California Ground Squirrel Integrated Management

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Squirrel Management

- Some biology
- Management tactics
- Integrating high and low pest density management tactics

Identification

Identification

Fur-bearing Mammal

Non-game Mammal

Some Biology

- Occur throughout most of California
- Thrive in disturbed habitats
- They are omnivores; will store food in burrows
- 6-20 entrances, 35 feet of tunnels, multi-family

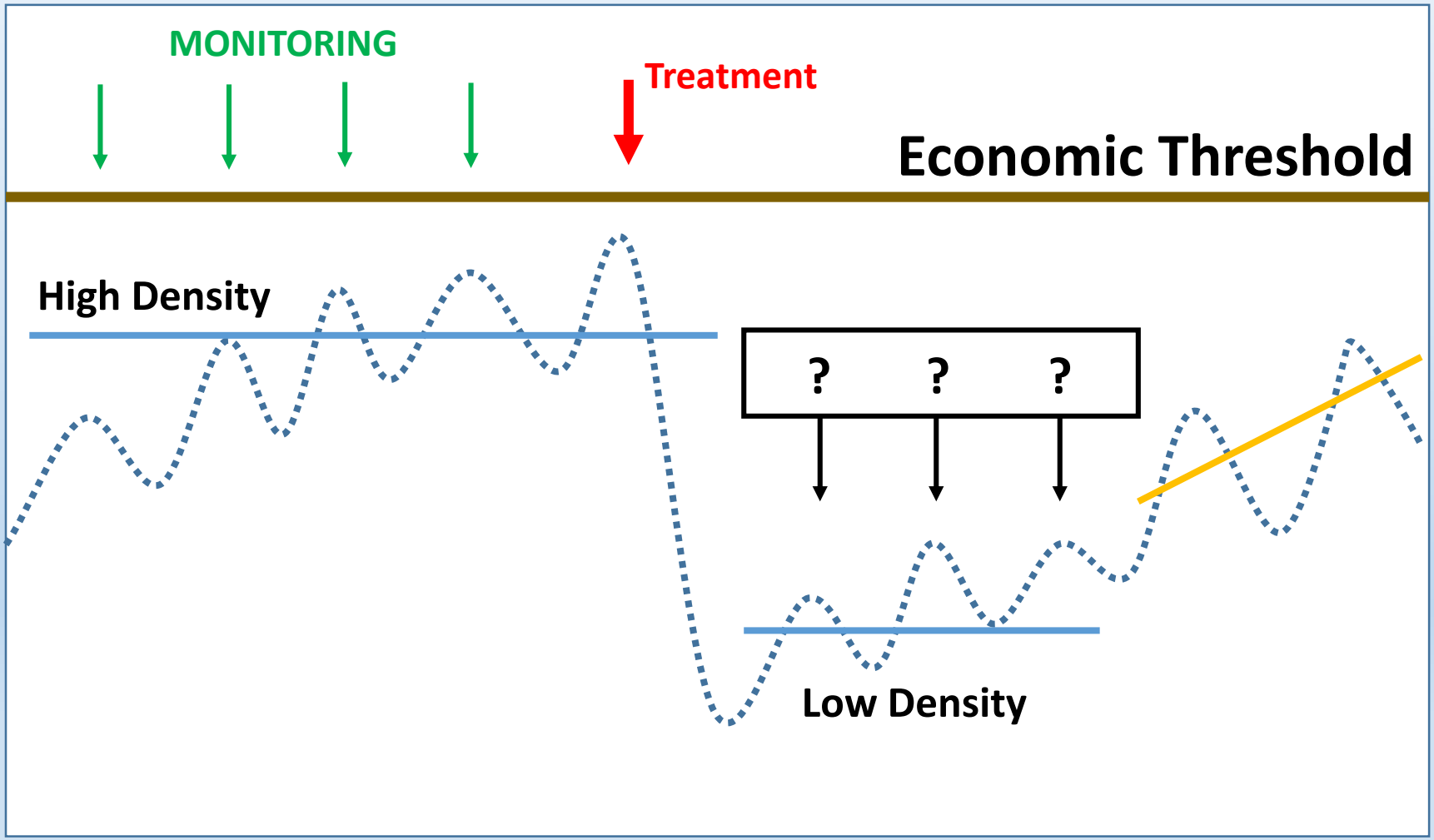
http://www.animaldamagemanagement.com/ground-squirrel-control


https://gopher-trapping.com/img_20161129_125547/

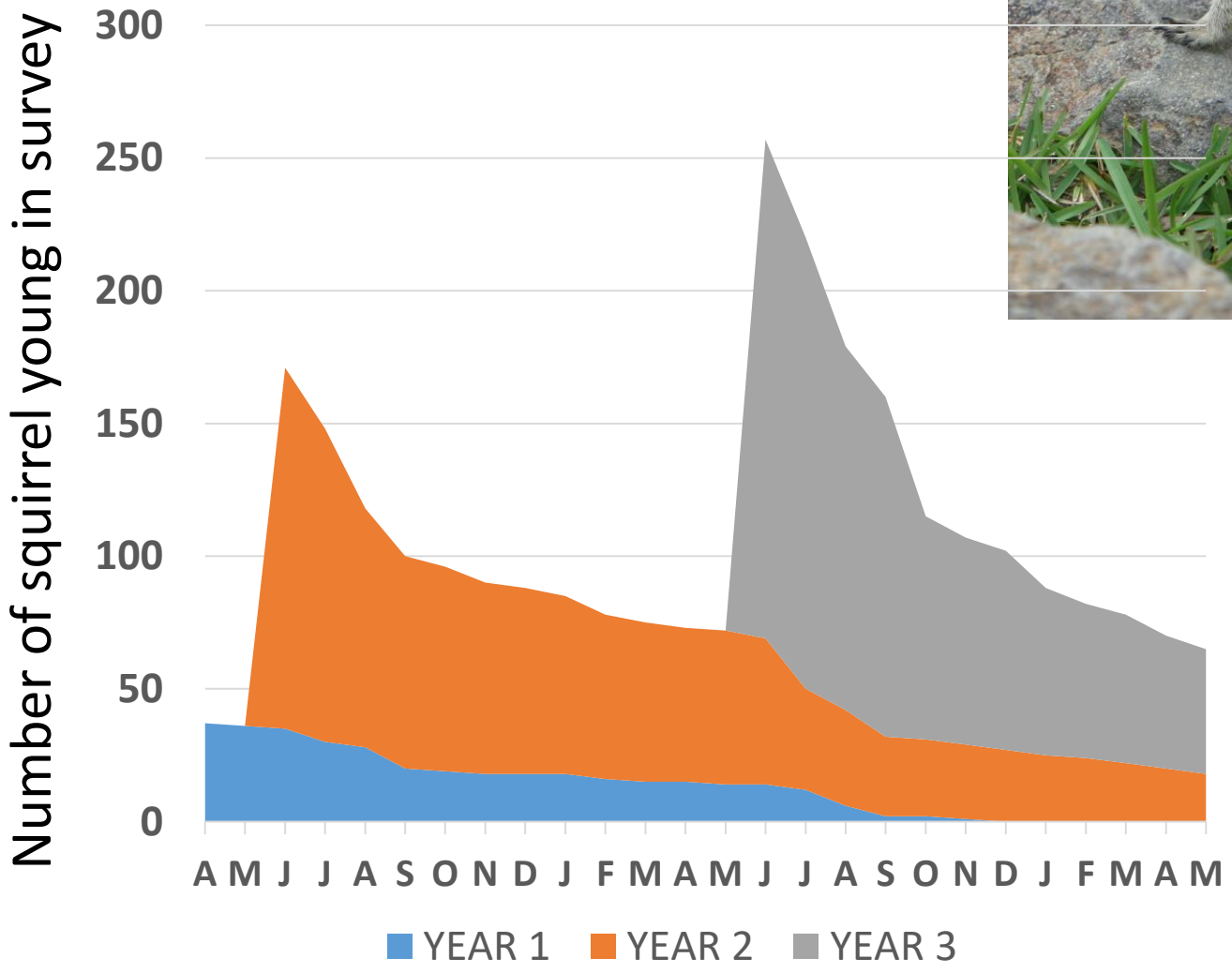
Some Biology

- Mating in early spring
- One litter per year
- 6-8 young per litter
- Sexually mature within a year
- Live for 4-5 years

Population Fluctuations



Annual Squirrel Populations

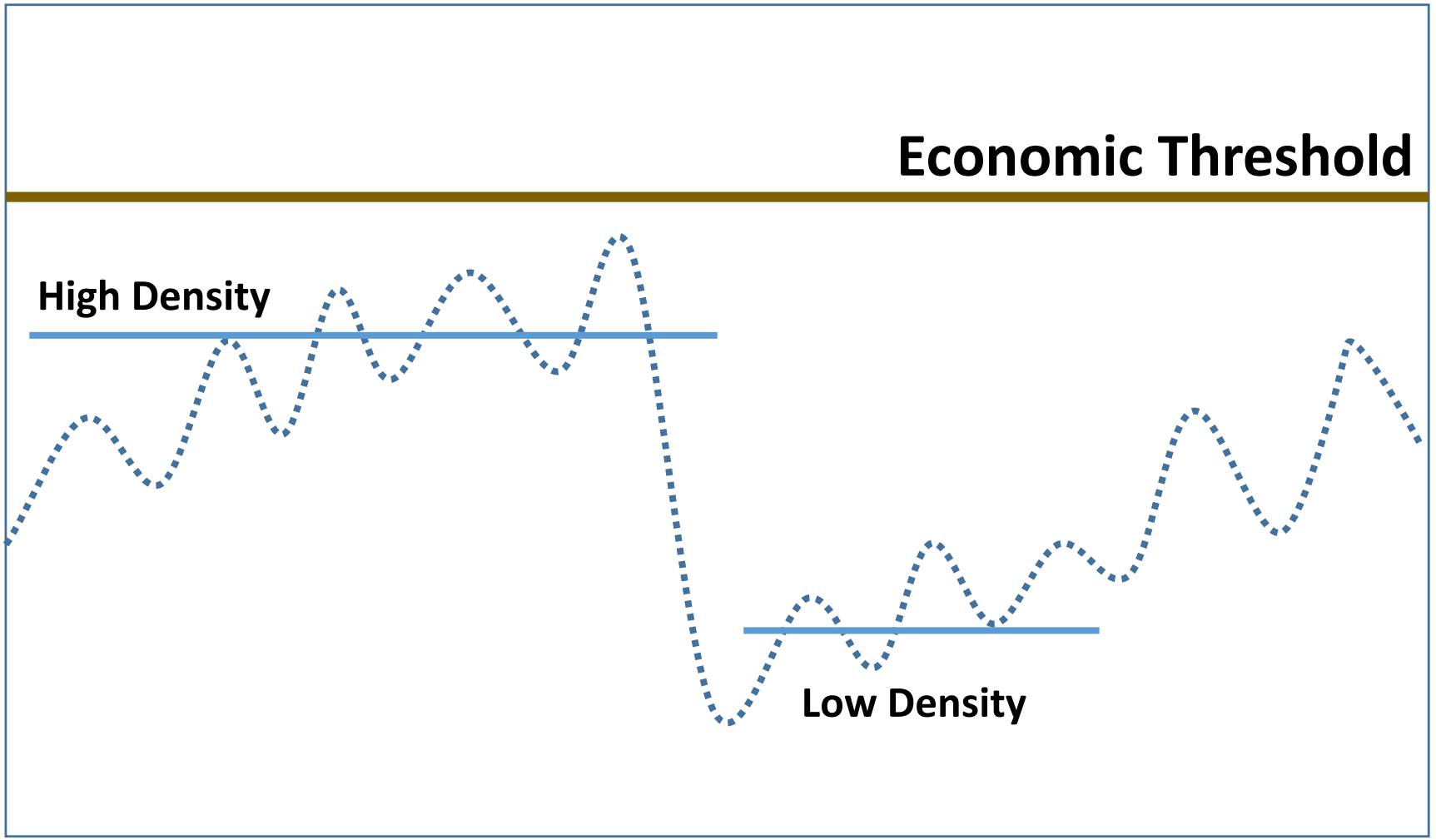


Adapted from F. C. Evans and R. Holdenried 1943. 80 acre field site in Bay Area

IPM

- Integrating management tactics requires categorizing them based on target population levels

- Annual fluctuation versus average population density


Economic Threshold
High Density
Low Density

High Density Tactics

- Work well to reduce large numbers of pests in a short period of time – easy to see results

- Also work well on larger acreage

Low Density Tactics

- Effective when squirrels are harder to find

…either in low numbers or very widespread

IPM

- Compelling need for an integrated approach – any method on its own will be limited in efficacy
- Why? The population numbers are in constant flux
- Key: must have a balance of high and low density tactics – and be able maintain the low density tactics to keep average populations well below economic levels
  - Which is easier and more affordable

- What are the tactics?

Tactics

- Toxins
- Predators
- Burrow destruction / flooding
- Shooting
- Trapping
- Repellants*

Toxins: Baits & Fumigants

- PCQ – diphacinone (**high** density)
  - 1st generation anti-coagulant
  - Broadcast vs stations
  - Must maintain
- Phosphides – zinc (bait) and aluminum (fumigant) (highly toxic) (**high** density)
    - Very effective
- Giant destroyer (OMRI approved) (**low** density)
  - Can work well at high densities – but labor intensive

Toxins

- Comes at a cost –
  - Resistance issues
  - Pest resurgence – the same size problem next year
  - **Environmental**

Environmental

- Secondary poisonings of predators/scavengers
- Yes, urban coyotes, bobcats, vultures, etc have anti-coagulant rodenticides in their tissues from eating poisoned rodents
- But what's the main source?

Toxins: Additional costs…

- Non-targets

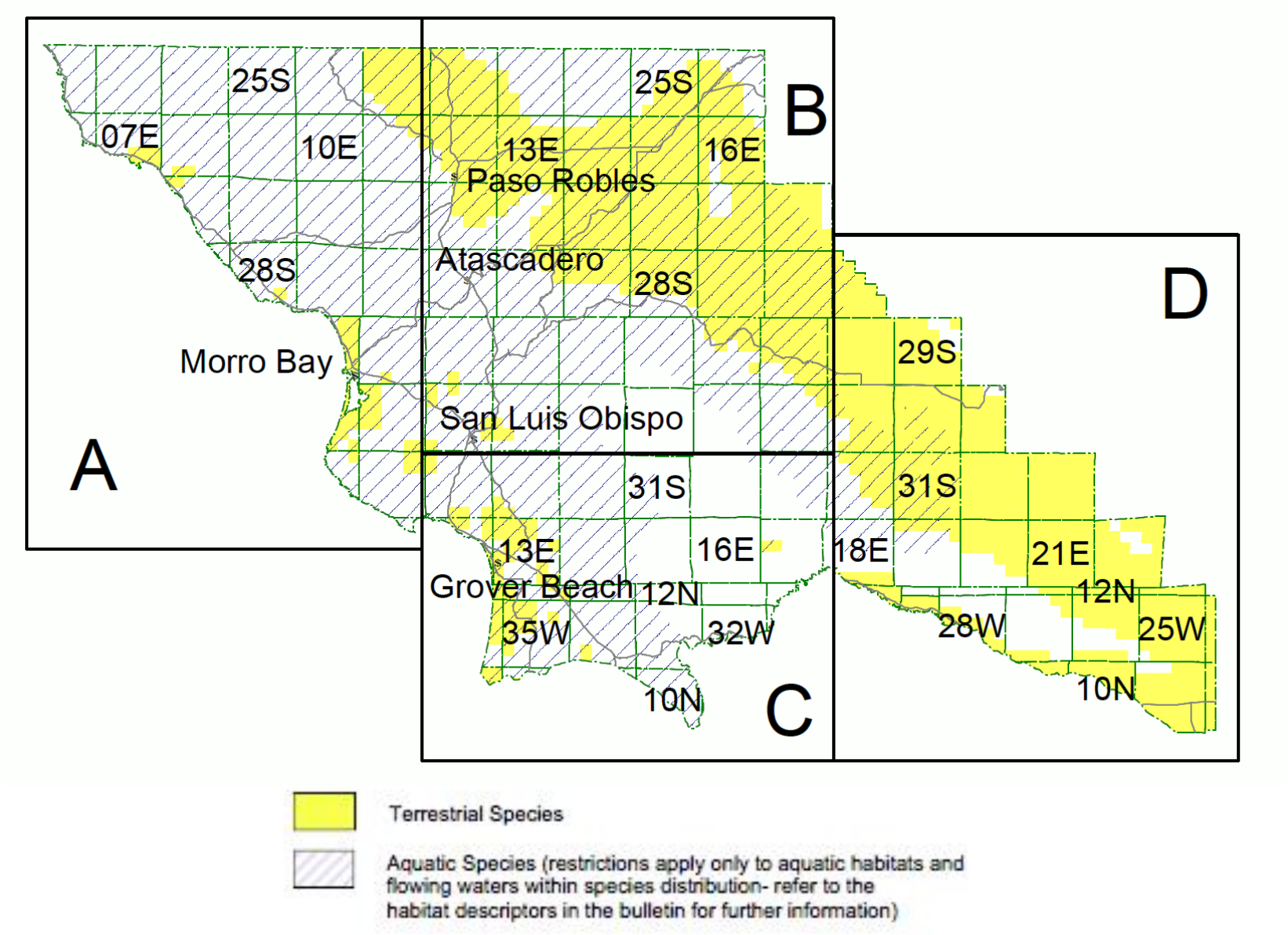
https://www.fisheries.noaa.gov/species/steelhead-trout

Fumigant Management Plan

- Regulatory issues – must submit for each fumigation

- Endangered/threatened species issues
  - In SLO Co all active ingredients have a hazard class listing for one or more listed species

SLO Co. Endangered Species



Non-toxic Alternatives

- Predators (**low** density)
- Burrow destruction /flooding (**high** density)
- Shooting (**high** density)
- Trapping (**low** density)

Key Predators

Predators

They are typically responsible for the spring population drop

- Bobcat mother with 2 kittens can eat 8000 rodents per year
- Coyote – can eat 9-10 rodents per day
- Kestrels – 520 rodents per breeding season

and what about rattlesnakes?

- They encountered 4 prey per day
- Young squirrels were the most common
- Average about one squirrel per day

Putman, et al., Herpetologica 2016, 72:55-63
https://doi.org/10.1655/HERPETOLOGICA-D-15-00045

Predators

- Is it a risk having coyotes, rattlesnakes and bobcats on the property?

- And are you willing/comfortable with that?

Predators: Kestrel boxes

- Location – based on biological needs of the predator, you may get 90% of what they require correct, but that other 10% will make the difference in whether they occupy or not

- Number of boxes – based on available resources: As prey goes down, occupancy goes down

http://nestboxbuilder.com/nestbox-article-spartar

https://www.svtweb.org/nature-sighting-type/nature-sighting?page=94

Burrow destruction

- Rodenator
  - Ineffective for squirrel burrow destruction (too big, too deep)
- Ripping with implements
  - Often impractical due to location

Burrow opening fillers

- Foam crack filler
  - Some good feedback
  - Expensive if you have a lot to do

Burrow flooding

- Large scale flooding significantly reduces and suppresses rodent populations

- Sand slurry fills squirrel burrows
- Water seeps away
- Blocks access for awhile

http://www.burrowblocker.com/

Monitoring for success

- Was the effort worth it?
- Monitoring is the only way to know, however:
  - The number of entrances is not a good indicator of squirrel number

Shooting

- Expensive, time consuming, legal issues

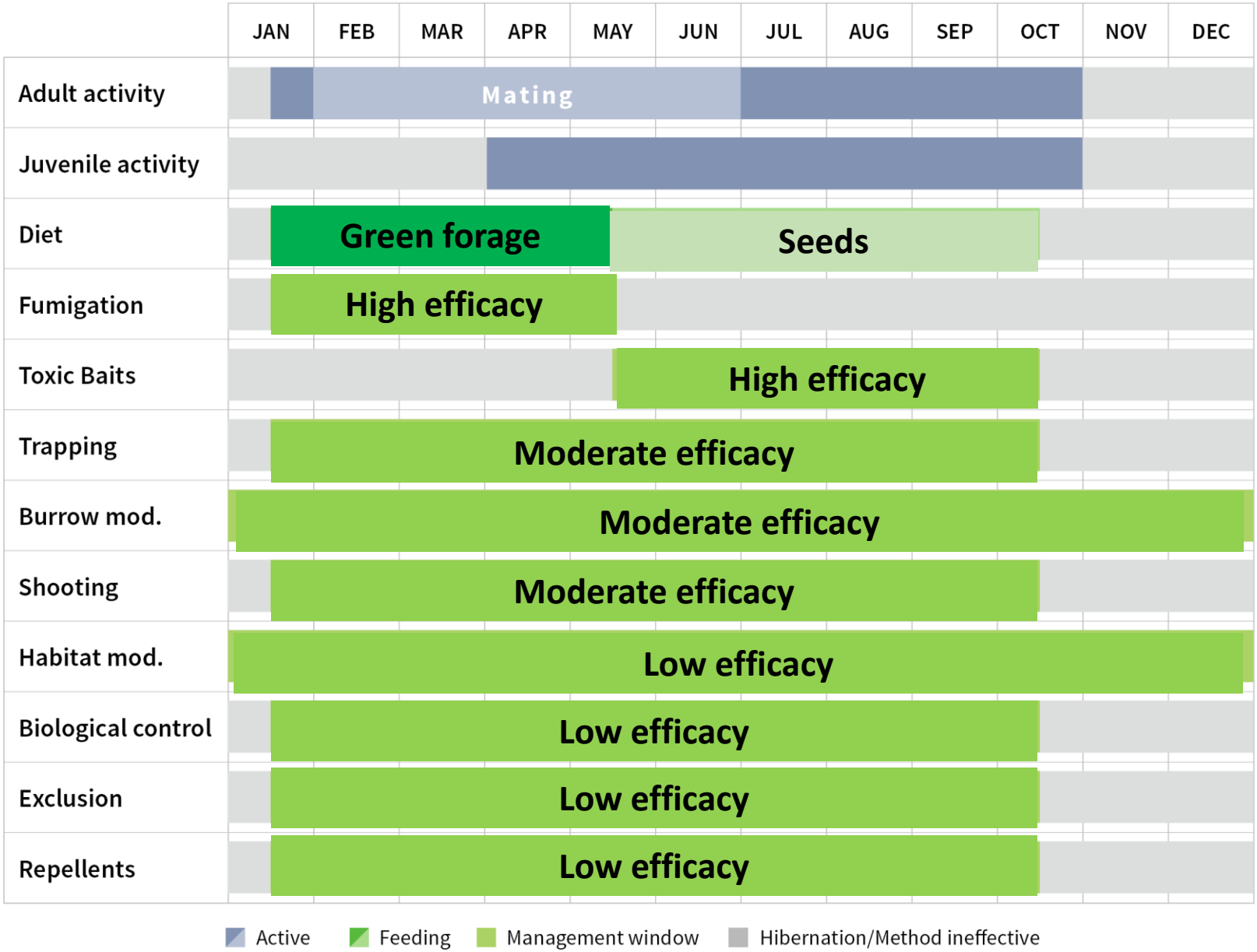
Trapping

- Labor intensive
- Euthanasia

Trapping

- The "150 yard rule" prohibits setting traps within 150 yards of any structure used as a permanent or temporary residence, unless these traps are set by a person who 1) controls the property or 2) possesses and carries with them written permission of the landowner stating that they are allowed to place the traps on the property.

How to Time Management Efforts | California Ground Squirrels



Note: Ground squirrel activity may vary by region. This variance may affect management windows.

UC Online Resources

- Best Management Practices: http://ucanr.edu/sites/Ground_Squirrel_BMP/

- Vertebrate Pest Control Research Advisory Committee:
- http://ttmqr.com/ucce/new_version/start_cs3.swf

- Questions?

Broadcast versus stations

- **Comparison of 0.005% and 0.01% diphacinone and chlorophacinone baits for controlling California ground squirrels (*Spermophilus beecheyi*).** Salmon, et al. 2007. *Wildlife Research* 34(1) 14-18

- We conducted field trials to compare the efficacy of 0.005% and 0.01% chlorophacinone and diphacinone baits in broadcast and spot applications for control of California ground squirrels on rangeland. We found no significant difference in efficacy owing to bait type, concentration or application method. Repeat testing is needed in other habitat types (e.g. crop areas) where alternative foods might reduce the effectiveness of a 0.005% bait application.

Monitoring

- Burrow entrances did not accurately indicate burrow area. Important for fumigant or burrow destruction as the area of treatment cannot be accurately determined based on the number of burrow entrances. Salmon, T. 2001. *Transactions of the Western Section of the Wildlife Society*

Fumigant efficacy

- **Fumigation of California Ground Squirrels Revisited: Are Fumigants an Effective Method for Controlling Ground Squirrels?** *Baldwin and Holtz. 2010. Proc. 24th Vertebr. Pest Conf. UC Davis, pp. 129-132.*

- We found that all fumigation methods resulted in marginal to exceptional control of ground squirrels (percent control: gas cartridges = 62 - 86%, aluminum phosphide = 97 - 100%, gas cartridges + aluminum phosphide = 59 - 71%). We suggest aluminum phosphide use could be expanded to increase ground squirrel control in California, given its high efficacy combined with its relatively cheap material cost.

Flooding

- **DECLINE AND RECOVERY OF SMALL MAMMALS AFTER FLOODING: IMPLICATIONS FOR PEST MANAGEMENT AND FLOODPLAIN COMMUNITY DYNAMICS.** 2011. Golet, et al. River Research and Applications.

- All species except the arboreal western gray squirrel experienced significant population declines following the flood and remained at depressed levels for at least a full year thereafter. Native species were not less susceptible to flooding than exotic species. California vole was the first species to recover. Our study suggests that frequent winter flooding may be desirable from an agricultural pest management perspective.

Environmental

- **Anticoagulant rodenticides in urban bobcats: exposure, risk factors and potential effects based on a 16-year study**. 2015. L. E. K. Serieys, et al. Ecotoxicology (2015) 24:844–862DOI 10.1007/s10646-015-1429-5

- We documented widespread exposure of bobcats to first- and second-generation ARs in two southern California areas. Bobcats are obligate carnivores that consume a wide range of small mammals (Anderson and Lovallo 2003) including mice, rats, and gophers (Fedriani et al. 2000; Riley et al. 2010) that are frequent targets of pest control activities within SMMNRA (Morzillo and Mertig 2011a, b; Morzillo and Schwartz 2011; Bartos et al. 2012) and elsewhere (Morzillo and Mertig 2011b). Given that bobcats are obligate carnivores, it is very unlikely that they consume rodent baits directly. Thus, bobcat exposure to ARs is predominantly, if not entirely, secondary through prey consumption. Exposure rates and compounds detected varied considerably by sample type, but in individuals having blood and liver data (and therefore most comprehensively sampled), we detected an AR exposure rate of 92 % across the study areas, with animals most frequently exposed to three or more compounds. These findings are among the highest reported prevalence rates for AR exposure in a nontarget predatory species (e.g. Shore 2003; Fournier-Chambrillon et al. 2004; Riley et al. 2007; Walker et al. 2008; Gehrt and Riley 2010; Elmeros et al. 2011; Gabriel et al. 2012; Sánchez-Barbudo et al. 2012). Additionally, the combined liver and blood results indicate that exposure prevalence and exposure to certain compounds, specifically diphacinone, may be underestimated with liver samples alone (Fig. 4). We detected exposure to multiple AR compounds in two fetal bobcats, the first such cases, to our knowledge, reported for any wildlife species in a natural population. These data, including individuals caught multiple times more than 4 months apart, indicate multiple exposure events and suggest the potential for chronic exposure to ARs that can begin during prenatal development.