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Burrowing Rodents:
Developing a Management Plan for Organic Agriculture in California

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By **MARGARET LLOYD** | *UCCE Small Farms Advisor, Yolo County*
and **ROGER BALDWIN** | *UCCE Specialist, Human-Wildlife Conflict Resolution*

Figure 1. Gopher snakes are a small but important that should be promoted to control rodents (photo by R. Baldwin.)

Figure 2. Mowing rows and leaving bare soil around the base of vines reduce likelihood of vole damage (photo by R. Baldwin.)

BURROWING RODENTS CAN CAUSE significant damage to farm operations by destroying irrigation lines, disrupting roots, girdling trees and building extensive burrow systems that are hazardous to farmers, to name a few. Although rodenticide baiting and burrow fumigation are regularly used for burrowing rodent control in conventional agriculture systems, Vitamin D3 is the only rodenticide certified for use within organic systems. Even then, it can only be used for roof rats (*Rattus rattus*), Norway rats (*Rattus norvegicus*) and house mice (*Mus musculus*), and only indoors or within 50 feet of a structure. Controlling burrowing rodents in organic systems requires combining multiple tactics that often include biocontrol, habitat modification, cultural practices, exclusion, trapping and shooting. In this article, we will discuss how available tools can be implemented for management of ground squirrels, pocket gophers and voles in organic production systems. For more in-depth information, visit anrcatalog.ucanr.edu/Details.aspx?itemNo=8688.

Biocontrol Using Natural Predators

Natural predators can be used to control rodent populations. The most common example is recruitment of the barn owl (Tyto *alba*) by installing nesting boxes. It is estimated that a single barn owl consumes 3,000 rodents annually in California vineyards, indicating they are effective predators of rodents. Importantly, barn owls are not overly territorial, which allows growers to artificially inflate barn owl numbers by erecting more barn owl boxes.

It bears noting that barn owls are not effective predators of ground squirrels because barn owls are active at night and ground squirrels are active during the day. Instead, raptor perches have been promoted for ground squirrel control. However, there is little evidence to suggest that this approach is especially effective. Gopher snakes (*Pituophis catenifer*; **Figure 1**) consume as little as 1.5 times their body mass annually, making them unlikely to significantly control rodent populations. Although raptors and gopher snakes may not consume as many rodents as barn owls, natural predators are an important part of the agricultural landscape and should be promoted to the extent tolerable. Consider natural predators a valuable part of an IPM program, but do not rely on them exclusively to manage your rodent problems.

Habitat Concerns and Modifications

Modifying rodent habitat has varying levels of effectiveness for differing rodent species but may be most effective against voles. Voles are very dependent on cover; without cover they are particularly susceptible to natural predation. Cover removal and reduction can be implemented in many ways. If dealing with tree or vine crops, be sure to keep two to three feet of bare soil around the base of trees or vines and keep rows between trees and vines mowed low, preferably less than two inches (**Figure 2**). Litter produced by mowing can form a thatch layer that can serve as good cover for voles. Be sure to keep

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Figure 3. Removing brush piles can reduce habitat for ground squirrels (photo by R. Baldwin.)

Figure 4. Deep ripping implements can be used to destroy old burrow systems (photo by Bob Beede, UCCE Emeritus.)

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this thatch layer away from the trunks of plants[3] and mow more frequently to minimize this thatch layer. When plastic mulch is used in organic production systems to suppress weed growth, it can provide ideal cover for voles, leading to substantial problems associated with vole girdling of the stems of trees and vines. Removing the weed barrier, if possible, eliminates this problem.

Ground squirrels readily use brush and pruning piles as harborage sites within orchards and vineyards (**Figure 3**). Removing piles within 100 yards of fields can help reduce damage associated with ground squirrels.

Cover crops can provide food and cover resources that burrowing rodents need. Avoiding cover crops that contain legumes and broadleaf plants with fleshy tap roots is a good strategy for reducing numbers of most burrowing rodents. For voles, planting bunch grasses is a good strategy to reduce preferred cover as well. For pocket gophers, the selection of lower-growing plants makes identification of gopher infestations easier. In both annual and perennial systems, incorporation of cover crops (e.g., by discing) is one of the best approaches for reducing rodent damage. However, when deciding on the timing of cover crop termination, one must consider the status of neighboring fields. A newly planted field is very vulnerable to rodent damage for it may become the next food source for displaced rodents.

Planting native California flowering plants (hedgerows) as habitat on field borders is becoming more common as a means to attract natural enemies for pest control and native bees for pollination services. Although some have expressed concern that hedgerow plantings can harbor rodents and lead to food safety problems, studies have shown that field-edge habitat is too narrow on a landscape scale to serve as habitat for large numbers of rodents. Rodents are everywhere in our agricultural lands; they need to be monitored and managed regardless of field-edge habitat type.

Cultural Practices

Two cultural practices that help reduce rodents are flooding fields and deep-ripping burrow systems with tractor implements. With the water shortages frequently experienced in California, flood irrigation has become less common. If flood irrigation is still an option, consider periodically using it as a tool to help reduce problems with ground squirrels, gophers and voles.

Deep-ripping of old ground squirrel burrow systems to a depth of at least 18 inches has been shown to substantially reduce reinvasion by adjacent populations of ground squirrels (**Figure 4**). Shallower ripping efforts have proven to be ineffective. Burrow destruction should occur after ground squirrels have been removed from the site because burrow destruction in areas with extant ground squirrel populations has been ineffective. Admittedly, burrow destruction is not possible in perennial crop production systems while the crops are in place. However, this approach can be effectively used before replanting a field and on the perimeters of fields from which rodents often invade.

Burrow destruction has not been tested as a management tool for pocket gophers, but it is believed to be beneficial for this species as well. For gophers, a 'best guess' is that ripping efforts will need to extend for 12 inches in depth

> **In organic production systems, effective rodent management will rely heavily on ensuring that rodent populations do not build up to numbers that are too high to effectively manage with available tools.**

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to ensure destruction of most burrow systems. For voles, the depth of plowing and discing tested in studies was 18 to 20 inches, but burrow destruction as shallow as 6 to 10 inches may be effective because of the shallower nature of vole burrow systems, though this has not been tested. Frequency of tillage is generally dictated by replanting efforts, although discing of row middles in perennial orchard and vine crops, where possible, might provide some relief.

Exclusion Through Physical Barriers

Exclusion using fences, root baskets and tree protectors can be an effective tool to reduce damage caused by pocket gophers and voles. Exclusionary fencing is not generally effective or practical for ground squirrels because of their digging and climbing capabilities. For gophers, field testing of buried perimeter fencing has not shown this approach to be effective. Wire baskets placed around the root systems of newly planted trees may provide some relief, but they are expensive and likely impractical over large acreage. When properly placed and operated, aluminum fencing can be effective at deterring vole movement into fields. Fencing should be buried at least 6 inches below ground and extend 10 to 12 inches above ground (**Figure 5**). For aluminum fencing to be effective, as much as possible of the perimeter around the field must

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Figure 5. Three-foot trench with a gopher tunnel system at the base illustrates the lack of effectiveness of fencing for keeping gophers out of fields (photo by D. Hannaford.)

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Figure 6. Plastic tree protectors are physical barriers that protect trees and vines from voles (photo by J. K. Clark.)

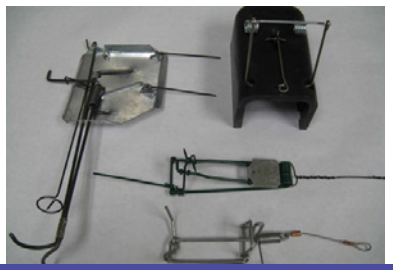

Figure 7. Common examples of gopher traps include the Cinch trap, Victor Black Box, Macabee and Gophinator (shown clockwise from top left). Many other trap designs are also available (photo by R. Baldwin.)

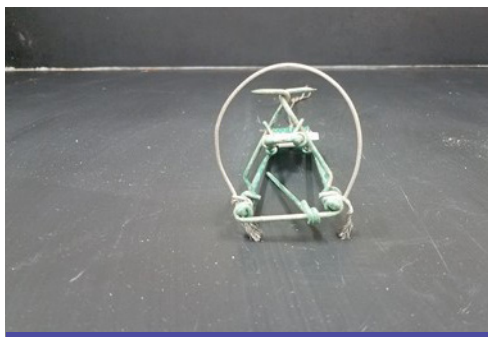

Figure 8. Modified Macabee designed to increase capture success for larger pocket gophers (photo by R. Baldwin.)

Continued from Page 37

be fenced; otherwise, voles will simply travel down the fence line until they find a way in. This type of exclusionary approach will not eliminate problems with voles but will help to slow movement into and out of fields.

Vole damage to tree crowns can be overcome with plastic tree protectors (**Figure 6**). Tree protectors can also help protect against sunburn in young trees and mechanical damage from weeding near tree trunks. Tree protectors should be buried two to six inches belowground to reduce vole access. If the protector is not buried, growers can see an increase in damage as the protectors will shelter the rodents from predators while they feed on the tree cambium.

Trapping

Once rodents have become established, trapping becomes one of the few tools available to remove them. Trapping has variable applicability for burrowing rodents; it is highly efficacious and fairly cost-effective for pocket gophers, is moderately efficacious for ground squirrels and is a viable option for voles only when numbers are low.

Gopher

Most trap designs for gophers are either pincer-style traps or choker-style traps (**Figure 7**). Of the traps tested, the Gophinator trap appears to be one of the most effective because it can capture larger individuals at a higher rate compared to the popular Macabee trap[16]. For each 45-gram increase in size, Macabee traps were an additional 25% to 26% less effective than Gophinator traps[16]. Macabee trap effectiveness can be increased by placing a cable restraint (0.06 inches in diameter and 9 inches in length) at the front of the Macabee trap to help keep larger individuals from escaping (**Figure 8**).

For trap placement, probe near a fresh mound to find the main tunnel, usually 6 to 8 inches deep. Because it isn't possible to know which side the pocket gopher is currently using, traps need to be placed in as many tunnels as are present (**Figure 9, see page 39**). Once set, covering traps is unnecessary. Various attractants have been tested and they do not appear to significantly increase capture success. Human scent also does not appear to influence capture success, so there is little reason to worry about handling traps with bare hands.

Pincer-type traps can also be placed in lateral tunnels, which are tunnels that lead directly to the surface. To trap in laterals, remove the plug from a fresh mound and place the trap in the lateral tunnel so that the entire trap is inside the tunnel. Pocket gophers will come to the surface to investigate the tunnel opening and will be caught.

Ground squirrels

Trapping for ground squirrels can be an effective approach and can be conducted year-round as long as the squirrels are active at the time the traps are in use (**Figure 10, see page 39**). Kill traps and live traps are available. In areas where nontarget captures such as pets are a concern, live traps may be preferred. Live traps generally require euthanasia, which should be done humanely (e.g., shooting or utilization of a carbon dioxide euthanasia chamber, see resources for more details.) Drowning is no longer considered a humane form of euthanasia and is illegal for dispatching animals in California, and translocation is neither legal in California nor scientifically advisable.

Because trapping for ground squirrels can be challenging, it is best when possible to plan trapping efforts for early in the year before young emerge aboveground. Body-gripping traps such as the Conibear 110 are ideal for this use. These traps are set in the burrow entrance (**Figure 12, see page 40**). They work best when the trap is flush to the surface of the soil. Some trappers note greater success when offsetting the trigger mechanism to the side somewhat to provide a less obscured view of the tunnel. One strategy for increasing the efficacy of this approach is to first plug up burrow entrances with soil, then come back the following day and set traps in entrances that have been reopened. One advantage of this style of trapping is that the trapper does not need to use bait to draw the ground squirrel into the trap. This is especially useful early in the year when ground squirrels actively feed on new plant growth, making baits less attractive and less effective. For other trap types,

Figure 9. Example of gopher trap set (photo by R. H. Smith.)

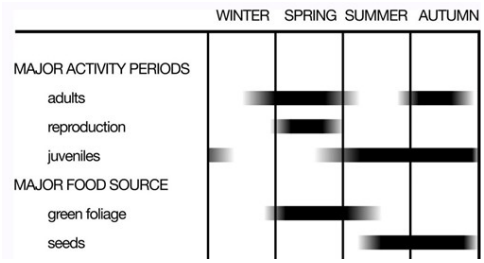

Figure 10. Major activity periods and food sources for California ground squirrels throughout the year.

Figure 11 . Example of a cage live trap frequently used to trap ground squirrels (photo by R. Baldwin.)

bait will generally be needed. Various baits can be used. Rolled oats are one of the simplest to use, but fresh fruit, vegetables and nuts work as well or better. Remember that the bait needs to be more desirable to squirrels than what they are already consuming. Ground squirrels can take several days to build up the courage to enter a trap. This can be overcome by prebaiting, or applying bait to traps without setting the traps. Once you notice the bait is regularly removed from the trap, activate the trap.

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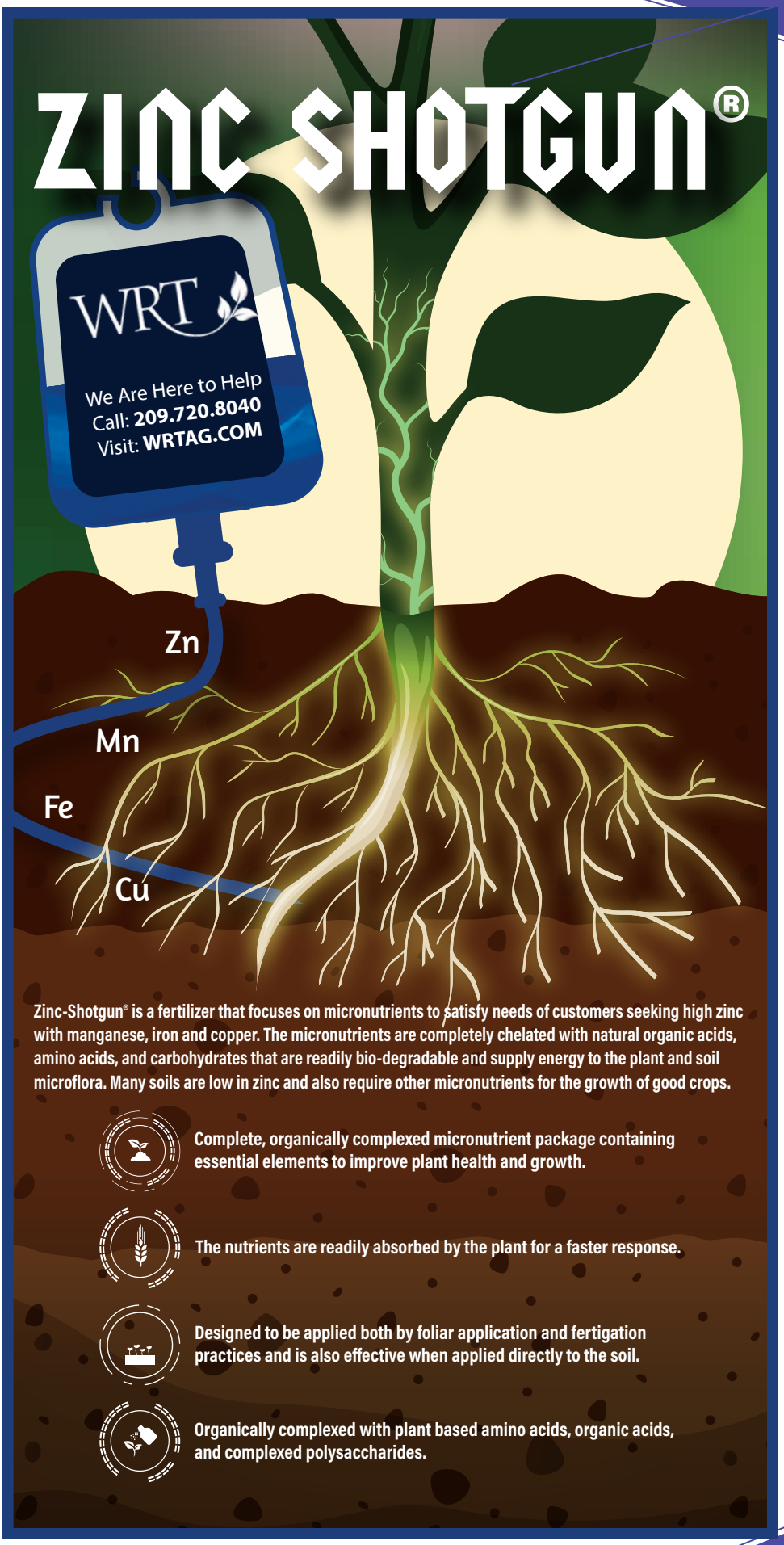

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Additional details on this process can be found at the Ground Squirrel Best Management Practices website, groundsquirrelbmp.com

Voles

Generally, trapping is only used for voles when a small number of voles need to be removed. Within targeted areas, look for vole burrows and runways in grass or mulch. Place standard mouse-size snap traps perpendicular along runways so that the trigger mechanism of the activated trap bisects the runway. Voles do not regularly deviate from their runways; the vole will run right over the trigger mechanism. Bait is generally not used. Traps should be examined daily. Dead voles should be removed and sprung traps should be reset as needed. Continue to trap in one location until you stop catching voles, then move the traps to a new location 15 to 20 feet away. 100 traps or more will likely be required when trapping even a relatively small area.

Figure 12. Body gripping trap placed at a ground squirrel burrow entrance (photo by R. Baldwin.)

Shooting

Shooting can be effective at controlling ground squirrels if the effort is consistent, but it is labor-intensive. Be sure to understand and adhere to all federal, state and local ordinances for discharging a firearm.

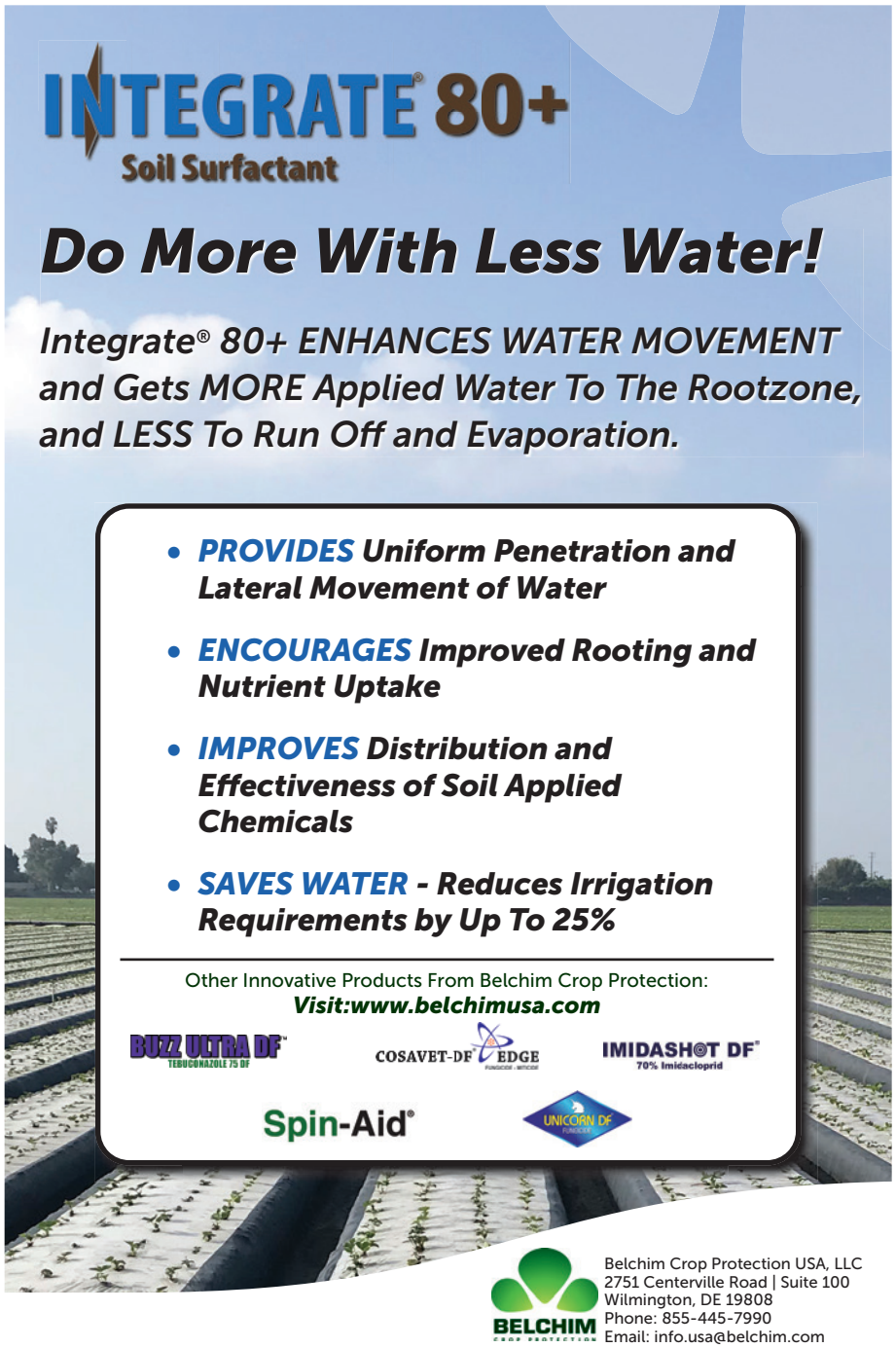
In organic production systems, effective rodent management will rely heavily on ensuring that rodent populations do not build up to numbers that are too high to effectively manage with available tools. Implementation of multiple strategies will be the cornerstone of effective rodent management programs in organic fields.

References

Kross, S. M., and R. A. Baldwin. 2016. Gopherbusters? A review of the candidacy of barn owls as the ultimate natural pest control option. Proceedings of the Vertebrate Pest Conference 27:345–352. https://doi.org/10.5070/V427110691

Diller, L. V., and D. R. Johnson. 1988. Food habits, consumption rates, and predation rates of western rattlesnakes and gopher snakes in southwestern Idaho. Herpetologica 44:228–233. https://www.jstor.org/stable/3892521

Whisson, D. A., and G. A. Giusti. 1998. Vertebrate Pests. In C. A. Ingels, R. L. Bugg, G. T. McGourty, and L. P. Christensen, eds. Cover cropping in vineyards: a grower's handbook, 126–131. UC Agriculture and Natural Resources Publication 3338. https://anrcatalog.ucanr.edu/Details.aspx?itemNo=3338



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. https://doi.org/10.1016/j.cropro.2018.02.005

Gilson, A., and T. P. Salmon. 1990. Ground squirrel burrow destruction: control implications. Proceedings of the Fourteenth Vertebrate Pest Conference 14:97–98. https://digitalcommons.unl.edu/vpc14/33/

Marsh, R. E. 1992. Reflections on current (1992) pocket gopher control in California. Proceedings of the Vertebrate Pest Conference 15:289–295. https://escholarship.org/uc/item/2j76r0pb

Jacob, J. 2003. Short-term effects of farming practices on populations of common voles. Agriculture, Ecosystems and Environment 95(1):321–325. https://doi.org/10.1016/s0167-8809(02)00084-1

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. https://doi.org/10.1007/s11356-019-05235-6

Salmon, T. P., R. H. Schmidt, and R. E. Marsh. 1990. An evaluation of fencing to exclude pocket gophers from experimental plots. Proceedings of the Vertebrate Pest Conference 14:95–96. https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1072&context=vpc14

Davies, R. J., and H. W. Pepper. 1989. The influence of small plastic guards, tree-shelters and weed control on damage to young broadleaved trees by field voles (*Microtus agrestis*). Journal of Environmental Management 28:117–125. https://agris.fao.org/agris-search/search.do?recordID=GB8905997

Marsh, R. E., A. E. Koehler, and T. P. Salmon. 1990. Exclusionary methods and materials to protect plants from pest mammals—a review. Proceedings of the Vertebrate Pest Conference 14:174–180. https://escholarship.org/uc/item/9766f2h9

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(5):389–397. https://doi.org/10.1071/WR16037

Marsh, R. E. 1994. Current (1994) ground squirrel control practices in California. Proceedings of the Vertebrate Pest Conference 16:61–65. https://digitalcommons.unl.edu/vpc16/35?utm_source=digitalcommons.unl.edu%2Fvpc16%2F35&utm_medium=PDF&utm_campaign=PDFCoverPages

O'Connell, R. A. 1994. Trapping ground squirrels as a control method. Proceedings of the Vertebrate Pest Conference 16:66–67. https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1042&context=vpc16

Witmer, G., N. P. Snow, L. Humberg, and T. Salmon. 2009. Vole problems, management options, and research needs in the United States. Proceedings of the Wildlife Damage Management Conferences 13:235–249. https://digitalcommons.unl.edu/icwdm_wdmconfproc/140?utm_source=digitalcommons.unl.edu%2Ficwdm_wdmconfproc%2F140&utm_medium=PDF&utm_campaign=PDFCoverPages

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. https://doi.org/10.1016/j.cropro.2012.12.018

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. https://doi.org/10.1016/j.cropro.2015.08.003

Witmer, G., N. P. Snow, L. Humberg, and T. Salmon. 2009. Vole problems, management options, and research needs in the United States. Proceedings of the Wildlife Damage Management Conferences 13:235–249. https://digitalcommons.unl.edu/icwdm_wdmconfproc/140?utm_source=digitalcommons.unl.edu%2Ficwdm_wdmconfproc%2F140&utm_medium=PDF&utm_campaign=PDFCoverPages

Salmon, T. P., and W. P. Gorenzel. 2010. UC IPM Pest Notes: Voles (meadow mice). Oakland: UC Agriculture and Natural Resources Publication 7439. http://ipm.ucanr.edu/PDF/PESTNOTES/pnvoles.pdf

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