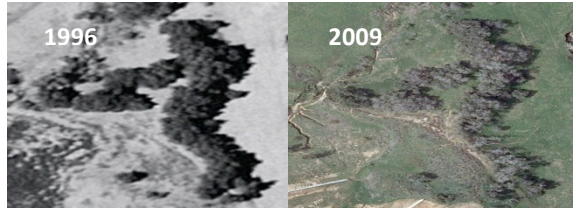




Oak Die-off

The unfortunate outcome has been a higher rate of oak mortality than the woodlands can sustain. Human impacts, coupled with 6 years of low rainfall led to a large die-off of oaks in Cienega Canyon starting in 2003.



Healthy trees in 1996 are dead or dying 2009

We All Get Old

Mature oaks live long enough to alter their surrounding environment, reducing the harsh effects of summer drought and winter frost. They shade the ground and modify the temperature below their canopies. They drop large numbers of leaves, building a layer of organic duff/ground cover, and add structure to soil with their roots.



To reach maturity, young oaks must grow faster than they accrue damage from injuries and diseases. But years of damage by wildfire, drought, insects, wildlife, and domestic animals eventually weaken oaks. In the past, large oaks at this stage of life would decline for decades, slowly creating opportunities for younger replacements. Because of man-made problems and multi-year droughts, declining oaks can die much faster than they are replaced.

Oak Regeneration is an Uncommon Event

One advantage of long lifespan is that oaks don't have to produce many new trees to maintain a woodland. In fact, woodlands in southern California often get a pulse of saplings during El Niño winters, and don't produce saplings in a normal year's rainfall. Ideal conditions for acorn development occur when a wet El Niño winter is followed by warm, dry spring. The best pulses of sapling growth also seem to occur with more than one heavier-than-average winter of rainfall. Even then, most acorns and seedlings are eaten before they ever become saplings and most saplings die from years of shading or insufficient water/nutrients. But there are always enough saplings at the right spot when resources become available, in part because mature oaks produce hundreds of thousands of acorns over their lifetimes. Eventually all oaks reach an age or point of decline where they no longer produce crops of acorns (called mast or masting) so a stand of older trees may not be able to replace themselves when a mortality event occurs.

So What Can Be Done?

We can help the natural process of oak regeneration in a number of different ways. Oaks trees come from seedlings and new seedlings come from germinated acorns. But it takes just the right conditions to get a new seedling started: (1) lots of acorns have to be produced because a high proportion are eaten by mammals, birds, and insects, or attacked by disease; (2) surviving acorns have to end up at a safe site in the ground to germinate, (3) acorns have to maintain enough internal moisture to germinate and then find enough soil moisture to survive, and finally (4) they have to grow past a number of herbivores to finally join the woodland canopy. So today we're going to nudge the process along by increasing the number of acorns in a declining woodland, moving them into the ground before they lose too much moisture, and giving them slightly better conditions to germinate and grow.



Oak leaf litter, oak duff, and mineral soil



Acorns Notes

Why Plant Acorns?

Oaks trees in our region live for 100 to 250 years, and can produce thousands of acorns in a single year. Some species have survived for over 40 million years, so why do they need our help?

Human Impacts

Human activities have changed Cienega Canyon woodlands: first, the structure of the woodlands has shifted into older-aged oak trees because larger trees can survive cattle grazing better than saplings and seedlings. Second, we've changed the hydrology, soil/substrates, and vegetation of the Cienega Canyon watershed; and third, there's been a worldwide increase in the movement of plant materials, including their pests and pathogens. The result is older, more susceptible trees living in an altered environment with a slow but constant introduction of new threats.

Oaks Pack the Acorn for Root Growth

Coast Live Oak need 6 to 8 months to produce an acorn, primarily because it takes that long for the tree to fill and acorn with all the material a new seedling needs. What sets acorns apart from other seeds is the amount carbohydrate they carry for root development. Acorns germinate in the fall, when rainfall starts to saturate the ground. Seedlings have to develop a good root system before the rains stop in April, but don't produce any shoots and leaves above ground until February or March. So all the energy for root growth must be provided by storage rather than photosynthesis – and this is why acorns have to be so large. When an acorn germinates, a single root (called a radical) splits the tip of the acorn (away from the cap). Radicals follow gravity, and develop for 4 to 6 months before a seedling breaks ground. If roots encounter no obstacles, they can grow over 6 feet into the ground to reach reliable sources of water.



An oak seedling tap root removed from the soil in February

What Oak Species to Plant?

There are over 28 varieties of oaks in southern California, from small shrubs to 80 ft tall trees. But the coast live oak (*Quercus agrifolia*) is most common and emblematic of California's cultural heritage. It's one of three red oaks (subgenus *Lobatae*) in our region. You may also observe shrub-form oaks (interior live oak - *Q. wislizeni*) and hybrids between coast and interior live oak, but these aren't attacked by as many pathogens and insects and don't need our help.



Left: coast live oak **Center:** intermediate hybrid **Right:** interior live oak

So What Makes a Good Acorn?

Given the odds against seedling survival, it's not easy to define the best acorns but it is possible to describe a bad one. Here are some key features to separate the good from the bad acorns:

- **ON THE TREE:** Acorns on the ground are often older and have less internal moisture than acorns on that are still on the tree. Acorns on the tree are ready when they easily twist out of their caps.
- **COLOR:** Note that ashen gray-brown acorns are probably too old (dry) to germinate.
- **NO SMALL BROWN SPOTS** on the side of the acorn as this is a sign that a weevil has laid an egg in the acorn. By the time it germinates, the weevil will have eaten about 40% of the carbohydrates.
- **NO DARK SYRUP** on the cap and side of acorn. This is a sign of drippy-nut disease and the acorn won't germinate or grow.
- **NO MOLDS** or **FUNGUS** on the cap or at the top of the acorn, and no dark blotches of discoloration. These will interfere with root growth.
- **NO SPLITS** or mechanical damage to outside of the acorn. These can lead to too much water loss.

The Float Test



Photo: Dr. Doug McCreary
U.C. Berkeley

Did you know that if acorns float they aren't any good for planting? Solid viable acorns with caps removed sink to the bottom while non-viable acorns float to the top. For detailed information describing how to regenerate oaks by UC Natural Resource Specialist Dr. Doug McCreary and other UC Specialists, go to the http://ucanr.org/sites/oak_range/pubList/

Storing Viable Acorns:

After float testing & air drying acorns, store in baggies (no more than 100 per baggie), in the vegetable drawer of your refrigerator. Leave an inch or two of the baggie's seal open to let moisture escape. Acorns can keep for months before planting. Perform another float test at planting time to discard any acorns that lost viability during storage.

Site Selection for Planting Acorns

Choose a sunny spot that has loose, well-drained soil and is fairly free of weeds. Also, avoid areas where there are lots of pocket gopher mounds or ground squirrel activity.

Planting Acorns

Acorns should be planted in the late fall or early winter after a soaking rain or as late as early spring. In Southern California, we frequently don't get our first real soaking rain until December. Plant the acorns ½ to 1 inch deep by digging a hole, laying the acorn on its side and covering it with dirt. Digging the hole a few extra inches deep and then backfilling to obtain the correct planting depth will loosen the soil and improves the acorn's chance of success. In subsequent years you can try replanting areas where the seedlings didn't make it.

Improving Seedling Survival

A critical factor affecting young oak seedling survival is competing vegetation. Adjacent plants, especially grasses, can use up so much of the available soil moisture that little is left for the seedlings. It is therefore recommended that a 2-3 foot radius circle around the planting spots be cleared of other vegetation. Another way of reducing weeds near seedlings is to place some type of mulch around the planting spots. Bark chips, straw, compost, mulching paper, or even black plastic can be used. Mulches have an added benefit in that they also help conserve moisture by reducing evaporation from the soil surface. In areas where water is accessible, several deep irrigations (2 gallons per seedling) during the late spring and early summer can also help ensure that the seedlings are not damaged by drought. Using a tree shelter greatly enhances a seedling's chance of survival (examples: Tubex; Tree-pee; Tree Sentry) preventing them from being browsed by animals.

Find more information on oaks at:

http://ucanr.org/sites/oak_range/pubList/

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