. Since an insecticide cannot be used where trees are grown organically, the highest label rate of oil applied in early March before bloom provided the best results. Aphid parasitoids may also be released.

Cherries
The cherries were all on size controlling Colt rootstock. The fruiting spurs are productive for 10-12 years so they are rarely pruned. Overall, the cherries have performed well. The Lapins variety was consistently the most productive and is self-fertile as is the Stella variety which did not perform as well. The Early Burlat which needs a pollenizing variety, tended to have light crops, more blossom brown rot (*Monilinia frucitcola* or *laxa*) in wet springs, and more bird damage. Netting is used to prevent crop damage from birds.

Walnuts
Walnut trees are deeply rooted so the rootstock used was Paradox noted for its vigor and better adaptation to marginal soils. This rootstock is more susceptible to crown gall disease however which was visible on one tree. Although initial tree growth was vigorous, all varieties showed reduced vigor within eight years on these heavier, shallow soils. The variety Tulare which has more vigor grew better than the Chandler variety; however, two declining Tulare trees and one Cisco (pollenizer) were removed after eleven years. In these soils, mature walnut trees need pruning at least every other year to stimulate growth. The walnuts had little pest damage other than crows eating the crop. Regardless of low pest damage, vigor and productivity progressively declined under foothill soil conditions.

Pecans - The pecan trees were slow to establish at this site. Zinc sulfate sprays are needed during the establishment period and zinc levels should be monitored on mature trees. Little pruning is needed except to keep the limbs from hanging down from the weight of the crop. Pecans have an alternate year bearing habit, so expect heavier crop years to be followed by a light crop. Western Schley, a pollenizer for Wichita and Shoshoni, should be included in foothill plantings although it was a low producer at this site. Pawnee was a more consistent producer in the early years than in the later years. It was a smaller tree than Shoshoni which can be a desirable trait for backyard orchards. Crows may eat the nuts before harvest so limbs should be netted to prevent damage. No aphid damage was observed.

Chestnuts – The two chestnut varieties, Silverleaf and Colossal, and one Colossal seedling pollenizer tree never grew very large on this foothill soil. Chestnuts are grown on a seedling rootstock. The Silverleaf trees were more vigorous and tended to produce heavy crops with generally smaller fruit size compared to the Colossal trees. One Silverleaf suddenly collapsed in 2002 from what appeared to be root and crown rot; chestnuts are sensitive to poor drainage. Wild turkey and crows may eat the crop.

Hazelnuts - Three own-rooted hazelnut varieties, Barcelona, Casina, and Butler, were planted in 2003, replacing walnut trees. These were trained as a multi-trunk bush rather than a tree. The trees were growing well but had not yet cropped at the study's conclusion.

Cultural and Pest Management Information

The Fruit and Nut Center at UC Davis, http://fruitsandnuts.ucdavis.edu, provides information on cultural practices of several tree crops such as pruning, fertilization, etc. Go to "The Backyard Orchard" on the home page. Explanations and information on chill hours is available by clicking on "Weather Services" on the home page. The average chill hours accumulated since 2003 from November 1 through February from the Browns Valley Cimis weather station when temperatures were between 32^{o} and 45 ^{o}F is 743 hours.

Information for scheduling irrigations based on weather based monitoring is available at the California Irrigation Management Information System (CIMIS) website, http://wwwcimis.water.ca.gov/cimis/welcome.jsp . You'll need to register the first time and then accessing data is free. Click on the info center and data tabs where you'll find the information you need to schedule irrigations based on historical or real time evapotranspiration values (ET) and crop coefficients. When obtaining data, the CIMIS weather station must be selected. The Browns Valley Cimis weather station located at the Sierra Foothill Research and Extension Center is station # 84.

The UC Davis Integrated Pest Management (IPM) website for the backyard and home orchard, http://ipm.ucdavis.edu/PMG/GARDEN/fruit.html, provides management information for major and minor pests of fruit and nut trees and cultural information on pruning, fertilizing, etc. Degree-days for determining spray timing for specific temperature driven insect pests such as codling moth and peach twig borer can be calculated using the "Degree-days" on the IPM website home page http://ipm.ucdavis.edu

Acknowledgements

This demonstration site was made possible by the generous contributions of trees from Fowler Nurseries, Inc., Sierra Gold Nurseries, Linwood Nurseries, Stuke Nursery, and Dave Wilson Nursery, and the irrigation system from Circle R Irrigation.

Table 1: Fruit and Nut Harvesting Timing

			Harvest Dates					
Fruit Tree Variety		Avg. Bloom	JUNE	JULY	AUG.	SEPT.	OCT.	PEST PROBLEMS/COMMENTS
PEACH	**PEACH**							Peach twig borer and leaf curl control needed
	SPRING CREST	**3/20**						Early producer; more susceptible to peach leaf curl; less sweet
	RED HAVEN	**3/10**						Consistently good producer; high quality fruit
	FLAVOR CREST	**3/20**						More susceptible to peach leaf curl
	NECTAR (WHITE)	**3/30**						White flesh; fragile; less susceptible to leaf curl
	GENE ELBERTA	**3/30**						Less susceptible to peach leaf curl
	FORTY NINER	**3/10**						More susceptible to peach leaf curl
	FAY ELBERTA	**3/20**						More susceptible to peach leaf curl
PLUM	**PLUM**							Leaf curl plum aphid is main problem
	SANTA ROSA	**3/5**						Consistent producer on Myro 29C rootstock
	ELEPHANT HEART	**3/10**			**Mid Aug - Sept.**			Leaf curl plum aphid is a problem
	SIMKA	**3/16**			**Mid Aug - Sept.**			Leaf curl plum aphid is a problem
APPLE	**APPLE**							Codling moth control needed
	GALA	**4/11**						Very susceptible to fire blight
	ROYAL GALA	**4/11**						Very susceptible to fire blight
	RED DELICIOUS	**4/11**						Intermediate susceptibility to fireblight
	BRAEBURN	**4/6**						Susceptible to fire blight
	RED FUJI	**4/11**						Very susceptible to fire blight
	FUJI	**4/11**						Very susceptible to fire blight
	GRANNY SMITH	**4/11**						Less susceptible to fire blight; use M7 rootstock
APRICOT	**APRICOT**							Expect a light crop if low chilling
	PATTERSON	**3/3**						Firm fruit, used for canning; well adapted to site
	GOLDSTRIKE							Do not use Nemaguard rootstock
	GOLDBAR							Use Citation rootstock
	ROBADA							Plant where drainage is good
CHERRY	**CHERRY**							Must net to protect from birds
	EARLY BURLAT	**3/26**	**4/24-5/18**					Variable crop load; average to small fruit
	LAPINS	**3/26**	**5/7-6/19**					Self-fertile; consistently most productive
	STELLA	**3/27**	**5/7-6/19**					Self-fertile; lower vigor as tree matured
	CHESTNUT							Wild turkeys eat chestnuts
	SILVERLEAF							Fruit tends to be smaller; trees more vigorous
	COLOSSAL						**Oct 1 - Nov**	Large, good quality fruits most years
PECAN	**PECAN**							Pecans alternate bear; crows eat crop
	PAWNEE							Good nut size; smaller tree
	SHOSHONI							Larger tree; Western Schley pollenizes
	WESTERN SCHLEY							Limit planting as pollenizer only
	WICHITA							Smaller tree; Western Schley pollenizes
WALNUT	**WALNUT**							Soil is marginal for walnuts; crows eat crop
	CISCO							Pollenizer for Chandler; declined most quickly
	CHANDLER							Declined within 10 years; light kernel
	TULARE							Self pollinating; more vigor; medium-light kernel

Table 2. Tree crops, varieties, and variety/rootstock combinations not recommended for low-elevation Sierra foothills based on poor performance at this site.

TREE CROP	VARIETY	ROOTSTOCK	REASON
Apple	Arkansas Black	M111 (only one tested)	Poor growth and fruit quality
Apple	Gala	M111 and M7	Poor growth
Apple	Granny Smith	M111	Poor growth
Apple	Spitzenberg	M7	Poor growth
Apricot	Blenheim (Royal)	Marianna 2624	Bacterial canker and Eutypa diseases
Nectarines	Summergrand, Fantasia, Flavortop, Royal Giant, Red Gold	Lovell	Poor production and fruit quality, peach leaf curl, thrips, waterlogging damage (Red Gold)
Plum	Kelsey	Lovell	Very poor growth; leaf curl plum aphid
Plum	Elephant Heart (EH)	Lovell	Leaf curl plum aphid, unless able to control it
Plum	Simka	Myro 29-C	Leaf curl plum aphid, unless able to control it; less vigor than EH
Walnut	Chandler, Cisco	Paradox	Poor growth

Native Oak Management and Regeneration

Doug McCreary
Cooperative Extension Natural Resources Specialist

Native oaks are common features of California's hardwood rangelands and provide a multitude of values and benefits. Livestock shade-up under their canopies that often provide the only protection during the scorching days of summer. For many species of wildlife oaks offer a variety of essential food-stuffs including acorns, foliage, and even flowers. They also provide home sites for cavity nesting birds, breeding habitat for deer, and shelter and protection for amphibians and reptiles. From an aesthetic standpoint, oaks are a key feature of an iconic landscape that many feel is emblematic of what California looks like. Oaks also anchor the soil, preventing erosion and sedimentation in the waterways that transport water from snowpack in the mountains to the farms, fisheries, and cities that can't survive without it. Oak woodlands are also the places where many residents go for recreation, be it hunting, fishing or just to get away and enjoy the beauty and solitude.

A little over two decades ago the University of California, in cooperation with the California Department of Forestry (now called CalFire) and the California Department of Fish and Game, initiated the Integrated Hardwood Range Management Program (IHRMP) to address concerns about oak management and to promote oak and oak woodland conservation. This program worked closely with many of the state's ranchers since, as owners and managers of the vast majority of woodlands in the state, ranchers held the key to the widespread implementation of conservation practices.

One of the key concerns that led to the establishment of the IHRMP in 1986 was the widespread view that several species of native California oaks, including blue oak and valley oak, were not regenerating adequately. Poor natural regeneration raised the specter that some oak stands could convert to grasslands or shrublands if the situation wasn't remedied. This was of grave concern because, as stated above, oak woodlands provide so many amenity values and ecological services. The Sierra Foothill Research and Extension Center has been at the forefront of research on both the causes of poor oak regeneration, and in developing strategies for successfully getting oaks to grow. Today we feel that we know how to successfully establish oaks, though this can require considerable time and money. One of the main obstacles to successful regeneration is the intense competition from the many introduced annual grasses and forbs so common in the understories of California's oak woodlands. It is essential to eliminate this competition in the vicinity of the newly planted acorns or seedlings for at least two years so that the young oaks can obtain sufficient moisture – as well as nutrients and light – to survive and begin growing. Another critical obstacle to deal with is the damage to young oaks from animals. There seems to be a long list of critters intent on eating either acorns, roots, or the tender new foliage of the young seedlings. We have evaluated several seedling-protection devices at the SFREC and have had good success with treeshelters. These are plastic tubes placed over individual seedlings that protect them from a range of animals including deer, rabbits, voles and grasshoppers. If the shelters are staked securely with metal fence posts, they can also protect seedlings from cattle in low-to-moderately grazed pastures.

We recently initiated a new research project to evaluate whether or not we could enhance the growth and survival of natural or "volunteer" oak seedlings. It is often easy to find numerous small oak seedlings – especially following a heavy mast year -- in the understories of existing oak stands. However, research has shown that the bottleneck for successful oak regeneration is often from the

seedling to the sapling stage. That is, few seedlings live long enough to progress to that intermediate size of trees called saplings. If they do become saplings, however, there is a very good chance they will continue growing into mature trees. Anything that can help seedlings progress to the sapling stage could therefore improve the chances that a stand of oaks continues to survive and prosper.

To examine the prospects of using natural blue oak seedlings as part of a regeneration strategy, we initiated a study at six field sites throughout the state broadly representing the range of blue oaks. One of these sites is here at the SFREC. At each site we have identified 144 small naturally-occurring seedlings which were numbered, measured, and randomly placed in treatments including all combinations of the following:

- In the open and under tree canopies;
- Covered with 4-ft treeshelters and left unprotected;
- Annual weed control around seedlings in the spring and no weed control.

This study has been underway for two years now and preliminary results suggest that both treeshelters and weed control can increase the growth and survival of small seedlings. But oaks live a long time so we need to evaluate the responses to these treatments for a while longer. We are optimistic that this new approach will add a new tool in our regeneration tool-bag, helping our efforts to conserve blue oaks, a critical species in California's oak woodlands.

Land Management to Preserve Wildlife Habitat

Bill Tietje, Area Natural Resources Specialist
UC Berkeley

More kinds of wildlife live in California oak woodland than any of the other major habitat types in state. One of the two main goals of the IHRMP since its establishment in 1986 is the maintenance of the native wildlife diversity. To that end, the IHRMP launched an intense program of research on woodland/wildlife relationships and extension of this information to owners and managers of the oak woodland. Some of this research occurred at the Sierra Foothill Research and Extension Center.

Selected Sierra Foothill R&E Center Wildlife Study

The Sierra Foothill R&E Center was one of three sites where wildlife diversity was evaluated in the late 1980s. More bird species (92) were recorded at the Field Station than at the other two study sites, the diversity directly related to the vegetation diversity provided by the oak woodlands, including shrubs, logs, leaf litter, forbs, and other habitat elements. Of the 92 species, 60 bird species bred at Sierra Foothill. Some species, such as Hutton's vireo and orange-crowned warbler, use mostly the more dense live oak woodland whereas other species, such as western bluebird and white-breasted nuthatch, use mostly in the more open blue oak woodland. The study identified seven species of small mammals and several species of amphibians and reptiles.

Cutting of oak trees for fuelwood was one of several land uses that prompted the development of the IHRMP. Researchers funded by the IHRMP addressed this issue on the Sierra Foothill R&E with an experimental study. The study, in blue oak, removed approximately a quarter of the basal area, leaving snags, acorn woodpecker granary trees, and some brush piles built with the branches of the cut trees. Open canopy species such as phainopepla and Bullock's oriole were favored by the cutting. Two dense-canopy associated species, the Pacific-slope flycatcher and Hutton's vireo, declined after the cutting. The study concluded that if such habitat elements such as snags, granary trees, and shrubs are kept intact, at least most of the bird community will remain.

Habitat Elements

Specific habitat elements or components of habitat quality were not manipulated and their importance to wildlife diversity was not examined in the study. The California Wildlife Habitat Relationships System (CWHR System) predicts that reduction in several habitat elements will adversely affect shrub-dependent bird species and other wildlife taxa (see Table 2). Native shrubs seem to be particularly important, their removal adversely affecting 84% of the vertebrate species. You can see from Table 2 that good management and maintenance of riparian areas and of logs and other woody debris, termed course woody debris, are also at the top of the list of importance to the maintenance of wildlife diversity.

Table 2. Changes in vertebrate species occurrence predicted by CWHR if each of several selected stand-level habitat elements within oak woodland was not present. Numbers are based primarily on expert opinion incorporated in the CWHR species occurrence models.

	# Species Lost by Excluding the Habitat Element				
Habitat Element	Birds	Mammals	Amphibians	Reptiles	Overall
Acorns	18 (9%)	25 (25%)	0	0	43 (11%)
Riparian	120 (59%)	33 (33%)	25 (63%)	14 (31%)	192 (49%)
Coarse woody debris	29 (14%)	50 (50%)	31 (78%)	36 (80%)	146 (37%)
Snags	76 (37%)	45 (45%)	3 (8%)	0	124 (32%)
Cavities	58 (28%)	35 (35%)	3 (8%)	0	96 (25%)
Shrubs	176 (86%)	93 (92%)	23 (58%)	37 (82%)	329 (84%)
Large trees (not considered a habitat element by CWHR)					

Wildlife Diversity at Exurban Development Sites Ranchettes

California's population is increasing at the rate of four million people per decade, and is projected to approach 50 million by 2050. Much of the burgeoning population is being absorbed into California's signature landscape—oak woodland. Again, not unlike with most research on anthropogenic effects on terrestrial vertebrates, birds are most studied. Response of birds to urbanization is species specific. Because there is less canopy cover, few large dead trees, and more ground cover, the canopy foraging birds are often replaced by ground foragers. At one end of the spectrum are the mockingbird and scrub jay, species that are favored by development. Orange-crowned warbler and lark sparrow, for example, disassociate with houses. Other species, such as Bewick's wren, occur as long as preferred habitat, shrub habitat in the case of wrens, is present locally. Overall bird diversity, but not of natives, is greater at intermediate levels of development (e.g., large lots and ranchettes) apparently due to the occurrence of birds that exploit exotic vegetation plus those that exploit native vegetation. The trick is to keep as much native vegetation as possible at the exurban, or ranchette, developments.

# # #

Using Soil Moisture Monitoring to Manage the Timing and Amount of Irrigation Water Application on Irrigated Pasture

Information Sources

Soil Moisture Monitoring: A Simple Method to Improve Alfalfa and Pasture Irrigation Management. S. Orloff, B. Hansen, and D. Putnam.
http://alfalfa.ucdavis.edu/SUBPAGES/Irrigation/IrrigationBrochure.pdf

Irrigated Pasture Production in the Central Valley of California. B. Reed, L. Forero.
http://anrcatalog.ucdavis.edu/product/21628.aspx

California Irrigation Management Information System, CIMIS. CA Dept. Water Resources.
http://wwwcimis.water.ca.gov/cimis/welcome.jsp

Goal

Proper application of irrigation water to irrigated pasture is critical in order to maintain pasture plant vigor and composition, optimize forage yield, conserve water, and reduce tailwater and pollutants lost from the pasture. Basing irrigation decisions upon direct, real-time measurements of plant available soil moisture is the first start in achieving proper irrigation.

Soil Moisture Tension

This term refers to how strongly the soil is holding soil water – the greater the tension, the more difficult it is for plants to extract soil water for growth. A low tension reading occurs when the soil is moist, and a high tension reading occurs when the soil is dry. At some point, the soil becomes so dry the plants cannot extract water from the soil. This dynamic process between plants and soil varies between soil types and plant species, so each pasture will have unique needs for timing and amount of irrigation.

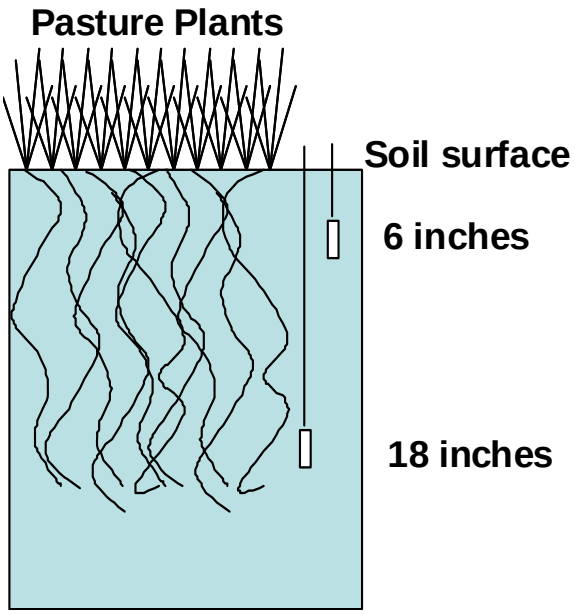
Irrigation Scheduling With Soil Moisture Sensors

Electrical Resistance Blocks

Resistance blocks are one tool to measure soil moisture tension. The blocks, or probes, are installed in the soil profile, and absorb/release water as the surrounding soil wets and dries. As the probes dry, they are less able to conduct electricity. Soil moisture tension is estimated by a meter which runs electricity through the block and measures resistance. The units of measurement are reported in *bars* or *centibars*. Saturated, or near saturated soils will give readings of 5 to 10 centibars (.05 to .10 bars). Sensor readings increase as water is lost from soil by crop uptake and evaporation.

Installing Resistance Blocks to Monitor Soil Moisture Conditions

A monitoring site should be established in a representative portion of the pasture of interest. The site should represent type soil, plant and irrigation characteristic of most of the pasture. If the pasture is very diverse, more than one monitoring site might be needed. Generally, one site is sufficient. For soils typical of the northern Sierra Nevada foothills, resistance blocks should be installed at ~6 and ~18 inches. Six inches commonly represents the upper 25% of the pasture rooting zone. Eighteen inches is commonly near the bottom of the rooting zone.



Irrigation Based on Resistance Block Reading

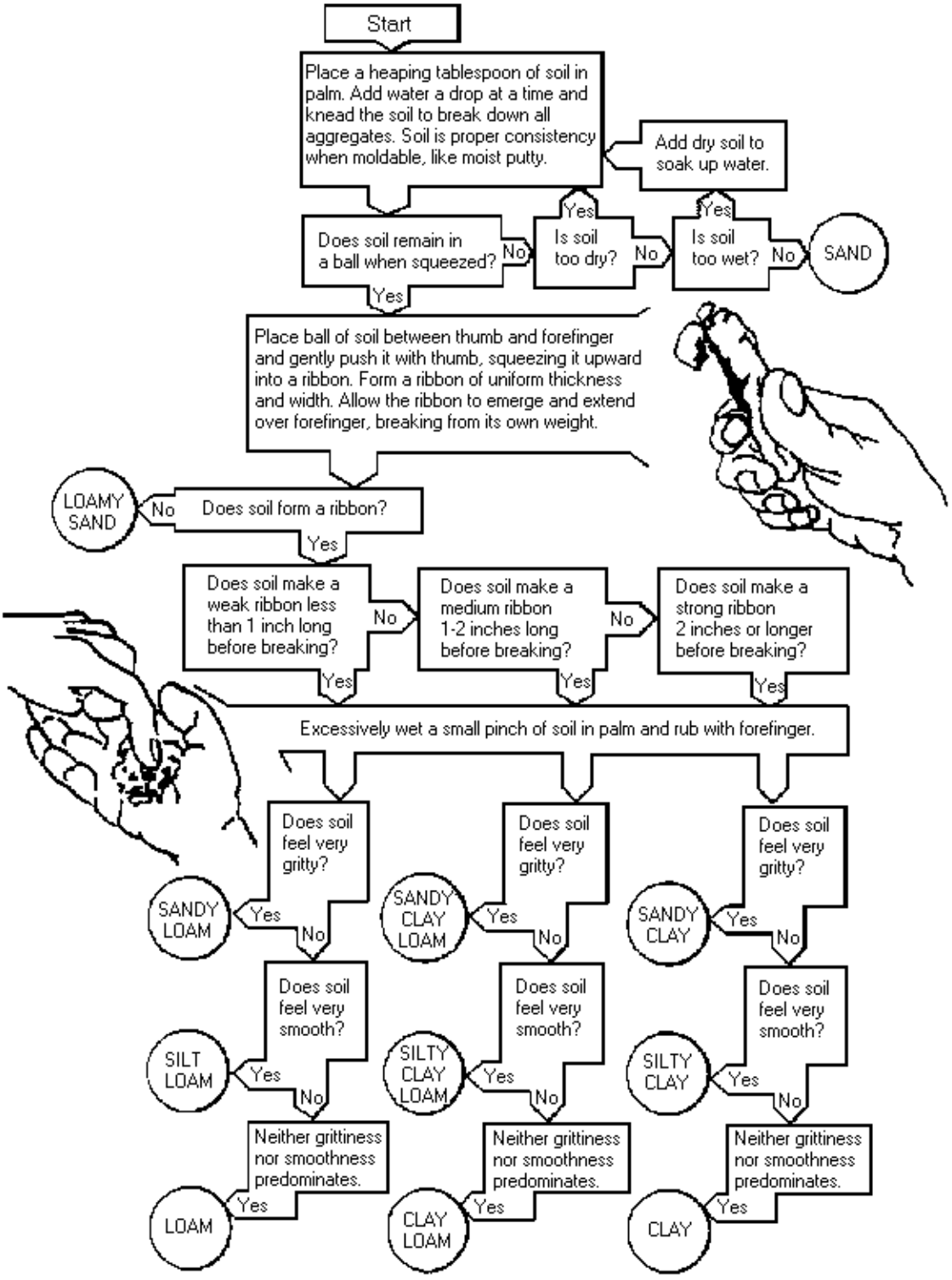
Basic soil and crop information as well as research conducted on irrigated pasture and alfalfa fields in northern California provide a starting point for identifying when to irrigate pasture. The table below reports recommended resistance block readings at 6 inches at which to irrigate, for different soil textures. These values are based upon 50% depletion of available soil moisture for the different soils. These values are a starting point. These values should be fine tuned based upon observations of plant status in the field. In terms of amount of irrigation water to apply, ideally adequate water will be applied to achieve the desired soil levels at the 18 inch depth. For example, in a clay loam, enough water would be applied to maintain readings between 90 and 120 centibars at 18 inches. Sensors can also be placed at soil depths (below the root zone) to understand how much irrigation is too much in order to avoid water loss by deep percolation.

	Resistance Block Reading	
Soil Texture	**Centibars**	**Bars**
Sand/Loamy Sand	40-50	0.4-0.5
Sandy Loam	50-70	0.5-0.7
Loam/Silt Loam/Silty Clay Loam/Sandy Clay Loam	60-90	0.6-0.9
Clay Loam/Sandy Clay/Clay/Silty Clay	90-120	0.9-1.2

How to Determine Soil Texture by Feel

Soil texture is the relative proportions of sand, silt, and clay in soil as described by textural classes. Each textural class represents ranges in particle sizes that require similar management consideration. Soil texture can be estimated using the “feel method”. The figure below outlines this process. It is based on the principle that sand feels gritty, silt feels smooth or buttery, and clay is sticky and malleable.

Soil Texture Flowchart



Supplemental Information

The amount of plant available water depends on soil textural class. Loams, Silt Loams, Clay Loams and Silty Clay Loams have the highest plant available water holding capacity (see figure below), and can be irrigated less frequently compared to sands and sandy loams. Clays require more frequent short-duration irrigations compared to loams. This is necessary because Clays rapidly become saturated, preventing oxygen uptake by roots.