

# FINAL REPORT

## STUDY TITLE:

Vertebrate pest “research needs” assessment for California agricultural commodities.

## PROJECT LEADER:

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## EXECUTIVE SUMMARY

Many wildlife species such as the California ground squirrel (*Spermophilus beecheyi*), pocket gopher (*Thomomys* spp.), and meadow vole (*Microtus* spp.) cause extensive damage to a variety of agricultural commodities in California, with estimates of

damage in excess of \$168 million annually. Controlling these pests is obviously warranted, but the scope of the problem far exceeds our ability to properly address all aspects of the problem. Given a limited availability of resources to solve all human-wildlife conflicts, we should focus our efforts on issues that will provide the greatest benefit to agricultural commodities in California. Therefore, we developed a survey to provide quantitative data on research needs to better guide future research efforts in developing more effective, practical, and appropriate methods for managing these pests. Results from our study included:

1. Ground squirrels (21% of respondents) and pocket gophers (18%) were listed as the primary wildlife pests. Birds (15%), coyotes (*Canis latrans*; 11%), voles (9%), and wild pigs (*Sus scrofa*; 8%) were also frequently listed. We did observe a significant pest × region interaction. Ground squirrels were considered a bigger pest in the central and desert valleys, coyotes were listed more frequently in the mountain region, while birds were considered a bigger pest in the statewide region. No other wildlife species differed regionally.
2. The wildlife pests deemed most in need of advancements in control methods were birds (21% of respondents), ground squirrels (18%), and gophers (17%). We observed no regional difference in response. Survey respondents indicated that a disproportionate amount of effort should be expended to develop better control methods for birds and wild pigs.
3. Wild pigs (6.8% loss), ground squirrels (5.9%), gophers (5.7%), and voles (5.3%) all caused equivalent levels of damage to agricultural commodities. However, this varied across crops with highest levels of damage reported for voles (11.3%) and gophers (8.8%) in alfalfa, wild pigs (10.0%), birds (9.6%), and ground squirrels (8.7%) in nut crops, and coyotes (8.9%) in rangelands.

4. Common forms of damage varied regionally for coyotes, but not for other wildlife pests. For coyotes, we observed no significant difference in types of damage caused in the central and desert valley region, although damage to irrigation structures received the greatest proportion of responses (57% of responses). In all other regions, depredation of livestock was the primary form of damage (84%).
5. Loss of crop production through consumption of foods was the primary form of damage caused by birds (77% of responses) and ground squirrels (69%). For gophers, loss of vigor or direct mortality of the plant was the primary form of damage (70%). No difference in forms of damage was noted for voles or wild pigs.
6. Control methods used most frequently and those deemed most effective differed regionally for birds. For the coastal region, exclusionary devices were used most frequently (75% of responses) and were considered most effective (82%). These values did not differ. For all other regions, frightening devices were used most frequently (84%), while frightening devices (37%) and shooting (22%) were considered most effective. These values did differ, indicating that frightening devices were not a preferred method for bird control.

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7. Control methods used most frequently for ground squirrels differed regionally. However, this difference was due to small sample sizes in the mountain region. As such, we combined all regions for analysis. Poison baits were used most frequently (85% of responses) and were considered to be the most effective (77%) control method for ground

squirrels. These values did not differ.

8. We observed no regional difference in the control methods used most frequently and those deemed most effective for all other wildlife pests. For gophers, poison baits were used most frequently (57% of responses), while poison baits (40%), traps (30%), and fumigants (19%) were considered most effective. The use of poison baits was both the most frequently used (68%) and most effective (63%) method for controlling voles. For wild pigs, shooting and trapping were considered to be both the most frequently used (61% and 26%, respectively) and most effective (50% and 28%, respectively) methods of control. Shooting (68%) was also the most frequently used method for controlling coyotes. Both shooting and trapping (34% and 44%, respectively) were considered equally effective. Values for the most frequently used and most effective methods did not differ for ground squirrels, gophers, voles, or wild pigs, but did differ for coyotes primarily due to the lower efficacy associated with shooting.
9. We observed no regional differences in why survey respondents felt the most frequently used and most efficacious methods differed for all pests. However, combined responses did differ for birds, gophers, wild pigs, and coyotes. For these pests, the most effective method was considered too costly (43%, 40%, 33%, and 18% of responses for birds, gophers, wild pigs, and coyotes). Other common responses were that the most effective method often required special certification to apply or was too restrictive to use (41%, 27%, and 22% for coyotes, birds, and wild pigs), and that there was a lack of knowledge on which control method was most effective (28% and 27% for wild pigs and gophers).

10. For all pests, greater advancements in control methods were listed as a top research priority ( x rank = 3.7–4.6). A better understanding of the economic damage caused by wild pigs ( x rank = 3.6) and the juxtaposition of crop fields and natural areas on the distribution and population dynamics of wild pigs ( x rank = 3.0) and voles ( x rank = 3.4) were also considered high priorities. A greater understanding of the biology of pest species ( x rank = 2.1–3.0) and greater knowledge of the impact of control methods to the environment ( x rank = 2.3–3.1) were frequently the lowest scoring responses. We observed no regional differences for any pest.
11. Collectively, the use of poison baits ( x rank = 3.9), trapping ( x rank = 3.8), and biocontrol ( x rank = 3.6) were considered the most appealing methods of control, while frightening ( x rank = 3.2) and gas explosive devices ( x rank = 2.9) were least appealing. However, we observed a significant control method × region interaction which illustrated substantial differences for various control methods across regions. In general, the coastal region was most different, with a stronger preference for non-lethal control methods such as exclusionary devices ( x rank = 4.0) and habitat modification ( x rank = 3.8). The central and desert valley region exhibited the opposite trend with a strong preference for lethal removal approaches such as baiting ( x rank = 4.2), burrow fumigants ( x rank = 3.6), and shooting ( x rank = 3.5). The statewide region trended toward approaches that are often more effective yet practical

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(poison baits [ x rank = 4.4]; burrow fumigation [ x rank = 4.0];

trapping [  $\bar{x}$  rank = 4.0]), while avoiding those that are not typically effective (e.g., biocontrol [  $\bar{x}$  rank = 3.0]; gas explosive devices [  $\bar{x}$  rank = 3.0]).

12. Most (61%) survey respondents believed that individuals involved in wildlife pest control in agriculture rely on an IPM approach for controlling these pests. However, this response varied regionally, as respondents in the central and desert valleys felt that most individuals used a single method that has proven effective (53% of respondents). The primary reasons provided as to why some individuals do not use an IPM approach were primarily due to a preference to use a single approach that has proven effective (43% of respondents), and a lack of effective control methods thereby eliminating the possible use of an IPM program (30%).
13. Of the listed attributes for control methods, efficacy was the most important (  $\bar{x}$  rank = 4.5). Methods that were quick and inexpensive were also highly preferred (  $\bar{x}$  rank = 3.6), while the humaneness of a control method was least important (  $\bar{x}$  rank = 1.8). We did observe a strong attribute  $\times$  region interaction. This interaction was primarily driven by differences in rankings between the attributes of environmental safety and applicator safety, where coastal and mountain region respondents believed that environmental safety was more highly preferred than applicator safety.

Collectively, our findings suggest that research and extension efforts should focus on developing better control methods for ground squirrels, pocket gophers, birds, wild pigs, coyotes, and voles. These control methods should be woven into an IPM program to maximize efficacy while minimizing negative effects to the environment. Special emphasis should be placed on control methods that are both efficacious and quick and inexpensive to apply. Regional differences should also be considered when

developing an appropriate control strategy. Lastly, our survey provides the framework with which to reassess these important factors at a later date. We strongly encourage such a reassessment at least every 10–15 years as changes in research needs are likely to occur.