

# An integrated approach to managing burrowing rodents

Roger A. Baldwin

UCCE Wildlife Specialist-UC Davis



**UC DAVIS**

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**COLLEGE OF AGRICULTURAL  
AND ENVIRONMENTAL SCIENCES**

# Species Identification (Ground Squirrels)

- Gray-brown fur with semi-bushy tail.
- Are social.
- Damage includes girdling of vines and trees, chewing of irrigation lines, and abundant burrow openings.





# Species Identification (Ground Squirrels)

- Squirrels are active throughout the day and are frequently visible.
- They prefer to burrow next to buildings, on field edges, and alongside fencerows and roadsides.





# Species Identification (Pocket Gophers)

- Burrowing rodent about 6-8 in long; rarely seen above ground.
- Gopher mounds are plugged and often fan-shaped.





# Species Identification (Pocket Gophers)

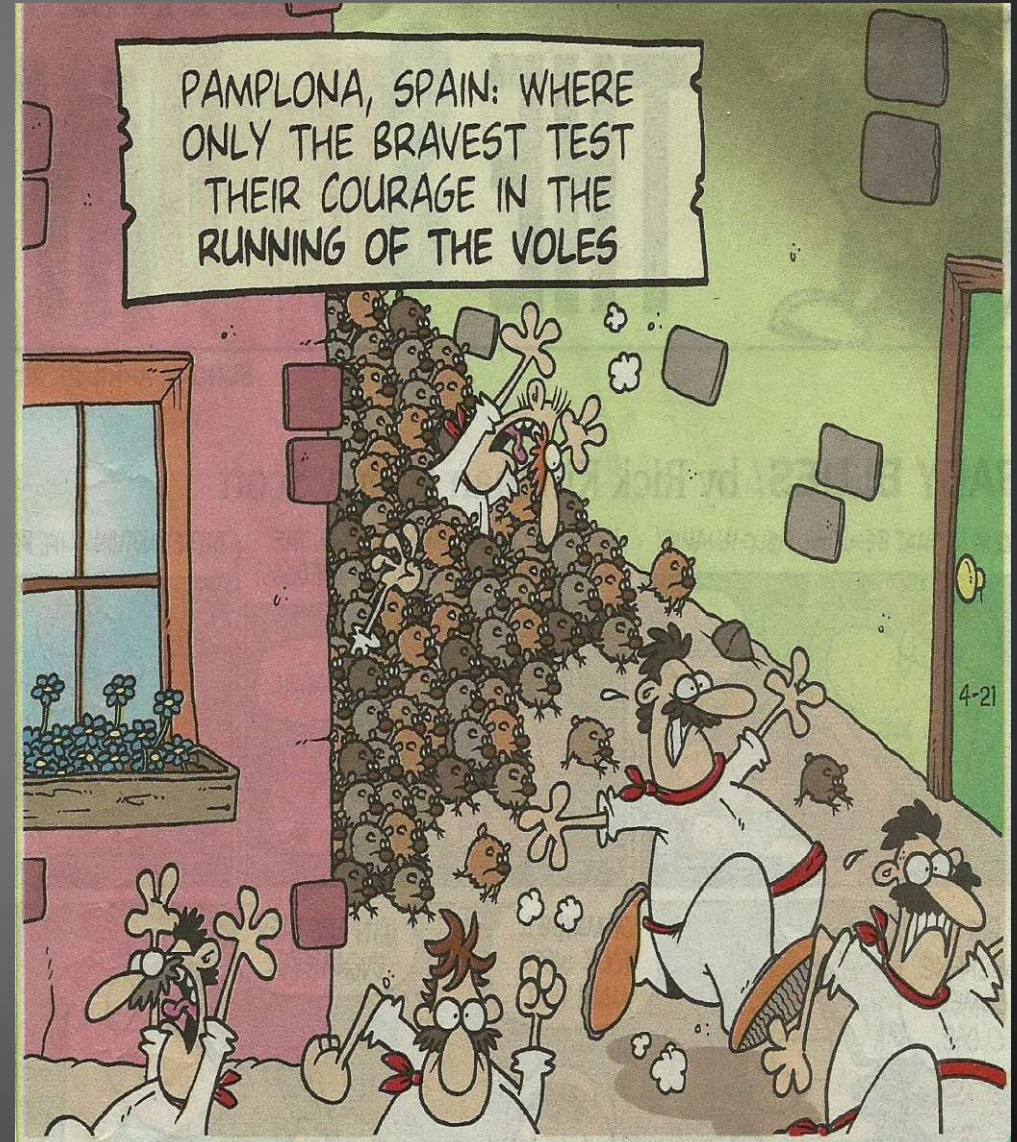
- They feed on taproots weakening and/or killing plants.
- Then can girdle trees and vines below ground.
- Mounds can also kill plants, can create weed seed-beds, and can increase erosion.





# Species Identification (Meadow Voles)

- Have dark grayish brown fur and are 4-6 inches in length.
- Populations tend to cycle, exhibiting irruptive growth patterns.





# Species Identification (Meadow Voles)

- Dig shallow burrows and leave well-worn trails. Fecal pellets are often present.
- Primary damage caused by girdling of stems, consumption of vegetation, and gnawing of cables, pipes, etc.





# Species Identification (Roof Rats)





# Species Identification (Roof Rats)





# Current Control Strategies

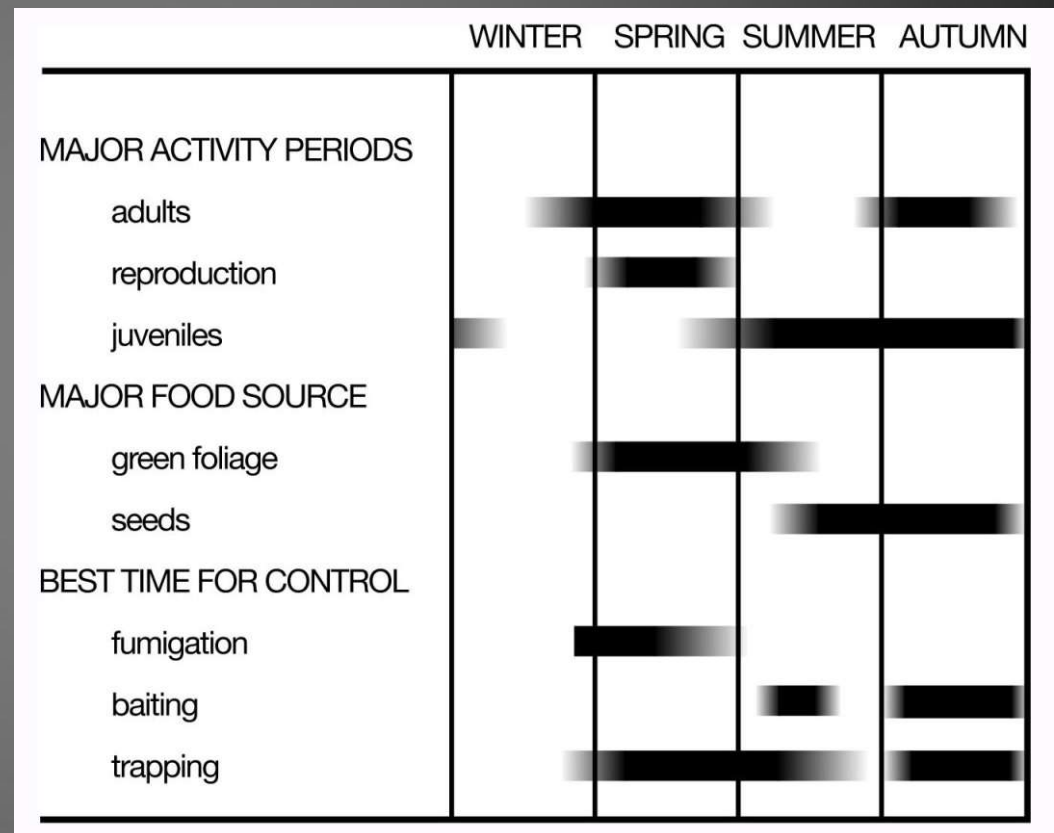
- Currently, we focus on an integrated approach that utilizes a number of strategies and tools to control vertebrate pests.





# Importance of Biology/Ecology

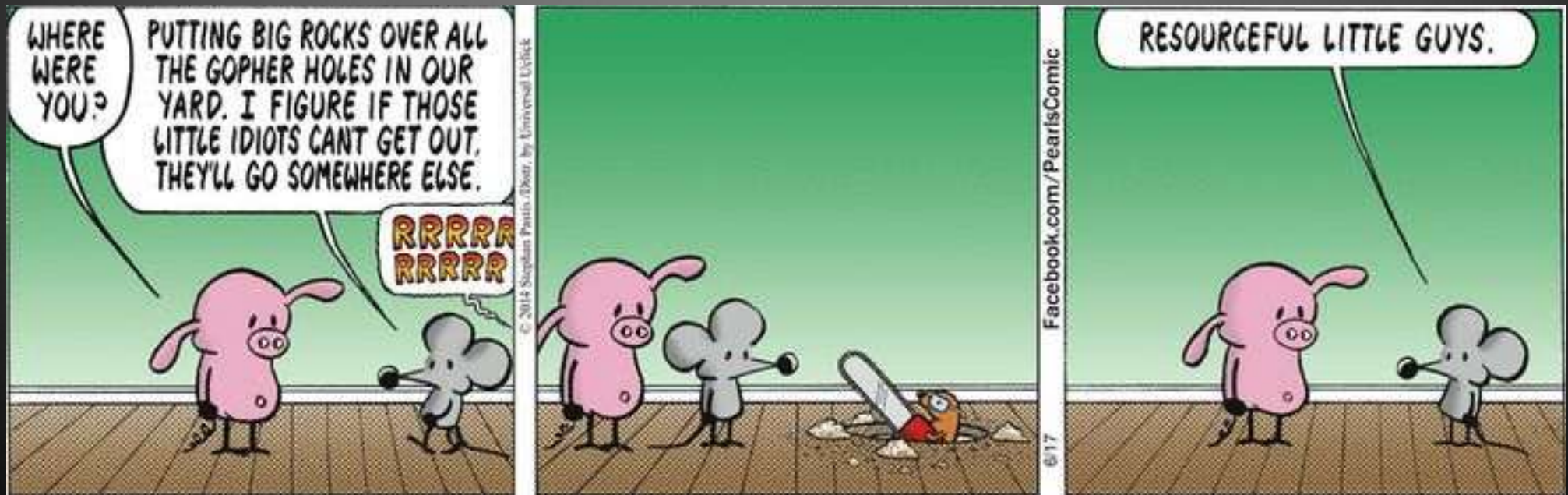
- Understanding the biology and ecology of vertebrate pests will guide management decisions.
- Example:
  - ground squirrels





# What Control Options are Available?

	Habitat modification	Baiting	Burrow fumigation	Trapping	Exclusion	Repellent	Frightening	Shooting
Ground squirrel	X	X	X	X				X
Pocket gopher	X	X	X	X		?		
Vole	X	X		?	X			
Roof rat	X	X	X	X				





# Control Options—Biocontrol

- Natural predators have been used to control vertebrate pests.





# Control Options—Biocontrol

- Natural predators have been used to control vertebrate pests.
- Owl boxes have shown some success for gophers; raptor perches appear ineffective for ground squirrels.





# Control Options—Habitat Modification

- Involves altering habitat to reduce the desirability for pests.
- Examples:
  - destroy old burrows





# Control Options—Habitat Modification

- Involves altering habitat to reduce the desirability for pests.
- Examples:
  - destroy old burrows
  - remove or reduce cover for voles





# Control Options—Exclusion

## Voles

- Tree protectors can eliminate damage caused by voles





# Control Options—Trapping

## Ground squirrels

- Body-gripping traps, tube traps, and box-type squeeze traps are common kill traps.





# Control Options—Trapping

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- Wire cage traps are common live traps.
- Live traps require euthanizing target animals.





# Control Options—Trapping

## Ground squirrels

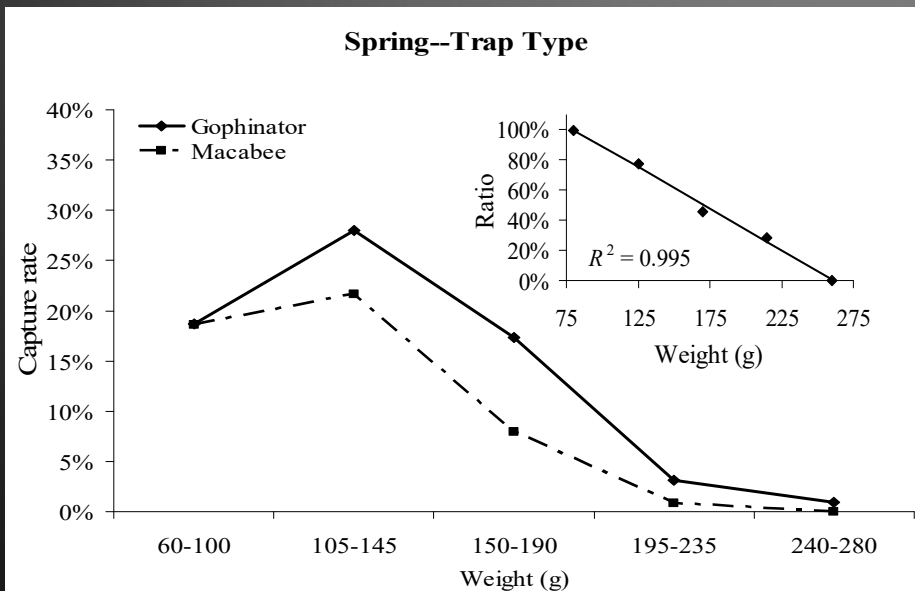
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# Control Options—Trapping

## Pocket gophers

- Gophinator trap was more effective.
- Covered sets yielded slightly higher capture rates in spring-summer, but not autumn.
- Efficacy was offset by setting time.
- We did not observe a difference in the number of captures across attractants.
- Human scent had no effect.

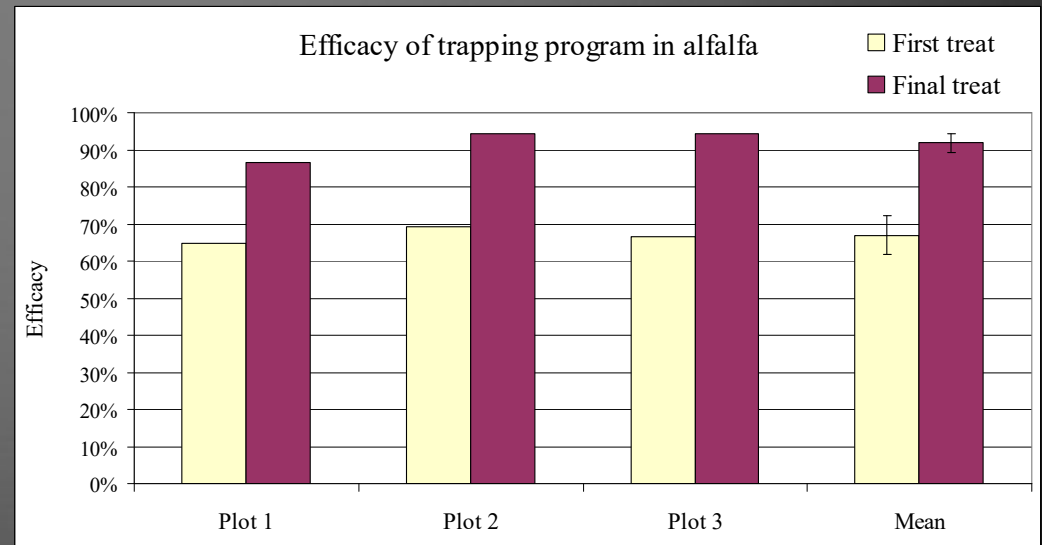
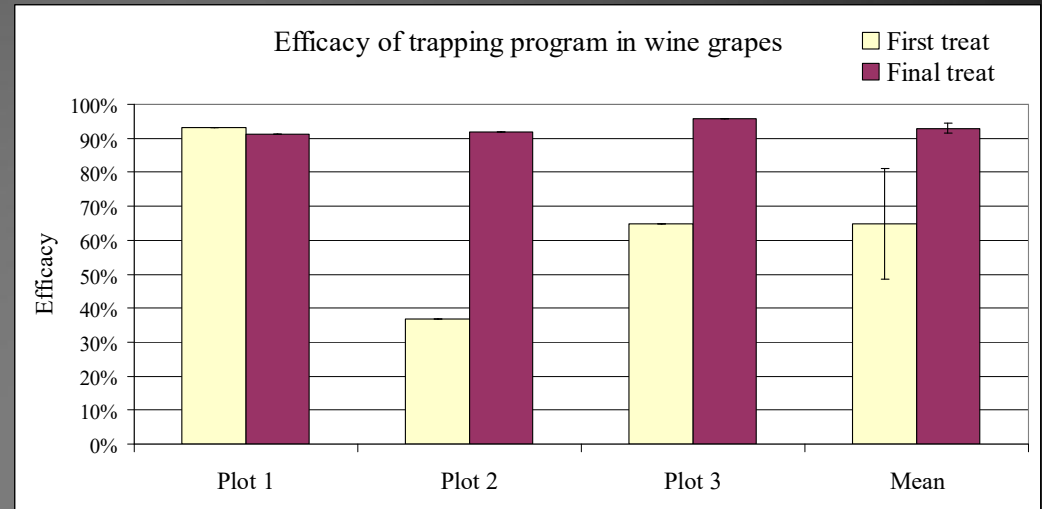




# Control Options—Trapping

## Pocket gophers

- Exhibited high efficacy in wine grapes after two treatments.
- Exhibited high efficacy in alfalfa after two treatments.



# Control Options—Trapping

## Roof rats

- Snap traps and live traps can be effective.





# Control Options—Trapping

## Roof rats

- Snap traps and live traps can be effective.



# Control Options—Baiting

- Involves use of poison baits to control vertebrate pests.
- Essentially all restricted-use products except for a few homeowner options for gophers and rats.

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	Anticoagulant	Zinc phosphide	Strychnine	Bromethalin	Cholecalciferol
Ground squirrel	?	X			
Pocket gopher	?	X	X		
Vole	?	X			
Roof rat	?	X		?	?

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# Control Options—Baiting

## G. squirrel/vole: Anticoagulants

- used for spot treatments, broadcast, or in bait stations
- require multiple feedings





# Control Options—Baiting

## G. squirrel/vole: Zinc phosphide

- is an acute toxin.
- potential bait shyness.
- can be used for spot treatments and broadcast baiting.
- not to be used in or around buildings.





# Control Options—Baiting

## Roof rat

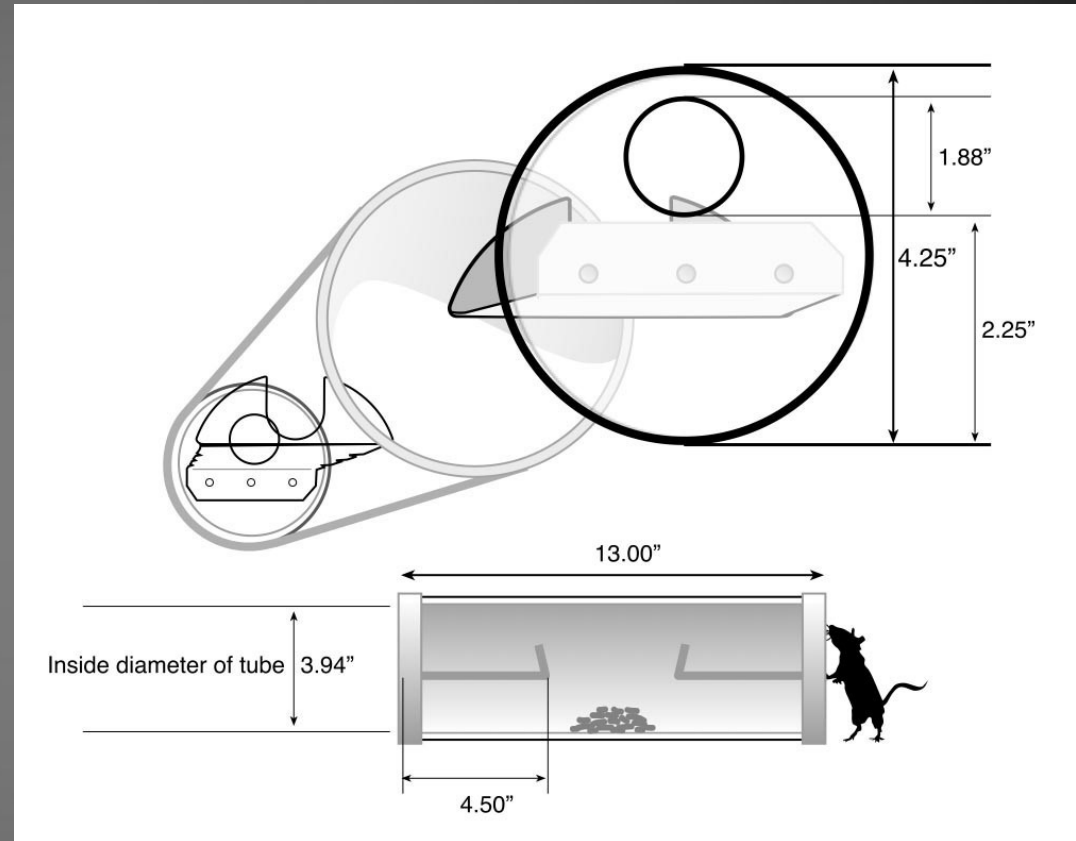
- Study showed 0.005% diphacinone grain effective against roof rats in almonds(90%) and citrus (73%).
- Must be used in elevated bait station.



# Control Options—Baiting

## Roof rat

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# Control Options—Baiting

## Pocket gophers

- Strychnine works best.
- Use probe to find tunnel.
- Dispense bait in tunnel.



# Control Options—Fumigation

- Involves use of poison gas in burrows to control vertebrate pests.
- Works best when soil moisture is high (late winter early spring for gophers and after ground squirrels emerge in spring).
- Fumigants should not be used around buildings.





# Control Options—Fumigation

## Gas cartridges

- Effective for ground squirrels (62–86% control).
- Not effective for gophers.
- Caution must be used to prevent fires.



## Aluminum phosphide

- Highly effective for both ground squirrels (97-100%) and gophers (90-100%).
- Is a restricted use pesticide.



# New Fumigation Category

## Non-Soil Fumigation (Category M)

### Category Description

#### Non-Soil Fumigation (Category M)

- 1) Perform pest control using a pesticide labeled as a fumigant to:
  - a. Fumigate enclosed areas including: tarpaulin-covered structures and commodities, vaults, chambers, greenhouses, vans, boxcars, ships, planes, and vehicles, containing:
    - i. Agricultural commodities for post-harvest fumigation; or
    - ii. Nonfood/nonfeed materials including but not limited to: pallets; dunnage; furniture; burlap bags; planting medium, including potting soil and potting mix; and wine barrels and corks.
  - b. Fumigate pest burrows in sites including, but not limited to: fields, rights-of-way, ditches, landscaping, and equipment yards.
  - c. Fumigate sewer lines, in-service utility poles, or other fumigations not covered by Category L – Soil Fumigation [6530(l)].
- 2) This category does not include structural pest control required to be licensed under Chapter 14 (commencing with Section 8500) of Division 3 of the Business and Professions Code.

PAC's will need to complete a 45-question test called, "Burrowing Vertebrate Fumigation Category".



# Control Options—Fumigation



# Control Options—Fumigation

Species	Device	Authors	# of fields	Efficacy
Pocket gopher	PERC	Orloff	3	56%
Pocket gopher	PERC	Baldwin & Orloff	3	62%
Pocket gopher	PERC	Baldwin & Orloff	2	68%
Belding's GS	PERC	Orloff	2	76%
California GS	PERC	Baldwin	2	66%
California GS	PERC	Baldwin	2	100%
California GS	Cheetah	Baldwin	3	-7%



# Control Options—Fumigation

## Carbon dioxide

- The Eliminator by IGI, LLC recently approved for use.





# Ground Squirrel BMP website

<http://www.groundsquirrelbmp.com>



Biography Identification Management Regulations Resources FAQs Search

## Ground squirrel management for California



Adult CA ground squirrel in an agricultural field

### What are BMPs?

**Best Management Practices (BMPs)** are the most efficient, cost effective, and environmentally-friendly management methods that can achieve successful ground squirrel management

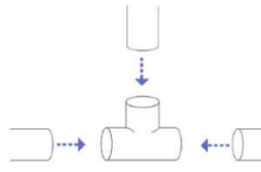
### What is IPM?

**Integrated Pest Management (IPM)** is a multi-faceted, long-term approach to pest management that minimizes risks to people and the environment



### Timing and Efficacy

Compare management methods for:  
California Ground Squirrel  
Belding's Ground Squirrel



### Step-by-Step Guides

Visual how-to's for:  
Bait Station Construction  
Calculating CO2 Flow  
Spreader Calibration



### Protecting Wildlife

Avoid harm to non-target wildlife:  
Range Maps for Endangered Species  
Range Maps for Non-Pest Ground Squirrels  
Legislation and Best Baiting Practices



# Vertebrate Pest Control Handbook

<http://vpcrac.org/about/vertebrate-pest-handbook/>

The screenshot displays the homepage of the Vertebrate Pest Control Handbook online. The website has a blue header with navigation links: Home, Research, Submissions, Calendar, About, and Contact. Below the header, there is a search bar and a main content area. The main content area is titled "The Vertebrate Pest Control Handbook online" and lists various resources. On the right side, there is a sidebar with links to About, Committee, VPCRCAC History, Surcharge Legislation, Vertebrate Pest Handbook, and Links.

**The Vertebrate Pest Control Handbook online**

**Current CDFA Rodenticide Labels:**

- CDFA Anticoagulant Labels - Chlorophacinone
  - [Rodent Bait Chlorophacinone Treated Artichoke Bracts \(0.01%\)](#)
  - [Rodent Bait Chlorophacinone Treated Grain \(0.01%\)](#)
  - [Rodent Bait Chlorophacinone Treated Grain \(0.005%\)](#)
- CDFA Anticoagulant Labels - Diphacinone
  - [Rodent Bait Diphacinone Treated Grain \(0.01%\)](#)
  - [Rodent Bait Diphacinone Treated Grain \(0.005%\)](#)
  - [Rodent Bait Diphacinone Bait Block \(0.005%\)](#)
- CDFA Zinc Phosphide Labels
  - [Rodent Bait Zinc Phosphide Treated Grain \(2.0%\)](#)

[Chapter 1 Laws and Regulations \(Revised\)](#)

[Chapter 2 Toxicants and Fumigants](#)

[Chapter 3 The Role of Wildlife in Spreading Diseases \(Revised\)](#)

[Chapter 4 Mammals, Introduction and Baiting Guidelines Part 1](#)

- [Bats](#)
- [Chipmunks](#)
- [Cotton Rat](#)
- [Coyote](#)
- [Deer Mice \(Revised\)](#)
- [Chapter 4 Mammals Part 2](#)
- [Golden Mantled Ground Squirrel](#)
- [California Ground Squirrel](#)
- [Pocket Gophers \(Revised\)](#)
- [House Mice](#)
- [Chapter 4 Mammals Part 3](#)
- [Kangaroo Rats](#)
- [Marmot](#)
- [Meadow Voles \(Revised\)](#)
- [Moles](#)
- [Muskrat](#)
- [Norway Rat](#)
- [Chapter 4 Mammals Part 4](#)
- [Opossum](#)
- [Porcupine](#)
- [Rabbits \(black tailed/jack cotton brush\) \(Revised\)](#)
- [Roof Rat](#)

**About**

- [Committee](#)
- [VPCRCAC History](#)
- [Surcharge Legislation](#)
- [Vertebrate Pest Handbook](#)
- [Links](#)



A photograph of a squirrel sitting on the ground next to a white pipe. The squirrel is facing left, holding its paws near its mouth. A speech bubble with the text "Thank you!" is positioned above the squirrel. The background shows dry grass and a large rock.

**Thank you!**