A. Cover Page

1. Project Title: Testing the applicability of new application strategies of zinc phosphide for managing ground squirrels.

2. Project Leader:

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3. Cooperators: NA

4. CDFA Funding Request Amount/Other Funding:

PY1 (2022-2023) = $98,380
PY2 (2023-2024) = $48,123

5. Agreement Manager:

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B. Executive Summary

1. Problem: Burrowing rodents cause extensive damage in agricultural systems throughout California and the world. Rodenticides are commonly used as part of an Integrated Pest Management program to help control these burrowing pests. However, there has been increased concern about non-target exposure to these rodenticides in recent years, leading to substantial proposed changes to how these rodenticides might be used moving forward. These proposed changes may lead to the elimination of broadcast applications and spot treatments for zinc phosphide and first-generation anticoagulant rodenticides (FGARs; i.e., chlorophacinone and diphacinone), instead focusing on bait stations and within-burrow applications moving forward. However, we do not know how effective within-burrow applications of zinc phosphide are for California ground squirrels (*Otospermophilus* spp.) and Belding's ground squirrels (*Urocitellus beldingi*), nor do we know how efficacious bait stations containing zinc phosphide are for these same ground squirrel species. Information is needed to better define the efficacy of zinc phosphide in these situations.

2. Objectives, Approach, and Evaluation: The objective for this project is to determine the efficacy of within-burrow and bait station applications of zinc phosphide for controlling California and Belding's ground squirrels. Applications will occur across a combination of rangeland, alfalfa field, airport grassland, and noncrop sites as appropriate. We will use ground squirrel counts to index ground squirrel abundance pre- and post-treatment to determine the efficacy of each approach. This information will be compared to efficacy data available on alternative control strategies to determine the utility of these bait application approaches to manage these target species.

3. Audience: The audience will be all potential agricultural users of zinc phosphide for California ground squirrel and Belding's ground squirrel control throughout California, and perhaps other localities within the western U.S. as well.

C. Justification

1. CDFA VPCRAC Mission and Responsibilities: Rodenticides are commonly used to manage burrowing rodents in production agricultural systems due to their high efficacy and cost-effective nature. The proposed changes included in the U.S. EPA's Proposed Interim Decisions (PIDs) released late last year would substantially alter how these products can be used moving forward. Of these rodenticides, FGARs and zinc phosphide are the primary options for use against field rodents. The proposed changes include bait application strategies that have not typically been used or recommended for these active ingredients. As such, research is needed to determine the utility of these application strategies to assess their long-term potential for inclusion into IPM programs to manage burrowing rodents. This topic fits squarely within the VPCRAC mission.

2. Impact: Burrowing rodents, such as California ground squirrels and Belding's ground squirrels, are responsible for many types of damage in agricultural production systems including direct reduction in crop production, mortality of crops, damage to irrigation infrastructure, and by posing a human health and safety risk, just to name a few. Rodenticides are the primary tool used to manage rodent populations in many of these settings. Recently proposed changes to rodenticide labels by the U.S. EPA would substantially impact when and how rodenticides could be used moving forward. For example, in many settings, zinc phosphide applications would only be allowed via bait stations (e.g., in California condor range). For decades, the use of zinc phosphide within bait stations has generally not been advocated for or allowed given the belief that the bait station will magnify the negative effect of the phosphine odor detected on the bait, but the efficacy of zinc phosphide applied via bait stations for most ground squirrel species is unknown. Likewise, rodenticides have generally not been applied within ground squirrel burrow systems given that past studies have shown that bait is more readily accepted when scattered around the burrow entrance (Mahl and Salmon 2003). That said, it is possible that bait applied within burrow systems could prove at least marginally efficacious (see Salmon et al. 2006 for limited testing). Given the potential loss of broadcast applications and spot treatments in most settings, it is imperative to assess the utility of the remaining application approaches to determine their validity for agricultural producers in California.

Mahl, U. H., and T. P. Salmon. 2003. Within-burrow and surface feeding of oat grain by California ground squirrels. Proceedings of the Wildlife Damage Management Conference 10:370–377.

Salmon, T. P., C. A. Wilen, T. Ellis, A. Sartaini, R. Miller, and C. Benham. 2006. Ground squirrel underground baiting. University of California, Davis. Final Report to CDFA.

3. Long-Term Solutions: If the changes listed in the U.S. EPA's PIDs for anticoagulant rodenticides and zinc phosphide are finalized, this will limit rodenticide application options for agricultural producers. The effectiveness of many of the remaining application strategies will be unproven. If these proposed application strategies are proven efficacious, then agricultural producers can have confidence in using them to manage ground squirrels. However, if these application strategies are ineffective, then additional research will be needed to come up with management strategies that will reduce damage from these burrowing rodents.

4. Related Research: Zinc phosphide applications have proven effective against California ground squirrels (Eisemann et al. 2003) and Belding's ground squirrels (Baldwin et al. 2019) with various treatment methods, but this active ingredient has rarely, if ever, been tested as a control strategy against these same species when applied via bait stations or within-burrow applications. In general, bait station applications of zinc phosphide have historically been considered less effective than scatter application approaches (e.g., Virchow and Hygnstrom 1991), yet little is available in the literature to indicate testing of this approach for ground squirrel species. Likewise, no studies testing the use of within-burrow applications of zinc phosphide have been found for ground squirrels. That said, research published by Mahl and Salmon (2003) and Salmon et al. (2006) showed that bait acceptance and subsequent efficacy is lower when anticoagulant baits are placed within burrow systems than when scattered aboveground, although some reduction in ground squirrel numbers was still observed with belowground applications of these toxicants. Therefore, it's certainly possible we could see acceptable efficacy with zinc phosphide applications within burrow systems, particularly given the acute nature of this toxicant, but this remains untested.

Baldwin, R. A., H. Halbritter, R. Meinerz, L. K. Snell, and S. B. Orloff. 2019. Efficacy and nontarget impact of zinc phosphide-coated cabbage as a ground squirrel management tool. Pest Management Science 75:1847–1854.

Eisemann, J. D., B. E. Peterson, and K. A. Fagerstone. 2003. Efficacy of zinc phosphide for controlling Norway rats, roof rats, house mice, *Peromyscus* spp., prairie dogs and ground squirrels: a literature review (1942). Proceedings of the Wildlife Damage Management Conference 10:335–349.

Mahl, U. H., and T. P. Salmon. 2003. Within-burrow and surface feeding of oat grain by California ground squirrels. Proceedings of the Wildlife Damage Management Conference 10:370–377.

Salmon, T. P., C. A. Wilen, T. Ellis, A. Sartaini, R. Miller, and C. Benham. 2006. Ground squirrel underground baiting. University of California, Davis. Final Report to CDFA.

Virchow, D. R., and S. E. Hygnstrom. 1991. Consumption of zinc phosphide-treated, bromethalin-treated, and untreated oats by prairie dogs at bait stations. Proceedings of the Great Plains Wildlife Damage Conference 10:62–67.

5. Contribution to Knowledge Base: Little is currently known about the efficacy of zinc phosphide applied via bait stations or within-burrow applications for ground squirrel control. This study will be the first of its kind to quantify the efficacy of these application strategies, and will provide baseline information for rodenticide application strategies for the management of burrowing rodents in California agricultural systems moving forward.

6. Grower Use: If proven efficacious, growers will be able to use the tested application strategies to effectively manage California and Belding's ground squirrels in similar agricultural systems. If these application strategies are ineffective, then agricultural producers will need to consider alternative management strategies to effectively manage these burrowing rodent pests.

D. Objectives: The objective for this project is to determine the efficacy of bait station and within-burrow applications of zinc phosphide for controlling California and Belding's ground squirrels.

E. Work Plans and Methods (project dates: Aug 1, 2023 to Jun 30, 2025)

1. Work Plan:
   a) California ground squirrel trials (PY1): We will initially identify field sites for California ground squirrel trials (Central Coast and Central Valley areas), likely in a combination of rangeland, alfalfa, or airport grasslands. We will conduct trials on two study sites in late summer 2023 and again across two sites in summer 2024. At each site, we will set up 3 study plots: 1) bait stations containing zinc phosphide, 2) within-burrow applications of zinc phosphide, and 3) a control. We will assess efficacy of treatments through ground squirrel counts conducted before and after treatment. We will consider the approach efficacious if we observe a >70% decrease in ground squirrel abundance post-treatment.

   b) California ground squirrel trials (PY2): The vast majority of these trials are expected to be completed in PY1, but we may need to complete some of these trials in summer PY2. Protocols will follow that listed for PY1.

   c) Belding's ground squirrels (PY1): We will conduct trials across one rangeland/noncrop site and one alfalfa site in late winter 2024. At each site, we will set up 3 study plots: 1) bait stations containing zinc phosphide, 2) within-burrow applications of zinc phosphide, and 3) a control. We will assess efficacy of treatments through ground squirrel counts conducted before and after treatment. We will consider the approach efficacious if we observe a >70% decrease in ground squirrel abundance post-treatment.

   d) Belding's ground squirrels (PY2): We will conduct trials across one rangeland/noncrop site and one alfalfa site in late winter 2025. Protocols will follow that listed for PY1.

e) Data analysis and final report: We anticipate a completion of analyses and the final report by June 30, 2025.

2. Methods: We will identify sites with abundant ground squirrels at each of the above-listed locations, and we will place three 10-acre plots in each site. We will conduct ground squirrel counts within an interior 1-acre censusing plot as defined by Baldwin et al. (2021) to index ground squirrel abundance before treatment. Immediately following indexing activities, we will establish bait stations in one randomly selected plot following an 8 × 8 grid structure, with bait stations separated by ~ 75 m. We will prebait the bait stations with nontoxic grain for 1 week to allow the ground squirrels to acclimate to the bait stations. If bait consumption is lacking at a site, we may prebait for an extended period to maximize the likelihood of success of our baiting program. Once the prebaiting period has concluded, we will remove the nontoxic grain and replace it with zinc phosphide bait. We will operate the bait stations containing zinc phosphide for 7 days, after which bait will be removed, and post-treatment ground squirrel counts will commence to quantify efficacy of the bait station treatment.
For within-burrow applications, plots will be established in the same manner except that bait stations will not be used. Instead, we will apply nontoxic grain within burrow systems at the start of the pretreatment period, and we will subsequently apply zinc phosphide within burrows 7 days later unless additional prebaiting time is needed in the bait station plot (i.e., we will sync the bait station and within-burrow treatments so that they occur in the same timeframe). Control plots will be operated at the same time and will not receive any bait applications. The same general protocols will be used for both California and Belding's ground squirrels.

Baldwin, R. A., T. A. Becchetti, N. Quinn, and R. Meinerz. 2021. Utility of visual counts for determining efficacy of management tools for California ground squirrels. Human-Wildlife Interactions 15:138–147.

3. Experimental Site: Exact observation location will be determined at the time of the study based on current ground squirrel activity. That said, we anticipate 4 sites occurring in alfalfa and rangeland/noncrop sites in Siskiyou and Modoc Counties for Belding's ground squirrels and 4 sites (most likely some combination of rangelands, alfalfa fields, and airport grasslands) in the Central Valley for California ground squirrels.

F. Project Management, Evaluation, and Outreach

1. Management: R. Baldwin will serve as the PI for the project and will oversee all aspects of the project.

2. Evaluation: Success on this project will entail an assessment of the efficacy of zinc phosphide applied via bait stations and within-burrow applications for reducing California ground squirrel and Belding's ground squirrel numbers at treatment sites. If proven efficacious, these application approaches can be used with confidence moving forward, but if proven ineffective, additional tools will need to be developed to effectively manage these burrowing rodent pests.

G. Budget Narrative

a. Personnel Expenses

Salaries - $58,652: *Salary costs use fiscal year 2022/2023 (July 1, 2022 through June 30, 2023) rates.*

Ryan Meinerz (Staff Research Associate II): Ryan will largely lead coordination of data collection. This will include travel to field sites to conduct all aspects of this study. Effort is estimated at 1,392 hours for year 1 and 696 hours for year 2 at a wage of $27.63 and $29.01, respectively (PY1 = $38,461, PY2 = $20,191).

Fringe Benefits - $30,567: *Employee Benefits are based on Federally Approved Composite Benefit Rates. The University of California's current Composite Benefit Rates have been federally reviewed and approved through June 30, 2023.*

Ryan Meinerz (Staff Research Associate II): Fringe benefits calculated at 51.6% for 2023/24 and 53.1% for 2024/25 (PY1 = $19,846; PY2 = $10,721).

b. Operating Expenses

Supplies - $350

Miscellaneous field items (e.g., flags, data notebooks, gloves, etc. = $150)

Bait = $200

Equipment:

N/A

Travel - $31,501:

Trip 1: From Aug 21 to Aug 29, 2023, SRA II will travel from Davis to anticipated field site in the San Luis Obispo area (TBD). This travel will correspond with identification of field site, site set up, and initial portions of the trials. Mileage will include travel to closest hotel locations, as well as to field sites in each area (anticipated at 1,022 miles round trip). Mileage is for a rental vehicle ($0.32/mile). The trip is anticipated to be 9 days/8 nights in duration with hotel ($145/night for 8 nights) and meals ($40/day x 9 days per trip) associated with this trip (PY1 = $1,847).

Trip 2: From Aug 25 to Aug 29, 2023, PI will travel from Davis to anticipated field site in the San Luis Obispo area (TBD). This travel will correspond with the prebaiting portion of the trial. Mileage will include travel to closest hotel locations, as well as to field sites in each area (anticipated at 782 miles round trip). Mileage is for a personal vehicle ($0.655/mile). The trip is anticipated to be 5 days/4 nights in duration with hotel ($145/night for 4 nights) and meals ($40/day x 5 days per trip) associated with this trip (PY1 = $1,292).

Trip 3: From Sep 3 to Sep 6, 2023, SRA II will travel from Davis to anticipated field site in the San Luis Obispo area (TBD). This travel will correspond with bait application. Mileage will include travel to closest hotel locations, as well as to field sites in each area (anticipated at 722 miles round trip). Mileage is for a rental vehicle ($0.32/mile). The trip is anticipated to be 4 days/3 nights in duration with hotel ($145/night for 3 nights) and meals ($40/day x 4 days per trip) associated with this trip (PY1 = $826).

Trip 4: From Sep 11 to Sep 14, 2023, SRA II will travel from Davis to anticipated field site in the San Luis Obispo area (TBD). This travel will correspond with bait removal and post-treatment surveys. Mileage will include travel to closest hotel locations, as well as to field sites in each area (anticipated at 722 miles round trip). Mileage is for a rental vehicle ($0.32/mile). The trip is anticipated to be 4 days/3 nights in duration with hotel ($145/night for 3 nights) and meals ($40/day x 4 days per trip) associated with this trip (PY1 = $826).

Trip 5: From Sep 21 to Sep 29, 2023, SRA II will travel from Davis to anticipated field site in the San Luis Obispo area (TBD). This travel will correspond with identification of field site, site set up, and initial portions of the trials. Mileage will include travel to closest hotel locations, as well as to field sites in each area (anticipated at 1,022 miles round trip). Mileage is for a rental vehicle ($0.32/mile). The trip is anticipated to be 9 days/8 nights in duration with hotel ($145/night for 8 nights) and meals ($40/day x 9 days per trip) associated with this trip (PY1 = $1,847).

Trip 6: From Oct 2 to Oct 5, 2023, SRA II will travel from Davis to anticipated field site in the San Luis Obispo area (TBD). This travel will correspond with bait application. Mileage will include travel to closest hotel locations, as well as to field sites in each area (anticipated at 722 miles round trip). Mileage is for a

rental vehicle ($0.32/mile). The trip is anticipated to be 4 days/3 nights in duration with hotel ($145/night for 3 nights) and meals ($40/day x 4 days per trip) associated with this trip (PY1 = $826).

Trip 7: From Oct 10 to Oct 13, 2023, SRA II will travel from Davis to anticipated field site in the San Luis Obispo area (TBD). This travel will correspond with bait removal and post-treatment surveys. Mileage will include travel to closest hotel locations, as well as to field sites in each area (anticipated at 722 miles round trip). Mileage is for a rental vehicle ($0.32/mile). The trip is anticipated to be 4 days/3 nights in duration with hotel ($145/night for 3 nights) and meals ($40/day x 4 days per trip) associated with this trip (PY1 = $826).

Trip 8: From Feb 22 to Mar 1, 2024, SRA II will travel from Davis to anticipated field site in the Tulelake area (TBD). This travel will correspond with identification of field site, site set up, and initial portions of the trials. Mileage will include travel to closest hotel locations, as well as to field sites in each area (anticipated at 1,200 miles round trip). Mileage is for a rental vehicle ($0.32/mile). The trip is anticipated to be 9 days/8 nights in duration with hotel ($120/night for 8 nights) and meals ($40/day x 9 days per trip) associated with this trip (PY1 = $1,704).

Trip 9: From Feb 26 to Mar 1, 2023, PI will travel from Davis to anticipated field site in the Tulelake area (TBD). This travel will correspond with the prebaiting portion of the trial. Mileage will include travel to closest hotel locations, as well as to field sites in each area (anticipated at 880 miles round trip). Mileage is for a personal vehicle ($0.655/mile). The trip is anticipated to be 5 days/4 nights in duration with hotel ($120/night for 4 nights) and meals ($40/day x 5 days per trip) associated with this trip (PY1 = $1,256).

Trip 10: From Mar 5 to Mar 8, 2023, SRA II will travel from Davis to anticipated field site in the Tulelake area (TBD). This travel will correspond with bait application. Mileage will include travel to closest hotel locations, as well as to field sites in each area (anticipated at 800 miles round trip). Mileage is for a rental vehicle ($0.32/mile). The trip is anticipated to be 4 days/3 nights in duration with hotel ($120/night for 3 nights) and meals ($40/day x 4 days per trip) associated with this trip (PY1 = $776).

Trip 11: From Mar 13 to Mar 16, 2023, SRA II will travel from Davis to anticipated field site in the Tulelake area (TBD). This travel will correspond with bait removal and post-treatment surveys. Mileage will include travel to closest hotel locations, as well as to field sites in each area (anticipated at 800 miles round trip). Mileage is for a rental vehicle ($0.32/mile). The trip is anticipated to be 4 days/3 nights in duration with hotel ($120/night for 3 nights) and meals ($40/day x 4 days per trip) associated with this trip (PY1 = $776).

Trip 12: From Mar 23 to Mar 31, 2024, SRA II will travel from Davis to anticipated field site in the Tulelake area (TBD). This travel will correspond with identification of field site, site set up, and initial portions of the trials. Mileage will include travel to closest hotel locations, as well as to field sites in each area (anticipated at 1,200 miles round trip). Mileage is for a rental vehicle ($0.32/mile). The trip is anticipated to be 9 days/8 nights in duration with hotel ($120/night for 8 nights) and meals ($40/day x 9 days per trip) associated with this trip (PY1 = $1,704).

Trip 13: From Apr 4 to Apr 8, 2023, SRA II will travel from Davis to anticipated field site in the Tulelake area (TBD). This travel will correspond with bait application. Mileage will include travel to closest hotel locations, as well as to field sites in each area (anticipated at 800 miles round trip). Mileage is for a rental vehicle ($0.32/mile). The trip is anticipated to be 4 days/3 nights in duration with hotel ($120/night for 3 nights) and meals ($40/day x 4 days per trip) associated with this trip (PY1 = $776).

Trip 14: From Apr 13 to Apr 16, 2023, SRA II will travel from Davis to anticipated field site in the Tulelake area (TBD). This travel will correspond with bait removal and post-treatment surveys. Mileage will include travel to closest hotel locations, as well as to field sites in each area (anticipated at 800 miles round trip). Mileage is for a rental vehicle ($0.32/mile). The trip is anticipated to be 4 days/3 nights in duration with hotel ($120/night for 3 nights) and meals ($40/day x 4 days per trip) associated with this trip (PY1 = $776).

Trip 15: From May 15 to May 23, 2023, SRA II will travel from Davis to anticipated field site in the Fresno area (TBD). This travel will correspond with identification of field site, site set up, and initial portions of the trials. Mileage will include travel to closest hotel locations, as well as to field sites in each area (anticipated at 830 miles round trip). Mileage is for a rental vehicle ($0.32/mile). The trip is anticipated to be 9 days/8 nights in duration with hotel ($120/night for 8 nights) and meals ($40/day x 9 days per trip) associated with this trip (PY1 = $1,586).

Trip 16: From May 20 to May 22, 2023, PI will travel from Davis to anticipated field site in the Fresno area (TBD). This travel will correspond with the prebaiting portion of the trial. Mileage will include travel to closest hotel locations, as well as to field sites in each area (anticipated at 470 miles round trip). Mileage is for a personal vehicle ($0.655/mile). The trip is anticipated to be 5 days/4 nights in duration with hotel ($120/night for 2 nights) and meals ($40/day x 3 days per trip) associated with this trip (PY1 = $668).

Trip 17: From May 27 to May 30, 2023, SRA II will travel from Davis to anticipated field site in the Fresno area (TBD). This travel will correspond with bait application. Mileage will include travel to closest hotel locations, as well as to field sites in each area (anticipated at 530 miles round trip). Mileage is for a rental vehicle ($0.32/mile). The trip is anticipated to be 4 days/3 nights in duration with hotel ($120/night for 3 nights) and meals ($40/day x 4 days per trip) associated with this trip (PY1 = $690).

Trip 18: From Jun 4 to Jun 7, 2023, SRA II will travel from Davis to anticipated field site in the Fresno area (TBD). This travel will correspond with bait removal and post-treatment surveys. Mileage will include travel to closest hotel locations, as well as to field sites in each area (anticipated at 530 miles round trip). Mileage is for a rental vehicle ($0.32/mile). The trip is anticipated to be 4 days/3 nights in duration with hotel ($120/night for 3 nights) and meals ($40/day x 4 days per trip) associated with this trip (PY1 = $690).

Trip 19: From Jun 14 to Jun 22, 2023, SRA II will travel from Davis to anticipated field site in the Fresno area (TBD). This travel will correspond with identification of field site, site set up, and initial portions of the trials. Mileage will include travel to closest hotel locations, as well as to field sites in each area (anticipated at 830 miles round trip). Mileage is for a rental vehicle ($0.32/mile). The trip is anticipated to be 9 days/8 nights in duration with hotel ($120/night for 8 nights) and meals ($40/day x 9 days per trip) associated with this trip (PY1 = $1,586).

Trip 20: From Jun 26 to Jun 29, 2023, SRA II will travel from Davis to anticipated field site in the Fresno area (TBD). This travel will correspond with bait application. Mileage will include travel to closest hotel locations, as well as to field sites in each area (anticipated at 530 miles round trip). Mileage is for a rental vehicle ($0.32/mile). The trip is anticipated to be 4 days/3 nights in duration with hotel ($120/night for 3 nights) and meals ($40/day x 4 days per trip) associated with this trip (PY1 = $690).

Trip 21: From Jul 3 to Jul 6, 2023, SRA II will travel from Davis to anticipated field site in the Fresno area (TBD). This travel will correspond with bait removal and post-treatment surveys. Mileage will include travel to closest hotel locations, as well as to field sites in each area (anticipated at 530 miles round trip). Mileage is for a rental vehicle ($0.32/mile). The trip is anticipated to be 4 days/3 nights in duration with hotel ($120/night for 3 nights) and meals ($40/day x 4 days per trip) associated with this trip (PY2 = $690).

Trip 22: From Feb 22 to Mar 2, 2025, SRA II will travel from Davis to anticipated field site in the Tulelake area (TBD). This travel will correspond with identification of field site, site set up, and initial portions of the trials. Mileage will include travel to closest hotel locations, as well as to field sites in each area (anticipated at 1,200 miles round trip). Mileage is for a rental vehicle ($0.32/mile). The trip is anticipated to be 9 days/8 nights in duration with hotel ($120/night for 8 nights) and meals ($40/day x 9 days per trip) associated with this trip (PY2 = $1,704).

Trip 23: From Feb 27 to Mar 2, 2023, PI will travel from Davis to anticipated field site in the Tulelake area (TBD). This travel will correspond with the prebaiting portion of the trial. Mileage will include travel to closest hotel locations, as well as to field sites in each area (anticipated at 800 miles round trip). Mileage is for a personal vehicle ($0.655/mile). The trip is anticipated to be 5 days/4 nights in duration with hotel ($120/night for 3 nights) and meals ($40/day x 4 days per trip) associated with this trip (PY2 = $1,044).

Trip 24: From Mar 6 to Mar 9, 2023, SRA II will travel from Davis to anticipated field site in the Tulelake area (TBD). This travel will correspond with bait application. Mileage will include travel to closest hotel locations, as well as to field sites in each area (anticipated at 800 miles round trip). Mileage is for a rental vehicle ($0.32/mile). The trip is anticipated to be 4 days/3 nights in duration with hotel ($120/night for 3 nights) and meals ($40/day x 4 days per trip) associated with this trip (PY2 = $776).

Trip 25: From Mar 14 to Mar 17, 2023, SRA II will travel from Davis to anticipated field site in the Tulelake area (TBD). This travel will correspond with bait removal and post-treatment surveys. Mileage will include travel to closest hotel locations, as well as to field sites in each area (anticipated at 800 miles round trip).

Mileage is for a rental vehicle ($0.32/mile). The trip is anticipated to be 4 days/3 nights in duration with hotel ($120/night for 3 nights) and meals ($40/day x 4 days per trip) associated with this trip (PY2 = $776).

Trip 26: From Mar 24 to Apr 1, 2024, SRA II will travel from Davis to anticipated field site in the Tulelake area (TBD). This travel will correspond with identification of field site, site set up, and initial portions of the trials. Mileage will include travel to closest hotel locations, as well as to field sites in each area (anticipated at 1,200 miles round trip). Mileage is for a rental vehicle ($0.32/mile). The trip is anticipated to be 9 days/8 nights in duration with hotel ($120/night for 8 nights) and meals ($40/day x 9 days per trip) associated with this trip (PY2 = $1,704).

Trip 27: From Apr 5 to Apr 9, 2023, SRA II will travel from Davis to anticipated field site in the Tulelake area (TBD). This travel will correspond with bait application. Mileage will include travel to closest hotel locations, as well as to field sites in each area (anticipated at 800 miles round trip). Mileage is for a rental vehicle ($0.32/mile). The trip is anticipated to be 4 days/3 nights in duration with hotel ($120/night for 3 nights) and meals ($40/day x 4 days per trip) associated with this trip (PY2 = $776).

Trip 28: From Apr 14 to Apr 17, 2023, SRA II will travel from Davis to anticipated field site in the Tulelake area (TBD). This travel will correspond with bait removal and post-treatment surveys. Mileage will include travel to closest hotel locations, as well as to field sites in each area (anticipated at 800 miles round trip). Mileage is for a rental vehicle ($0.32/mile). The trip is anticipated to be 4 days/3 nights in duration with hotel ($120/night for 3 nights) and meals ($40/day x 4 days per trip) associated with this trip (PY2 = $776).

Trips 29-31: Travel from Davis to VPCRAC meeting sites (TBD) to provide updates on project. Mileage will include travel to closest hotel locations, as well as to meeting location (anticipated at 350 miles round trip). Mileage is for a personal vehicle ($0.655/mile). Trips are anticipated to be 2 days/1 night in duration with associated hotel ($120/night) and meals ($40/day x 2 days per trip) associated with each trip. Total cost per trip estimated at $429. Three trips are anticipated during the project period. Travel reimbursement will be claimed by either R. Baldwin or SRA II (PY1 = $429; PY2 = $858).

Professional/Consultant Services - $3,314:

UC ANR Intermountain Research and Extension Center staff will provide 32 hours of field assistance per fiscal year at a rate of $31.46/hour (PY1 = $1,007; PY2 = $1,007).

Bait testing to verify zinc phosphide concentration: 4 samples x $325/sample (PY1 = $975; PY2 = $325)

Other Expenses - $8,800:

A rental truck will be needed to haul supplies around for project. The rental truck also comes with a lower mileage rate, which will save funds when compared to using a personal vehicle. The cost of the rental truck is $800/month. We will charge 8 months of the rental truck for field use in 2023-2024 and 3 months in 2024-2025 (PY1 = $6,400; PY2 = $2,400).

Indirect (F&A) Costs - $13,319

Indirect costs are calculated in accordance with the University budgeted indirect cost rate in Exhibit B.

Per the agreement between the University of California and the California Department of Food and Agriculture, indirect costs have been calculated at 10% Total Direct Cost (TDC) for the project (PY1 = $8,944; PY2 = $4,375).

c. Other Funding Sources –

N/A

I. Appendices – Resume: Roger Allen Baldwin

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EDUCATION

Ph.D. Wildlife Science/Range Science, Department of Animal and Range Sciences
New Mexico State University, Las Cruces, NM 88003. February 2008.

M.S. Biology, Emphasis on Vertebrate Zoology
The University of Memphis, Memphis, TN 38152. August 2003.

B.S. Wildlife Biology, Secondary Major in Natural Resource and Environmental Science
Kansas State University, Manhattan, KS 66506. May 2000.

CURRENT APPOINTMENT

Assistant (July 2013 to June 2015), Associate (July 2015 to June 2020), and Full Cooperative Extension Specialist (July 2020 – Present)—Human-Wildlife Conflict Resolution
University of California Cooperative Extension, Division of Agriculture and Natural Resources; and Department of Wildlife, Fish, and Conservation Biology, University of California, Davis.

RESEARCH FUNDING

Extramural grants: *Total funding $10,645,157*

Current titles:

Investigating invasive roof rat resistance by screening for genetic mutations and metabolic changes. Vertebrate Pest Control Research Advisory Committee (July 2022 – June 2023; Co-PI).

Determining utility of drones for monitoring ground squirrel burrow systems. Vertebrate Pest Control Research Advisory Committee (February 1, 2023 – January 31, 2024).

Developing and testing an IPM approach for managing roof rats in citrus. Vertebrate Pest Control Research Advisory Committee (March 2022 – February 2024).

Evaluation of use of owl nest boxes for rodent control in winegrape vineyards. USDA National Institute of Food and Agriculture-Crop Protection and Pest Management Plan (September 2022 – August 2024; Co-Investigator).

Scientific challenges and cost-effective management of risks associated with implementation of produce safety regulations. USDA/NIFA/Specialty Crops Research Initiative (September 2020 – August 2024).

Intramural grants: *Total funding $257,071*

Industry/programmatic funding and in-kind support: *Total funding $227,034*

REPRESENTATIVE REFEREED PUBLICATIONS

Baldwin, R. A., T. A. Becchetti, J. S. Davy, R. E. Larsen, F. E. Mashiri, R. Meinerz, R. K. Ozeran, and D. Rao. 2022. Estimating reduction in standing crop biomass from California ground squirrels in central California rangelands. Rangeland Ecology & Management 83:50–58.

Baldwin, R. A., R. Meinerz, and A. B. Shiels. 2022. Efficacy of Goodnature A24 self-resetting traps and diphacinone bait for controlling black rats (*Rattus rattus*) in citrus orchards. Management of Biological Invasions 13:577–592.

Baldwin, R. A., T. A. Becchetti, R. Meinerz, and N. Quinn. 2021. Potential impact of diphacinone application strategies on secondary exposure risk in a common rodent pest: implications for management of California ground squirrels. Environmental Science and Pollution Research 28:45891–45902.

Baldwin, R. A., T. A. Becchetti, N. Quinn, and R. Meinerz. 2021. Utility of visual counts for determining efficacy of management tools for California ground squirrels. Human-Wildlife Interactions 15:138–147.

Baldwin, R. A., H. Halbritter, R. Meinerz, L. K. Snell, and S. B. Orloff. 2019. Efficacy and nontarget impact of zinc phosphide-coated cabbage as a ground squirrel management tool. Pest Management Science 75:1847–1854.

Baldwin, R. A., B. G. Abbo, and D. A. Goldade. 2018. Comparison of mixing methods and associated residual levels of zinc phosphide on cabbage bait for rodent management. Crop Protection 105:59–61.

Baldwin, R. A., R. Meinerz, and G. W. Witmer. 2016. Cholecalciferol plus diphacinone baits for vole control: a novel approach to a historic problem. Journal of Pest Science 89:129–135.

Baldwin, R. A., N. Quinn, D. H. Davis, and R. M. Engeman. 2014. Effectiveness of rodenticides for managing invasive roof rats and native deer mice in orchards. Environmental Science and Pollution Research 21:5795–5802.

Baldwin, R. A., T. P. Salmon, R. H. Schmidt, and R. M. Timm. 2014. Perceived damage and areas of needed research for wildlife pests of California agriculture. Integrative Zoology 9:265–279.

Baldwin, R. A., T. P. Salmon, R. H. Schmidt, and R. M. Timm. 2013. Wildlife pests of California agriculture: regional variability and subsequent impacts on management. Crop Protection 46:29–37.

PRESENTATIONS

Extension Presentations

Over 310 presentations to various commodity groups, advisory committees, Master Gardener groups, universities, and private organizations.

Professional Presentations

Over 80 presentations at a variety of professional meetings and conferences, including The Wildlife Society National Conference, the Vertebrate Pest Conference, and the American Society of Mammalogists.

California Department of Food and Agriculture
PHPPS - Integrated Pest Control Branch

2023/2024 VPCRAC Project Proposal Budget Template

State of California
VPCRAC-B1
Revised 3/10/2023

Complete the budget template below by filling in information. This template uses formulas to automatically calculate totals. **Do not** alter the formatting or formulas in cells. Rows may be added to accommodate additional personnel or funding sources, if necessary. Contact the CDFA staff at (916) 262-1102 or David.Kratville@cdfa.ca.gov for help filling out this template.

Project Title:	Testing the applicability of new application strategies of zinc phosphide for managing ground squirrels.
Project Leader(s):	Roger Baldwin

	2023-2024	2024-2025	2025-2026	Total
A. PERSONNEL (name, role, % based on full time salary)				
Salary				
Ryan Meinerz, SRA II: 1,392 hours and 696 hours at	$38,461.00	$20,191.00		$58,652.00
$27.63/hr and $29.01/hr for PY1 and PY2, respectively				$0.00
				$0.00
				$0.00
Salary Total	$38,461.00	$20,191.00	$0.00	$58,652.00
Benefits				
SRA II: 51.6% and 53.1% for 2023-24 and 2024-25	$19,846.00	$10,721.00		$30,567.00
				$0.00
				$0.00
				$0.00
Benefits Total	$19,846.00	$10,721.00	$0.00	$30,567.00
Personnel Cost (A)	$58,307.00	$30,912.00	$0.00	$89,219.00
B. OPERATING EXPENSES				
Supplies	$350.00			$350.00
Equipment				$0.00
Travel	$22,397.00	$9,104.00		$31,501.00
Professional/Consultant Services(Cannot exceed $65/hour)	$1,982.00	$1,332.00		$3,314.00
Other	$6,400.00	$2,400.00		$8,800.00
Operating Cost (B)	$31,129.00	$12,836.00	$0.00	$43,965.00
TOTAL Costs (A+B)	$89,436.00	$43,748.00	$0.00	$133,184.00
C. Indirect Costs (Cannot Exceed 10% of Total Costs (A+B))	$8,944.00	$4,375.00	$0.00	$13,319.00
TOTAL CDFA FUNDING REQUESTED (A+B+C)	$98,380.00	$48,123.00	$0.00	$146,503.00
D. OTHER FUNDING SOURCES				
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
TOTAL OTHER FUNDING (C)	$0.00	$0.00	$0.00	**$0.00**
TOTAL PROJECT BUDGET (A+B+C+D)	$98,380.00	$48,123.00	$0.00	$146,503.00