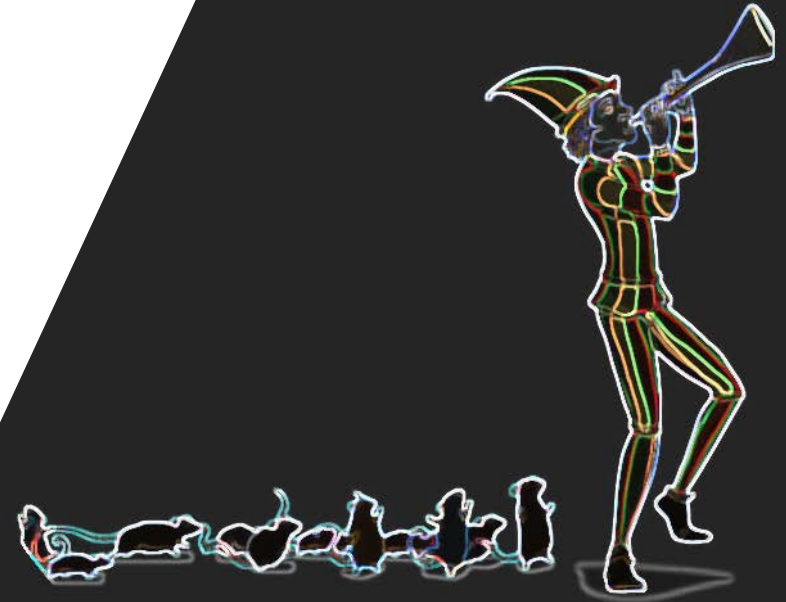


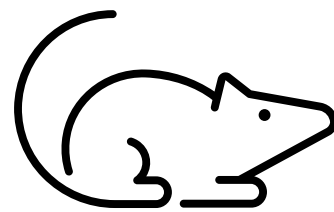
Rats, Rodenticides, and Regulations

Niamh Quinn, PhD

Human-Wildlife Interactions Advisor

University of California





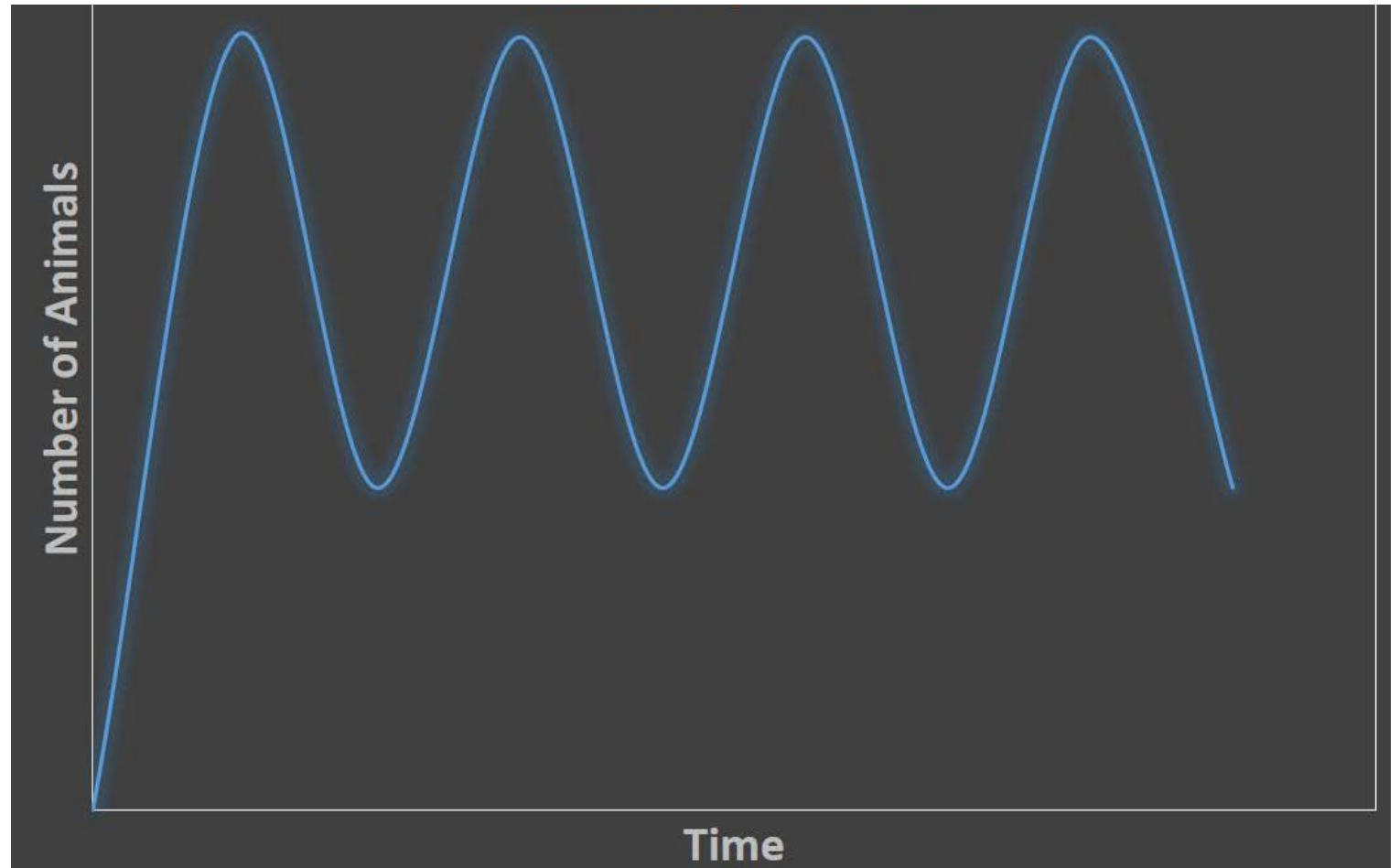
We know more about polar bears than we do about commensal rodents!



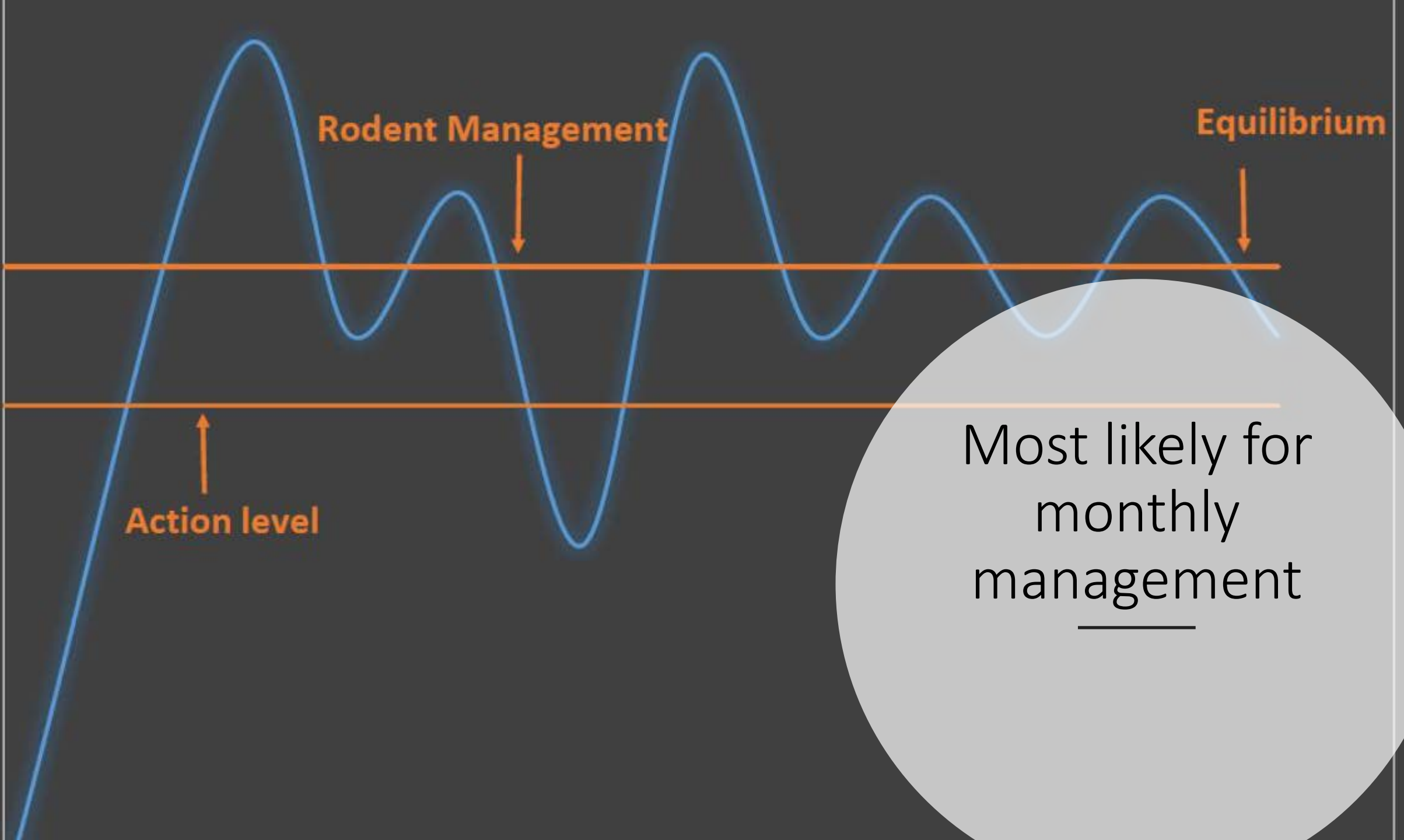
We are relying on an imperfect system to help us manage commensal rodents



Quarterly
Service



Number of Animals



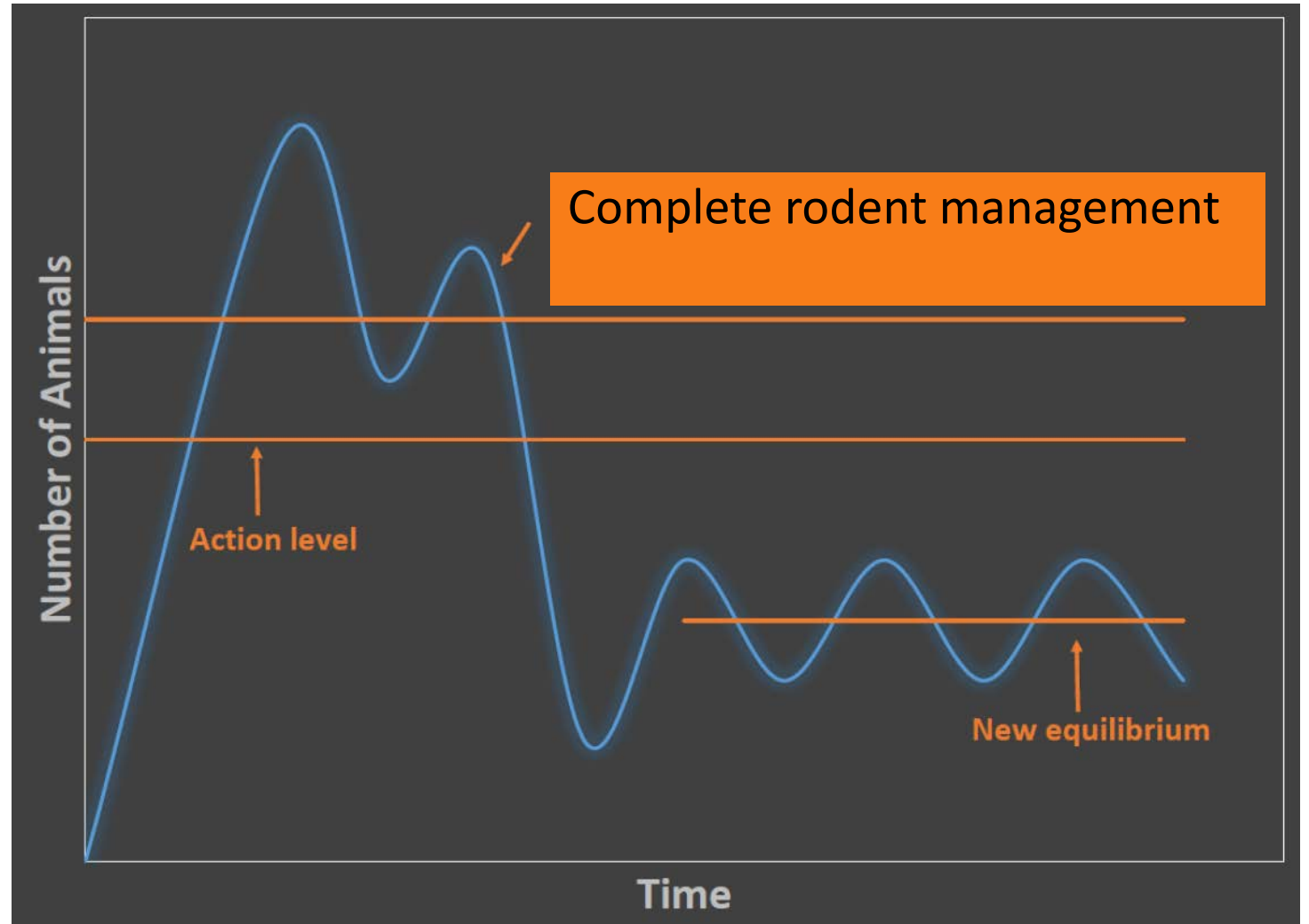
Rodent Management

Equilibrium

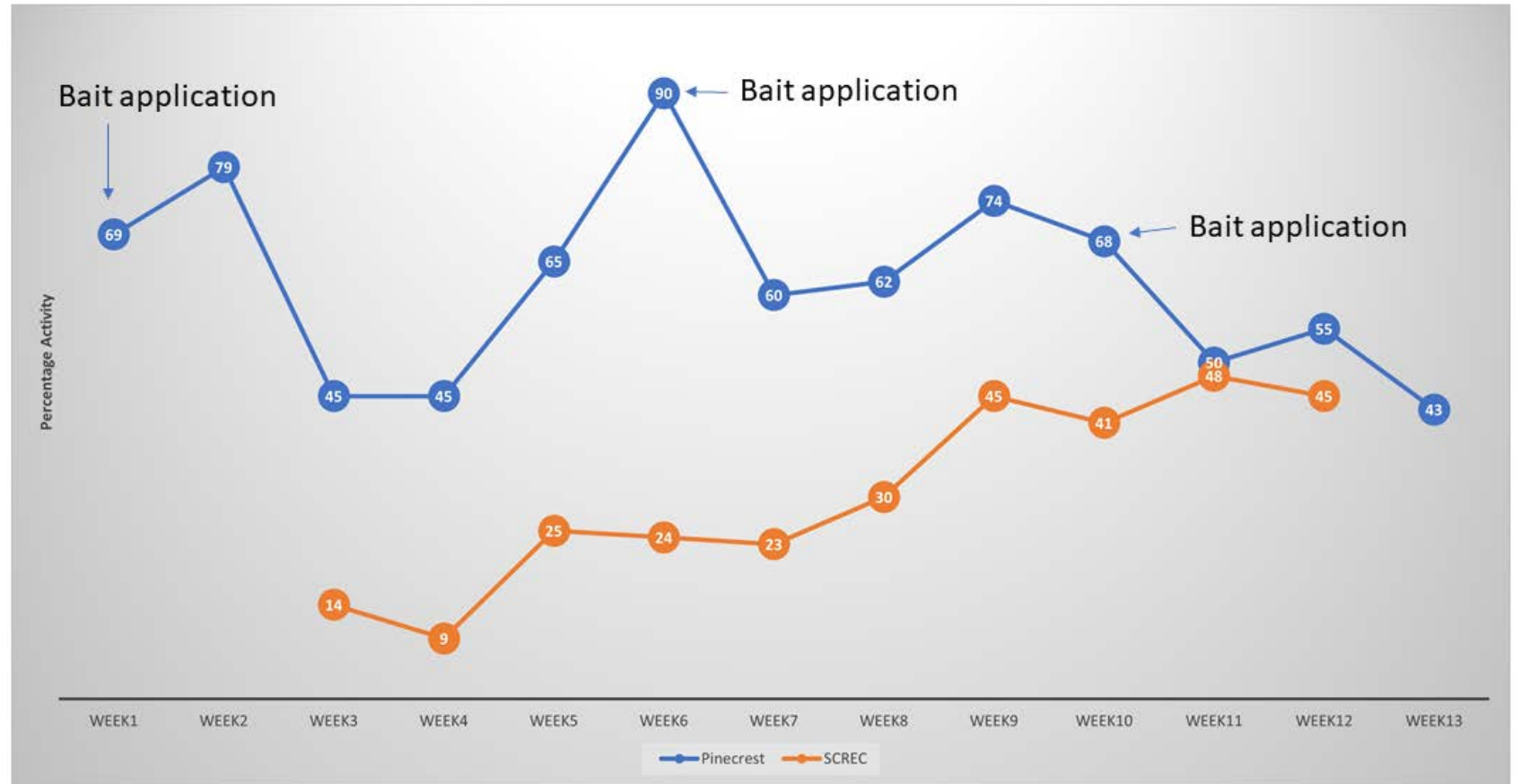
Action level

Most likely for
monthly
management

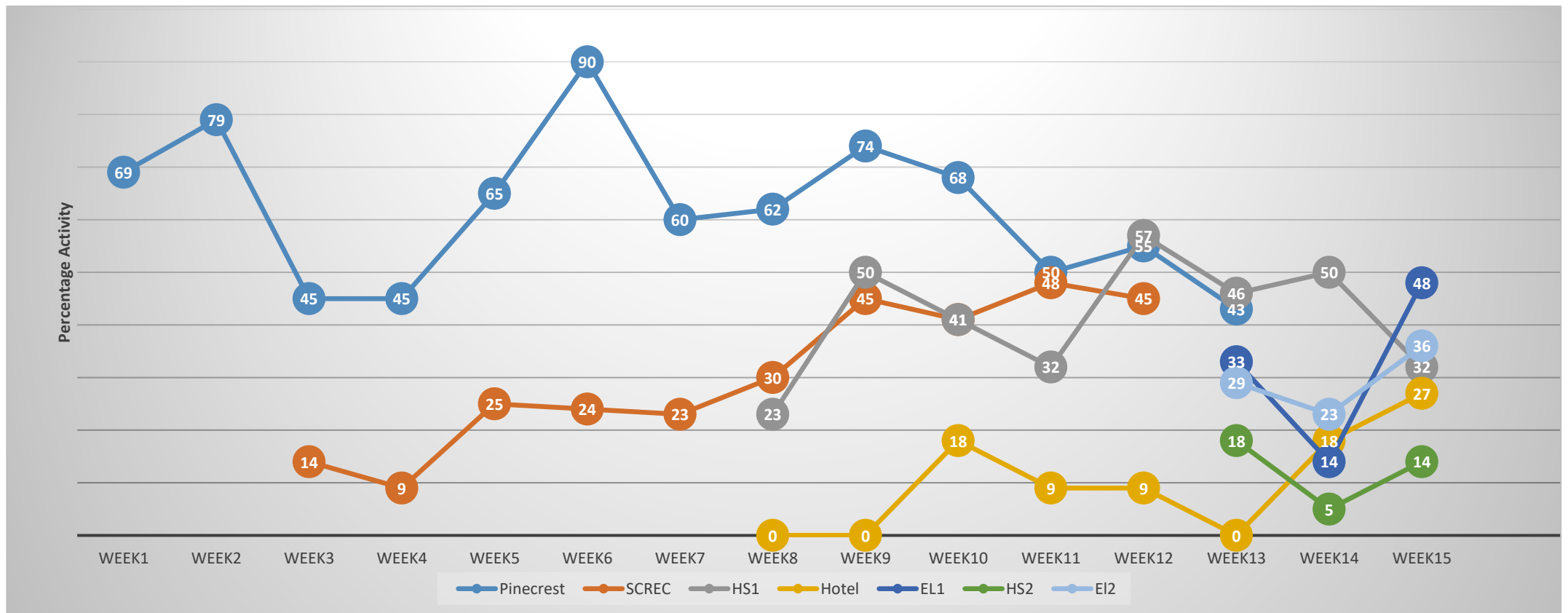
Ideal scenaria

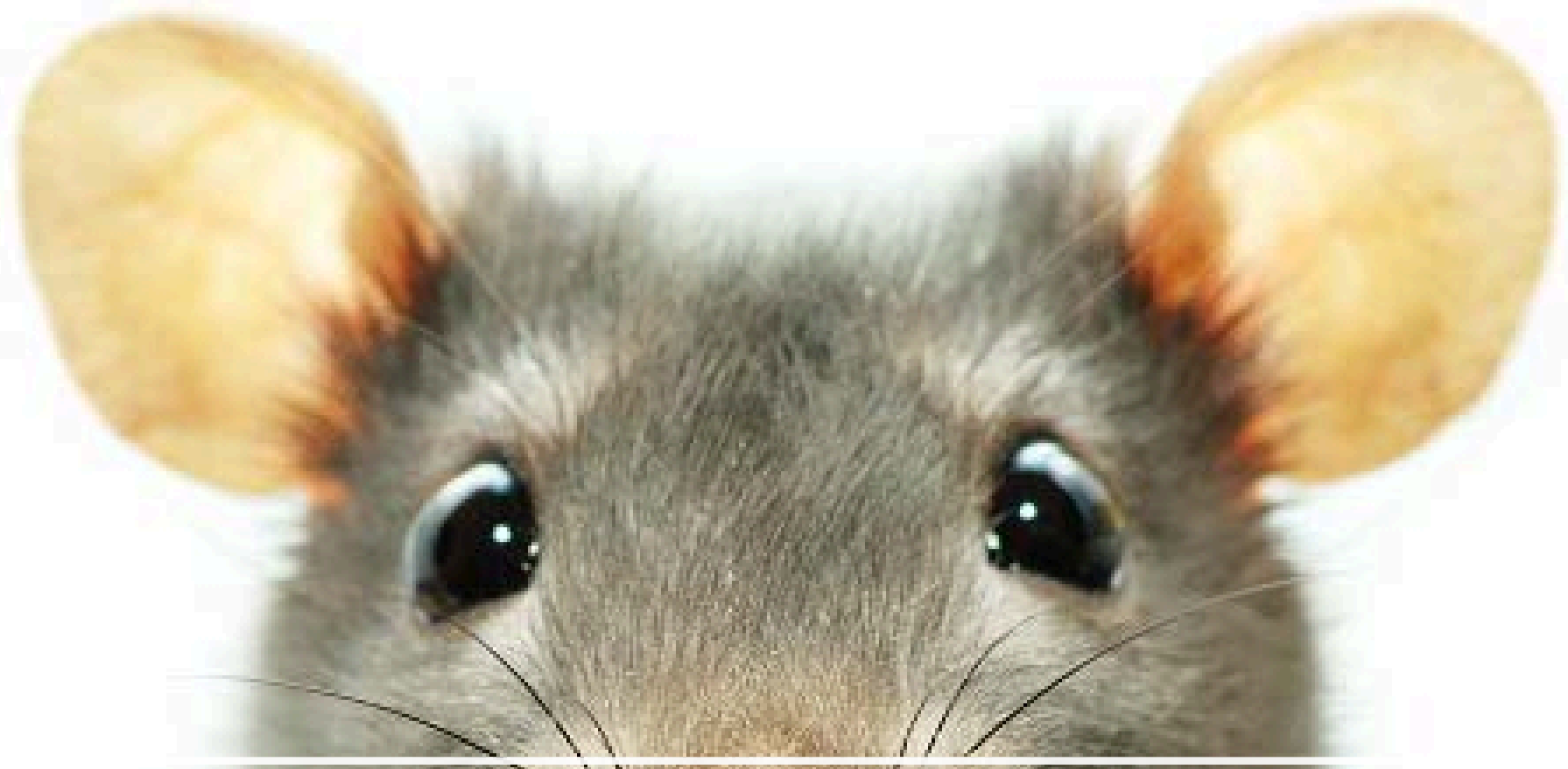


Real life....

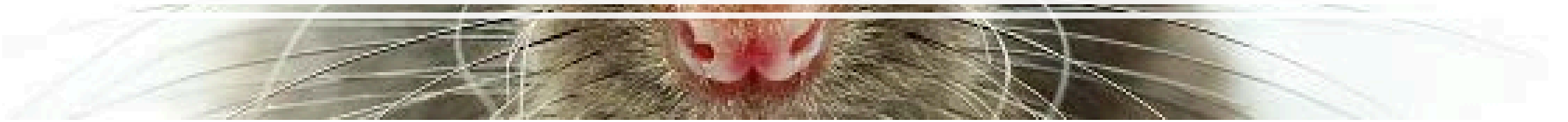


Still working on figuring out what is going on.....





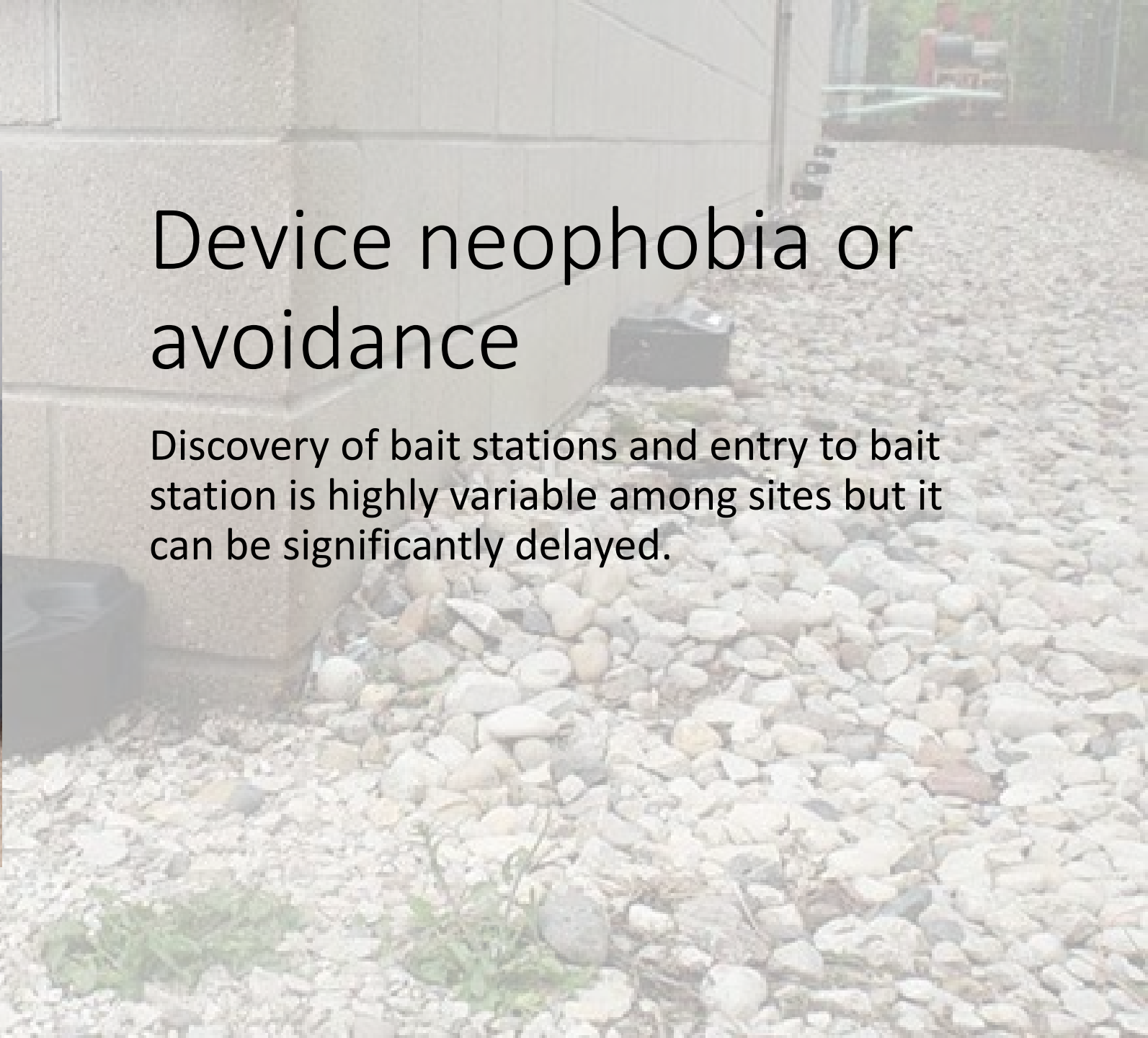
Why so much activity?



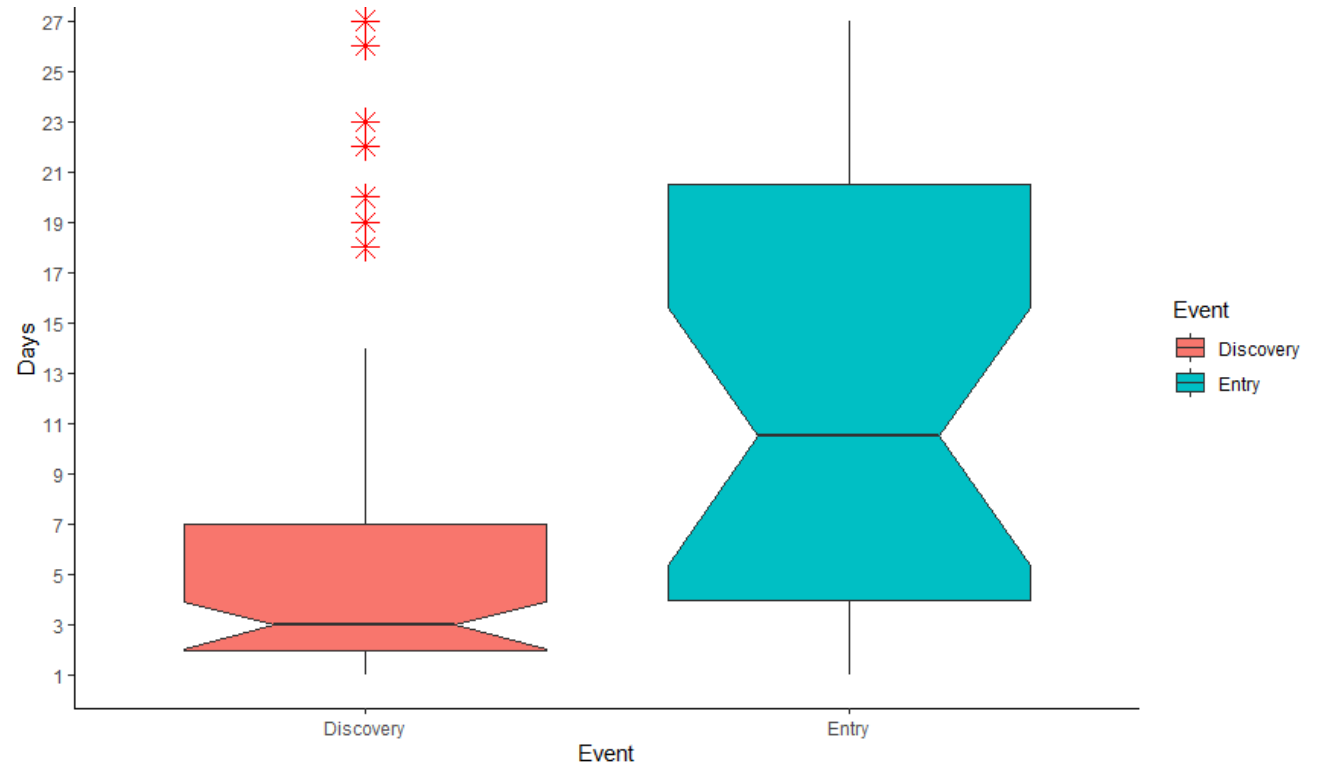


Device neophobia or avoidance

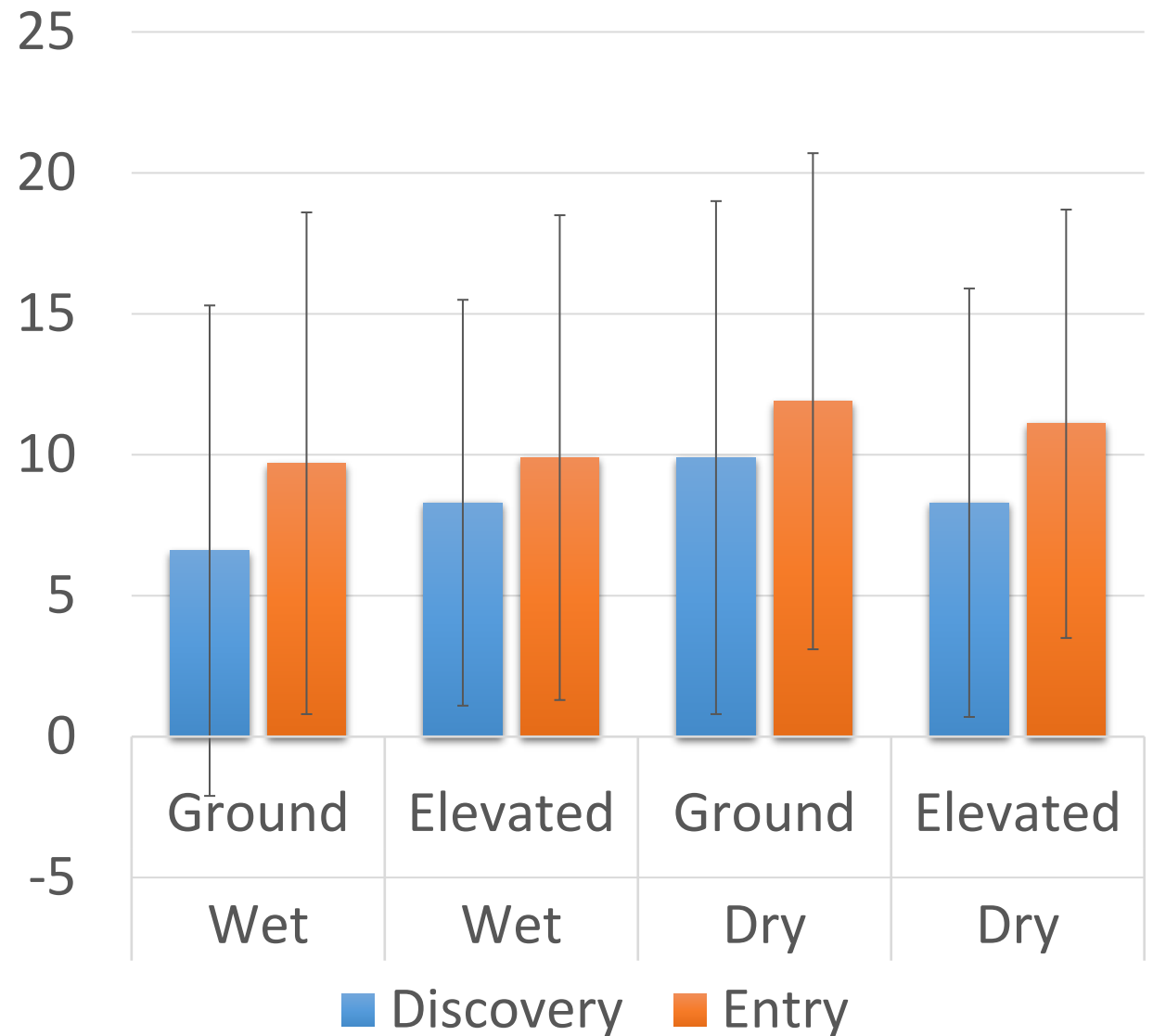
Discovery of bait stations and entry to bait station is highly variable among sites but it can be significantly delayed.



Device neophobia or avoidance



- Burke, C.B et al. (2021) Use of rodenticide bait stations by commensal rodents at the urban-wildland interface: Insights for management to reduce non-target exposure. Pest Management Science



A black plastic bait station is shown from a three-quarter perspective. A small brown mouse is peeking out from the circular entrance on the right side of the station. The station has a textured top surface with some faint markings.

Figuring out neophobia is key to success

Rats entered only 37-70% of the bait stations they visited

Rodenticide resistance in California



City	Rats	Y25F Mutants (%)
Anaheim	1	0 (0)
Fullerton	1	0 (0)
Huntington Beach	1	1 (100)
Irvine	3	1 (33)
Laguna Hills	1	1 (0)
Laguna Niguel	2	0 (0)
Newport Beach	6	6 (100)
Orange	2	0 (0)
Placentia	1	0 (0)
San Clemente	5	3 (60)
San Juan Capistrano	2	1 (50)
Santa Ana	3	1 (33)
Tustin	1	0 (0)
Villa Park	1	1 (100)
Yorba Linda	2	2 (100)

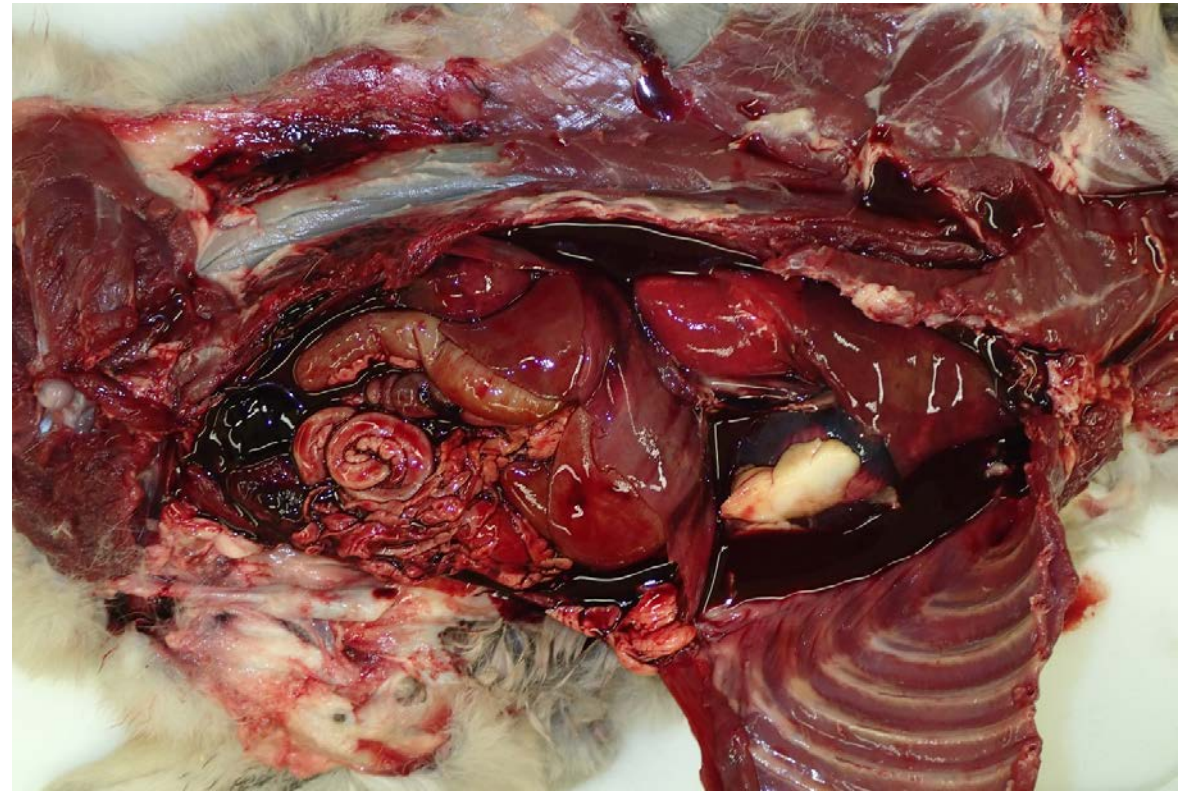


Why study
rodenticides?



Jaime Rudd-CDFW

Z17-0848
SJKF
10-20-17



Endangered Species

- San Joaquin kit fox



Endangered Species

Pacific fisher



Illegal applications

Mountain lion survived deadly California fires. Rat poison likely killed him, rangers say

BY JARED GILMOUR

APRIL 30, 2019 04:24 PM, UPDATED MAY 09, 2019 03:25 PM



Media attention: Exposure to
charismatic megafauna

Wildlife Deaths From Rat Poison Remain A Concern As Rat Population Grows In California Cities



Kiawah Island's bobcat population drops below 10, town seeks rodenticide ban

by Tony Fortier-Bensen | Friday, July 17th 2020

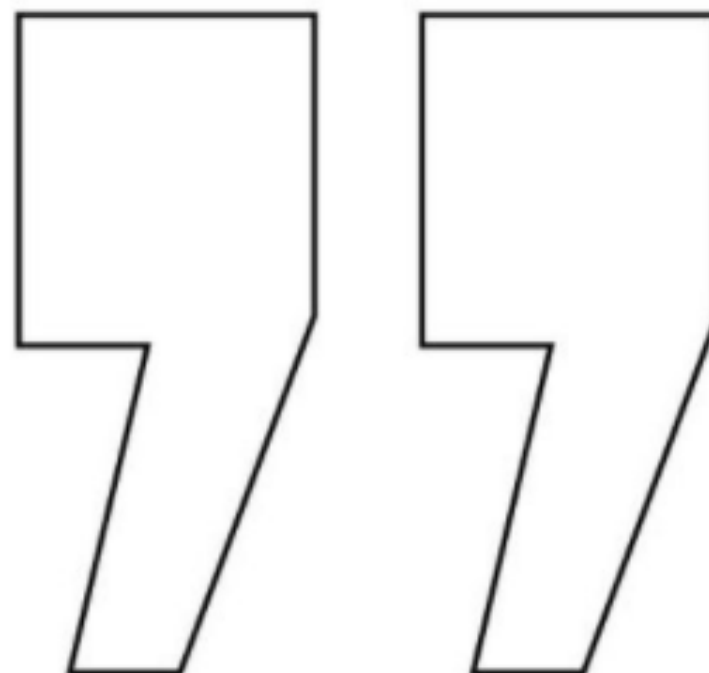
AA



Should Massachusetts ban the use of poison for rodent control?

Read two views and vote in our online poll.

Updated April 23, 2020, 6:12 p.m.



CROW: Results from remains of Harriet and M15's eaglet are in



Photo by: Southwest Florida Eagle Cam

Georgia

Anticoagulant Rodenticide Exposure and Toxicosis in Coyotes (*Canis latrans*) in the Denver Metropolitan Area

Sharon A. Poessel,^{1,5} Stev Resources, Utah State Unive Wildlife Services, National W Colorado Parks and Wildlife 80525, USA; ⁴US Departmen Wildland Resources, Utah 5 author (email: sharpoes@grr

Ecotoxicology (2016) 25:1061–1071
DOI 10.1007/s10646-016-1662-6



ABSTRACT: Anticoagulan widely used in urban an pests and are responsibl sioning in many nontarge tested the livers of five c in the Denver Metropoi US, for anticoagulant r livers were positive fo values ranging from 95 | one liver was positive for value of 885 ppb. Both of second-generation antic more potent and more lik poisoning than first-gene due to their accumulatio the liver. We concluded t rodenticides may have c least two of the five coyot in our study area are c rodenticides.

Key words: Brodifac poison, second-generatio

Anticoagulant rode extensively throughout control rodent popula Watt et al. 2005). These interrupting the norm: ting factors in the li commences, resulting ing (Eason and Spurr 2002). Second-genera (e.g., brodifacoum and more potent than first

Increase owls (*T*) with de

Andrew C. I
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Abs
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RESEARCH ARTICLE

Land use change and rodenticide exposure trump climate change as the biggest stressors to San Joaquin kit fox

Science of the Total Environment 609 (2017) 68–76

Contents lists available at ScienceDirect

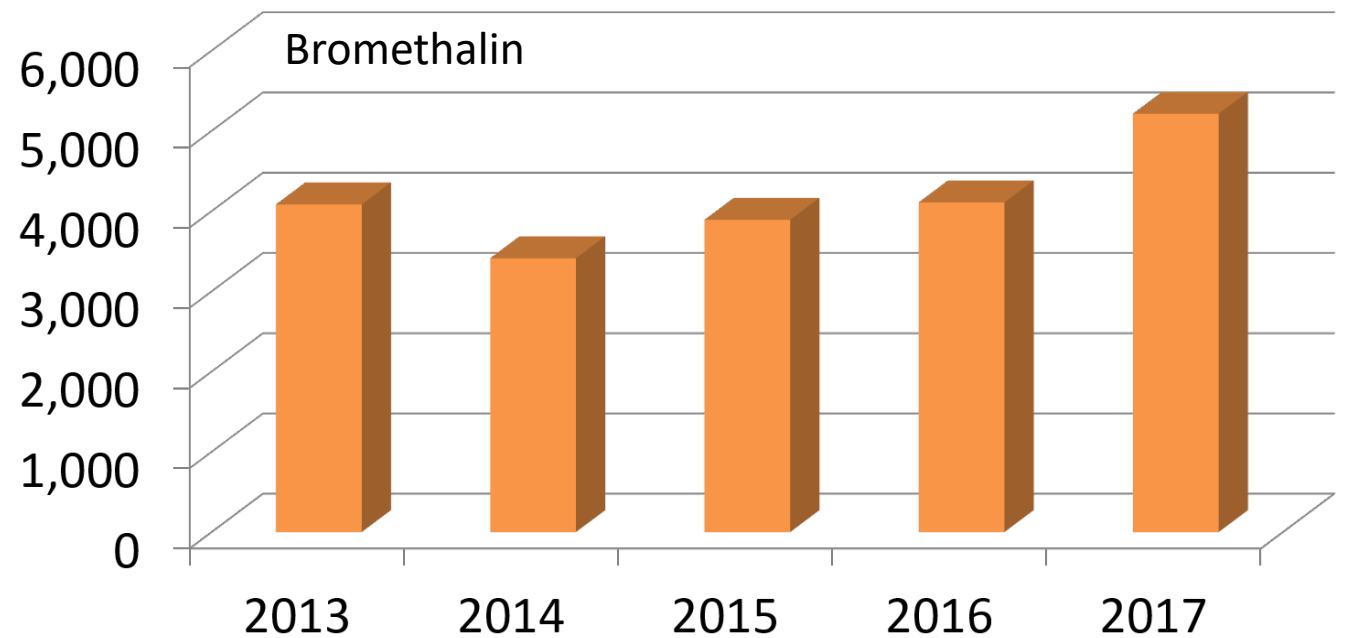
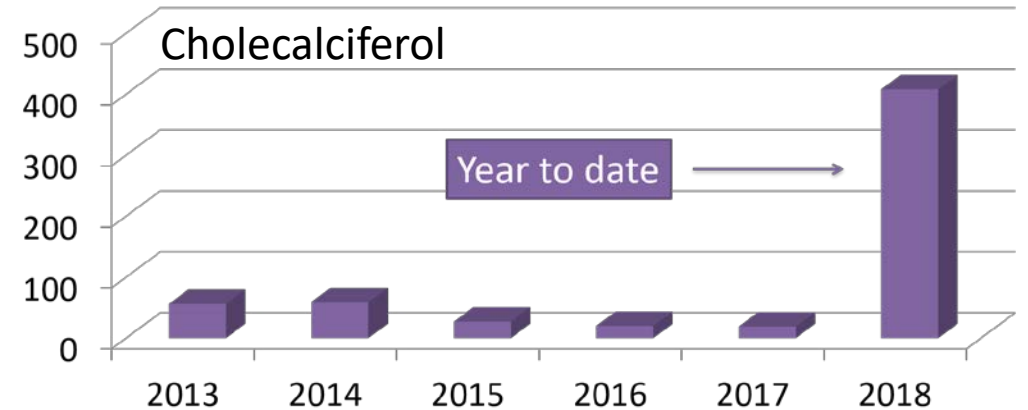
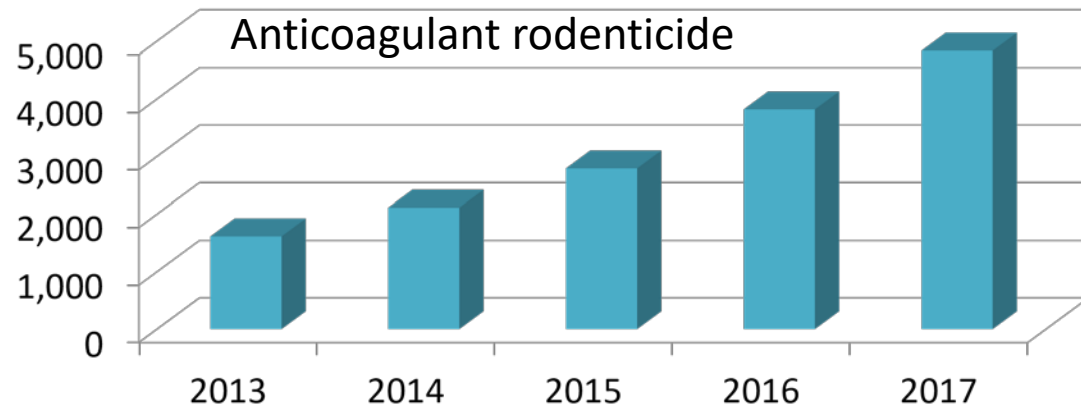
Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

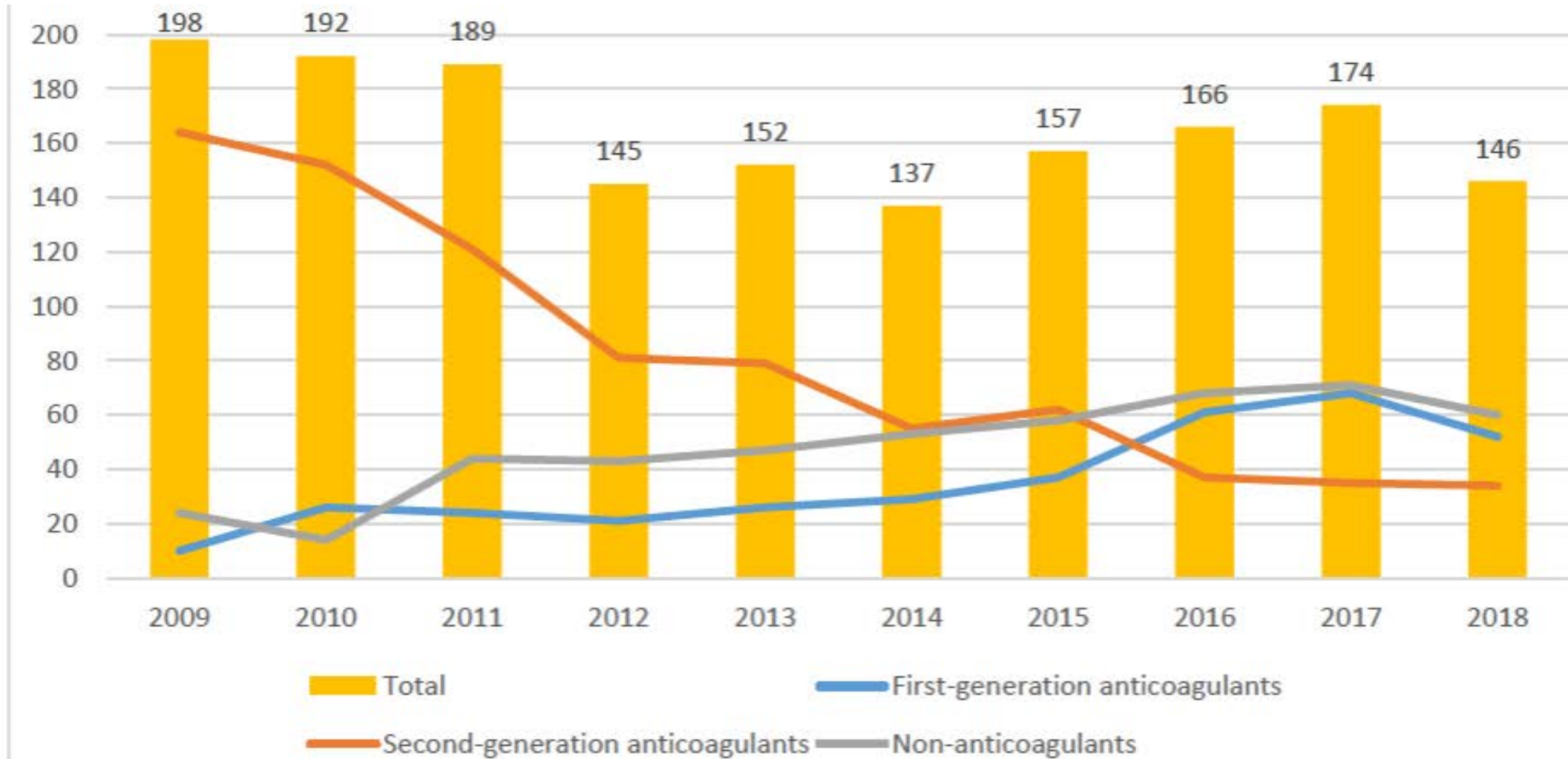


Rodenticide incidents of exposure and adverse effects on





Total Rodenticide Incidents, FGARs, SGARs, and Non ARs incidents reported to main and aggregate IDS from 2009 and 2018





Bloom AB 1788
California Ecosystems Protection Act of 2020



AB 1788

- This bill, the California Ecosystems Protection Act of 2020, would additionally prohibit the use of any second generation anticoagulant rodenticide, as defined, in this state until the director certifies to the Secretary of State that, among other things, the Department of Pesticide Regulation has completed a reevaluation of second generation anticoagulant rodenticides and the Department of Pesticide Regulation, in consultation with the Department of Fish and Wildlife, has adopted any additional restrictions necessary to ensure that continued use of second generation anticoagulant rodenticides is not reasonably expected to result in significant adverse effects to nontarget wildlife, as provided.

But.....

A thick white curved line, resembling a large arc or a partial circle, is positioned on the right side of the image. It starts from the bottom edge and curves upwards and to the left, ending near the top edge. The background is a solid dark gray.

Rat infest residents



Rats have become a major Place, between Underhill a

Rodent of Dise



CALI



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1 |

Of

California reports first human plague case in 5 years

By Rachael Rettner - Senior Writer 5 hours ago

The infected person is a resident of South Lake Tahoe.



Comments (0)

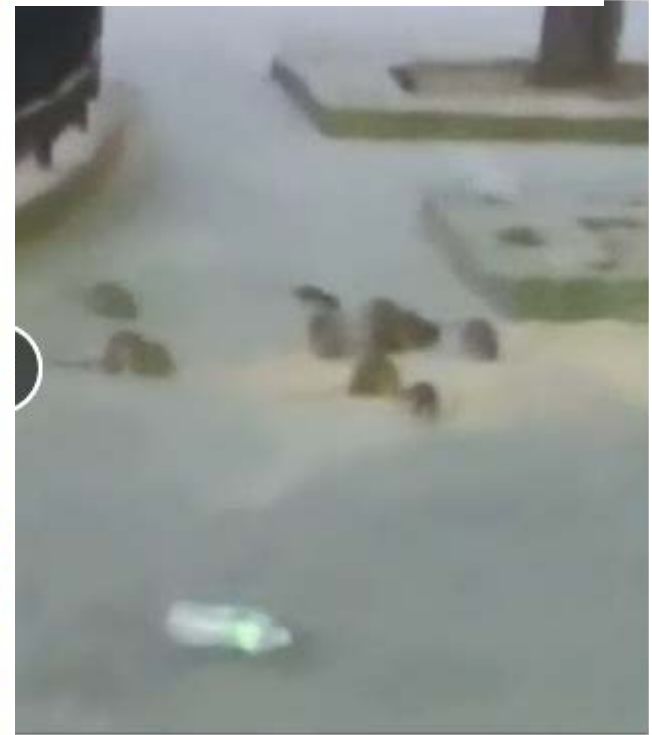


(Image: © Shutterstock)

Los Angeles City Hall mid the downtown buil

reports. (Published Tuesday, Feb. 14, 2017)

remove all carnets
Jrine: NYC Health



ase commonly spread by contact with rat urine, ase, city health officials say. Checkey Beckford

The State Worker

**Battling rats at the CalEPA headquarters: poison,
traps and hourly patrols**

Association Between Allergen Exposure in Inner-City Schools and Asthma Morbidity Among Students

William J. Sheehan, MD; Perdita Permaul, MD; Carter R. Petty, MA; Brent A. Coull, PhD; Sachin N. Baxi, MD; Jonathan M. Gaffin, MD, MMsc; Peggy S. Lai, MD, MPH; Nina D. Gold, MD, MPH; Woods Christensen, MD, MSc

IMPORTANCE Home aeroallergen exposure in inner-city children, yet little is known about the contribution to asthma morbidity.

OBJECTIVE To evaluate the effect of school dust on asthma morbidity among students, adjusted for home dust exposure.

DESIGN, SETTING, AND PARTICIPANTS Cohort study evaluating 284 students in 37 inner-city elementary schools in the Vancouver area from July 1 and August 31, 2013. Enrolled students who had no asthma at school year started and were then observed for asthma outcomes during the school year.

EXPOSURES Indoor aeroallergens, including mouse allergen, measured in dust samples collected from classrooms and homes.

MAIN OUTCOMES AND MEASURES The primary outcome was asthma symptoms over 12 weeks with asthma symptoms. Secondary outcomes included asthma-associated morbidity, including asthma-associated school absenteeism and by forced expiratory volume in 1 second.

RESULTS Among 284 students (median age, 7.5 years; 136 girls), exposure to mouse allergen in schools was associated with asthma morbidity. Levels of mouse allergen in schools were significantly higher than in homes (median settled dust level, 0.90 vs 0.14 µg/g; $P < .001$). School dust exposure was associated with an asthma symptom day (odds ratio, 1.27; 95% CI, 1.01–1.60) and points lower predicted forced expiratory volume in 1 second. This effect was independent of allergen exposure at home. No associations were associated with worsening asthma.

CONCLUSIONS AND RELEVANCE In this study, mouse allergen in schools was associated with asthma morbidity among students.

VECTOR-BORNE AND ZOOLOGICAL DISEASES
Volume 15, Number 1, 2015
© Mary Ann Liebert, Inc.
DOI: 10.1089/vbz.2014.1657

An Investigation of *Bartonella* spp., *Rickettsia typhi*, and Seoul Hantavirus in Rats (*Rattus* spp.) from an Inner-City Neighborhood of Vancouver, British Columbia: Is Pathogen Presence a Reflection of Local Rat Population?

Chelsea G. Himsworth,^{1,2} Ying Bai,³ Michael Y. Kosoy,³ Robbin Lindsay,⁴ Julie Bidulka,² Patrick Tang,^{5,6} Clair

Abstract

Urban Norway and black rats (*Rattus norvegicus* and *Rattus rattus*) are common pathogens. Many of these pathogens, including *Rickettsia typhi*, *Bartonella* spp., and Seoul Hantavirus, are thought to be endemic in rat populations worldwide; however, they are absent in certain rat populations. Rats (*Rattus* spp.) from Vancouver, British Columbia, Canada, were tested for exposure to and/or infection with SEOV as *Bartonella* spp. (using culture and sequencing). Approximately 50% of rats were associated with both season and sexual maturity. Seroreactivity

DOI: 10.7559/2014-09-242

Journal of Wildlife Diseases, 51(3), 2015, pp. 589–597
© Wildlife Disease Association

PREVALENCE AND CHARACTERISTICS OF *ESCHERICHIA COLI* AND *SALMONELLA* SPP. IN THE FECES OF WILD URBAN NORWAY AND BLACK RATS (*RATTUS NORVEGICUS* AND *RATTUS RATTUS*) FROM AN INNER-CITY NEIGHBORHOOD OF VANCOUVER, CANADA

Chelsea G. Himsworth,^{1,2,7} Erin Zabek,² Andrea Desruisseau,³ E. Jane Parmley,³ Richard Reid-Smith,³ Claire M. Jardine,⁴ Patrick Tang,^{5,6} and David M. Patrick¹

¹ School of Population and Public Health, University of British Columbia, 2206 E Mall, Vancouver, British Columbia V6T 1Z9, Canada

² Animal Health Centre, British Columbia Ministry of Agriculture, 1767 Angus Campbell Road, Abbotsford, British Columbia V3G 2M3, Canada

³ Laboratory for Foodborne Zoonoses, Public Health Agency of Canada, 160 Research Lane, Guelph, Ontario N1G 5W1, Canada

⁴ Department of Pathobiology and Canadian Wildlife Health Cooperative, University of Guelph, 50 Stone Road, Guelph, Ontario N1G 2W1, Canada

⁵ British Columbia Centre for Disease Control, 655 W 12th Avenue, Vancouver, British Columbia V5Z 4R4, Canada

⁶ Department of Pathology and Laboratory Medicine, University of British Columbia, 2211 Westbrook Mall, Vancouver, British Columbia V6T 2B5, Canada

⁷ Corresponding author (email: Chelsea.Himsworth@gov.bc.ca)

Schools and
rats.....



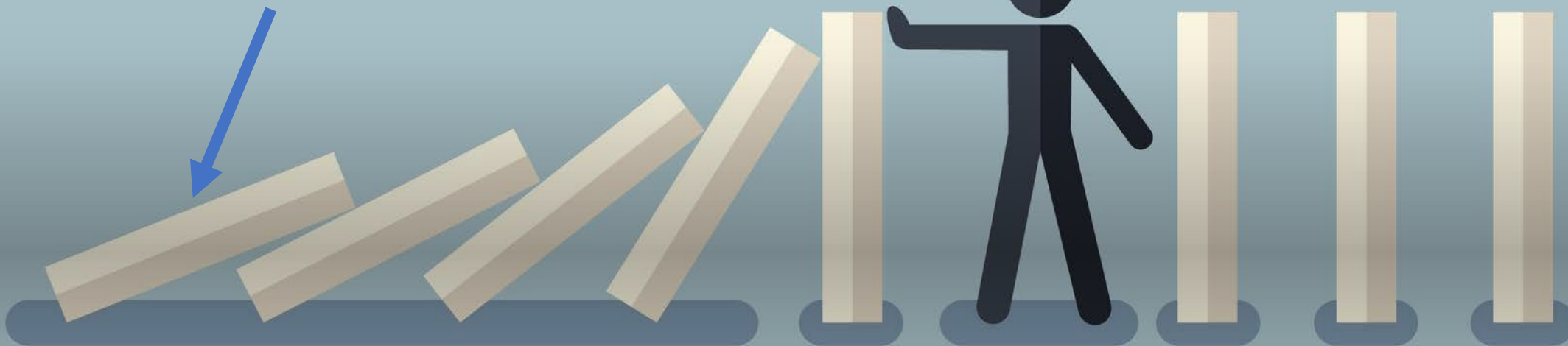
Schools and rats



Does California pesticide
legislation matter?



California



California is full of crazies! That will never happen here!



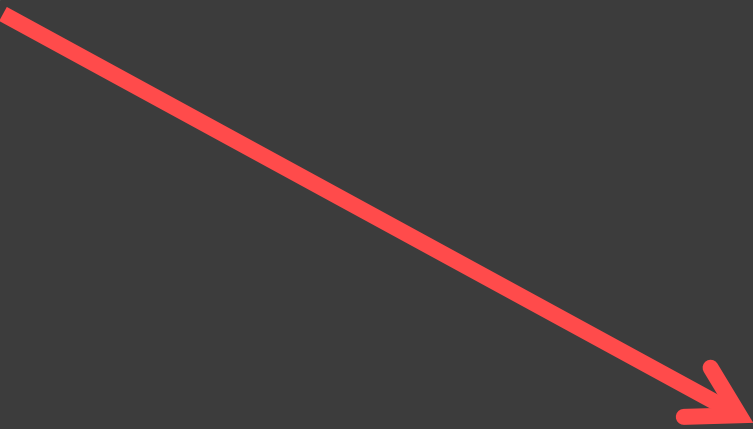
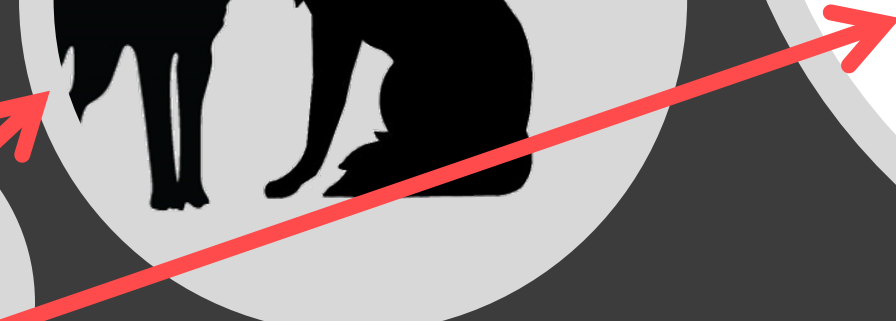
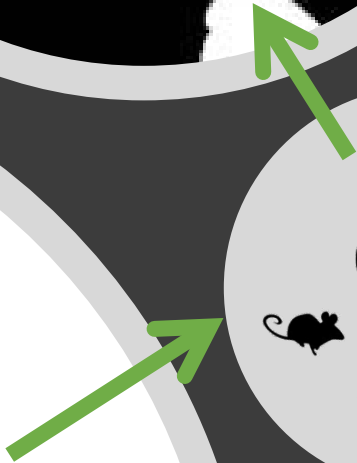
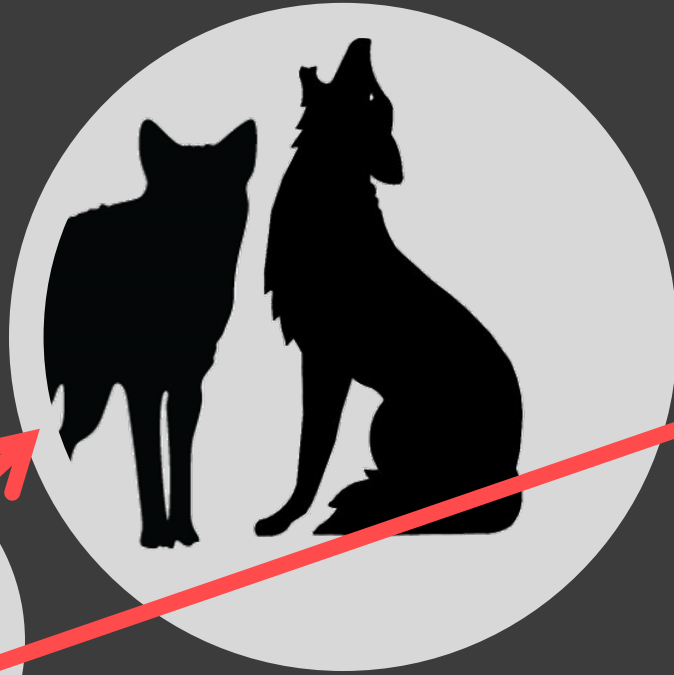
- Healthy Schools Act
- Pyrethroid label changes
- Fipronel

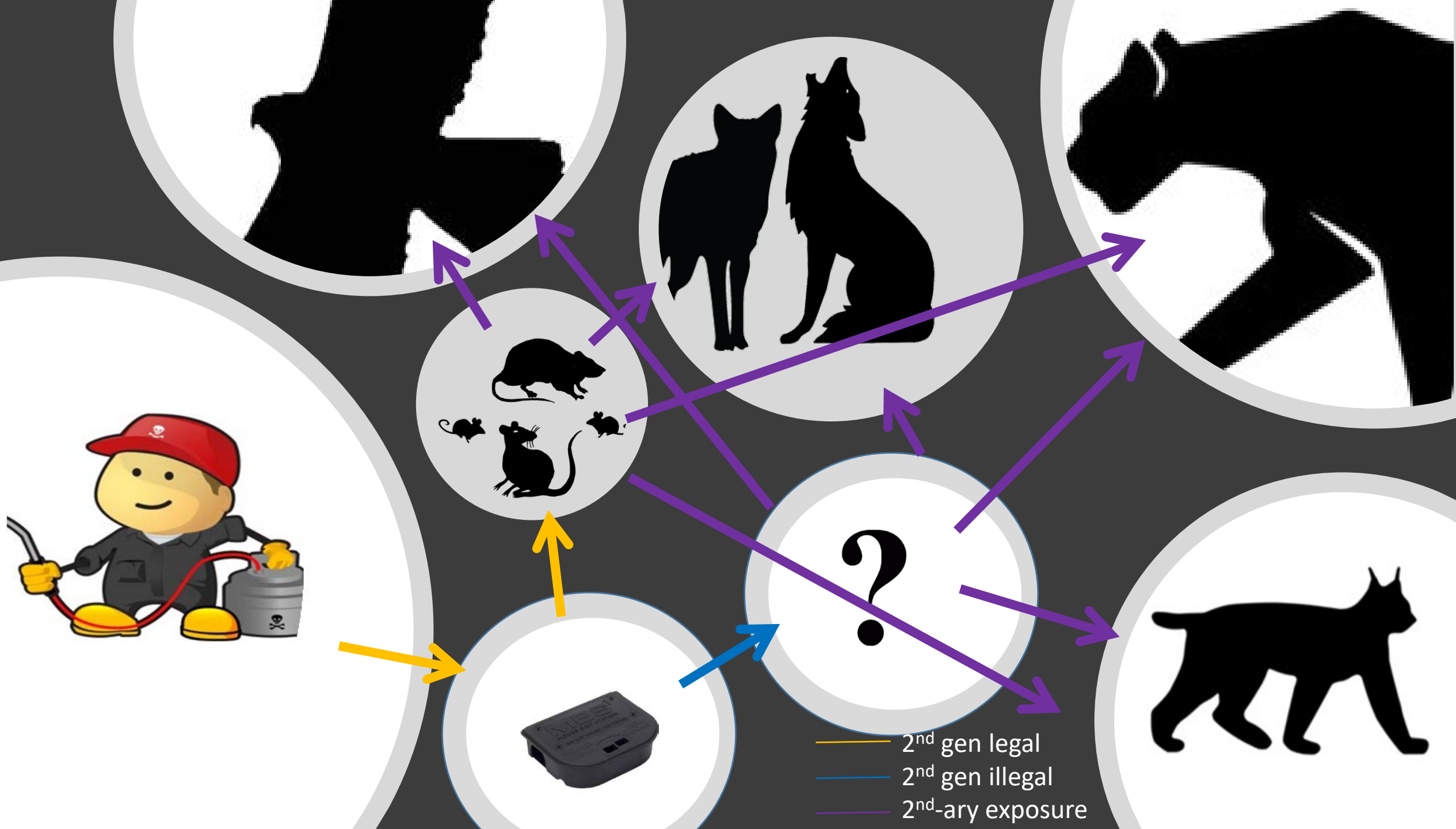


Who is responsible for rodenticide exposure to wildlife in California?



- 2nd gen legal
- 2nd gen illegal
- 2nd-ary exposure

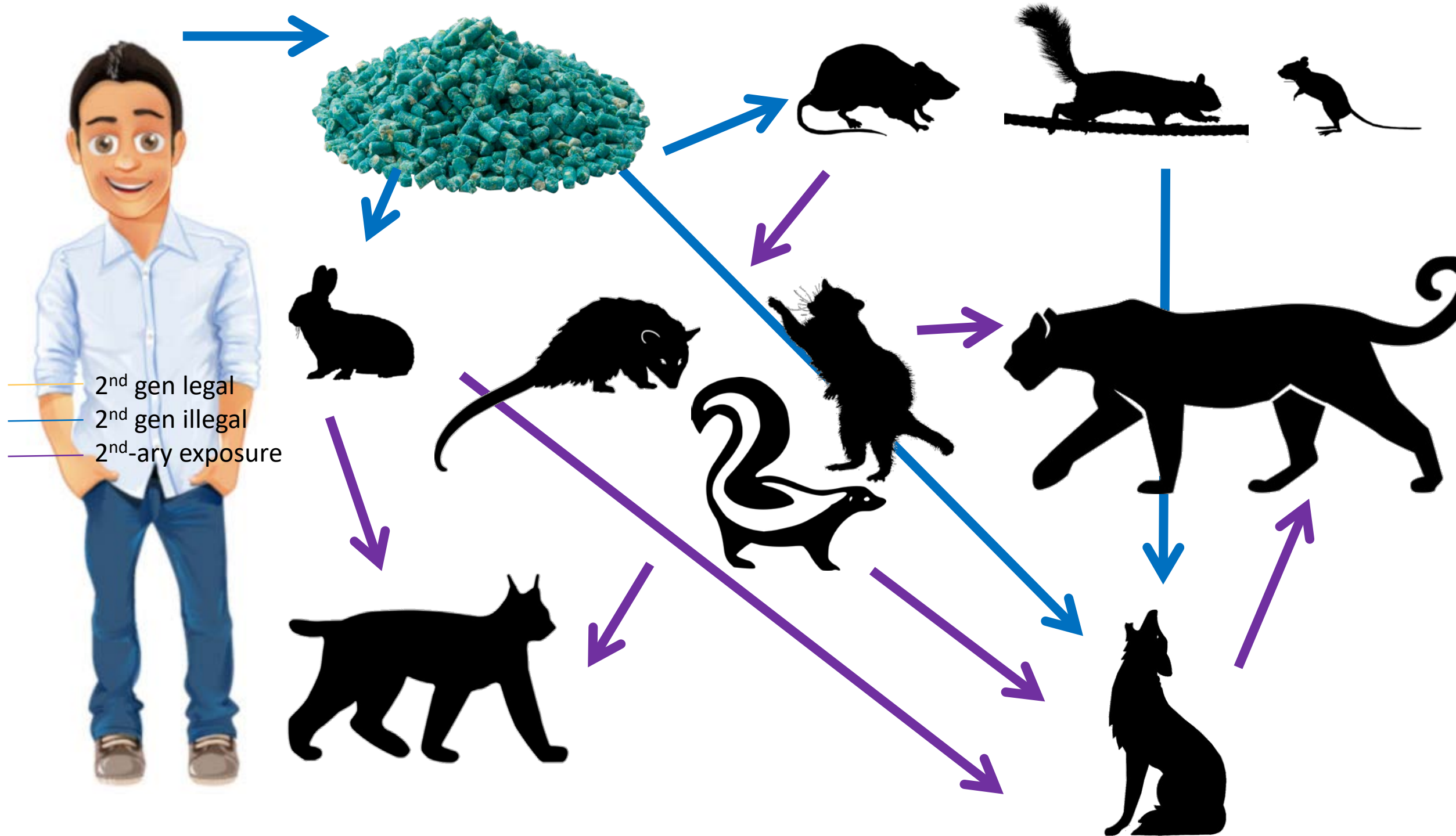




Reported Use of Rodenticide and Second Generation Anticoagulant Rodenticide (SGAR) by Local Vector Control Agencies, 2018-19*

Pesticide use data are from CDPR's provisional 2018-19 Public Health monthly pesticide use reports provided to CDPH for review

County	Agency	Approx. Total lbs of Rodenticide Products Used (% SGAR)	
		2018	2019
Alameda	Alameda County Vector Control District	1089 (99.7%)	1143 (98%)
Contra Costa	Contra Costa Mosquito and Vector Control District (MVCD)	223 (44%)	299 (66%)
Kern	Kern MVCD	197 (26%)	157 (14%)
Los Angeles	City of Long Beach	35 (59%)	82 (0%)
Orange	Orange County MVCD	5 (100%)	8 (100%)
Riverside	Northwest MVCD	114 (100%)	110 (100%)
Sacramento/Yolo	Sacramento-Yolo MVCD	2 (100%)	3 (100%)
San Mateo	San Mateo County MVCD	149 (88%)	274 (27%)
San Francisco	SF Environmental Health Dept.	654 (0%)	572 (0%)
TOTAL		2468 (61%)	2649 (58%)





California's wildlife,
exposure and research
updates



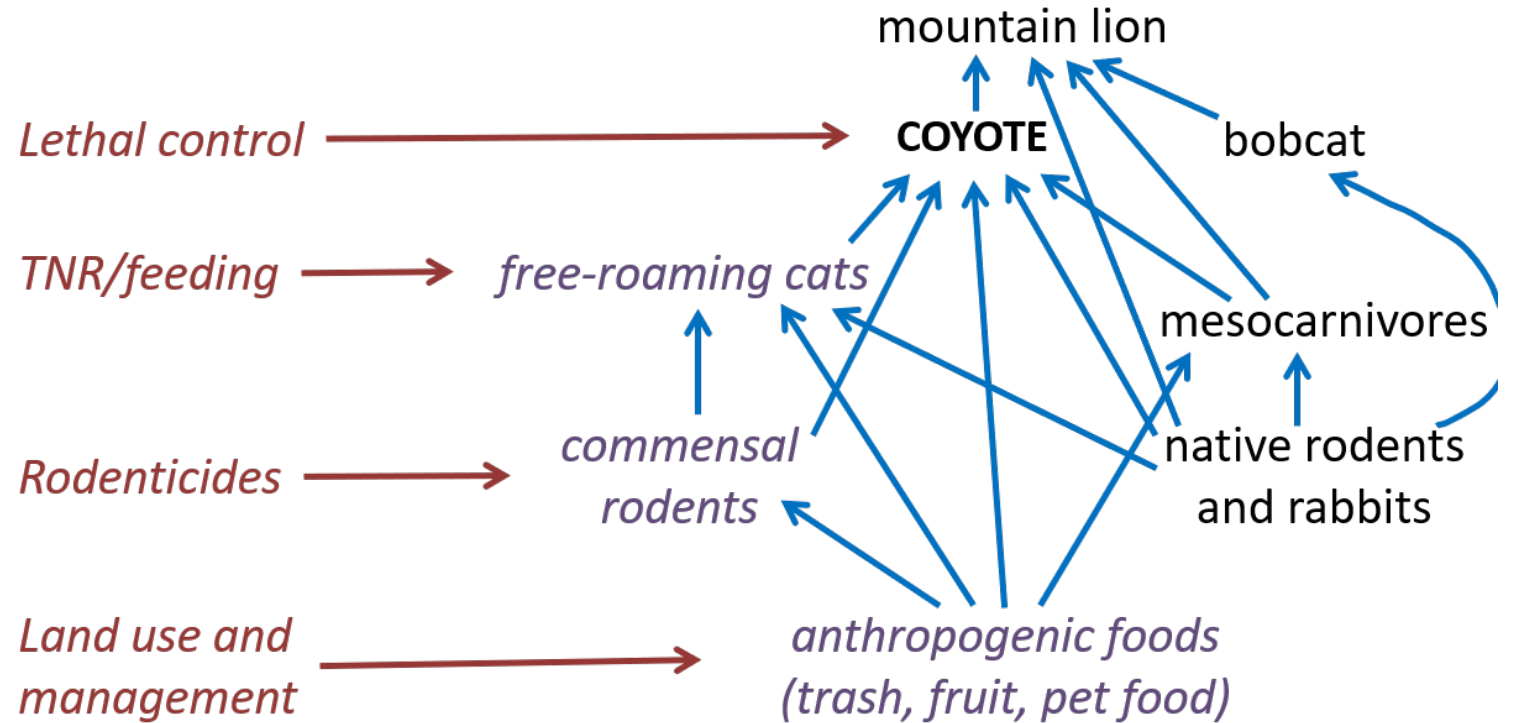






Investigating the pathways of rodenticide and the sources of exposure in urban systems in Southern California

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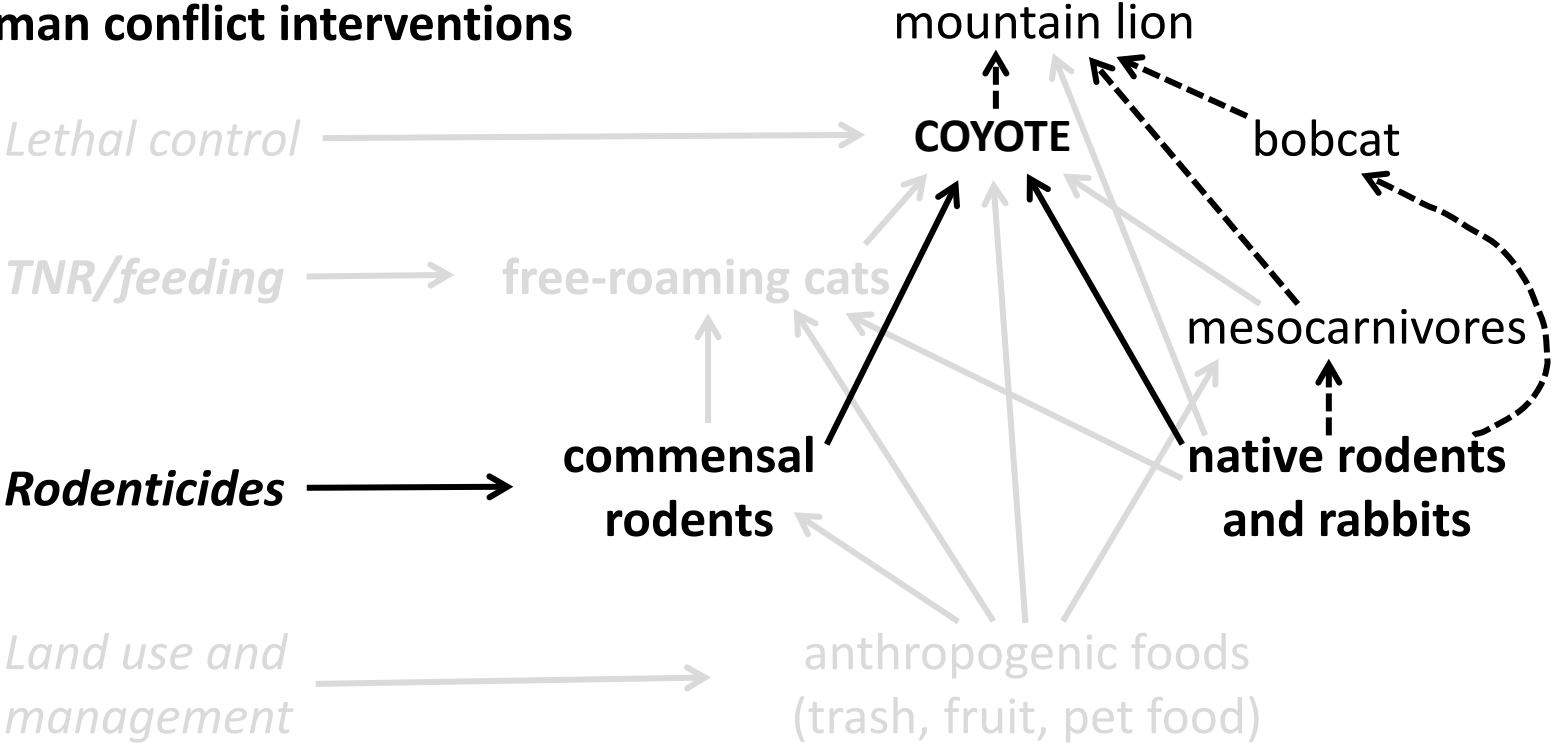
**100%
FUNDED!**



Gaining a better understanding of rodenticide pathways to help inform pest management professional about choices to reduce potential of non-target animal poisoning at point of application



Human conflict interventions

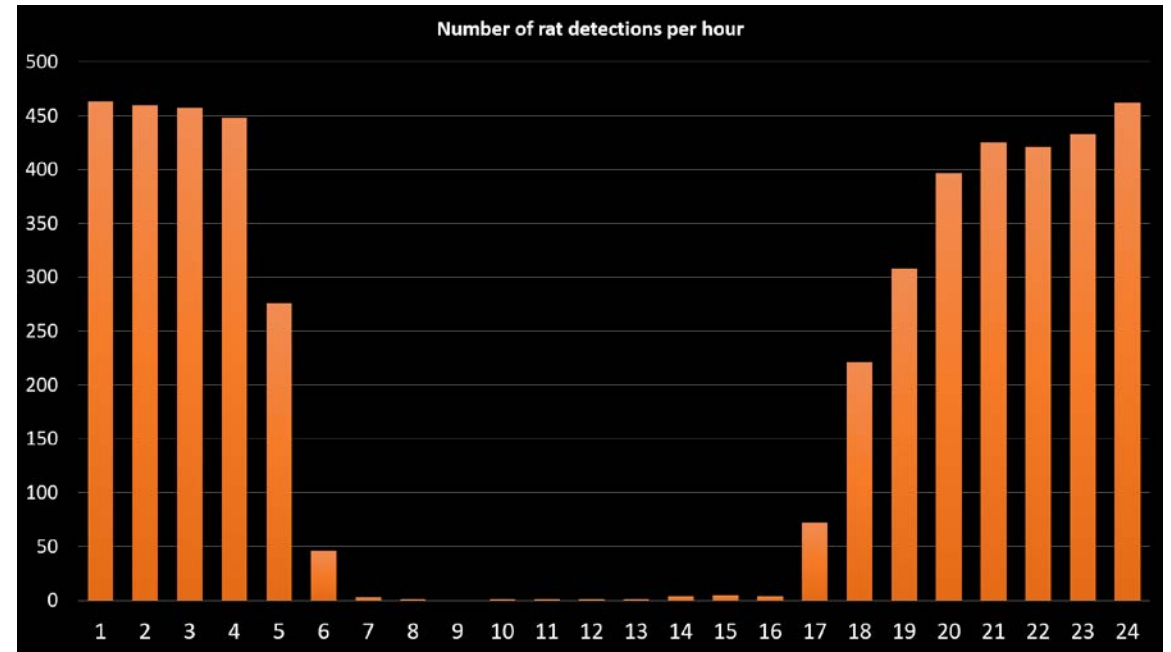
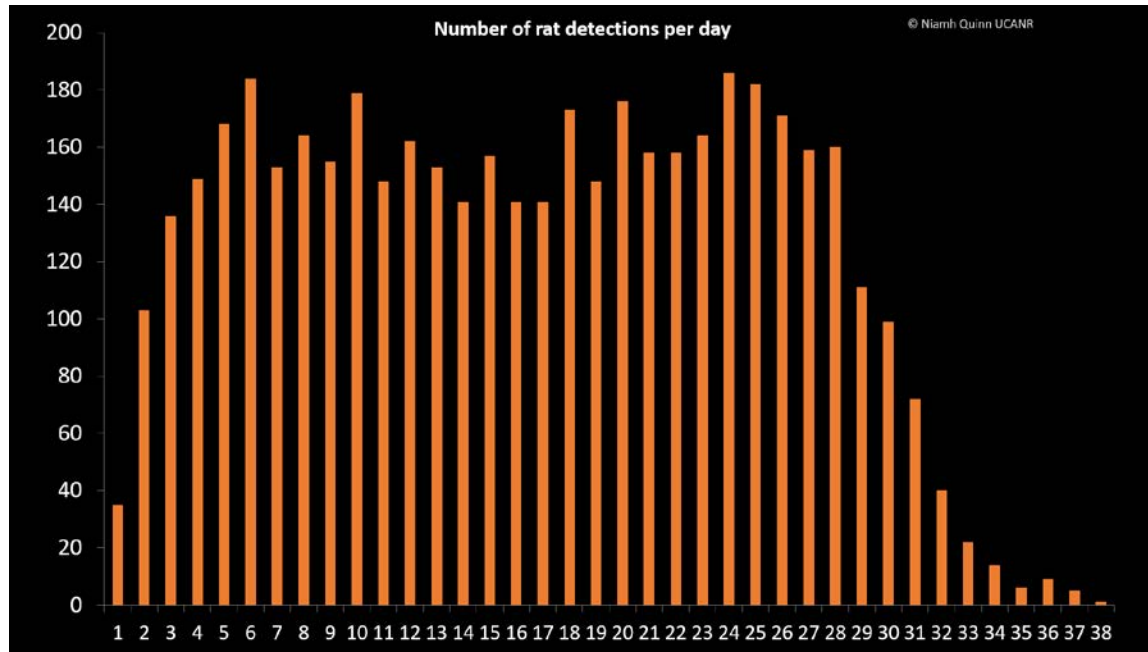




Can above ground baiting reduce the risk of exposure?



- *Rattus rattus*
- *Sciurus niger*
- *Felis catus*
- *Didelphis virginiana*
- *Procyon lotor*
- *Canis latrans*
- *Lynx rufus*
- *Mephitis mephitis*
- *Neotoma spp.*
- *Peromyscus spp.*
- *Otospermophilus beecheyi*
- *Sylvilagus audubonii*
- *Lepus californicus.*



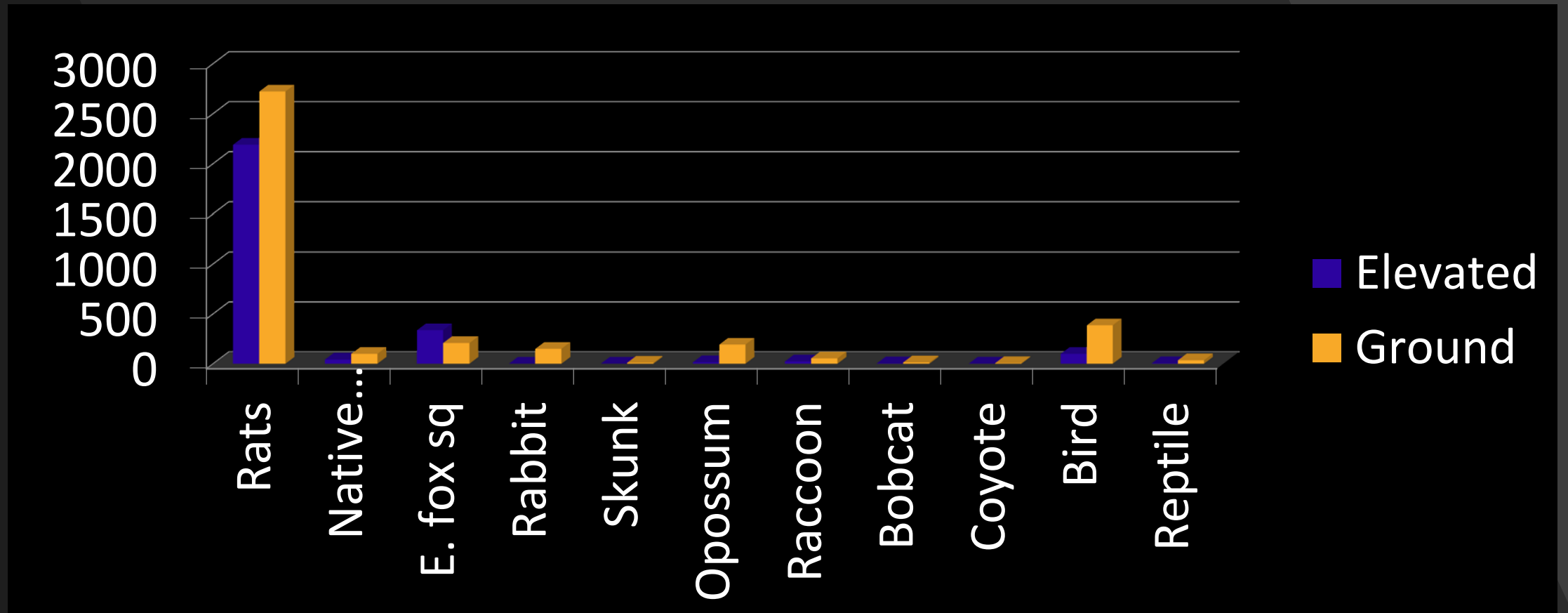
Rodent and Wildlife Detections

Rodent Behavior

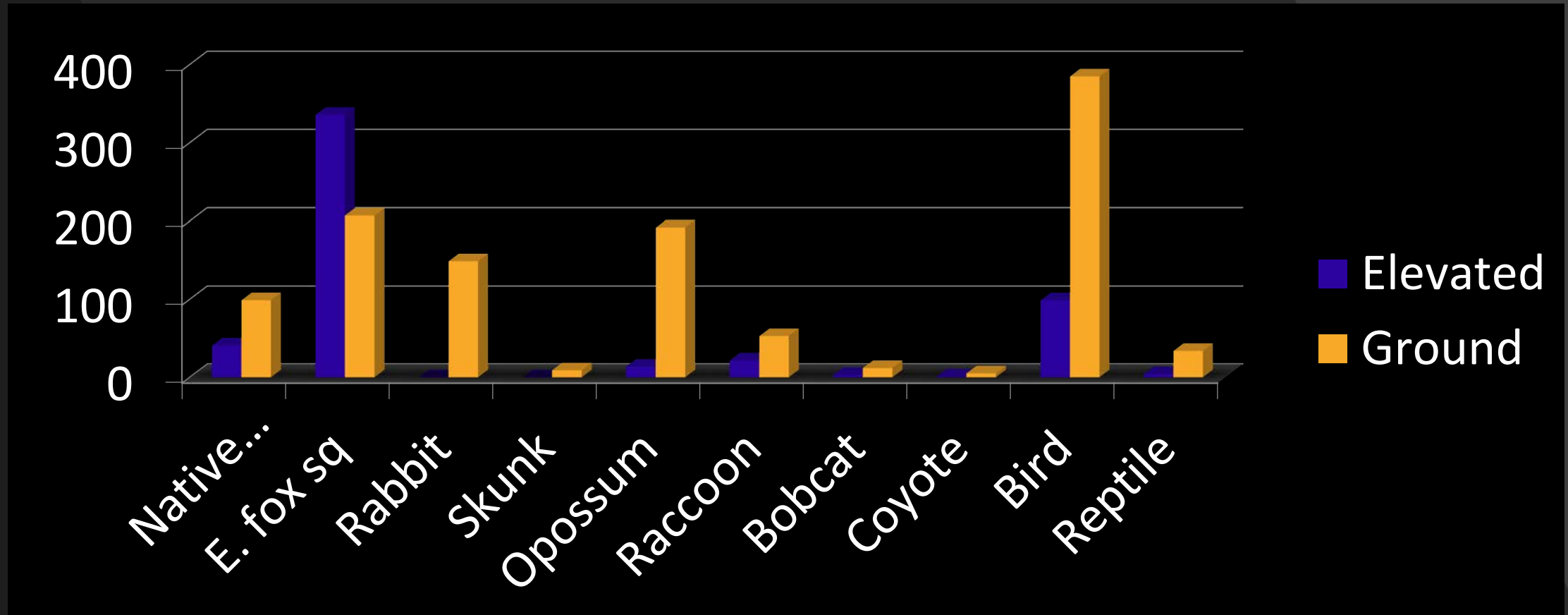
- Discovery of bait stations and entry to bait station is highly variable among sites but it can be significantly delayed.



Species detected around bait stations



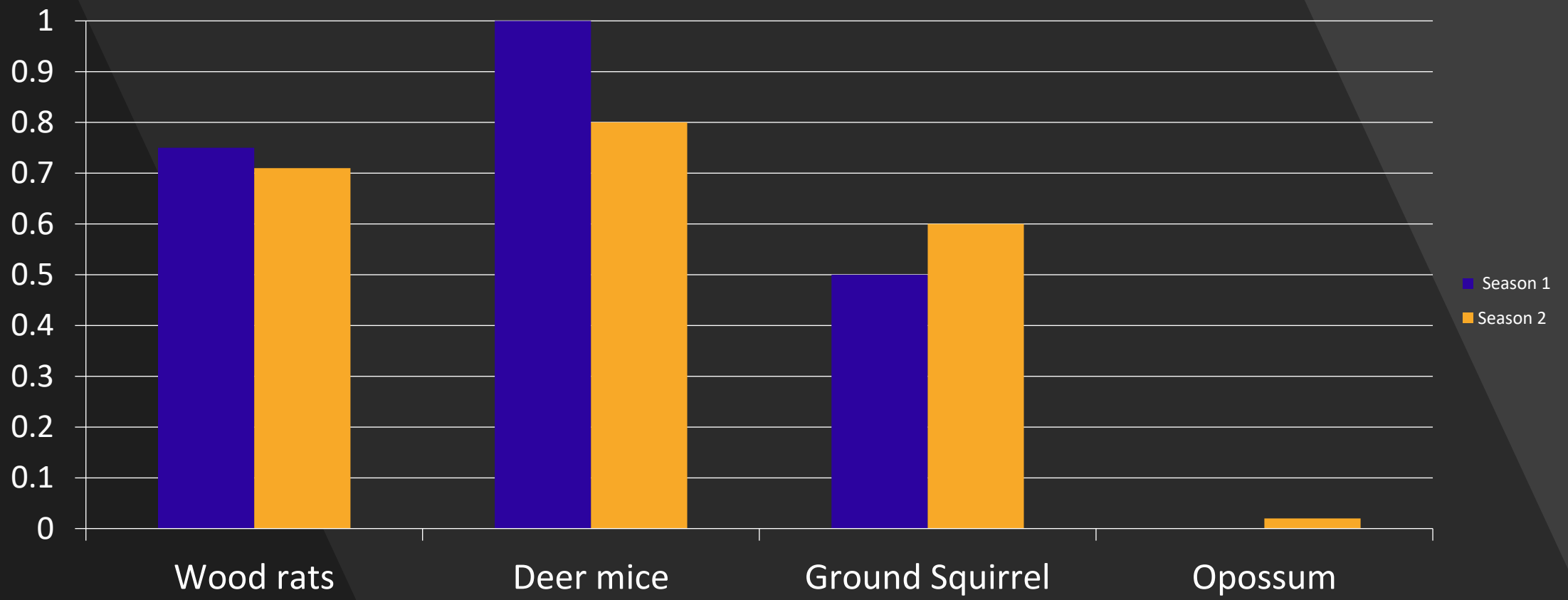
Species (excluding rats) detected around bait stations





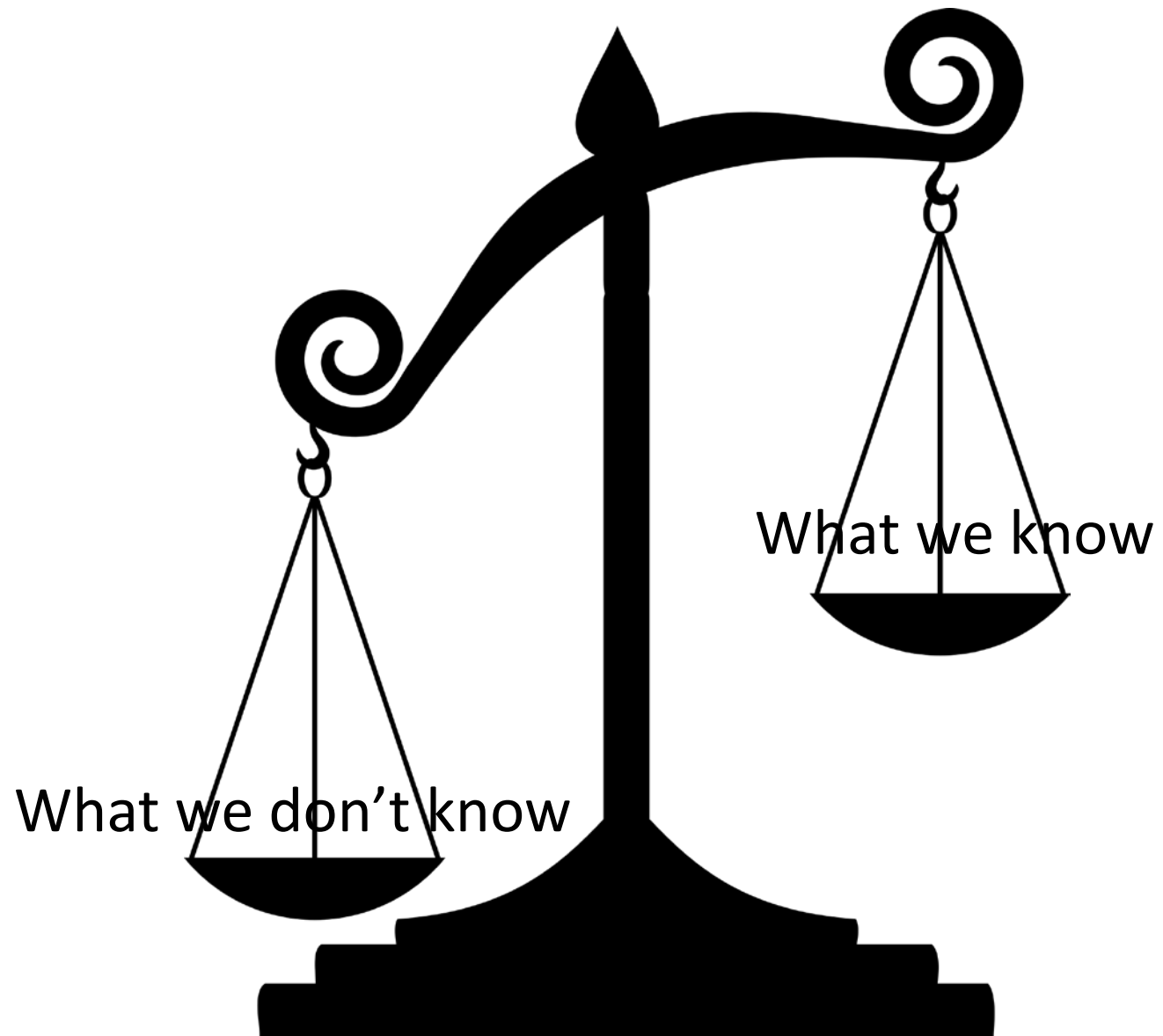
Non target species and
access to bait

Non target species and access to bait



Non target species and access to bait





Primary exposure to nontarget wildlife from legal applications of rodenticides for structural pest control is unlikely to be a major route of exposure

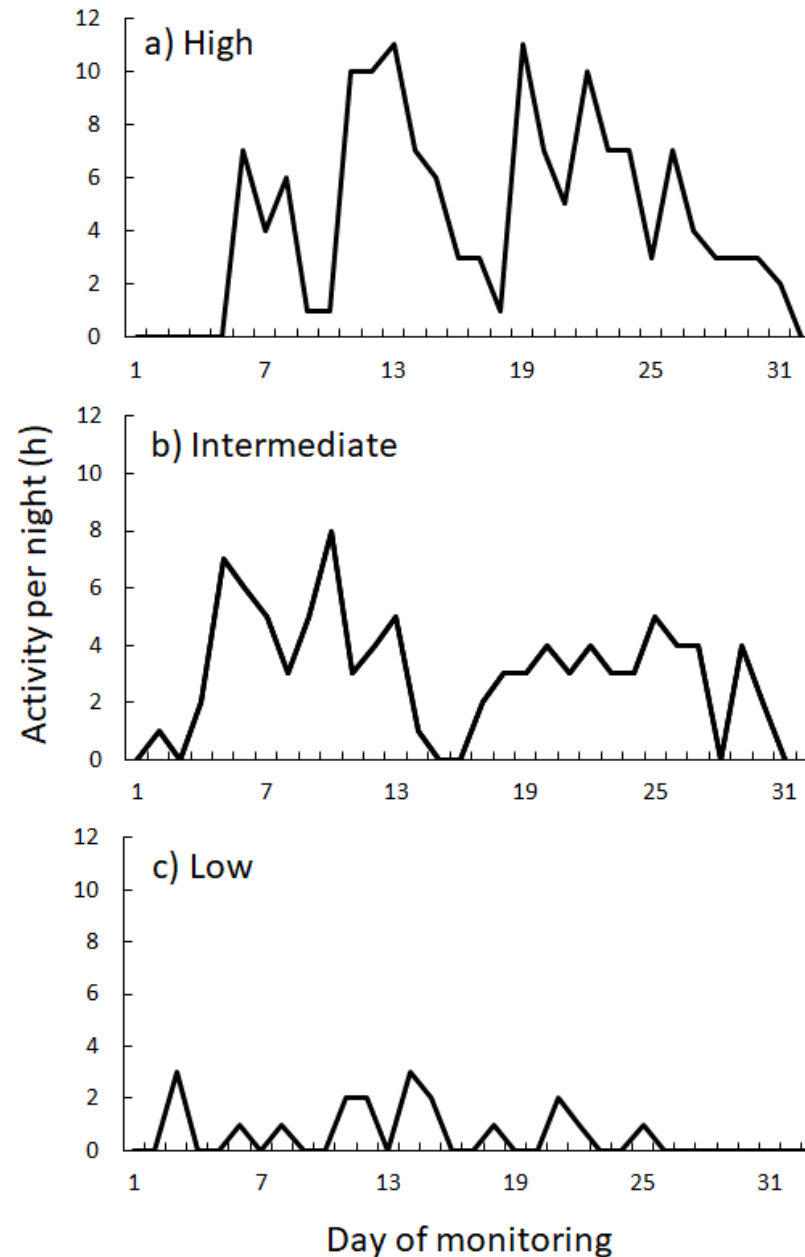
Exposed
nontarget prey
of carnivores are
unlikely to be a
major pathway
of exposure





Primary exposure
may be mitigated
by applying
rodenticide above
and off the ground

Rats respond to bait depletion



- Bait stations without bait can't kill rats
- Bait should be monitored closely
- Population recovery allows for opportunity for more intoxicated rats
 - More intoxicated nontargets



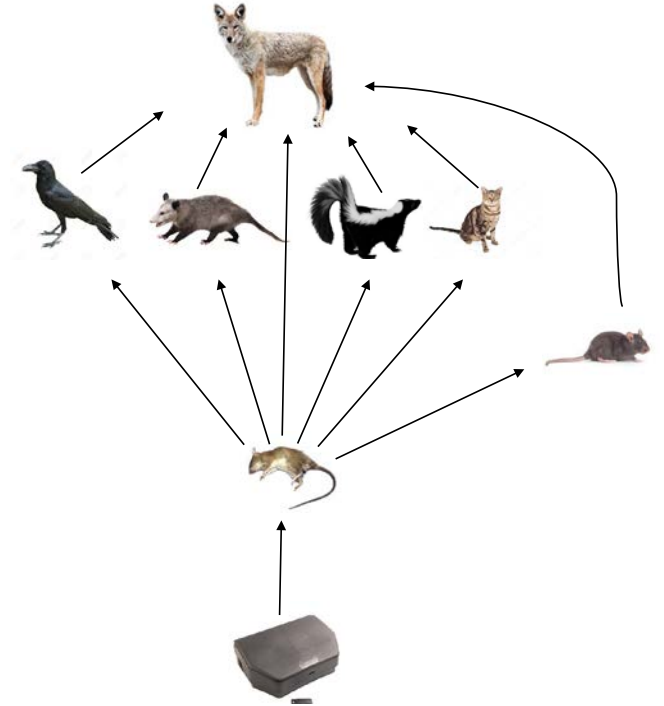
The presence of nontarget wildlife can be predicted by yard type and distance to green space

Yard type matters!

Figuring out neophobia is key to success

Rats entered only 59-70% of the
bait stations they visited





Consumption of rat carcasses as a pathway for rodenticide exposure of wildlife in southern California





How are urban carnivores getting exposed?



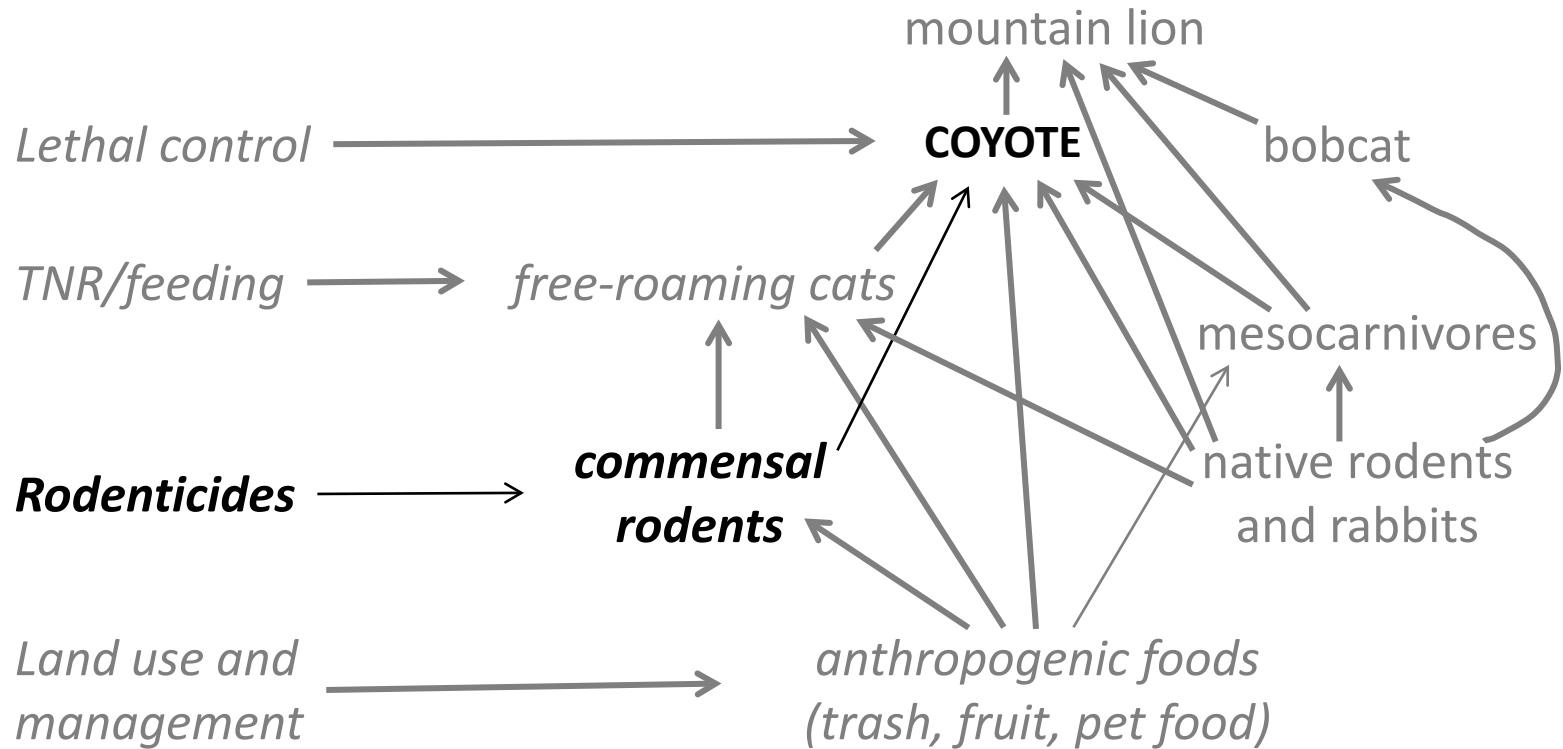
UNIVERSITY OF CALIFORNIA
Agriculture and Natural Resources

Methods

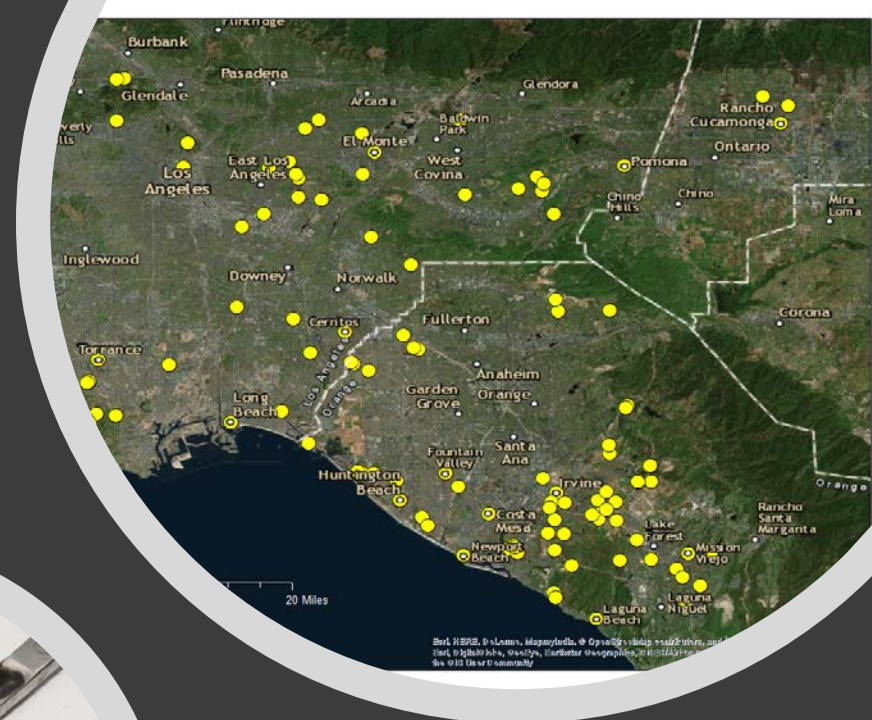


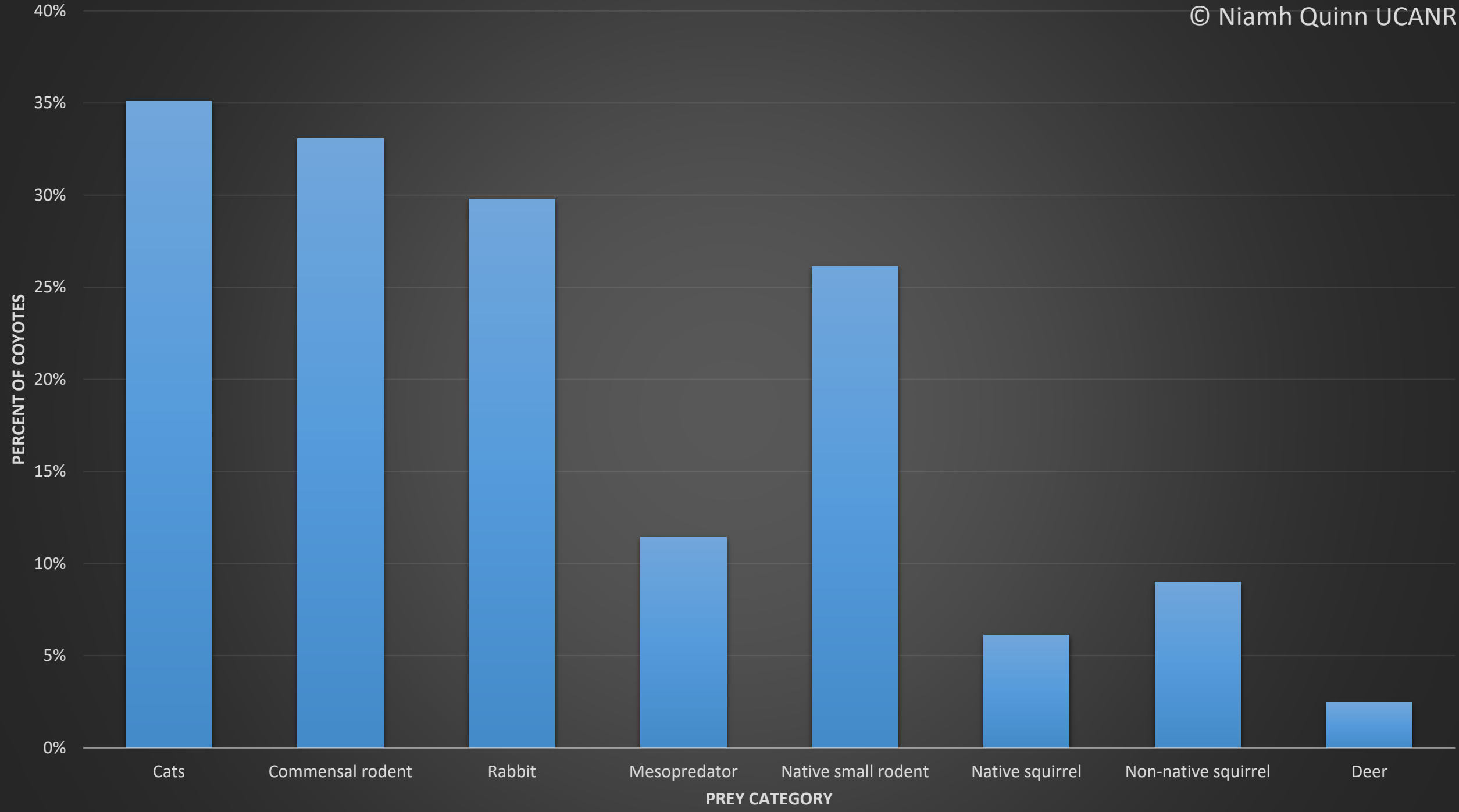
- **Short-term diet (single–few meals)**
Conventional stomach contents analysis
Sort and identify remains visually with reference collection
Identify by hair structure

Molecular (DNA) analyses
(with R. Walter - CSUF)
Homogenize stomach contents
Extract prey DNA
PCR screen using primers of *Felis*, *Rattus*, *Mus* and 13 native genera

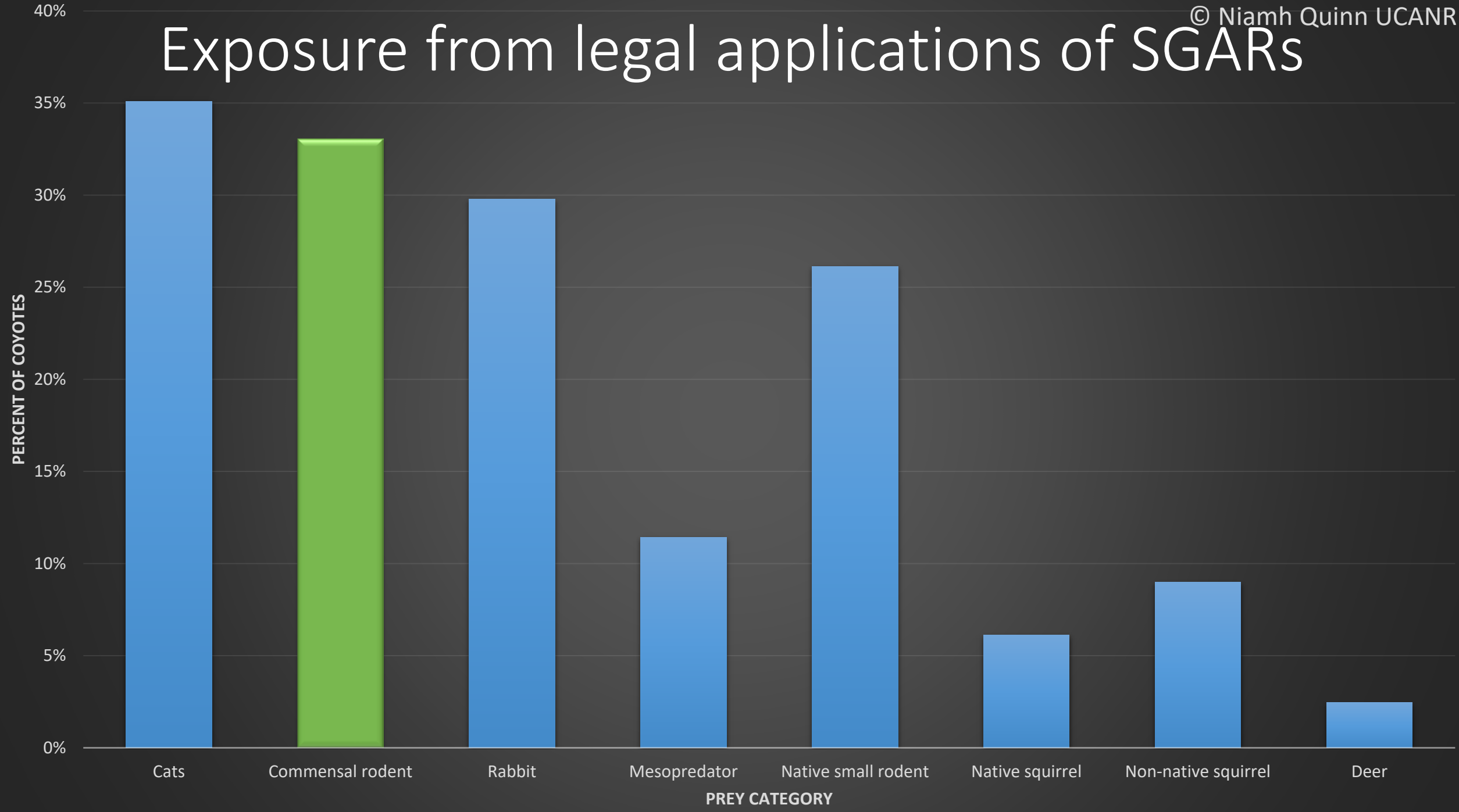


- As of today, we have necropsied >550 coyotes
 - Federal, State, County Agencies
 - Cities
 - Pest management professionals

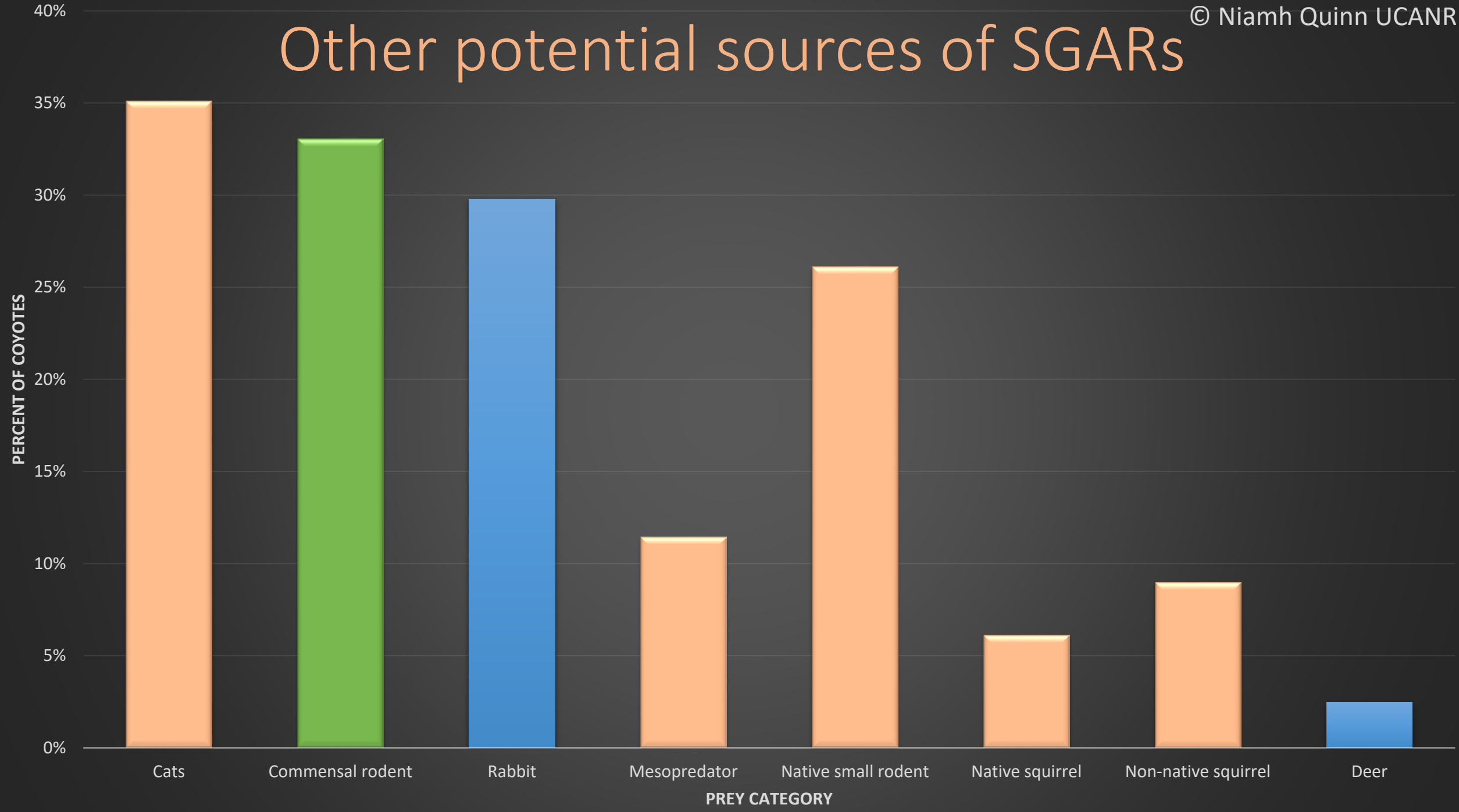


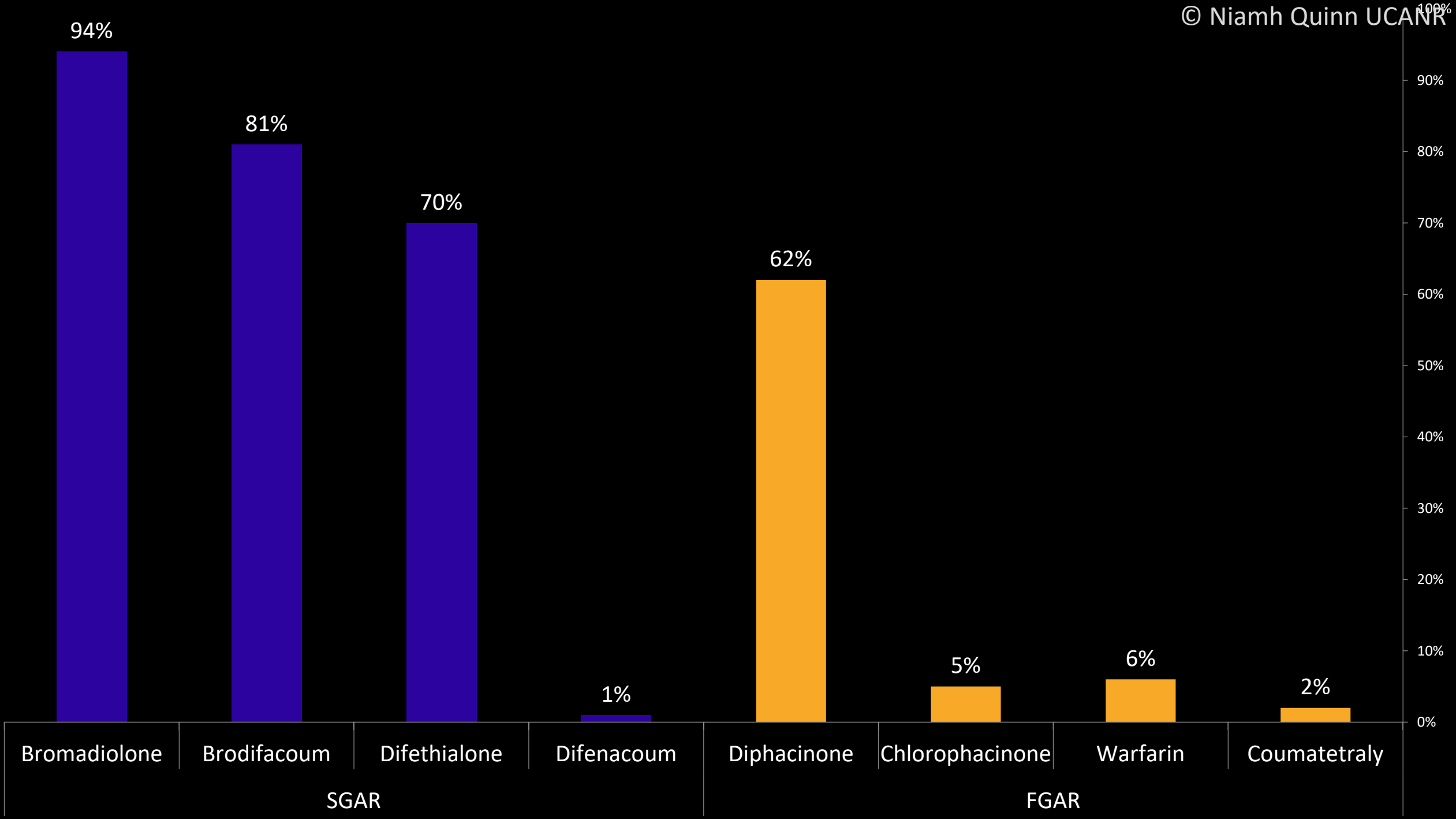


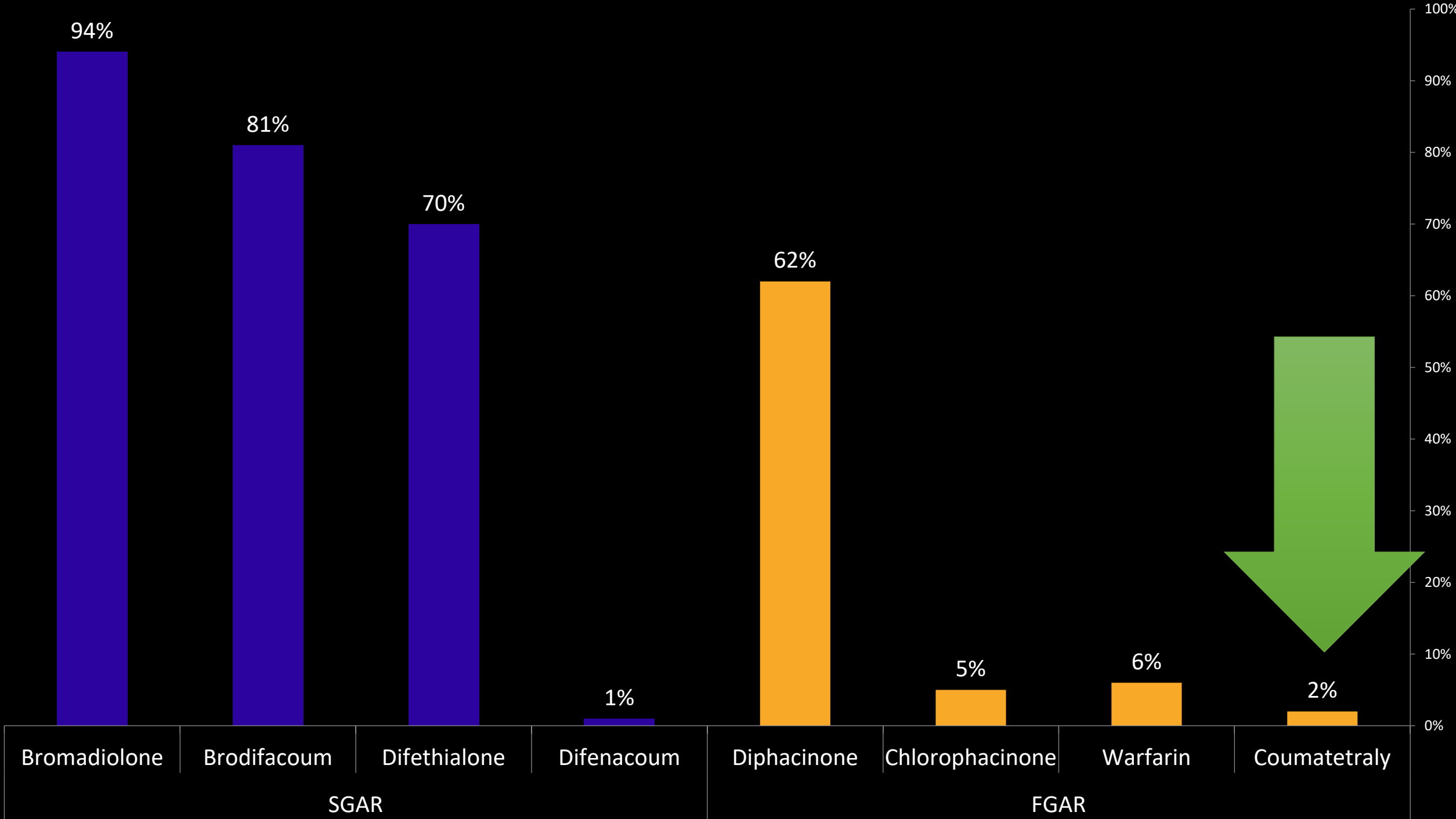
Exposure from legal applications of SGARs



Other potential sources of SGARs







94%

81%

70%

1%

62%

5%

6%

2%

Bromadiolone

Brodifacoum

Difethialone

Difenacoum

Diphacinone

Chlorophacinone

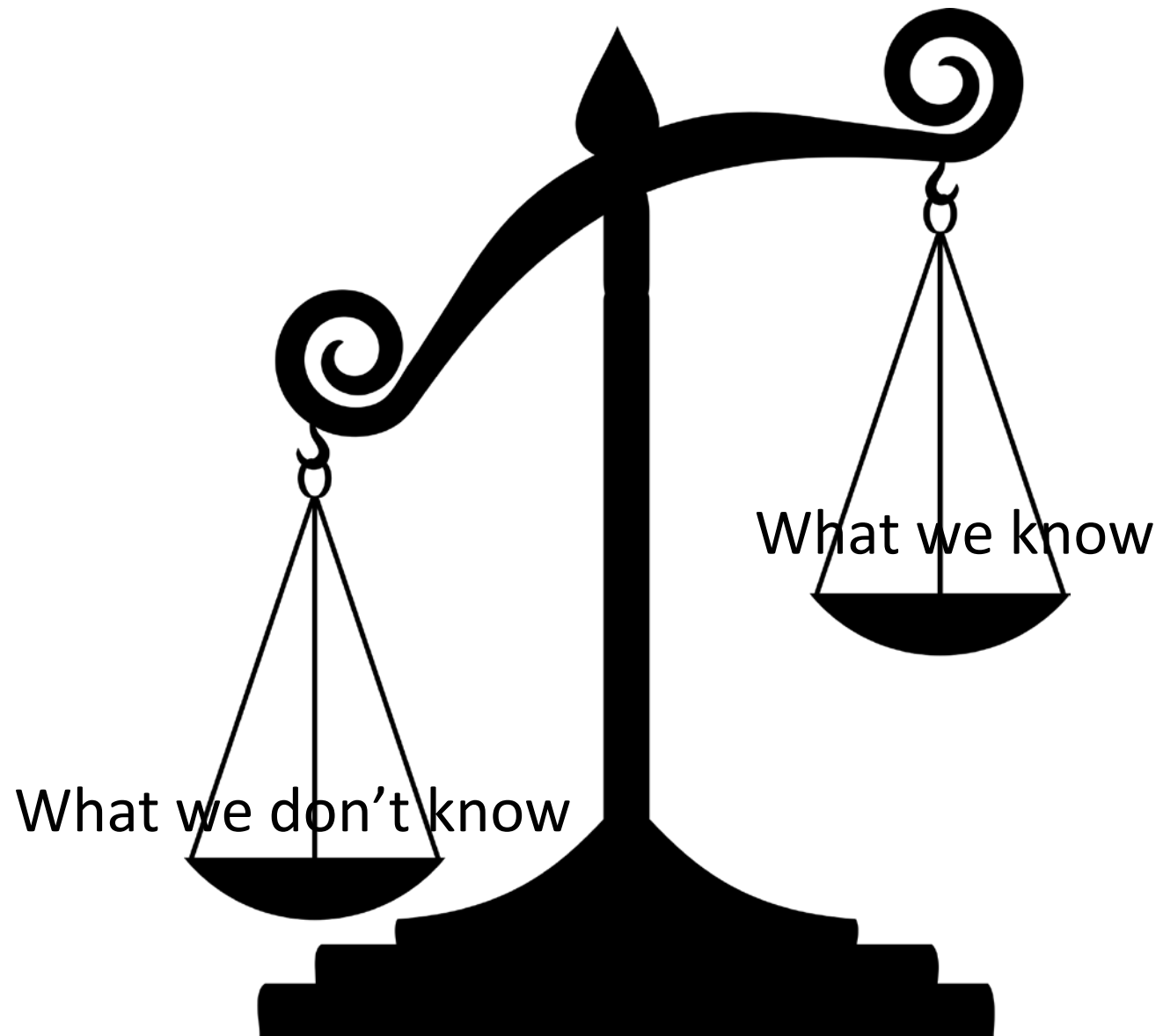
Warfarin

Coumatetraly

SGAR

FGAR

100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%





Detection of coumatetraly is evidence of illegal applications of rodenticides in Southern California



Illegal Rodenticide

R02 RAT Poison



Is exposure to urban coyotes occurring from legal applications of anticoagulant rodenticide by pest management professionals?



However, even if this is true, exposure may not be having any population level impact on coyotes in urban southern California (or other predators and birds of prey)





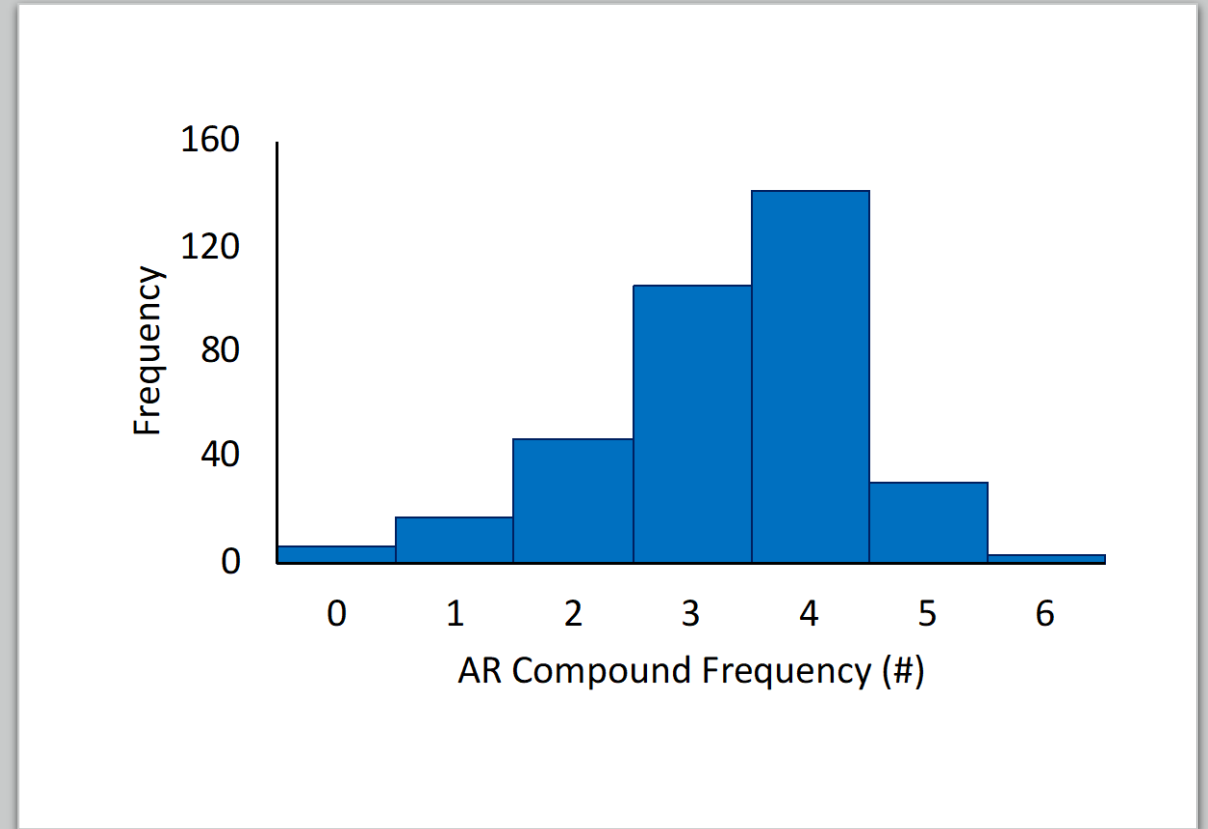
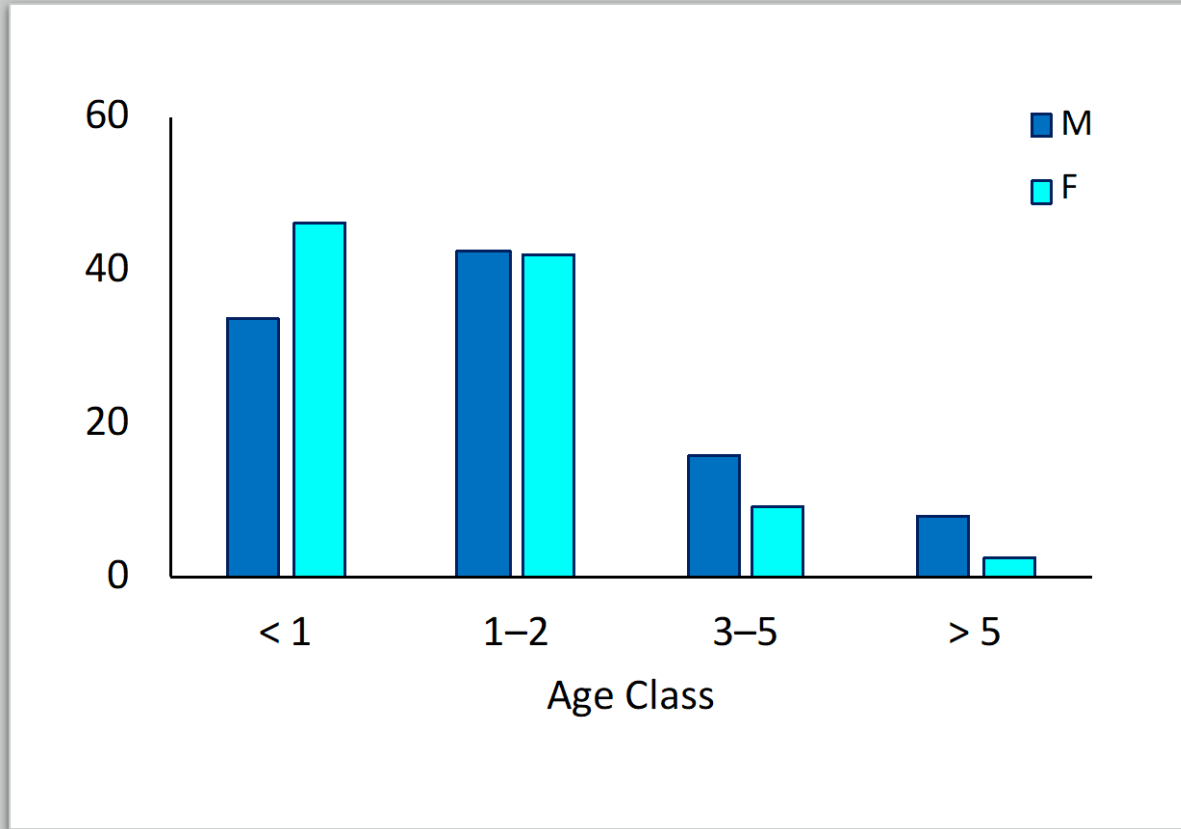
Researching the sublethal impacts of rodenticide exposure on urban coyotes

 **UNIVERSITY OF CALIFORNIA**
Agriculture and Natural Resources

Are we learning anything new about AR exposure?

AR Compound	Compound Frequency		Residue Concentration (ppb)		
	#	%	Mean ± SD	Median	Min – Max
SGAR					
Bromadiolone	335	95	611.61 ± 571.09	464	0 – 2776
Brodifacoum	294	83	99.92 ± 168.24	31	0 – 1269
Difethialone	257	73	144.53 ± 258.40	46	0 – 1653
Difenacoum	4	1	0.06 ± 0.56	0	0 – 6
FGAR					
Coumatetralyl	3	1	0.15 ± 2.53	0	0 – 47
Diphacinone	229	65	71.63 ± 158.74	16	0 – 1752
Chlorophacinone	23	7	5.09 ± 30.63	0	0 – 414
Warfarin	23	7	0.25 ± 1.20	0	0 – 11

More rodenticide.....

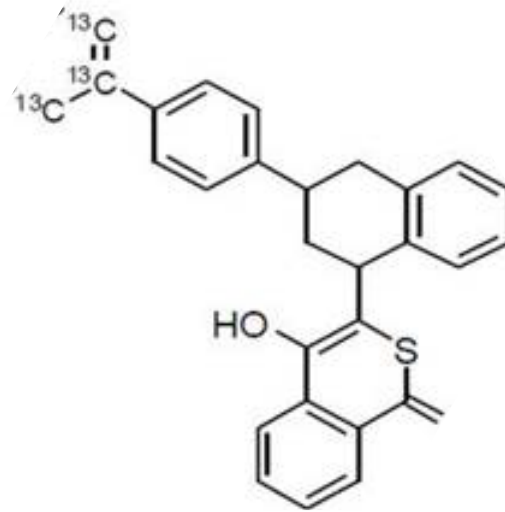




**JURY
IS STILL
OUT**

There is no apparent relationship between body condition and AR exposure

100% FUNDED!



Investigation of Rodenticide Pathways in an Urban System Through the Use of Isotopically Labelled Bait

 UNIVERSITY OF CALIFORNIA
Agriculture and Natural Resources



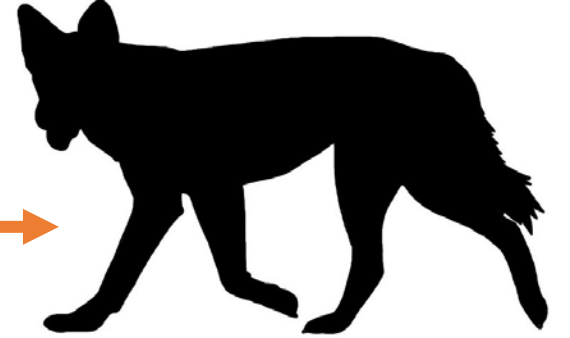
LIPHATECH



UCDAVIS
UNIVERSITY OF CALIFORNIA

Wildlife Services
NWRC
National Wildlife Research Center





100%
FUNDED!



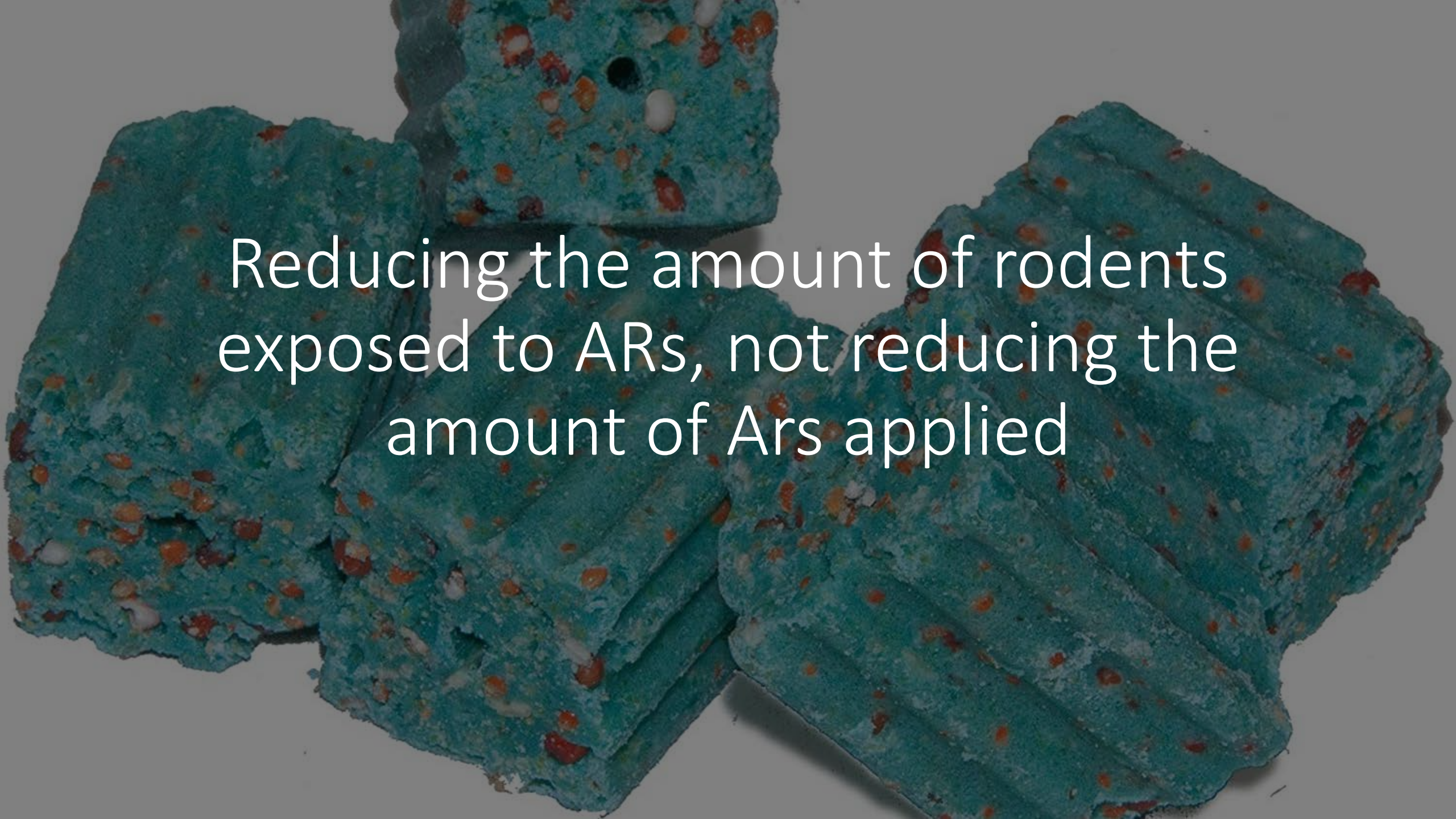
California Department of Pesticide Regulation



Development of best management practices to manage urban rats, protect public health, and reduce rodenticide use

BMPs generated from workshop

- Improved ID, record taking, electronic monitoring
 - Restrictions on number of days bait can be applied
 - Several iterations of “pulse baiting”
- Education of consumers of pest management
- Better PMP education
- Mitigation in sensitive areas
 - Restrict all applications of SGARs in environmentally sensitive environments
 - Avoid placing stations in areas/habitats where nontargets are present
 - Place bait stations above ground to limit nontargets
 - Place stations <100ft from structures, but also consider structures that border open space to be sensitive areas
 - Limit SGAR application to specific situations
 - Encourage trapping only in certain areas



Reducing the amount of rodents
exposed to ARs, not reducing the
amount of Ars applied

Proposed Action

- Reducing the proportion of rats that are exposed to ARs on the front end
 - Trapping first, ARs subsequently
 - Trapping in conjunction with use of ARs
 - Acute rodenticide first, ARs subsequently





How are we going to
achieve this....

Very challenging to develop....

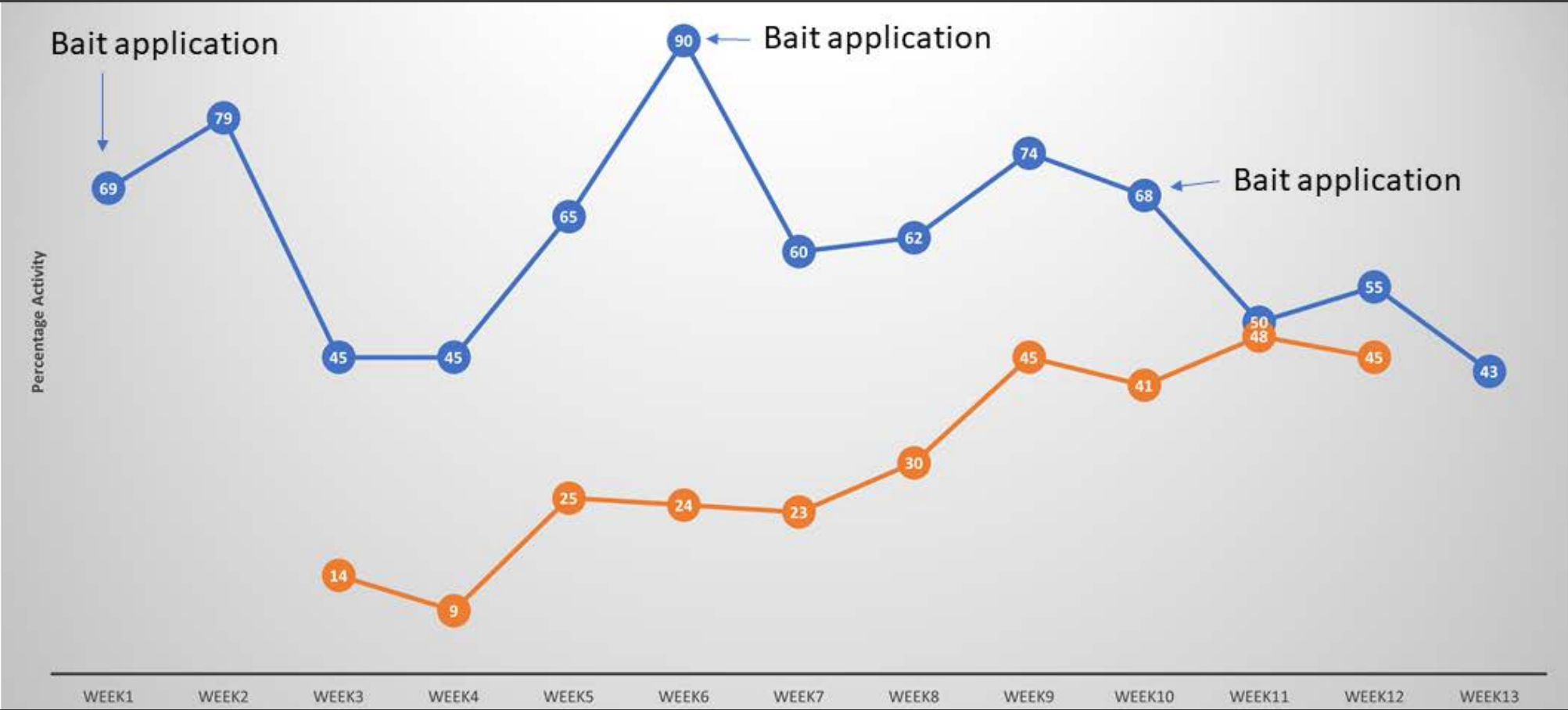
Complex telemetry system

- Testing how quick it will take to kill approx. 10 rats with
- Second generation anticoagulant only
- Trapping only
- Mixed management
 - Trapping
 - Rodenticide

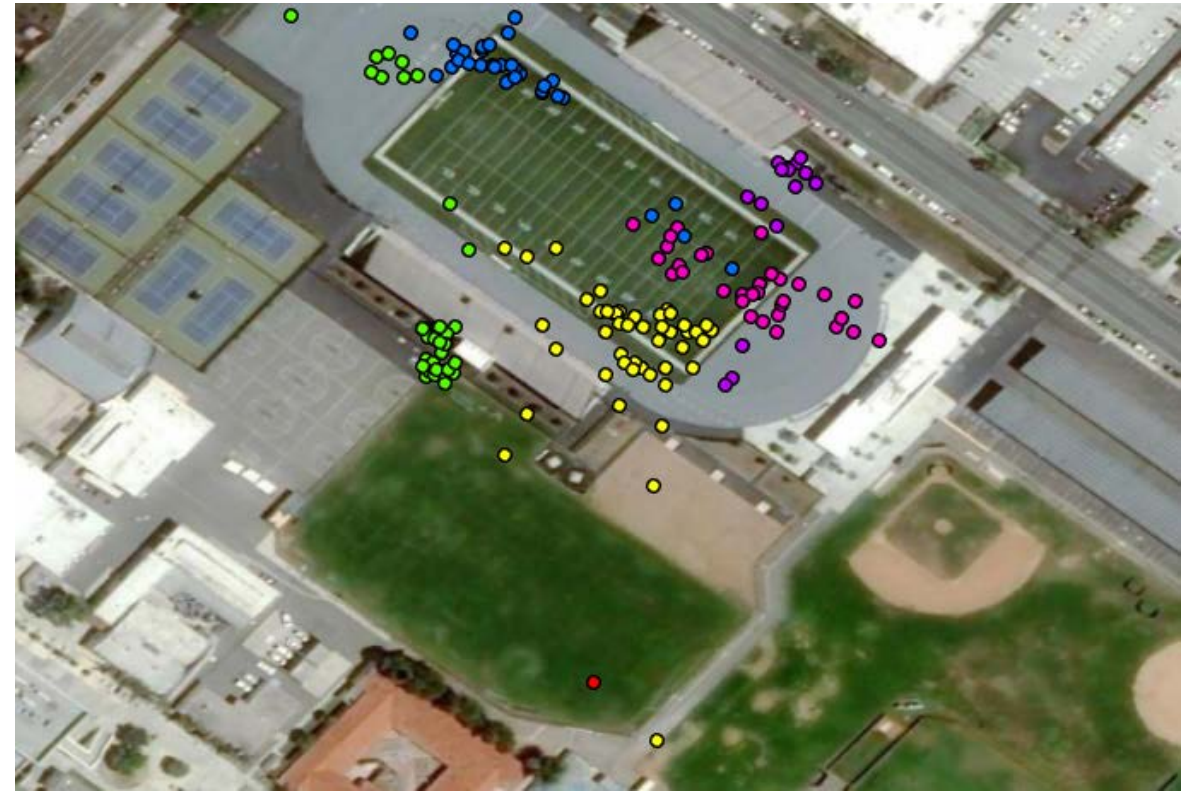
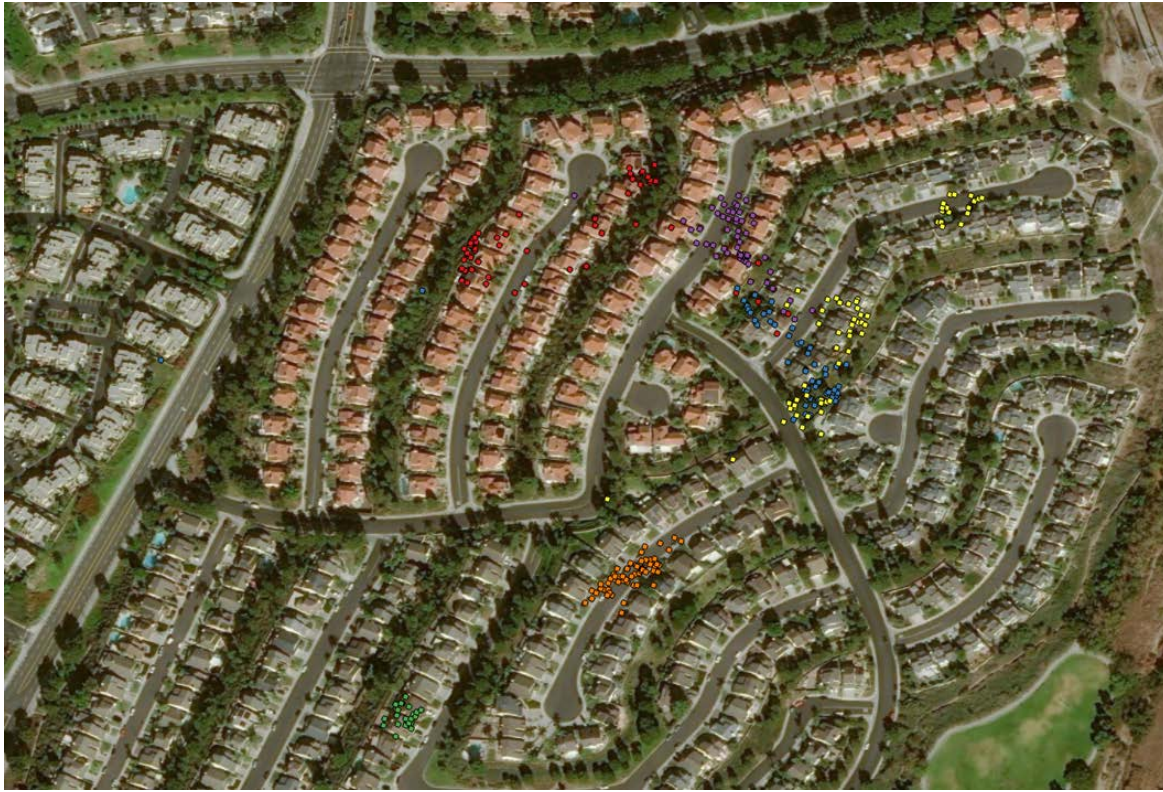








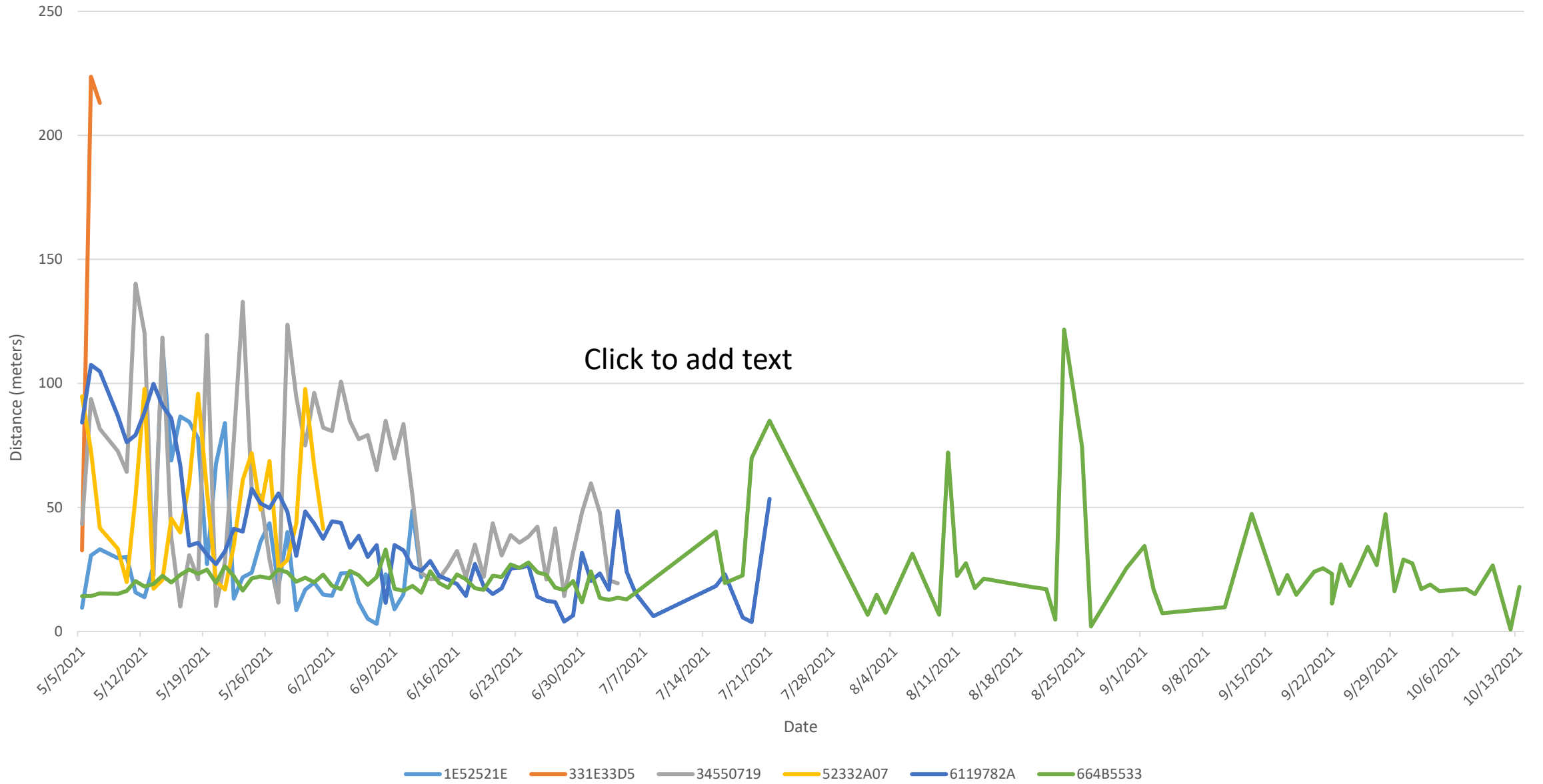
Preliminary results



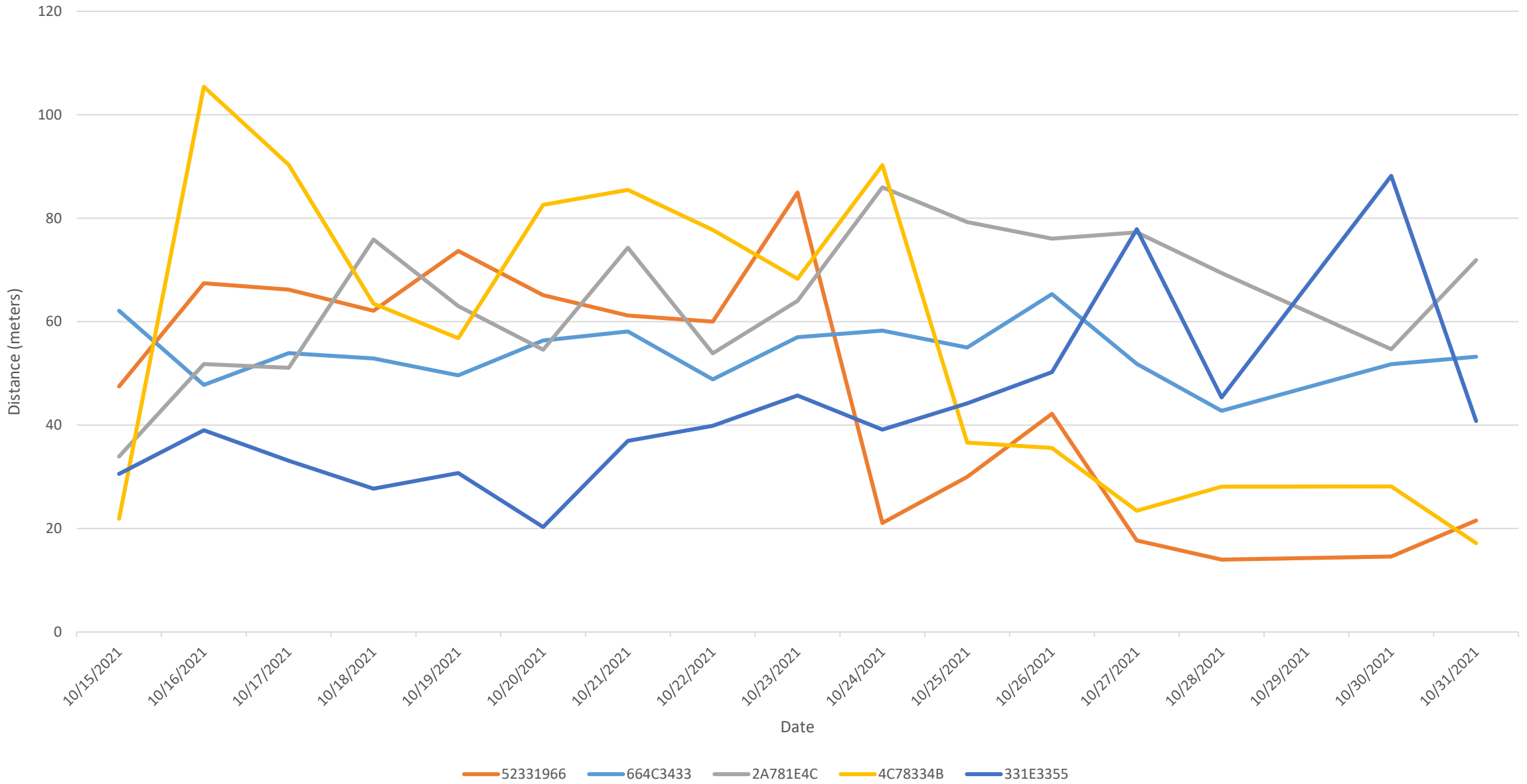
Roof rat movements

- Data from a school site and large HOA

SCREC: Collared Rat Movement



Newport Harbor High School: Collared Rat Movement



Indirect
research-Coyote
collaring and
population
density estimates

Are ARs
impacting urban
coyote densities



Quality and Productivity
Commission


An assessment of secondary toxicity risk for 0.005% diphacinone treated grain via three application strategies for CA ground squirrels



Number of radiotransmitted California ground squirrel carcasses that were located belowground, aboveground, and the proportion located belowground at rangeland locations in central California during summer and autumn, 2018–2019.



	Belowground	Aboveground	Proportion belowground	Potentially scavenged	Adjusted proportion
Summer	19	3	0.86	0	0.86
Autumn	23	1	0.96	5	0.79
Comp	42	4	0.91	5	0.82



An assessment of
secondary impacts
of anticoagulant
rodenticides on
predators

 **UNIVERSITY OF CALIFORNIA**
Agriculture and Natural Resources



Results—Exposure

- Liver tissue collected from dead coyotes
 - - 44 of 83 exhibiting exposure (53%); lower than urban studies
 - - 63 of 82 with concentrations ≤ 100 ppb (77%)
 - - 27 were exposed to multiple ARs (max 4)

	Brod	Brom	Difeth	Diph	Chloro	SGAR	FGAR	Total
Number	22	29	10	25	8	33	29	44
Max ppb	613	657	316	238	295	795	295	953
Ave ppb	18	45	9	16	10	72	26	98

What lessons
can be
learned from
California?





Stab in the dark
legislation and
regulations do
not work!

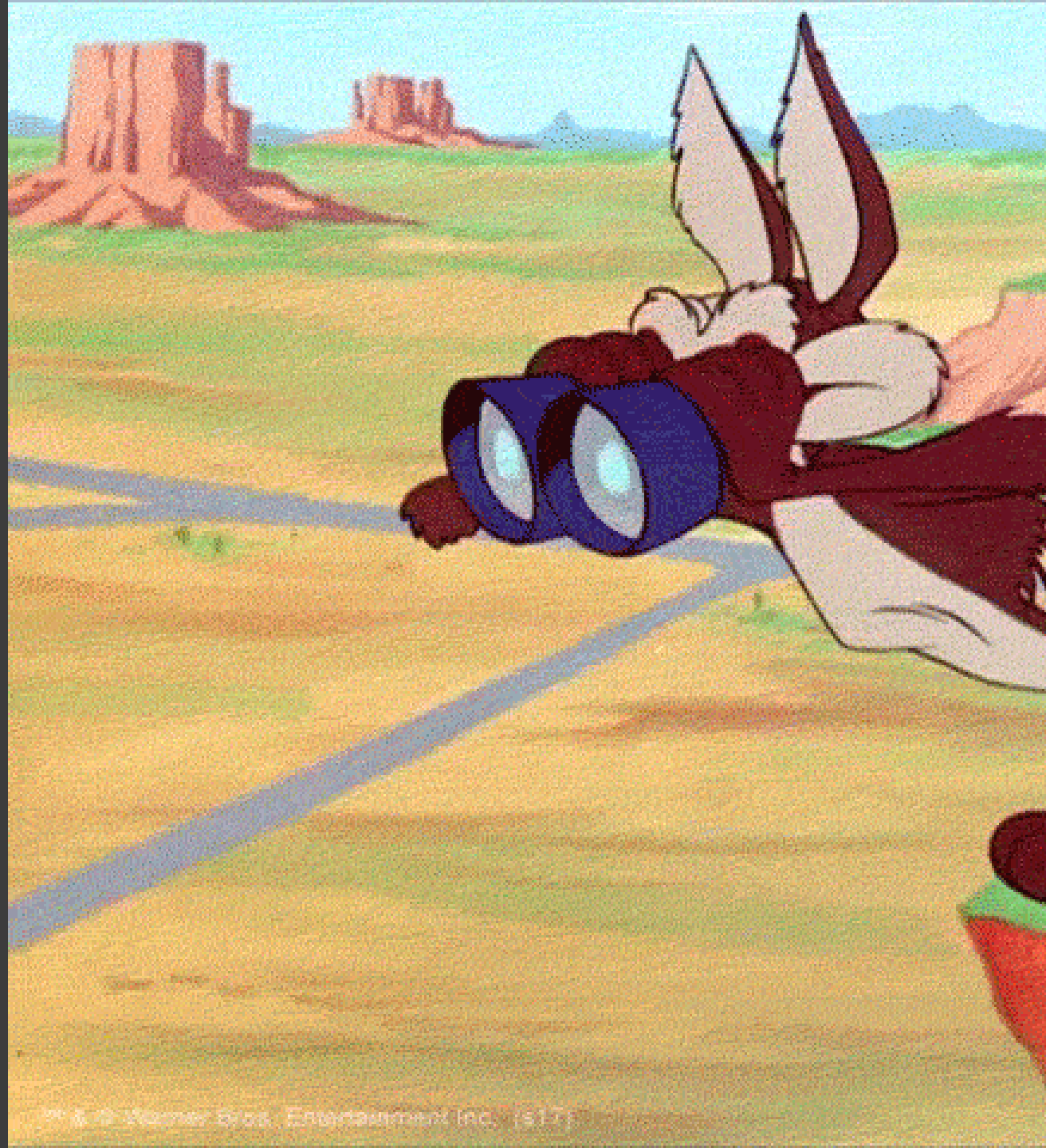



Rats are likely a major part of the rodenticide pathway



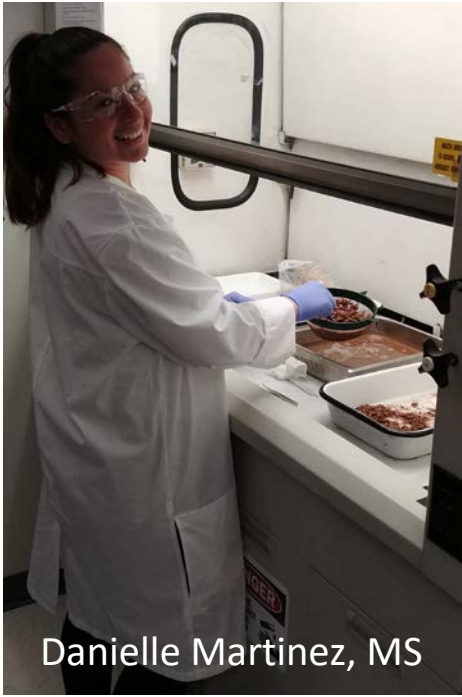
The more we learn
about rat
management, the
more I realize we
know so little

The data needed to make better decisions and future mitigation measures are not available



A cluster of black gears of various sizes is positioned on the left side of the image, partially overlapping the text. The gears are arranged in a way that suggests a mechanical or interconnected system. The background is a solid, medium gray color.

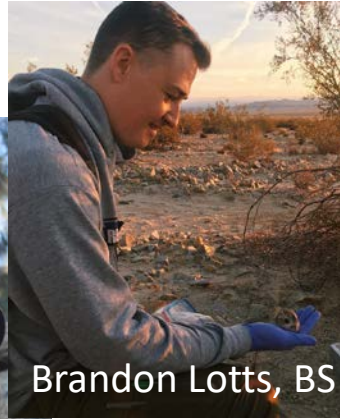
If you don't know
how something is
broken, can you
fix it?



Danielle Martinez, MS



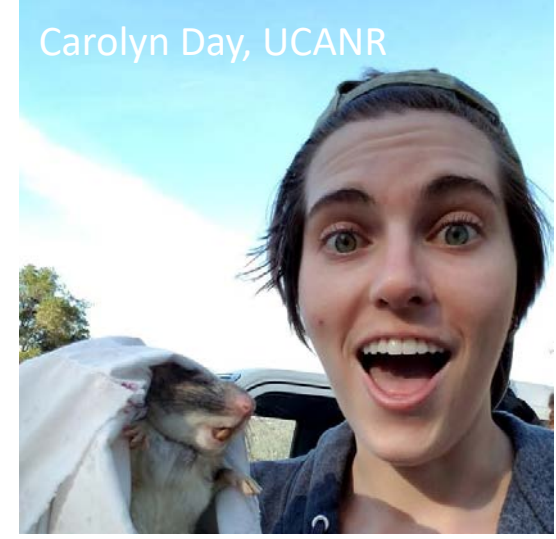
Jennifer Shedden, MS



Brandon Lotts, BS



Dr. Natalie Levy, UCANR



Carolyn Day, UCANR



Chris Burke, MS



Ariana McKenzie, MS



Dr. Paul Stapp



Dr. Roger Baldwin



Questions



Dr. Niamh Quinn

Human-Wildlife Interactions Advisor

 **nmquinn@ucanr.edu**

 **949-301-9182 ext 1004**

 **@SCUWMCouncil**

 **@cosmopolitancoyotes**

 **www.ucSCURRI.com**