A. Cover Page

1. Project Title: A test of management tools for invasive roof rats in citrus orchards

2. Project Leaders:

Roger A. Baldwin, Ph.D.
Cooperative Extension Specialist
Dept. Wildlife, Fish, and Conservation Biology
One Shields Ave.
University of California, Davis
Davis, CA 95616
Phone: 530-752-4551
E-mail: rabaldwin@ucdavis.edu

Aaron B. Shiels, Ph.D.
Research Biologist, Rodent Project
National Wildlife Research Center
USDA-APHIS-WS
4101 LaPorte Ave.
Fort Collins, CO 80521
Phone: 970-266-6324
E-mail: Aaron.B.Shiels@usda.gov

3. Cooperators:

Katie Swift
Manager of Regulatory Compliance
Liphatech, Inc.
3600 West Elm Street
Milwaukee, WI 53208
Phone: 808-284-8322
E-mail: swiftk@liphatech.com

Kylli Paavola
Sr. Regulatory Compliance Specialist
Liphatech, Inc.
3600 West Elm Street
Milwaukee, WI 53208
Phone: 414-410-7261
E-mail: paavolak@liphatech.com

Chris Morales
Research and Development/Field Support Manager
Liphatech, Inc.
3600 West Elm Street
Milwaukee, WI 53208
Phone: 414-702-8558
E-mail: paavolak@liphatech.com

Ross Horn
Business Manager/Field Products
Liphatech, Inc.

3600 West Elm Street
Milwaukee, WI 53208
Phone: 559-970-5775
E-mail: hornr@liphatech.com

4. CDFA Funding Request Amount/Other Funding:

   CDFA Funding Request:

   PY 1 (2020-2021) = $73,448
   PY 2 (2021-2022) = $8,438

   Other Funding:

   Liphatech, Inc.

   Contact:
   Ross Horn
   Business Manager/Field Products
   Liphatech, Inc.
   3600 West Elm Street
   Milwaukee, WI 53208
   Phone: 559-970-5775
   E-mail: hornr@liphatech.com
   PY 1 contribution = $8,000

   Automatic Trap Company

   Contact:
   Ty Huggins
   Director of Marketing
   638 Michigan Avenue
   Buffalo, New York 14203
   Phone: 1-877-992-8868 ext. 616
   E-mail: ty.huggins@automatictrap.com
   PY 1 contribution = $5,000

5. Agreement Manager:
   Grace I. Liu, J.D.
   Associate Director, Research Administration
   Sponsored Programs
   1850 Research Park Drive, Suite 300
   University of California, Davis
   Davis, CA 95618
   Phone: 530-754-7700
   E-mail: awards@ucdavis.edu

B. Executive Summary

1. Problem: Roof rats (*Rattus rattus*) cause extensive damage in a number of tree crops including citrus. Roof rat populations seem to be expanding and growing throughout many agricultural regions in CA, yet management options for limiting this damage have been largely unsuccessful. The development of an IPM program could greatly reduce this damage, but we currently lack a good understanding of the efficacy of management tools for roof rats in citrus. Citrus is an important commodity in California. Collectively, oranges, lemons, tangerines, and grapefruits were worth >$2.4 billion to California in

2018 (California Agricultural Statistics Review 2018-2019). Effective management of roof rats in citrus is needed to protect this valuable commodity.

2. Objectives, Approach, and Evaluation: Our specific objective for this project is to determine the efficacy of three different strategies for reducing roof rat numbers in citrus orchards: 1.) CDFA's Rodent Bait Diphacinone Treated Grain (0.005%), 2.) a 0.005% chlorophacinone soft bait, and 3.) A24 repeating traps. To accomplish this objective, we will operate up to two indexing protocols to assess roof rat activity before and after treatment. For indexing, we plan to use tracking tunnels and remote-triggered cameras. Both rodenticides will be applied in elevated bait stations throughout the treatment area. A24 traps will also be placed in trees. Bait stations and A24 traps will follow a grid pattern throughout the treatment areas. We will operate all three treatment types and a control (i.e., a reference site that lacks rat suppression) simultaneously at one site, with treatments active for ~4 weeks at that site. Once complete, we will move to a second site and repeat the process. We plan to operate a total of 4 sites for this project (i.e., a total of 16 plots). Efficacy will be determined through a comparison of roof rat activity before and after treatment, with reductions in activity ≥70% considered efficacious. This project will be considered a success if we are able to identify at least one management tool that resulted in efficacy ≥70%.

3. Audience: Citrus growers are expected to be the primary beneficiaries of this project. This could have a substantial impact to California agriculture given the high value of citrus in the state. Although this research is targeted toward citrus production, the results may be applicable to other orchard systems as well, thereby increasing the value of this project.

C. Justification

1. CDFA VPCRAC Mission and Responsibilities: At several previous meetings, VPCRAC has identified projects that lead to more effective management of roof rats in citrus as a top priority. Both PIs on this project are currently involved in projects that are setting the foundation for addressing this issue. This proposed project will build off some of this early research and will initiate field testing of three management strategies. It is important to note that roof rats are invasive rodents that cause extensive agricultural damage throughout California and globally. As such, results from this project may have substantial applicability across many tree crops in California, and potentially to other parts of the U.S. and globally. Additionally, roof rat burrowing activity can potentially damage irrigation infrastructure, they pose substantial human health and safety risks both through disease and parasite transmission and through food safety concerns, and they can have substantial negative impacts to native wildlife through predation, disease transmission, and by outcompeting them for limited resources. As such, the development of effective management strategies for roof rats fits very squarely within the VPCRAC mission.

2. Impact: Rats (*Rattus* spp.) are a common and very damaging invasive pest found throughout much of the world, with one projection of damage caused by rats in the U.S. estimated at $19 billion annually (Pimentel et al. 2005). Although much of the damage they cause occurs in residential areas, they are also common agricultural pests. In

particular, nut and tree fruit crops can incur substantial damage from rats when present. For example, roof rats (*Rattus rattus*) cause an estimated 5–10% loss in developing macadamia nut crops in Hawaii each year (Tobin et al. 1997). Furthermore, roof rats cause frequent damage to citrus crops (Worth 1950), with anecdotal information suggesting roof rat damage is on the rise in citrus orchards in California. Effective management options for these invasive rodents are needed to minimize losses in these orchard systems, yet little seems to work for roof rats in citrus orchards (Sun Pacific, pers. comm.).

Common roof rat damage observed in citrus includes consumption of fruit, extensive damage to trees through girdling of limbs, and a loss of irrigation water down burrow systems. Growers also have increasing concerns about food safety risks associated with rats located within orchards. First-generation anticoagulant (chlorophacinone and diphacinone) baits and trapping with snap traps are two of the most frequently used methods for controlling rats in agricultural settings. However, trapping via snap traps is time consuming and results in numerous non-target mortalities (Tobin et al. 1993). Conversely, first-generation anticoagulant baits require less time to apply (e.g., Witmer et al. 2007), and as such, are preferred by many growers for controlling rats in many agricultural settings. However, there is increasing scrutiny over the use of anticoagulant rodenticides due to secondary toxicity concerns. An alternative control option that could be used to supplement rodenticide applications would help alleviate some of these concerns by allowing for the development of a more rigorous IPM approach for managing roof rats in citrus orchards. The use of A24 (Goodnature®, https://goodnature.co/) traps to control various rat species has substantially increased in island conservation efforts over the last several years. This trap kills the animal with a sharp blow to the head from a CO_2-fired bolt. It automatically resets after activation, and can fire 24 times with a single CO_2 cartridge. It comes with a long-lasting lure, allowing for several months of activation without resetting. These attributes would greatly reduce the amount of labor required to set and maintain a trapping grid, thereby increasing the utility of trapping as a potential management tool for roof rats in orchard systems. The collective use of anticoagulant rodenticides and automatically resetting traps could provide the level of roof rat control needed by many citrus growers in California.

3. Long-Term Solutions: Rats cause extensive damage to agricultural products each year (Pimentel et al. 2005), and based on feedback from numerous growers and PCAs, damage has become increasingly common in citrus in recent years. CDFA's rodenticide labels have not traditionally allowed for bait application within orchards during the bearing season, which has been substantially limiting in citrus where fruit is on the trees almost year-round. New changes to the CDFA diphacinone label now allow for bait application within elevated bait stations during the bearing season, but little is known as to the efficacy of these products in citrus, particularly when fruit is on the tree. Additionally, although diphacinone tested well in previous trials in almond orchards (Baldwin et al. 2014), chlorophacinone did not. Further testing with a different chlorophacinone product is warranted to see if a different formulation might yield better results. An alternative to rodenticides would also be very valuable for inclusion into Integrated Pest Management (IPM) rat control programs. The A24 trap provides a potential alternative, but they have not been tested in agricultural systems. Collectively, this study would allow for a robust

assessment of potential management practices for roof rats. This information will help drive the final portion of this study (not part of this proposal) that will address long-term efficacy and costs of implementation to allow for the formation of an IPM program for mitigating roof rat damage in citrus. Such a program would provide a long-term solution to an increasingly common agricultural pest for citrus growers.

4. Related Research: Chlorophacinone and diphacinone baits have effectively controlled roof rats in a number of locations and situations (Claffey et al. 1986, Donlan et al. 2003, Witmer et al. 2007). In particular, Baldwin et al. (2014) determined that the Rodent Bait Diphacinone Treated Grain (0.005%) product registered to CDFA was particularly effective against roof rats in almond orchards. Interestingly, the Rodent Bait Chlorophacinone Treated Grain (0.005%) product was not found to be overly efficacious, yet studies have documented efficacy with chlorophacinone in other settings (e.g., Whisson et al. 2004). Having another active ingredient for use in citrus orchards would greatly assist long-term management goals by limiting the potential for development of resistance, while also allowing for an additional product on the market should one be unavailable at a particular time.

   Another alternative for controlling roof rats in agricultural systems is trapping. Historically, snap trapping has been used in these settings, but snap trapping requires constant labor to set and check traps, and thus is generally considered too time consuming and costly for large areas. More recently, we have seen an increase in the use of automatic resetting traps that allow for many captures without rebaiting or resetting (Goodnature A24 trap; e.g., Carter et al. 2016, Shiels et al. 2019). These traps are currently in use for removing rats from islands to protect native species, and are now sold in the U.S. for use in commensal and agricultural settings. If effective, they could provide an interesting addition to bait application programs to bolster the concept of IPM in many orchard settings.

   Quinn and Baldwin (2014) previously provided an informative outreach document for orchards to help provide guidance on roof rat management in these cropping systems. However, the spacing between bait stations in this document was based on expert opinion given a lack of movement data available for this species in California orchards. The PI for this proposal currently has a project underway that is addressing movement patterns in roof rats to better define the needed spacing for bait stations and traps in citrus orchards. This information will be used to guide bait station and trap distribution for our proposed trials.

5. Contribution to Knowledge Base: Roof rats (*Rattus rattus*) cause extensive damage in a number of tree crops including citrus. Roof rat populations seem to be expanding and growing throughout many agricultural regions in California, yet management options for limiting this damage have been largely unsuccessful. The development of an IPM program could greatly reduce this damage, but we currently lack a good understanding of the efficacy of management tools for roof rats in citrus. Citrus is an important commodity in California. Collectively, oranges, lemons, tangerines, and grapefruits were worth >$2.4 billion to California in 2018 (California Agricultural Statistics Review 2018-2019). Effective management of roof rats in citrus is needed to protect this valuable commodity. Our project will provide an assessment of three of the tools most likely to

succeed at reducing roof rat numbers, and should provide the basis for the development of an IPM program for this invasive species.

6. Grower Use: Citrus is one of the most important commodities grown in California, with oranges, lemons, and tangerines all within the top 20 commodities in 2018 (California Agricultural Statistics Review 2018-2019). Roof rats cause extensive damage to citrus crops through direct fruit consumption, through mortality of limbs from extensive girdling damage, and through an increased food safety risk due to fecal contamination. This research will hopefully identify efficacious management strategies to help combat this damage. As such, we expect growers to readily adopt the efficacious management tools into an IPM program, ultimately allowing for increased crop production and lower food safety risk. Although this research is targeted toward citrus production, the results may be applicable to other orchard systems as well, thereby increasing the value of this project.

Literature Cited

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.

Carter, A., S. Barr, C. Bond, G. Paske, D. Peters, and R. van Dam. 2016. Controlling sympatric pest mammal populations in New Zealand with self-resetting, toxicant-free traps: a promising tool for invasive species management. Biological Invasions 18:1723–1736.

Claffey, D. P., M. G. Madon, and R. T. Smith. 1986. An integrated pest management approach to roof rat control in oceanfront riprap, Ventura County, California. Proceedings of the Vertebrate Pest Conference 12:60–65.

Donlan, C. J., G. R. Howald, B. R. Tershy, and D. A. Croll. 2003. Evaluating alternative rodenticides for island conservation: roof rat eradication from the San Jorge Islands, Mexico. Biological Conservation 114:29–34.

Pimentel, D., R. Zuniga, and D. Morrison. 2005. Update on the environmental and economic costs associated with alien-invasive species in the United States. Ecological Economics 52:273–288.

Quinn, N., and R. A. Baldwin. 2014. Managing roof rats and deer mice in nut and fruit orchards. Division of Agriculture and Natural Resources, Publication 8513.

Shiels, A. B., T. Bogardus, J. Rohrer, and K. Kawelo. 2019. Effectiveness of snap and A24-automated traps and broadcast anticoagulant bait in suppressing commensal rodents in Hawaii. Human-Wildlife Interactions 13:226–237.

Tobin, M. E., A. E. Koehler, and R. T. Sugihara. 1997. Effects of simulated rat damage on yields of macadamia nuts. Crop Protection 16:203–208.

Tobin, M. E., A. E. Koehler, R. T. Sugihara, G. R. Ueunten, and A. M. Yamaguchi. 1993. Effects of trapping on rat populations and subsequent damage and yields to macadamia nuts. Crop Protection 12:243–248.

Whisson, D. A., J. H. Quinn, K. Collins, and A. Engilis, Jr. 2004. Developing a management strategy to reduce roof rat, *Rattus rattus*, impacts on open-cup nesting songbirds in California riparian forests. Proceedings of the Vertebrate Pest Conference 21:8–12.

Witmer, G. W., F. Boyd, and Z. Hillis-Starr. 2007. The successful eradication of introduced roof rats (*Rattus rattus*) from Buck Island using diphacinone, followed by an irruption of house mice (*Mus musculus*). Wildlife Research 34:108–115.

Worth, C. B. 1950. Field and laboratory observations on roof rats, *Rattus rattus* (Linnaeus), in Florida. Journal of Mammalogy 31:293–304.

D. Objectives: Our specific objective for this project is to determine the efficacy of three different strategies for reducing roof rat numbers in citrus orchards: 1.) CDFA's Rodent Bait Diphacinone Treated Grain (0.005%), 2.) a 0.005% chlorophacinone soft bait, and 3.) A24 repeating traps.

E. Work Plans and Methods

1. <u>Work Plan:</u> This proposed project is part of a longer-term tiered project. The initial stages are currently underway. They involve an assessment of movement patterns of roof rats, as well as the development of indexing protocols to track roof rat population size. This information will be used to inform the first task for our current proposed project, which is to determine the efficacy of three different strategies for reducing roof rat numbers in citrus orchards: 1.) CDFA's Rodent Bait Diphacinone Treated Grain (0.005%), 2.) a 0.005% chlorophacinone soft bait, and 3.) A24 repeating traps. Indexing protocols will allow us to compare roof rat activity before and after treatment to assess efficacy, while the movement data will be used to identify ideal spacing of bait stations and traps. We anticipate fieldwork concluding in late June or early July 2021. The final product for this study will be efficacy data on the three proposed management strategies. Therefore, our second task will be the completion of our final report for this project. We anticipate a completion of analyses and the final report by December 31, 2021.
2. <u>Methods:</u> For this study, we will follow a randomized complete block design with three treatments and a control to allow for direct comparisons at each site. Each treatment and control will consist of an inner monitoring plot that will be 210 m × 210 m in size. Monitoring protocols will follow those established in a current research project funded by VPCRAC. In short, we anticipate using a 5 × 5 grid of remote-triggered cameras and tracking tunnels to monitor roof rat populations before and after treatment. Monitoring plots will be operated shortly before initiation of treatments. Following completion of pretreatment indices, we will initiate our baiting and trapping trials. For bait station trials, we will use tubular bait stations spaced throughout the rodenticide treatment area (Baldwin et al. 2014). They will be placed on branches or boards within trees. The spacing for these bait stations will be determined by results from our currently funded roof rat movement project, but spacing is anticipated to be around 45 m. We will initially apply ~ 1 cup of toxicant per bait station. Bait stations will be checked every few days to ensure a constant bait supply throughout the study period. We anticipate running bait stations for ~ 4 weeks.

Concurrent to the bait station trials, we will also run trials using A24 traps. As with bait stations, the spacing of these traps will be determined based on the current roof rat movement study, but spacing is anticipated to be around 45 m, likely following a 5 × 5 grid structure. Traps will be baited with an automatic lure pump with a chocolate-scented attractant. These traps will also be operated for 4 weeks to allow for a direct comparison to results from rodenticide trials. A control plot will also be established where no treatments will occur to allow for a check against natural changes in roof rat activity over the study period. All plots will be surrounded by a buffer zone to minimize any potential movement of roof rats into other treatment areas. The exact size of the buffer area will be determined in part from roof rat movement data currently being collected, but it is anticipated the buffer area will be 100 – 125 m in width.

Following the end of the 4-week treatment period, we will again initiate the indexing protocols to provide an assessment of roof rat activity post-treatment. This process will be repeated across three additional sites for a total of 4 replicates for each treatment and control. Treatment methods will be considered efficacious if they result in a ≥70% reduction in index values post-treatment. We will use a one-sample *t*-test to determine if collective efficacy is significantly ≥70%.

3. Experimental Site: Treatment sites will be determined at the time of the study based on current numbers of roof rats at orchard locations. That said, we anticipate sites occurring in Kern and Tulare Counties.

F. Project Management, Evaluation, and Outreach

1. Management: R. Baldwin will serve as the primary PI for the project and will oversee all aspects of the project. A. Shiels will serve as Co-PI and will be involved extensively in study design and data collection, and will assist in analysis and report/publication writing. K. Swift and C. Morales will serve as cooperators on the project. They will provide extensive knowledge on roof rat ecology and management, which will be helpful in study design and data collection. They will also provide an extensive review of the final report. R. Baldwin will be responsible for coordinating all key contributors to this project.
2. Evaluation: Success for this project will depend on our ability to identify one or more strategies that are effective for reducing roof rat numbers in citrus orchards. If we find a successful option or options, we then hope to move onto a final stage of this project, which would be to identify the long-term effectiveness of each management tool, the cost associated with implementing a year of control using each management tool, and ultimately how to combine that information into an IPM program that would allow for safe, practical, efficacious, and sustainable roof rat management. Such future activities and evaluation are beyond the scope of this proposed project, though. That said, long-term cost of management programs would be key, as high costs would pose a substantial barrier to implementation of such an IPM program.

G. Budget Narrative

Personnel Expenses

Salaries - $31,057: *Salary costs use fiscal year 2020/2021 (July 1, 2020 through July 31, 2021) 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. Extensive lab time will be required for analyzing data as well. Effort is estimated at 1,044 hours for year 1 and 174 hours for year 2 at a wage of $25.39 and $26.15 for 2020-21 and 2021-22, respectively. This is equivalent to 100% time for 6 and 1 month per project year (PY1 = $26,507, PY2 = $4,550).

Fringe Benefits - $16,491: *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, 2021.*

Ryan Meinerz (Staff Research Associate II): Fringe benefits calculated at 53.1% for 2020/21 and 2021/22 (PY1 = $14,075, PY2 = $2,416).

Operating Expenses

Supplies - $4,469:

Tracking tunnels ($7/station × 20 stations = $140)

Tracking cards ($0.60/card × 300 cards = $180)

Ink for tracking tunnels ($17/container × 1 containers = $17)

Lithium AA batteries for remote-triggered cameras ($30/pack × 20 packs = $600)

Remote-triggered cameras (7 × $330/camera = $2,310)

SD cards for cameras (7 × $11/card = $77)

Bait for bait stations (200 lbs × $1.80/lbs = $360)

Wooden boards for tracking tunnels and bait stations (40 boards by $9/board = $360)

Zip ties and bungees for attaching bait, traps, bait stations and cameras when needed ($125)

Cordless drill for attaching items in field ($150)

Miscellaneous field items (e.g., flags, flagging tape, Ziploc bags, data notebooks, etc. = $150)

Equipment:
N/A

Travel - $21,720:
Trip 1: From Jan 15 to Feb 1, 2021, SRA II will travel from Davis to anticipated field site in the Bakersfield area (TBD). This travel will correspond with site establishment and initiation of study. Mileage will include travel to closest hotel locations, as well as to field sites in each area (anticipated at 2,045 miles round trip). Mileage is for a rental vehicle ($0.29/mile). The trip is anticipated to be 17 days/16 nights in duration with hotel ($105/night for 17 nights) and meals ($35/day x 18 days per trip) associated with this trip (PY1 = $3,008).

Trip 2: From Jan 21 to Jan 27, 2021, PI will travel from Davis to anticipated field site in the Bakersfield area (TBD). This travel will correspond with site establishment and initiation of study. Mileage will include travel to closest hotel locations, as well as to field sites in each area (anticipated at 1,110 miles round trip). Mileage is for a personal vehicle ($0.575/mile). The trip is anticipated to be 7 days/6 nights in duration with hotel ($105/night for 6 nights) and meals ($35/day x 7 days per trip) associated with this trip (PY1 = $1,513).

Trip 3: From Feb 5 to Feb 6, 2021, SRA II will travel from Davis to anticipated field site in the Bakersfield area (TBD). This travel will correspond with monitoring bait stations and traps. Mileage will include travel to closest hotel location, as well as to field sites in each area (anticipated at 765 miles round trip). Mileage is for a rental vehicle ($0.29/mile). The trip is anticipated to be 2 days/1 night in duration with hotel ($105/night for 1 night) and meals ($35/day x 2 days per trip) associated with this trip (PY1 = $397).

Trip 4: From Feb 10 to Feb 11, 2021, SRA II will travel from Davis to anticipated field site in the Bakersfield area (TBD). This travel will correspond with monitoring bait stations and traps. Mileage will include travel to closest hotel location, as well as to field sites in each area (anticipated at 765 miles round trip). Mileage is for a rental vehicle ($0.29/mile). The trip is anticipated to be 2 days/1 night in duration with hotel ($105/night for 1 night) and meals ($35/day x 2 days per trip) associated with this trip (PY1 = $397).

Trip 5: From Feb 15 to Feb 16, 2021, SRA II will travel from Davis to anticipated field site in the Bakersfield area (TBD). This travel will correspond with monitoring bait stations and traps. Mileage will include travel to closest hotel location, as well as to field sites in each area (anticipated at 765 miles round trip). Mileage is for a rental vehicle ($0.29/mile). The trip is anticipated to be 2 days/1 night in duration with hotel ($105/night for 1 night) and meals ($35/day x 2 days per trip) associated with this trip (PY1 = $397).

Trip 6: From Feb 20 to Mar 13, 2021, SRA II will travel from Davis to anticipated field site in the Bakersfield area (TBD). This travel will correspond with completion of trials on site 1 and initiation of trials on site 2. Mileage will include travel to closest hotel locations, as well as to field sites in each area (anticipated at 2,470 miles round trip). Mileage is for a rental vehicle ($0.29/mile). The trip is anticipated to be 22 days/21 nights in duration with hotel ($105/night for 21 nights) and meals ($35/day x 22 days per trip) associated with this trip (PY1 = $3,691).

Trip 7: From Mar 17 to Mar 18, 2021, SRA II will travel from Davis to anticipated field site in the Bakersfield area (TBD). This travel will correspond with monitoring bait stations and traps. Mileage will include travel to closest hotel location, as well as to field sites in each area (anticipated at 765 miles round trip). Mileage is for a rental vehicle ($0.29/mile). The trip is anticipated to be 2 days/1 night in duration with hotel ($105/night for 1 night) and meals ($35/day x 2 days per trip) associated with this trip (PY1 = $397).

Trip 8: From Mar 22 to Mar 23, 2021, SRA II will travel from Davis to anticipated field site in the Bakersfield area (TBD). This travel will correspond with monitoring bait stations and traps. Mileage will include travel to closest hotel location, as well as to field sites in each area (anticipated at 765 miles round trip). Mileage is for a rental vehicle ($0.29/mile). The trip is anticipated to be 2 days/1 night in duration with hotel ($105/night for 1 night) and meals ($35/day x 2 days per trip) associated with this trip (PY1 = $397).

Trip 9: From Mar 27 to Mar 28, 2021, SRA II will travel from Davis to anticipated field site in the Bakersfield area (TBD). This travel will correspond with monitoring bait stations and traps. Mileage will include travel to closest hotel location, as well as to field sites in each area (anticipated at 765 miles round trip). Mileage is for a rental vehicle ($0.29/mile). The trip is anticipated to be 2 days/1 night in duration with hotel ($105/night for 1 night) and meals ($35/day x 2 days per trip) associated with this trip (PY1 = $397).

Trip 10: From Apr 1 to Apr 22, 2021, SRA II will travel from Davis to anticipated field site in the Bakersfield area (TBD). This travel will correspond with completion of trials on site 2 and initiation of trials on site 3. Mileage will include travel to closest hotel location, as well as to field sites in each area (anticipated at 2,470 miles round trip). Mileage is for a rental vehicle ($0.29/mile). The trip is anticipated to be 22 days/21 nights in duration with hotel ($105/night for 21 nights) and meals ($35/day x 22 days per trip) associated with this trip (PY1 = $3,691).

Trip 11: From Apr 26 to Apr 27, 2021, SRA II will travel from Davis to anticipated field site in the Bakersfield area (TBD). This travel will correspond with monitoring bait stations and traps. Mileage will include travel to closest hotel location, as well as to field sites in each area (anticipated at 765 miles round trip). Mileage is for a rental vehicle ($0.29/mile). The trip is anticipated to be 2 days/1 night in duration with hotel ($105/night for 1 night) and meals ($35/day x 2 days per trip) associated with this trip (PY1 = $397).

Trip 12: From May 1 to May 2, 2021, SRA II will travel from Davis to anticipated field site in the Bakersfield area (TBD). This travel will correspond with monitoring bait stations and traps. Mileage will include travel to closest hotel location, as well as to field sites in each area (anticipated at 765 miles round trip). Mileage is for a rental vehicle ($0.29/mile). The trip is anticipated to be 2 days/1 night in duration with hotel ($105/night for 1 night) and meals ($35/day x 2 days per trip) associated with this trip (PY1 = $397).

Trip 13: From May 6 to May 7, 2021, SRA II will travel from Davis to anticipated field site in the Bakersfield area (TBD). This travel will correspond with monitoring bait stations and traps. Mileage will include travel to closest hotel location, as well as to field sites in each area (anticipated at 765 miles round trip). Mileage is for a rental vehicle ($0.29/mile). The trip is anticipated to be 2 days/1 night in duration with hotel ($105/night for 1 night) and meals ($35/day x 2 days per trip) associated with this trip (PY1 = $397).

Trip 14: From May 11 to Jun 1, 2021, SRA II will travel from Davis to anticipated field site in the Bakersfield area (TBD). This travel will correspond with completion of trials on site 3 and initiation of trials on site 4. Mileage will include travel to closest hotel location, as well as to field sites in each area (anticipated at 2,470 miles round trip). Mileage is for a rental vehicle ($0.29/mile). The trip is anticipated to be 22 days/21 nights in duration with hotel ($105/night for 21 nights) and meals ($35/day x 22 days per trip) associated with this trip (PY1 = $3,691).

Trip 15: From Jun 5 to Jun 6, 2021, SRA II will travel from Davis to anticipated field site in the Bakersfield area (TBD). This travel will correspond with monitoring bait stations and traps. Mileage will include travel to closest hotel location, as well as to field sites in each area (anticipated at 765 miles round trip). Mileage is for a rental vehicle ($0.29/mile). The trip is anticipated to be 2 days/1 night in duration with hotel ($105/night for 1 night) and meals ($35/day x 2 days per trip) associated with this trip (PY1 = $397).

Trip 16: From Jun 10 to Jun 11, 2021, SRA II will travel from Davis to anticipated field site in the Bakersfield area (TBD). This travel will correspond with monitoring bait stations and traps. Mileage will include travel to closest hotel location, as well as to field sites in each area (anticipated at 765 miles round trip). Mileage is for a rental vehicle ($0.29/mile). The trip is anticipated to be 2 days/1 night in duration with hotel ($105/night for 1 night) and meals ($35/day x 2 days per trip) associated with this trip (PY1 = $397).

Trip 17: From Jun 15 to Jun 16, 2021, SRA II will travel from Davis to anticipated field site in the Bakersfield area (TBD). This travel will correspond with monitoring bait stations and traps. Mileage will include travel to closest hotel location, as well as to field sites in each area (anticipated at 765 miles round trip). Mileage is for a rental vehicle ($0.29/mile). The trip is anticipated to be 2 days/1 night in duration with hotel ($105/night for 1 night) and meals ($35/day x 2 days per trip) associated with this trip (PY1 = $397).

Trip 18: From Jun 21 to Jun 28, 2021, SRA II will travel from Davis to anticipated field site in the Bakersfield area (TBD). This travel will correspond with completion of trials on site 4. Mileage will include travel to closest hotel location, as well as to field sites in each area (anticipated at 1,195 miles round trip). Mileage is for a rental vehicle ($0.29/mile). The trip is anticipated to be 8 days/7 nights in duration with hotel ($105/night for 7 nights) and meals ($35/day x 8 days per trip) associated with this trip (PY1 = $1,362).

Professional/Consultant Services:
N/A

Other Expenses - $705:
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 $705/month and will be covered by Liphatech funds for 2020-2021. We will charge one month of the rental truck for field use in 2021-2022 (PY2 = $705).

Indirect (F&A) Costs - $7,444

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 (MTDC) for the project (PY1 - $6,677; PY2 - $767).

Other Funding Sources - $13,000

Liphatech, Inc.:
They will provide $8,000 in funding and in-kind support for the project. Assistance will include funding for a rental truck for the project, additional travel support, 0.005% chlorophacinone bait for application, and nontoxic monitoring bait for assessing roof rat activity before and after treatment applications.

Automatic Trap Company:
They will provide $5,000 in in-kind support for the project. This will include all A-24 traps and all attachments and attractants required to properly operate these traps.

2020 VPCRAC Project Proposal
Budget Template

Project Title: A test of management tools for invasive roof rats in citrus orchards.
Project Leader(s): Roger A. Baldwin, Aaron B. Shiels

	2020-2021	2021-2022	2021-2022	Total
A. PERSONNEL (name, role, % based on full time salary)				
Salary				
Ryan Meinerz, SRA II: 1,044 hrs/yr at $25.39/hr and 174	$26,507.00	$4,550.00		$31,057.00
hrs/yr at $26.15 for 2020-21 and 2021-22, respectively				$0.00
				$0.00
				$0.00
				$0.00
Salary Total	$26,507.00	$4,550.00	$0.00	$31,057.00
Benefits				
SRA II, 53.1% for 2020-21 and 2021-22	$14,075.00	$2,416.00		$16,491.00
				$0.00
				$0.00
				$0.00
				$0.00
Benefits Total	$14,075.00	$2,416.00	$0.00	$16,491.00
Personnel Cost (A)	$40,582.00	$6,966.00	$0.00	$47,548.00
B. OPERATING EXPENSES				
Supplies	$4,469.00			$4,469.00
Equipment				$0.00
Travel	$21,720.00			$21,720.00
Professional/Consultant Services (Cannot exceed $65/hour				$0.00
Other		$705.00		$705.00
Operating Cost (B)	$26,189.00	$705.00	$0.00	$26,894.00
TOTAL Costs (A+B)	$66,771.00	$7,671.00	$0.00	$74,442.00
C. Overhead Expense (10% TDC)	$6,677.00	$767.00	$0.00	$7,444.00
TOTAL CDFA FUNDING REQUESTED (A+B+C)	$73,448.00	$8,438.00	$0.00	$81,886.00
D. OTHER FUNDING SOURCES				
Liphatech	$8,000.00			$8,000.00
Automatic Trap Company	$5,000.00			$5,000.00
				$0.00
				$0.00
				$0.00
TOTAL OTHER FUNDING (C)	$13,000.00	$0.00	$0.00	**$13,000.00**
TOTAL PROJECT BUDGET (A+B+C+D)	$86,448.00	$8,438.00	$0.00	$94,886.00

UNIVERSITY OF CALIFORNIA, DAVIS

BERKELEY • DAVIS • IRVINE • LOS ANGELES • MERCED • RIVERSIDE • SAN DIEGO • SAN FRANCISCO | SANTA BARBARA • SANTA CRUZ

UNIVERSITY OF CALIFORNIA, DAVIS
OFFICE OF RESEARCH
SPONSORED PROGRAMS, 1850 Research Park Dr., #300
DAVIS, CALIFORNIA 95618

TELEPHONE: (530) 754-7700
FAX: (530) 752-0333

August 28, 2020

California Department of Food and Agriculture
Office of Grants Administration
1220 N Street
Sacramento, CA 95814

Proposal entitled: .... "A test of management tools for invasive roof rats in citrus orchards."
Principal Investigator: .... Roger Baldwin

Dear Administrator,

On behalf of The Regents of the University of California, Davis campus, it is my pleasure to provide institutional support and approval in support of the proposal referenced above.

This proposal is being presented with the understanding that the current **Model Language for Contracts with the University of California and California State Universities**, as directed by the California Department of General Services and available online at https://www.ucop.edu/research-policy-analysis-coordination/research-sponsors-agreements/state-of-california/california-model-agreement.html, **will be utilized for any resulting award and subawards.**

Please contact me with any administrative questions. We request correspondence pertaining to this proposal be sent via email to proposals@ucdavis.edu or mailed to the Office of Research Sponsored Programs Office, 1850 Research Park Drive, Suite 300 Davis, CA 95618-6153. Please refer to SP #21-0633 on all future correspondence

We look forward to working with you on this important project.

Sincerely,

Chris D. Dye-Hixenbaugh
Contracts and Grants Officer

Send Award Notice to:

Office of Research, Sponsored Programs
1850 Research Park Drive, Suite 300
University of California
Davis, California 95618
awards@ucdavis.edu

Send Checks (Payable to The Regents of the University of California) to:

Cashier's Office
University of California Davis
PO BOX 989062
West Sacramento, California 95798-9062

ROGER ALLEN BALDWIN

Department of Wildlife, Fish, and Conservation Biology
University of California, Davis
One Shields Ave., Davis, CA 95616

Phone: (530) 752-4551
E-mail: rabaldwin@ucdavis.edu

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 $9,134,938*

Selected titles (current projects overlapping proposed project underlined):

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); time commitment = 2% annually; this will not impact the proposed project.

An assessment of quantitative indexing tools and movement patterns in invasive roof rats in citrus orchards. Vertebrate Pest Control Research Advisory Committee (January 2020 – December 2020).

Rangeland forage loss from California ground squirrels. Vertebrate Pest Control Research Advisory Committee (January 2019 – June 2021); time commitment = 5% annually; this will not impact the proposed project.

An assessment of secondary impacts of anticoagulant rodenticides on predators. Vertebrate Pest Control Research Advisory Committee (November 2018 – June 2021); time commitment = 5% annually; this will not impact the proposed project.

Reregistration of CDFA baits for control of roof rats and deer mice in agricultural fields. Vertebrate Pest Control Research Advisory Committee (April 2010 – March 2012).

Intramural grants: *Total funding $257,071*

Industry/programmatic funding and in-kind support: *Total funding $197,394*

REPRESENTATIVE REFEREED PUBLICATIONS

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., D. I. Stetson, M. G. Lopez, and R. M. Engeman. 2019. An assessment of vegetation management practices and burrow fumigation with aluminum phosphide as tools for managing voles within perennial crop fields in California, USA. Environmental Science and Pollution Research 26:18434–18439.

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, G. W. Witmer, and S. J. Werner. 2018. The elusive search for an effective repellent against voles: an assessment of anthraquinone for citrus crops. Journal of Pest Science 91:1107–1113.

Sellers, L. A., R. F. Long, M. T. Jay-Russell, X. Li, E. R. Atwill, R. M. Engeman, and **R. A. Baldwin**. 2018. Impact of field-edge habitat on mammalian wildlife abundance, distribution, and vectored foodborne pathogens in adjacent crops. Crop Protection 108:1–11.

Wolf, K. M., M. A. Whalen, R. P. Bourbour, and **R. A. Baldwin**. 2018. Rodent, snake, and raptor use of restored perennial native grasslands is lower than use of unrestored exotic annual grasslands. Journal of Applied Ecology 55:1133–1144.

Baldwin, R. A., R. Meinerz, and S. B. Orloff. 2016. Burrow fumigation versus trapping for pocket gopher (*Thomomys* spp.) management: a comparison of efficacy and cost effectiveness. Wildlife Research 43:389–397.

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. 2016. Vertebrate Pests. In: UC IPM Pest Management Guidelines—Citrus. University of California Division of Agriculture and Natural Resources, Publication 3441.

Engeman, R. M., **R. A. Baldwin**, and D. I. Stetson. 2016. Guiding the management of an agricultural pest: indexing abundance of California meadow voles in artichoke fields. Crop Protection 88:53–57.

Baldwin, R. A., A. Chapman, C. P. Kofron, R. Meinerz, S. B. Orloff, and N. Quinn. 2015. Refinement of a trapping method increases utility for pocket gopher management. Crop Protection 77:176–180.

Baldwin, R. A. 2014. Determining and demonstrating the importance of training and experience for managing pocket gophers. Wildlife Society Bulletin 38:628–633.

Baldwin, R. A., R. Meinerz, and S. B. Orloff. 2014. The impact of attractants on pocket gopher trapping. Current Zoology 60:472–478.

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.

Quinn, N., and **R. A. Baldwin.** 2014. Managing roof rats and deer mice in nut and fruit orchards. Division of Agriculture and Natural Resources, Publication 8513.

Baldwin, R. A., D. B. Marcum, S. B. Orloff, S. J. Vasquez, C. A. Wilen, and R. M. Engeman. 2013. The influence of trap type and cover status on capture rates of pocket gophers in California. Crop Protection 46:7–12.

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.

Aaron B. Shiels, Research Scientist – Abbreviated Resume

USDA, APHIS, Wildlife Services
National Wildlife Research Center
4101 LaPorte Ave, Fort Collins, CO. 80521

Email: aaron.b.shiels@usda.gov
Phone: 808-960-5108

Education:

B.S., Denver University, 1998, Environmental Science Department
M.S., University of Nevada, Las Vegas, 2002, Biology Department
Ph.D., University of Hawaii at Manoa, 2010, Botany Department
Postdoctoral Research Associate, USDA, 2011-2015

Employment:

Research Scientist, Rodents Project, USDA, APHIS, WS, National Wildlife Research Center, 2015-current.

Relevant Current Research:

2020 Lead PI for "Development of an A24 rat trap excluder to prevent nontarget bird entry and impact". Funding: Department of Land and Natural Resources (Hawaii); Period: Feb 2020 to Jan 2021; *the proposed VPCRAC study will not be impacted by this study.*

2019 Co-PI for "Efficacy testing a novel rat specific toxicant in Norway and black rats". Funding: California Department of Food and Agriculture, Vertebrate Pest Control Research Program; Period: 2019-2021; *the proposed VPCRAC study will not be impacted by this on-going study, as the on-going study will be in the final laboratory testing phase.*

--------------------------------------*Research studies below are 100% complete*--

2019 Lead PI for "Efficacy and humanness of Goodnature A24 rat+stoat self-resetting traps with Chocolate Lure for use on house mice (*Mus musculus*)". Funding: Automatic Trap Company, Inc.; Period: 2019.

2019 Lead PI for "Test and evaluation of infrared small mammal surveys and tracking tunnels to compare with traditional trapping surveys at airports". Funding: USDA, APHIS, Wildlife Services Operations; Period: 2019-2020.

2018 Lead PI for "Assessment of invasive rat (*Rattus* spp.) control methods in the Waianae Mountains, Oahu". Funding: U.S. Army Natural Resources Program; Period: 2018-2020.

2018 Co-PI for "Identification of Rose-ringed Parakeet damage, distribution, and management solutions on Kauai". Funding: State of Hawaii; Period: 2018-2020.

2017 Co-PI for "Management of urban black-tailed prairie dog populations using non-lethal reproductive control". Funding: Botstiber Institute for Wildlife Fertility Control. Period: 2017-2019.

2017 Co-PI for "Restoring ecosystems and biodiversity through development of safe and effective gene drive technologies". Funding: U.S. Department of Defense, Defense Advanced Research Project Agency (DARPA); Period: 2017-2018.

2017 Lead PI for "Invasive rat (*Rattus rattus*) impacts in Luquillo rainforest, Puerto Rico". Funding: University of Puerto Rico & Luquillo LTER; Period: 2017-2018.

2017 Co-PI for "Review of possible methods to control and remove rose-ringed parakeets from damaging Kauai agriculture, native species, and human health & safety". Funding: State of Hawaii; Period: 2017-2018.

2016 Lead PI for "Assessment of an aerial-broadcast rodenticide bait trial to control rats (*Rattus* spp.) in the Waianae Mountains, Oahu". Funding: Oahu Army Natural Resources Program; Period: 2016-2018.

2016 Lead PI for "Biological monitoring and nontarget species impacts during aerial broadcast of rodenticide to remove invasive rats (*Rattus rattus*) from Desecheo Island, Puerto Rico". Funding: U.S. Fish & Wildlife Service; Period: 2016-2017.

Representative Publications:

Shiels, A.B., C.D. Lombard, L. Shiels, and Z. Hillis-Starr. 2020. Invasive rat establishment and changes in small mammal populations on Caribbean islands following two hurricanes. *Global Ecology and Conservation* 22: e00986.

Shiels, A.B., T. Bogardus, J. Rohrer, and K. Kawelo. 2019. Effectiveness of snap and A24-automated traps and broadcast anticoagulant bait in suppressing commensal rodents in Hawaii. *Human-Wildlife Interactions* 13: 226-237.

Shiels, A.B., and G.E. Ramírez de Arellano. 2019. Habitat use and seed removal by invasive rats (*Rattus rattus*) in disturbed and undisturbed rainforest, Puerto Rico. *Biotropica* 51: 378-386.

Shiels, A.B., and G.E. Ramírez de Arellano. 2018. Invasive rats (*Rattus* sp.), but not always mice (*Mus musculus*), are ubiquitous at all elevations and habitats within the Caribbean National Forest, Puerto Rico. *Caribbean Naturalist* 48: 1-14.

Shiels, A.B., A.C. Medeiros, E.I. von Allmen. 2017. Shifts in an invasive rodent community favoring black rats (*Rattus rattus*) following restoration of a native forest. *Restoration Ecology* 25: 759-767.

Duron, Q., **A.B. Shiels**, and E. Vidal. 2017. Control of invasive rats on islands and priorities for future action. *Conservation Biology* 31: 761-771.

Shiels, A.B., and D.R. Drake. 2015. Barriers to seed and seedling survival of once-common Hawaiian palms: the role of invasive rats and ungulates. *AoB PLANTS* 7: plv057 (1-10).

Shiels, A.B., W.C. Pitt, R.T. Sugihara, and G.W. Witmer. 2014. Biology and impacts of Pacific island invasive species. 11. *Rattus rattus*, the black rat (Rodentia: Muridae). *Pacific Science* 68: 145-184.

Shiels, A.B., C.A. Flores, A. Khamsing, P.D. Krushelnycky, S.M. Mosher, and D.R. Drake. 2013. Dietary niche differentiation among three species of invasive rodents (*Rattus rattus*, *R. exulans*, *Mus musculus*). *Biological Invasions* 15: 1037-1048.

Pender, R.J., **A.B. Shiels**, L. Bialic-Murphy, and S.M. Mosher. 2013. Large-scale rodent control reduces pre- and post-dispersal seed predation of the endangered Hawaiian lobeliad, *Cyanea superba* subsp. *superba* (Campanulaceae). *Biological Invasions* 15: 213-223.

Shiels, A.B., and D.R. Drake. 2011. Are introduced rats (*Rattus rattus*) both seed predators and dispersers in Hawaii? *Biological Invasions* 13: 883-894.

Shiels, A.B. 2011. Frugivory by introduced black rats (*Rattus rattus*) promotes dispersal of invasive plant seeds. *Biological Invasions* 13: 781-792.

LIPHATECH

3600 W. Elm Street
Milwaukee, WI 52309

Phone: 414/351-1476
Fax: 414/247-8166

August 20, 2020

Roger A. Baldwin, Ph.D.
Wildlife Specialist
Department of Wildlife, Fish, and Conservation Biology
One Shields Ave.
University of California, Davis
Davis, CA 95616

Aaron B. Shiels, Ph.D.
Research Biologist, Rodent Project
National Wildlife Research Center
USDA-APHIS-WS
4101 LaPorte Ave.
Fort Collins, CO 80521

Subject: Support for the grant proposal 'A test of management tools for invasive roof rats in citrus orchards'

Dear Dr. Baldwin & Dr. Shiels:

Liphatech will contribute a total of $8,000 to this project. Liphatech will provide $7475 in direct funds, and an additional $525 in supplies, including toxic bait and nontoxic attractant.

In addition, the following Liphatech personnel are authorized to contribute time to the project:

1) Katie Swift
Manager of Regulatory Compliance
3600 West Elm Street
Milwaukee, WI 53208
(808) 284-8322
swiftk@liphatech.com

80 hours for regulatory compliance with state and federal laws, study design.

2) Kylli Paavola
Sr. Regulatory Compliance Specialist
3600 West Elm Street
Milwaukee, WI 53208
(414) 410-7261
paavolak@liphatech.com

80 hours for quality assurance, regulatory compliance with state and federal laws, study design.

3) Chris Morales
Research and Development/Field Support Manager
3600 West Elm Street
Milwaukee, WI 53208
(414) 702-8558
moralesc@liphatech.com

120 hours for project coordination, study design, field assistance.

4) Ross Horn
Business Manager – Field Products
3600 West Elm Street
Milwaukee, WI 53208
hornr@liphatech.com

40 hours for project coordination, field site logistics, field assistance.

We appreciate the opportunity to support this project.

Sincerely,

Ross Horn
Business Manager – Field Products

AUTOMATICTRAP.COM goodnature®

08/15/2020

Attn:
Roger A. Baldwin, Ph. D.
Dept. Wildlife, Fish, and Conservation Biology
One Shields Ave.
University of California, Davis
Davis, CA 95616
Phone: 530-752-4551
E-mail: rabaldwin@ucdavis.edu

Aaron B. Shiels, Ph.D.
National Wildlife Research Center
USDA-APHIS-WS
4101 LaPorte Ave.
Fort Collins, CO 80521
Phone: 970-266-6324
E-mail: Aaron.B.Shiels@usda.gov

Hello Roger & Aaron,

We understand that you are looking to conduct a study on the efficacy of Goodnature traps and black/roof rats (*Rattus rattus*) in agricultural and specifically orchard settings. Goodnature and Automatic Trap have supported clinical trials similar to this in the past. Most recently, we worked with Aaron on the USDA released study regarding the efficacy of the Goodnature A24 and its ability to humanely dispatch house mice (*Mus musculus*).

While studies like this have intrinsic and authoritative value for our traps, we originally come from the field of conservation and understand how trials such as this can help protect crop yields, quell the spread of diseases rats carry, and ultimately lead to better, safer rodent control.

We would like to offer our help with your study. Goodnature and Automatic Trap would be interested in providing you with in-kind support for the project in the form of our Goodnature A24 traps and all related trapping supplies (i.e., bio-attractant lure, Digital Strike Counters, etc.).

Is this something that would interest you both? Please let us know how we can help push the study forward and assist with any other equipment needed.

All the best,

Ty Huggins
Director of Marketing
Automatic Trap & Goodnature.co
ty.huggins@automatictrap.com
1-877-992-8868 ext. 616