

History of Ground Squirrel Control in California

California has a long history of controlling ground squirrels as they have been a major agricultural pest.

Early History

- Ground squirrels were mentioned as early as 1579 when Sir Francis Drake visited California, noting their abundance
- Native Americans used ground squirrels for food and clothing
- The first recorded organized squirrel control campaign occurred in Santa Barbara in 1808
- Throughout the early 1800s, missions reported problems with squirrels damaging crops

Legal Approaches

- Early legal approaches included a bounty system for over 50 years in mid to late 1800s. Bounty laws provided for assessments on taxable property to fund payments for killed squirrels
- In the late 1800s county ordinances established inspector systems.
- After bubonic plague was discovered in ground squirrels in 1908, the U.S. Public Health Service launched extensive control campaigns
- In 1917, County Commissioners were given authority over ground squirrel control.
- Statewide "Squirrel Week" campaign in 1918 was organized to encourage public participation.
- In the 1970's the focus shifted towards conservation. The Mohave ground squirrel was listed as rare in 1971. The California ground squirrels habitats overlaps making identification crucial before implementing control. CA ground squirrel burrows are also used by other endangered or protected species like the San Joaquin kit fox, burrowingowls, some kangaroo rats, and CA Tiger Salamander.
 - Western gopher snakes and Pacific rattlesnakes occupy squirrel burrows, both being predators of the squirrels
- The California Ecosystems Protection Act of 2023 placed a moratorium on first-generation anticoagulants. The Poison Free Wildlife Act, January 2025 expands prohibitions on the use of rodenticides.



Early Control Methods

- Early methods included drowning, trapping, shooting, and using dogs
 - Position Bait. Poison formulas, primarily using strychnine, were developed and refined over time
 - Fumigation. Carbon disulphide became a popular fumigant after being introduced by Professor E.W. Hilgard (UC Berkeley) in 1878
 - Various mechanical devices for delivering fumigants were invented and improved over time

- Early research supported Integrated Pest Management
 Scientists used captive ground squirrels to study their behavior, hibernation patterns, and responses to different poisons and control methods. For example, researchers studied "the phenomena of hibernation" by keeping squirrels in a small cellar where they could be "examined from day to day, weighed and photographed at the will of the observer without even being disturbed from their repose."

Results supported control strategies including

- Using less poison bait by targeting squirrels when they were gathering and carrying grain in their cheek pouches
- Using different control methods based on seasonal diet varies
- Timing control efforts based on squirrel hibernation and breeding patterns

Trap Placement

- During winter, traps can be set in the open
- Bait traps in the morning before squirrels began to feed
- In summer, place traps in shaded areas such as under rocks, trees, bushes, or “cow pies”
- Place traps strategically, near burrow mounds. Squirrels may be shy of traps encountered while foraging.
- Protect traps from the sun by covering with strips of wood, bark, or cow chips
- In summer, bait traps in the early morning and late afternoon to coincide with the squirrels' two daily foraging periods

Extent of Rodenticide Use

	Tons of Treated Bait (annual average)			Treated Acres	
	Anti-coagulant	Compound 1080	Zinc Phosphide	Net	Gross
1950-1977	277	216	129	1.7 m	5.7 m

Diet of the California Ground Squirrel

Main Food Sources

The majority of their diet consists of a few key species:

- Filaree (most important year-round food source)
- Acorns (major food source in summer and fall)
- Tarweed (important for succulence during dry seasons)
- Eriogonum (buckwheat)
- Popcorn flower
- Grass seeds especially, Ripgut grass seeds

- Other species, Foxtail (green grass and seed heads), wild oats, burr clover (especially the seeds), Elderberry (Sambucus) seeds, Turkey mullein (Eremocarpus) seeds, Manzanita berries (Arctostaphylos), Wild hyacinth bulbs (Brodiaea hyacinthine), Mallow (Malva) seeds, Dandelion roots, starthistle leaves

Diet Selectivity

- Squirrels are highly selective, choosing nutritious foods with high protein and mineral content--63 different plant species have been recorded as being eaten
- Plant parts consumed included leaves, flowers, seeds, fruits/berries, stems, and whole plants
- Preferred green vegetation over dry plant material
- Competition with livestock occurred mainly in winter/spring when both consumed the same green vegetation

Ground squirrels occasionally consume animal matter, including insects (particularly grasshoppers), bird eggs, small mammals (young rabbits, pocket gophers), reptiles, and even scavenge on dead squirrels.

Seasonal Diet Patterns

- **Winter/Early Spring:** Primarily consumes green leafy vegetation, especially filaree rosettes, popcorn flower leaves, and new grass growth
- **Spring:** Shifts to flowers and seed material, including filaree seeds, ground lupine pods, and various flower heads
- **Summer/Fall:** Acorns become dominant (up to 83% of diet by fall), along with tarweed seeds, ripgut grass seeds, and other dry seed materials

Food Storage and Consumption

- Squirrels cache acorns extensively in shallow holes, especially in October
- They can fill their cheek pouches with 350-500 kernels of grain for storage
- A single squirrel consumes approximately 70 grams of green vegetation daily or 22.5 grams of dry grain

Evidence of Successful Eradication

The U.S. Biological Survey reported successfully treating entire national forests, with some areas being completely cleared of squirrels. By 1918, they had treated approximately 827,715 acres across various California counties and national forests.

Forest rangers reported "a noticeable increase in the carrying capacity of the range, estimated at from 15 per cent to 25 per cent" in areas where squirrel control had been implemented.

Permanent eradication required persistent follow-up efforts due to the squirrels' high reproductive rate and ability to quickly reinfest areas from surrounding populations. Even after achieving 90% effectiveness in an eradication campaign, without follow-up work, the population could return to normal levels within two years.

Ways People have tried to Use Ground Squirrels

As Food

Ground squirrels were an important food source for Native Americans. As noted in the document, "The people eat their bodies, and make great account of their skins." This tradition continued into later periods:

In the 1870s, Chinese laborers developed a taste for ground squirrels, particularly roasted young squirrels which became "quite a delicacy among the Chinese of San Francisco." Some considered squirrels to be similar to "grain-fed hog" in terms of food quality, and young squirrels were sought after for their tenderness. High-end restaurants in San Francisco even served what were essentially squirrel "frog legs" as a delicacy.

Recipes for "squirrel fricasse" were shared during 1873, and squirrels were marketed in San Francisco and Oakland as food for many years until bubonic plague was discovered in them in 1908.

For Clothing and Materials

Indigenous people used ground squirrel skins for clothing.

In 1877, an entrepreneurial person had "fifty squirrel skins tanned, made into gloves, and pressed into service." These were examined by glove manufacturers, and while they gave "exceptional satisfaction and good service to the wearer," commercial production wasn't feasible due to the small size of the skins requiring excessive piecing work.

There were also suggestions that tail hairs might serve as substitutes for "camel's-hair or badger-bristle brushes," though this doesn't appear to have been commercialized.

Ground Squirrel Behavior: Foraging, Burrowing, and Burrow Use

Foraging Behavior

The California Ground Squirrel exhibits distinct foraging patterns:

- They are strictly diurnal (active during daylight), appearing about an hour after sunrise and retreating before sunset They avoid the intense heat of midday, being most active during mid-morning and late afternoon
- When foraging, they travel along regular routes, creating visible trails 2½ to 3 inches wide through grasslands
- Rather than eating food where found, they typically stuff items into their cheek pouches and carry them to safer locations near burrow entrances
- Their diet shows seasonal variation:
 - In spring, they feed heavily on green vegetation, particularly alfalfa, foxtail, and bur clover
 - As vegetation dries, they shift to seeds and grains
 - They store seeds in underground chambers for later use
- They can carry impressive quantities in their cheek pouches - records show up to 1,520 kernels of wheat and 1,834 kernels of barley in individual squirrels
- A ground squirrel consumes approximately two ounces of green forage or half an ounce of dry grain per day

Burrowing Behavior

Ground squirrels create complex burrow systems:

- Burrows are not randomly dug but form organized systems with specific patterns and functions
- The document describes three primary burrow types:
 1. Male burrows: Relatively short, shallow, and simple
 2. Female breeding burrows: More complex with multiple chambers and "blind alleys"
 3. Colonial burrows: Extensive networks with multiple entrances (sometimes 6-20), used by multiple squirrels as "safety zones"
- Burrow dimensions vary significantly: length from 5 to 138 feet (average 35.2 feet), diameter around 4.3 inches, and a volumetric air content of 1.0 to 17.8 cubic feet
- Nests are carefully constructed inside chambers slightly above the main tunnel for drainage, using finely shredded grass blades and stems
- Burrows include designated waste chambers for feces, located away from nest areas