Common Wildlife Pests and Preferred Management Practices Differ Regionally Throughout California

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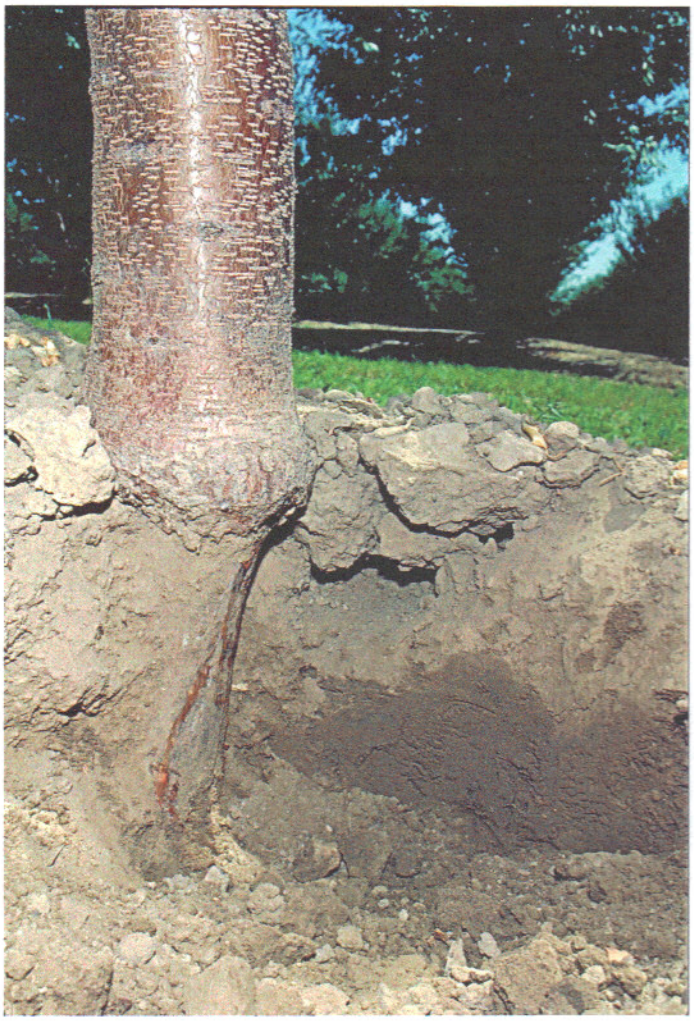
Introduction

Agriculture is an essential part of the California economy, accounting for $39 billion annually (Shwiff et al. 2009). Agricultural commodities in California are also extremely diverse, with over 400 commodities produced in 2009. This high economic value combined with a broad diversity in commodities makes controlling wildlife pests in California imperative, yet quite challenging. For example, a recent study investigating the economic damage caused by bird and rodent pests to just 22 commodities across 10 counties in California indicated a loss of $168–$504 million annually (Shwiff et al. 2009). However, this value took into account only a portion of the agricultural production that occurs throughout California, and did not account for additional impacts such as structural damage to dams and levees (e.g., loss of structural integrity of irrigation canals caused by burrowing rodents), ecological damage (e.g., nesting failures for song birds), and disease transmission (e.g., spread of bubonic plague or hanta virus by rodents). Clearly, controlling wildlife pests is often warranted to reduce these deleterious impacts.

Management tools that are incorporated into an IPM program will vary depending on the pest species involved. Many wildlife species are considered major pests of agricultural commodities including the California ground squirrel (*Spermophilus beecheyi*), pocket gopher (*Thomomys* spp.), meadow vole (*Microtus* spp.), and coyote (*Canis latrans*) although there was uncertainty as to which species posed the greatest threat to agricultural production. Greater insight into the methods used to control these pests is needed. Quantifiable data on these issues would aid the development of more effective control programs to deal with these damaging pests.

Therefore, the goal was to develop an electronic survey that would target individuals involved with assisting or regulating agricultural producers who experience wildlife pest problems to provide quantitative data on management and research needs to better guide future research efforts in developing more effective, practical, and appropriate methods for managing these pests. The primary participants for this survey were University of California Cooperative Extension and County Agricultural



Gopher burrow and crown of tree damaged by a pocket gopher, *Thomomys* sp.
Courtesy UC Statewide IPM Program, Photo by Jack Kelly Clark

Commissioner's office employees, although various Commodity boards, other University affiliated faculty, USDA Wildlife Services, and California Department of Fish and Game (CDFG) employees were also surveyed. A number of questions were asked of survey participants, but two of the primary objectives were to determine which wildlife species were most frequently listed as a common pest species, and which management practices were preferred for managing wildlife pests. Specifically, these questions were worded as follows: 1.) In your opinion, which wildlife pest results in the GREATEST, SECOND GREATEST, and THIRD GREATEST number of complaints each year?; and 2.) Many people have differing perspectives on what are appropriate methods for controlling wildlife pests. Based on your interaction with most growers, ranchers, pest control advisors, and other individuals responsible for wildlife pest control in agriculture in your area, provide a score ranging from 1–5 (1 = highly undesirable, 2 = undesirable, 3 = neutral, 4 = desirable, and 5 = highly undesirable) for the following potential methods of wildlife pest control given their appeal to these individuals.

Individuals often have varying viewpoints on these issues depending on a variety of factors including the local agricultural systems and wildlife species, personal upbringing, social status, and political beliefs. These viewpoints are often represented by regional differences in responses. As such, survey participants were divided into 4 separate regions (coastal, mountain, central and desert valley, and statewide regions) that were believed to be relatively similar in agricultural and socio-political composition. This allowed me to account for regional differences in these objectives as well. The number of respondents in each region was: coastal = 43, mountain = 16, central and desert valley = 57, statewide = 26.

Common Wildlife Pests

Survey participants were asked to rank the wildlife pest species that resulted in the greatest, 2nd greatest, and 3rd greatest number of complaints annually. These rankings received a score of 3, 2, or 1 respectively, with scores averaged across each species. Comparison of the 6 most common pest groupings (birds, gophers, ground squirrels, voles, wild pigs [*Sus scrofa*], and coyotes) indicated significantly different rankings ($P < 0.001$). Of these pests, ground squirrels ($\bar{x} = 1.31$) and gophers ($\bar{x} = 1.09$) were the highest ranking, followed by birds ($\bar{x} = 0.67$), coyotes ($\bar{x} = 0.63$), wild pigs ($\bar{x} = 0.47$), and voles ($\bar{x} = 0.37$).

I also observed a significant difference in pest rankings by region ($P = 0.011$) indicating that the importance of pests varied depending on which region of the state the survey participant was located. For regional comparisons, mean ranks for birds were higher for the statewide region ($\bar{x}$ rank = 1.19) than for all other regions ($\bar{x}$ rank = 0.19–0.64), while ranks for ground squirrels were highest for the central and desert valley region ($\bar{x}$ rank valley region = 1.64, $\bar{x}$ rank for all other regions = 0.81–1.19; Table 1). Coyote ranks were highest for the mountain region ($\bar{x}$ rank = 1.25) and lowest for the coastal ($\bar{x}$ rank = 0.50) and valley ($\bar{x}$ rank = 0.51; Table 1) regions. Regional ranks for other pests did not differ (Table 1).

Table 1. Mean rank scores (Rank) for the 6 wildlife pests most frequently listed as 1 of the top 3 wildlife pests that result in the greatest number of complaints annually across 4 separate regional classes in California. Multiple comparisons (Fishers LSD) were conducted to test for differences in rank scores for each species across regional classes (Reg).

	BIRD		GOPHER		G. SQUIRREL		VOLE		WILD PIG		COYOTE	
REGION	Rank[a]	Reg[b]	Rank[a]	Reg[b]	Rank[a]	Reg[b]	Rank[a]	Reg[b]	Rank[a]	Reg[b]	Rank[a]	Reg[b]
Coastal	0.57	B	1.19	A	1.19	B	0.19	A	0.57	A	0.50	B
Mountain	0.19	B	0.88	A	0.81	B	0.38	A	0.56	A	1.25	A
Valley	0.64	B	1.15	A	1.64	A	0.58	A	0.36	A	0.51	B
Statewide	1.19	A	0.96	A	1.12	B	0.19	A	0.46	A	0.73	AB

[a] For each survey participant, the highest ranking pest received a score of 3, the second highest ranking pest received a score of 2, and the third highest ranking pest received a score of 1. All other pests received a score of 0.
[b] Means in the same column with the same letter did not differ ($P < 0.05$).

Preferred Management Practices

Rankings were not equivalent for the various control methods that were provided to survey participants ($P < 0.001$). Collectively, baiting ($\bar{x}$ rank = 3.92), trapping ($\bar{x}$ rank = 3.83), and biocontrol ($\bar{x}$ rank = 3.61) were considered the most appealing methods of control (Fig. 1). The use of frightening ($\bar{x}$ rank = 3.19) and gas explosive devices ($\bar{x}$ rank = 2.91) were least appealing (Fig 1).

Rankings of control methods also varied by region ($P < 0.001$). The use of baiting ($\bar{x}$ rank = 3.45–4.41), trapping ($\bar{x}$ rank = 3.32–4.09), and biocontrol ($\bar{x}$ rank = 3.00–3.98) typically scored high, although trapping scores were lower for the central and desert valley regions ($\bar{x}$ rank = 3.32), while biocontrol scored low for the statewide region ($\bar{x}$ rank = 3.00; Table 2). The appeal of chemical repellents ($\bar{x}$ rank = 3.13–3.38), frightening devices ($\bar{x}$ rank = 2.91–3.60), and gas explosive devices ($\bar{x}$ rank = 2.75–3.02) was typically quite low, although frightening devices did score somewhat higher for the statewide region ($\bar{x}$ rank = 3.60; Table 2). Other control methods exhibited variable responses. For example, exclusionary devices were the most appealing control method in the coastal region ($\bar{x}$ rank = 4.03), but were the least appealing method in the central and desert valley region ($\bar{x}$ rank = 2.58; Table 2). Likewise, the scores associated with shooting ($\bar{x}$ rank = 2.91) and fumigants ($\bar{x}$ rank = 3.18) were low for the coastal region, but were relatively high for the statewide region (shooting: $\bar{x}$ rank = 3.75, fumigants: $\bar{x}$ rank = 3.95; Table 2).

Putting it all into perspective

Ground squirrels and pocket gophers were consistent wildlife pests throughout California and have long been considered to be the two most damaging pests to California agriculture. Ground squirrels were a particularly large pest in the central and desert valleys. This region of the state is responsible for much of the nut and tree fruit production that occurs in California, for which consumption of these food sources was the primary form of damage caused by ground squirrels (Baldwin et al. 2011). However, ground squirrels will also girdle trees, consume green vegetation, and cause considerable damage to irrigation hose, microsprinklers, and irrigation canals. In fact, ground squirrels were among the highest ranking pests with respect to the amount of damage caused (Baldwin et al. 2011), with previous estimates of damage ranging from $20–$28 million

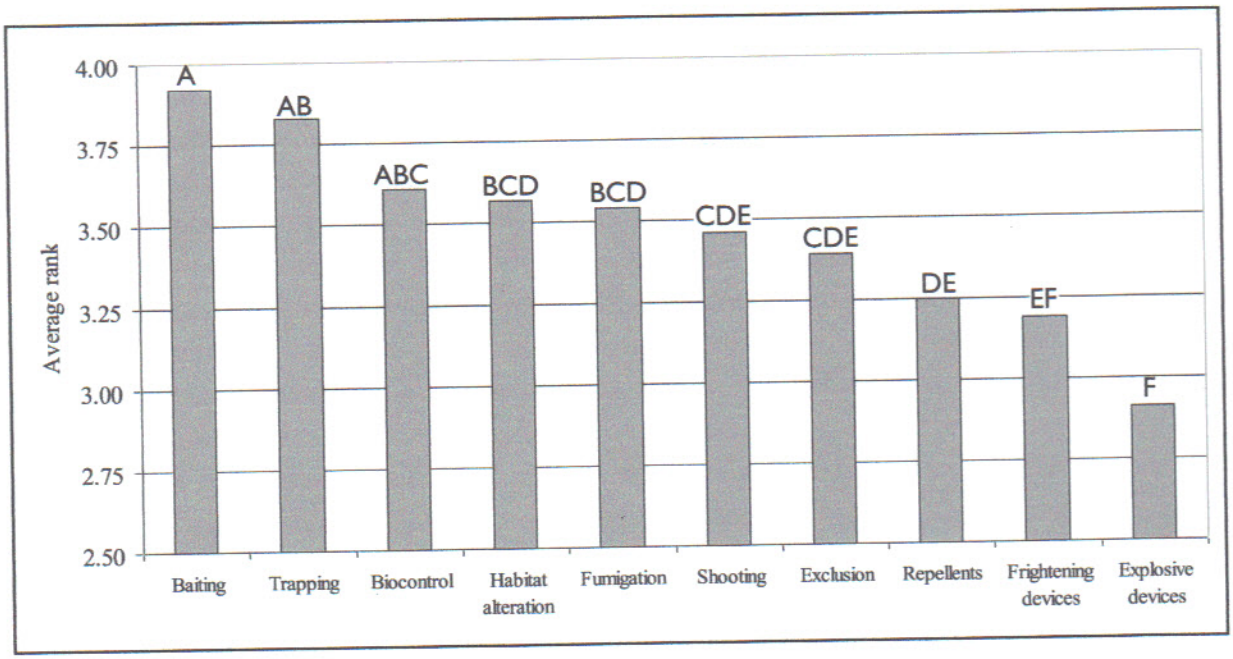


Figure 1. Mean rank scores indicating the appeal of each of the listed wildlife pest control methods throughout California. Possible ranks ranged from 1–5 with 5 indicating highly desirable and 1 indicating highly undesirable. Multiple comparisons (Fisher's LSD) were conducted to test for differences in rank scores across each control method. Means with the same letter did not differ ($P < 0.05$)

annually (Marsh 1998).

Like ground squirrels, pocket gophers cause extensive damage to a wide variety of crops. However, in contrast to ground squirrels, primary gopher damage is attributed to a loss in vigor or direct mortality of plants through damage to roots and girdling of stems (Baldwin et al. 2011). Other common forms of damage include consumption of crops and damage to irrigation infrastructure. Although gopher damage is fairly consistent across most crops, damage was highest in alfalfa (8.8% loss; Baldwin et al. 2011), so particular attention should be made to gopher presence in this crop.

Primary bird pests included crows (*Corvus brachyrhynchos*), blackbirds (*Agelaius* spp.), and starlings (*Sturnus vulgaris*). Individually, none of these bird species were considered as great a pest as pocket gophers, ground squirrels, voles, wild pigs, or coyotes, although collectively, birds were considered substantial pests, particularly by those who managed agricultural commodities or wildlife pests statewide. This strong statewide response is most likely representative of the respondent's employer, as 63% (10 of 16 total bird responses) of the individuals who listed birds as one of the most frequent pests in the statewide region worked for government agencies (either CDFG or Wildlife Services). These agencies are responsible for much of the bird control that occurs in California. As such, they likely had a stronger opinion on the impact caused by these pests.

The frequency with which coyotes were reported as pests also differed regionally, as coyote-human conflict was highest in the mountain region where much of the rangeland exists in California. The primary concern with coyotes was depredation of livestock, with losses by coyotes predictably the greatest in rangelands (8.9% loss; Baldwin et al. 2011), although damage to microsprinklers was a substantial concern in the central and desert valley region as well (Baldwin et al. 2011).

No regional differences were observed in the ranking for frequency of complaints for wild pigs. However, in locations where they are found, the composite damage from wild pigs was estimated to be greater than for all other wildlife pests (6.8% loss compared to 3.4–5.9% for other wildlife pests; Baldwin et al. 2011) surveyed in California. As such, wild pigs are definitely a major pest in many areas of California.

Of the 6 pest groupings discussed, voles were reported as the least frequent pest; this did not vary regionally. However, when voles were present, they were responsible for substantial economic losses, particularly in alfalfa where they resulted in the greatest amount of damage of any wildlife pest in any crop (11.3%; Baldwin et al. 2011). Therefore, when present, voles should be aggressively managed

Table 2. Mean rank scores (Rank) indicating the appeal of each of the below-listed wildlife pest control methods for Coastal, Mountain, Valley, and Statewide regions throughout California. Multiple comparisons (Fishers LSD) were conducted to test for differences in rank scores across each control method within the same regional class (Meth).

	COASTAL		MOUNTAIN		VALLEY		STATEWIDE	
CONTROL METHOD	RANK[a]	METH[b]	RANK[a]	METH[b]	RANK[a]	METH[b]	RANK[a]	METH[b]
Bait	3.61	AB	3.45	AB	4.22	A	4.41	A
Trap	3.94	A	4.09	A	3.32	BC	3.95	AB
Biocontrol	3.97	A	3.50	AB	3.98	AB	3.00	CD
Habitat alteration	3.79	A	3.45	AB	3.41	BC	3.62	BC
Fumigant	3.18	BC	3.44	AB	3.58	B	3.95	AB
Shooting	2.91	C	3.67	AB	3.53	B	3.75	B
Exclusion	4.03	A	3.30	AB	2.58	D	3.67	B
Repellent	3.13	BC	3.22	AB	3.28	BC	3.38	BCD
Frightening device	2.94	C	2.91	B	3.30	BC	3.60	BCD
Explosive device	2.75	C	2.90	B	3.02	CD	2.95	D

[a] Possible ranks ranged from 1–5 with 5 indicating highly desirable and 1 indicating highly undesirable.
[b] Means in the same column with the same letter did not differ ($P < 0.05$).

to prevent substantial damage to a variety of crops.

Collectively, the use of poison baits, trapping, and biocontrol were the most preferred methods of control for wildlife pests, while frightening and gas explosive devices were least preferred (Fig. 1). However, these rankings varied regionally (Table 2). Generally speaking, the coastal region was most different, with a stronger preference for non-lethal control methods such as exclusionary devices and habitat modification. The central and desert valley region exhibited the opposite trend with a strong preference for lethal removal approaches such as baiting, burrow fumigants, and shooting. These differences should not be unexpected given the more urban composition of the coastal region as opposed to the more rural make-up of the central and desert valleys. The only clear difference for the mountain region was a preference for trapping and a selection against frightening and gas explosive devices.

Interestingly, the statewide region trended toward approaches that have proven more effective yet practical (poison baits, burrow fumigation, and trapping), while avoiding those that have not been proven effective (e.g., biocontrol and gas explosive devices). Given the low efficacy of biocontrol, it is curious why it scored so high in all other regions. Possible explanations for this high ranking are a lack of knowledge on the low efficacy associated with this approach, or perhaps a strong desire to find a biocontrol method that is efficacious. Certainly the reliance on natural predation would lower the costs and environmental risks associated with other alternative control methods. Regardless, the strong regional differences observed clearly illustrate the importance of considering varying perspectives on the appropriateness of wildlife pest control methods. What may be economically and politically appropriate in one region, may not be met with the same enthusiasm elsewhere. Combining this information with knowledge on the most common wildlife pests in the differing regions of California should assist growers and PCAs in the development of an effective control program for these pests.

Lastly, it should be noted that the information presented here is a small sub-set of a much more extensive project on research and management needs as they pertain to wildlife pests in California. If you are interested in additional information on this topic, please contact the author for a copy of the Final Report.

Literature Cited

Baldwin, R. A., T. P. Salmon, R. H. Schmidt, and R. M. Timm. 2011. Vertebrate pest "research needs" assessment for California agricultural commodities. University of California, Davis, unpublished Final Report to CDFA.

Marsh, R. E. 1998. Historical review of ground squirrel crop damage in California. International Biodeterioration and Biodegradation 42:93–99.

Shwiff, S. A., K. Gebhardt, and K. N. Kirkpatrick. 2009. The economic impact of bird and rodent damage to California crops: an economic evaluation of the losses caused by bird and rodent damage and selected benefits of pest control expenditures. Report prepared for the California Department of Food and Agriculture, Vertebrate Pest Control Research Advisory Committee, 35pp.