Department of Pesticide Regulation

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MEMORANDUM

TO: Ann Prichard, Chief
Department of Pesticide Regulation
Pesticide Registration Branch

FROM: Deborah Daniels, DVM
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916-322-0344

DATE: June 27, 2013

SUBJECT: SUMMARY OF SECOND GENERATION ANTICOAGULANT RODENTICIDES ASSESSMENT COMMENTS AND RESPONSES

In a July 2011 memorandum, the California Department of Fish and Wildlife (CDFW) (formerly the Department of Fish and Game) requested that the Department of Pesticide Regulation (DPR) designate all second generation anticoagulant rodenticides (SGARS) as California restricted materials. On September 19, 2012, DPR completed its final draft assessment, based on a review of available data, of the potential and actual risk to non-target wildlife from second generation rodenticides.

In addition to the four peer reviewer's comments, which are addressed in a separate memorandum, DPR received comments on its assessment from five individual/organizations.

Below is a summary of each reviewer's comments and DPR's responses to those comments:

Ms. Victoria Hornbaker
California Department of Food and Agriculture

Reviewer Comment: On page 1, paragraph 3, the author is combining effective with dangerous to non-target animals and it may be confusing to readers. A suggestion rewording could be: "Compared to first generation anticoagulants, second generation anticoagulants are considered to be more effective as they only require a single feeding and to date, no resistance has been reported. However, based on the LD_{50}s for these products and their long half-life, they are potentially more hazardous to non-target wildlife, including birds and mammals."

DPR Response: Per the commenter's suggestion, the paragraph was revised.

Reviewer Comment: On page 7, paragraph 3, it states, "To address this problem, the product's label was amended to prohibit use in fields once the artichokes have been harvested." This is not accurate. The product label states, "To reduce the potential for exposure to non-target animals and birds, do not apply this bait for a period of 30 days before or after chopping or cut-back of artichoke plants." This is not a harvest, but a cultural practice.

DPR Response: Thank you for the clarification.

Reviewer Comment: On page 13, paragraph 1, the last sentence reads, "What prey would a song bird consume that would have eaten bait?" This would be a primary exposure of birds consuming bait not a secondary exposure.

DPR Response: This paper addresses non-target exposure. While this exposure was primarily secondary exposure, we did not exclude primary exposures. The songbird species in the Dowding et al (1999) study included:

- Blackbird (*Turdus merula*) is an introduced, omnivorous species that consumes insects and other invertebrates, seeds, berries, and small vertebrates (including frogs and lizards).
- Chaffinch (Fringilla coeleba) primarily consumes seed, but the hatchlings, nestlings, and fledglings eat insects and the adults eat insects during breeding season.
- Common myna (*Acridotheres tristis*) is an invasive, omnivorous species that feeds on insects (especially grasshoppers) and other invertebrates (such as crustaceans), reptiles, small mammals (such as mice) and birds, lizards and snakes, seeds and grains grains, fruit and vegetable, and human refuse.
- Australian Magpie (*Cracticus tibicen*) is an omnivorous species consumes insects (including cockroaches, bees, and ants) and other invertebrates, mice, frogs, grain, figs, walnuts, toads, and a variety of other foods.

All of these birds consume insects and/or other invertebrates, and 2 of the 4 consume small vertebrates (including mice). As stated in Appendix I, several papers have suggested that invertebrates might be a potential source of rodenticides, including weta, cockroaches, beetles (*Holcaspis stewartensis* and *Mecodema*), locusts, land crabs, and snails. As such, these bird species could potentially obtain rodenticide residues through the consumption of exposed invertebrates. The birds may be exposed to rodenticides through primary (by consuming the rodenticide directly) or secondary (invertebrate and/or rodent) exposure.

Thank your time and for all of your comments.

Arthur Lawyer, Ph.D.
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Reckitt Benckiser, LLC

Anne Fairbrother, Ph.D., DVM
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Reviewer Comment: Although the objective of the document as stated in the opening paragraph is to present the "potential and actual risk" of SGARs to non-target wildlife, the document primarily focuses on addressing questions of exposure of wildlife, including prevalence and source. There is some discussion about the hazard of these chemicals and incident reports are used to substantiate that wildlife may die from directed or accidental ingestion of SGARs. However, while there is strong evidence that a large percentage of wildlife are exposed (i.e., they have measurable residues in their livers), data limitations preclude a rigorous assessment of the amount of harm (death or sub-lethal effects) that accrues to wildlife populations as a result. Thus, although it is appropriate for the document to conclude that "impacts to non-target wildlife" result from SGAR exposure, there is no quantification of the degree of this impact (the relative risk). The reader is left to infer that it is at a level that should be of concern, but even that is not stated. Impacts to individual animals certainly occur as SGARs are known poisons to both birds and mammals, but how that affects the overall population of various species is not addressed.

DPR Response: The assessment included information on the half-lives of the rodenticides, as well as, the lethal dose expected to kill 50 percent of animals tested (LD_{50}) for the most sensitive animals. DPR provided the data in terms of the percentage of animals with residues, the percentage of animals with residues above the LD_{50}s of sensitive species, and the percentage of animals that likely died due to exposure to rodenticides. While the assessment did not include impacts on the overall population of various species, as you point out, the data support DPR's conclusion that "second generation anticoagulant rodenticides present a hazard related to persistent residues in target animals resulting in impacts to non-target wildlife."

Reviewer Comment: This ambiguity of what is meant by "impacts to wildlife" stems from the lack of explicitly stating the assessment endpoint of the risk analysis (U.S. EPA, 2003). If the endpoint is the individual animal, then the conclusion of risk to wildlife is correct. However, if the endpoint is whether the use of, and widespread exposure to, SGARs is causing an ecologically-relevant impact, then the document falls short as it does not investigate population changes during the time of SGAR use.

DPR Response: The term "impacts to wildlife" refers both to impacts on individual animals, as well as populations of animals. However, DPR's assessment was limited to an analysis of the data that we were able to collect from various sources. Therefore, the analysis is based on the data presented. The document is an assessment of available data, not a complete risk assessment.

Reviewer Comment: For example, the United States Geological Survey (USGS) breeding bird survey data show positive trends in the Cooper's hawk and red-tailed hawk populations in California during the past 30 years (Figure 1), suggesting that the impact of these products has not been severe (or even noticeable).

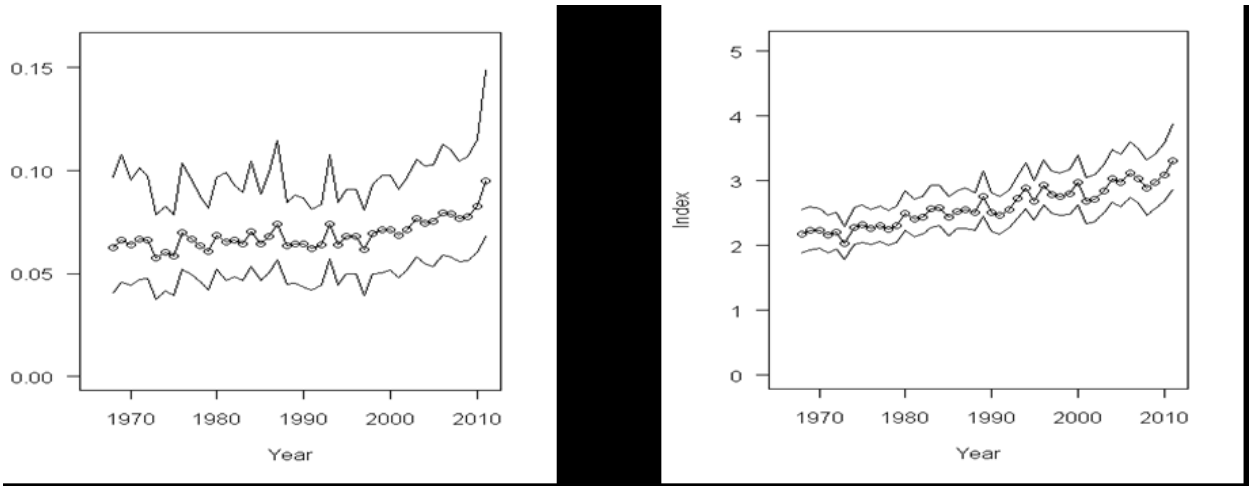

Figure 1. Population trends for Cooper's hawks (A) and red-tailed hawks (B) in California, from 1970 to 2010 (USGS Breeding Bird Survey, http://www.mbrpwrc.usgs.gov/bbs/). Graphs show the average (line with open circles), and upper and lower 95% confidence intervals.

DPR Response: All migratory birds are fully protected, under both the Migratory Bird Treaty Act of 1918 and Fish and Game Code section 3700-3705. This Act and Code, respectively, prohibit anybody from "take" (including harming or killing) any native bird (including raptors) without a permit or license. Table 2 of DPR's assessment indicates that approximately 73% of animals have second generation rodenticides, with approximately 64% of birds having residues of brodifacoum, and approximately 22% of birds having residues of bromadiolone. Based on the data received, DPR was able to determine that the mortality of at least one Cooper's hawk was most likely due to exposure to brodifacoum. While the above chart indicates that populations of red-tailed hawks and Cooper's hawks have been trending positively, the data reviewed by DPR indicate that SGARS have adversely impacted individual raptors.

Additionally, Naim et al (2011) compared the breeding performance of Barn Owls in Oil Palms. The study included untreated controls, and owls treated with warfarin, brodifacoum, or a bio-

rodenticide (*Sarcocystis singaporensis*, a parasitic protozoon). The hatchling and fledgling success rate for untreated controls was 84% and 78%. However, the hatchling and fledgling success rate for owls treated with brodifacoum was 43% and 10%. Clearly, exposure to second generation anticoagulant rodenticides had an adverse impact on Barn Owls ability to hatch and fledge. While this is a small scale study, it indicates that without exposure to SGARS, red-tailed and Cooper's hawks populations might be even higher than shown in the above chart.

Reviewer Comment: The issue in regard to population impacts of SGARs on endangered species also is not clear-cut. Cypher and Frost (1999) showed that the population of San Joaquin kit foxes living in Bakersfield is healthier and reproducing better than rural fox populations. They suggested this was due to increased food availability that resulted in better reproductive fitness (larger litters and better kit survival). Today, the Bakersfield population numbers around 400 individuals[1], in spite of the fact that a large proportion of the foxes have measurable SGAR residues (Cypher 2010).

Taken together, these population data also suggest that the sub-lethal effects of SGARs are insubstantial. If reproductive fitness was impaired, or survival time shortened in a substantial portion of the population, then increasing trends in population growth would not be evident. The increased reproductive rate of urban kit foxes is particularly compelling in this regard. Therefore, the conclusion of "impact" must remain open until the assessment endpoint is explicitly stated and appropriately addressed.

DPR Response: San Joaquin kit foxes are federally listed as an endangered species and state listed as a threatened species. According to the U.S. Fish & Wildlife Services (2013), "'Endangered' means a species is in danger of extinction throughout all or a significant portion of its range." Although the number San Joaquin kit fox living in Bakersfield *might* be as high as 400 individuals, this number has not been deemed sufficient to keep them from going extinct, especially since "a century ago, more than 12,000 foxes roamed the San Joaquin Valley (Cypher (2010))."

In their "5-Year Review: Summary and Evaluation" the U.S. Fish and Wildlife Service (2010) found that:

> Pesticides, and specifically rodenticides, pose a threat to kit fox through direct or secondary poisoning. For example, kit fox may be killed if they ingest rodenticide in a bait application, or if they consume rodents that have consumed bait… Secondary exposure to SGARs is particularly problematic due to the high toxicity of the compounds and their long persistence in body tissues. For example, brodifacoum, a common SGAR, is persistent in tissue, bioaccumulates, and appears to impair reproduction… Even in cases where the proximate cause of death has been identified as automobile strike, predation, or disease, toxicologists and pathologists have attained sufficient toxicological

> evidence to conclude that rodenticide-induced blood loss increased animal vulnerability to the proximate cause of death (USEPA 2008)… the Service expects that effects of rodenticide exposure could have substantial population level effects where exposure is present, especially where kit fox populations are small and where they rely on target species, such as ground squirrels and murid rodents, for prey.

The Endangered Species Act prohibits take, including harming or killing, endangered species without a permit. The death of at least one San Joaquin kit fox was most likely caused by exposure to brodifacoum. Out of 110 San Joaquin kit foxes sampled, approximately 64% were positive for residues of brodifacoum and approximately 33% were positive for bromadiolone residues. Based on the analysis by DPR and the U.S. Fish and Wildlife Service, exposure to SGARS can cause take, including mortality.

Reviewer Comment: A second important point that the document attempted to address is the pathway by which wildlife are being exposed to SGARs. In particular, the analysis tried to understand the use patterns of the products to determine if wildlife exposure is primarily from consumers, professional pest control operators (PCO), or agricultural entities. While the assessment failed to determine the dominant pathway, it highlighted two particularly important points: 1) exposure is wide-spread throughout both urban and rural counties, and 2) there is a significant amount of illegal use. The illegal use is highlighted by the recent discovery of fisher and badger exposures around illegal marijuana farms in wilderness areas, but likely also occurs in more developed areas (e.g., for squirrel and chipmunk control). Furthermore, parsing out the predominant exposure pathways in urban environments is also difficult, as homeowners, pest control operators, and governmental rodent control agencies all place bait in urban areas. The use of the Pesticide Use Report in support of this effort is discussed further in the Detailed Comments below.

DPR Response: While DPR may not have unraveled the entire exposure pathway, Morzillo and Mertig 2011(a) found that only 10% of residents who used rodenticides were aware of the potential non-target effects. Additionally, Morzillo and Schwartz (2011) found that residents, particularly in single-family homes, use anticoagulant rodenticides in an attempt to control target animals, as well as non-target pests, including the San Joaquin kit fox, coyotes, and bats. Banos et al found that residents in the San Fernando Valley and Bel Air-Hollywood used rodenticides to target rats and mice, as well as opossums, snakes, and raccoons up to 300 feet from structures. In the study, PCOs were found to primarily use snap traps to control rats and mice in outdoor landscaping. Arndt (2012) found that non PCO businesses in Bakersfield and Santa Monica were likely to use rodenticides to control mice, rats, and/or squirrels. In addition, Arndt found that businesses were generally less aware than households of the potential secondary harm to non-target wildlife, and that when these non-PCO businesses were informed that rodenticide use might harm wildlife, more than 50% stated that they would continue to use the same rodenticide, less than 50% would reduce the amount of rodenticide they were using, and less than 25% stated

that they were likely or somewhat likely to stop using rodenticides.

Reviewer Comment: Finally, it is important to remember that this document only addresses SGARs. It does not address the relative risks of alternative products. Although the document discusses the mechanisms of actions of first generation anticoagulants (FGARs) and several non-anticoagulant rodenticides (for example, bromethalin, cholecalciferol, and zinc phosphide) (DPR, 2012, page 3), it does not provide any meaningful assessment of the possible impacts these alternatives have on individual non-target organisms or non-target populations. The commenters stated that, in the final section of their comments, they would provide some suggestions on how DPR will likely need to expand its assessment of rodenticides to alternate classes, since all can have potential impacts on non-target organisms, public health, and California's need to address rodent infestations.

DPR Response: This document addresses both first and second generation anticoagulant rodenticides throughout the entire document. As stated at the beginning of DPR's document, the assessment is intended to assess "the potential and actual risk to non-target wildlife from second generation rodenticides." The assessment is not intended to cover possible mitigation measures; therefore, a discussion of alternatives is not appropriate.

Reviewer Comment: With regard to page 3, the top paragraph, while it is true that anticoagulant rodenticides can be additive in their effect, the report oversimplifies the effect. Because FGARs and SGARs have the same mode of action, the concentration at the cellular receptor will be additive. However, they have different potencies so the amount that needs to be ingested to cause the same level of receptor response will differ among the chemicals. Therefore, they are additive only after adjusting for relative potency.

DPR Response: While it may be a slight oversimplification to say that brodifacoum and difethialone are completely additive within a given individual. The general statement is supported by Gabriel et al (2012) and Riley et al (2007).

Reviewer Comment: On page 3, the last paragraph there is no supporting documentation for the statement that bromethalin causes paralysis and death. The commenter feels that it is important to indicate the timing of these effects relative to when the treatment occurred because it is not the same in all animals. In some species, a lower dose can result in prolonged symptoms prior to death (see, for example, Dunayer (2003)).

DPR Response: Bromethalin is a neurotoxin that uncouples oxidative phosphorylation causing cells to lose osmotic control and swell. This causes an increase in cerebral spinal fluid pressure resulting in demyelination of the nerves, an increased intracranial pressure, and a decreased conduction of nerve impulses. At high doses (acute effect), it can cause hyperexitability, seizures, hyperthermia, Schiff-Sherrington, seizures, paralysis, and death. At low doses (chronic

effect), it can cause ataxia, muscle tremors, CNS depression, and vomiting [(Klausen (1997), Means (2011), Merck Sharp & Dohme Corp (2011)].

DPR modified its description of the effects of bromethalin. However, DPR did not include the effect of every dose nor did include the effects on every species. This is important because of the species, dose, and individual differences. For instance, guinea pigs are resistant to bromethalin. Bromethalin is highly lipophilic, indicating that animals with more body fat are likely to be more susceptible. DPR would expect a high degree of individual variability even within a given species.

Reviewer Comment: Furthermore, because strychnine is still registered for use in California, and despite the fact that it has a low rate of use, the commenter feels that DPR should have included it in the description of non-anticoagulant rodenticides since its relative level of use is likely to be impacted by the regulatory adjustments being considered by the U.S. EPA.

DPR Response: Strychnine was not discussed as it is only labeled for use in below-ground gopher control. Only rodenticides labeled for above-ground commensal mice and rat control were discussed in DPR's assessment.

Reviewer Comment: With regard to page 4, Table 1, the commenter questions why cholecalciferol was included in this comparison of the single-dose half-lives of several rodenticides, but zinc phosphide and strychnine was not.

DPR Response: DPR included data on bromethalin and cholecalciferol in its assessment where available and relevant. As stated in Table 1, superscript 2, "Data is not available for zinc phosphide, so it is not included on the chart." DPR's reasons for not including strychnine were previously discussed in this document.

Reviewer Comment: With regard to page 4, the first paragraph, the commenter states that one approach, that might not conflict with pest control industry needs and food processor laws, would be to label *consumer-use products* as "indoor only," while allowing continued use by PCOs. However, it is unclear if this would significantly reduce the wildlife exposure problem if other pathways have equal or greater importance.

DPR Response: The comments are noted and appreciated.

Reviewer Comment: With regard to page 6, the third paragraph, the commenter expressed concern that strychnine was not considered in this discussion of currently registered rodenticides in California.

DPR Response: DPR's reasons for not including strychnine were previously discussed in this document.

Reviewer Comment: With regard to page 7, the second paragraph of the "Evaluated Data," the commenter stated that the parsing of the incident data as outlined here is appropriate and appreciated, especially their inclusion in the Appendices.

DPR Response: The comments are noted and appreciated.

Reviewer Comment: With regard to page 8, the top paragraph, the statement is made that "DPR believes that the data provide value and do not over-represent positive values for [SGARs]"even though approximately 29% of the data set came from CDFW information, where only the positive animals were reported, and the total number of animals analyzed was unknown. DPR said they "compared the data sets" and found they were not statistically significantly different. However, it is not clear what was being compared: Was it the percent positives? For the reader to feel the same level of comfort that DPR has in the similarity of the data sets, more information should be provided (for example, What parameter was being compared? What are the numbers in the two data sets? etc.) so the analysis can be re-created.

DPR Response: As with a paper for a scientific journal, the complete data are not presented within the paper. However, all commenters were presented with all of the references, including the data, and that same information is available to the public, upon request. However, DPR reworded the sentence as requested to clarify how the analysis was conducted. The analysis was conducted as prescribed by Fisher exact and Chi-squared, as the exact numbers, not the percentages.

Reviewer Comment: With regard to page 8, the second paragraph of the "Analysis" section, the statement is made that "because of its relatively recent entry into the rodenticide market, none of the 492 animals….were tested for difenacoum residues." It is not; however, why bromethalin residues were not measured? Bromethalin is in common use and may become much more prevalent if regulatory actions being proposed by U.S. EPA are moved forward. The report should state what the rationale is for excluding certain rodenticides other than difenacoum, which is already noted in the document.

DPR Response: The goal of DPR's assessment was to determine, based on available data, the potential and actual risk to non-target wildlife from SGARS. Bromethalin is not an anticoagulant rodenticide; therefore, it was not the focus of DPR's assessment. In addition, bromethalin is not part of the same panel as anticoagulant rodenticides at any laboratory. Bromethalin normally results in a normal gross necropsy, and is confirmed by histopathology and toxicology (Klausen (1997)) and Merck (2012b)). However, concomitant ingestion of a SGAR with bromethalin could obscure or complicate the results of a necropsy. Therefore, bromethalin was not excluded,

but is not generally analyzed for unless it is seen on histopathology and then confirmed via toxicology.

Reviewer Comment: On page 11, the paragraph between tables, the commenter feels that the definitions of LD_{50} and LC_{50} need to be revised. Specifically, LD_{50} should more accurately be described as a single exposure dose toxic to 50% of the test population, expressed as mg/kg-body weight. And the LC_{50} is not just "normally in the air or water" but is also routinely measured in food for mammalian and avian toxicity testing. The LC_{50} is the concentration in food that is toxic to 50% of the test population; it can be described as mg/kg-food or as an average daily dose (ADD) as mg/kg-body weight/day.

DPR Response: The definitions for LD_{50} and LC_{50} have been updated based on the comments provided and U.S. EPA's definitions.

Reviewer Comment: The commenter is not entirely clear what point is being made on Page 2, the Table and text with the information on "extremely toxic" versus "moderately toxic." Is there a standard criteria being used for this categorization? If so, the standard should be described and put into perspective. What is of concern, of course, is the relative toxicity of the rodenticide to the targeted organisms (rats and house mice) as compared to non-target organisms (birds, etc.).

DPR Response: The criterion is from U.S. EPA (2011) and is the same as is utilized by U.S. EPA and DPR to determine labeling requirements. The criteria was specified just above Table 6 "based on the U.S. EPA's Pesticide Assessment Guidelines" and in Table 6 (From the EPA Pesticide Assessment Guidelines (U.S. EPA, 2011)). The LD_{50} and relative toxicity for birds only applies to non-target organisms, while those for mammals can apply for both target and non-target animals.

Reviewer Comment: On page 12, Table 6, it is noted that the table presents toxicity values for the "most sensitive" bird or mammal. Perhaps it would be more informative to present the range of values for the species that were tested in each class, and have a separate column that indicates the LD_{50} or LC_{50} for the target species.

DPR Response: While additional information could be provided, DPR feels that the table as presented is clear and concise.

Reviewer Comment: On page 12, the second paragraph the statement is made that the LD_{50} tests are "run in a laboratory setting, where the animals are not subject to the need to forage, or to predation or pathogen pressures." The implied conclusion from this is that wild animals would be more susceptible to the toxicity of these chemicals. While this implication of greater toxicity in field situations is often made, it actually is not universally true (see, for example, Schauber et

al. (1997)). Additionally, wild animals have alternative food sources so may not forage exclusively on rodenticide baits, thereby having lower exposures than in lab studies.

DPR Response: It is true that wild animals have alternate food sources and so may not forage exclusively on rodenticide baits. However, it is also true that in a laboratory setting, the animals are not subject to the "need" to forage, or to predation or pathogen pressures.

Reviewer Comment: Also in the second paragraph of page 12, the "sub-lethal doses" that "could or did cause mortality" seem to be a contradiction. It is not surprising that clotting and other abnormalities occur prior to death from chemical exposure, nor is it surprising that near-lethal doses would cause abnormalities. The question that needs to be addressed is at what exposure concentrations are such sub-lethal effects seen. One would assume this may vary by species as well as by chemical.

DPR Response: Sub-lethal doses can become lethal for a variety of reasons, including the animal consuming another dose, increased time (the chemicals normally take 5 to 7 days to become lethal), and/or getting a laceration (which would normally clot but due to the clotting deficiencies, were unable to clot). To date, DPR is not aware of any studies that have determined the exact concentration at which sub-lethal effects occur, especially since species, individual, and rodenticide variations would occur.

Reviewer Comment: Page 12, the last paragraph, describes exposures and subsequent tissue residues and mortality from an island baiting study designed to eradicate invasive rats. These types of studies use saturation baiting, where the likelihood of encountering a lot of bait with high concentrations of rodenticides is very high. Therefore, there is significantly greater primary exposure of non-target animals in this situation than would be found in normal use scenarios in cities and around agricultural buildings (in both the number of animals exposed and the concentrations in the animals). While such examples are useful for understanding the possible type of reactions to high exposures, they do not provide very much predictive information about risks to wildlife under normal use scenarios.

DPR Response: DPR included data from the Dowding et al (1999) study because it contained data on a wide range of non-target animals (including ducks, songbirds, raptors, and felids). The data also contained the liver concentrations when the animals died or were euthanized, and the amount of time it took (given potential food sources). DPR believes that the study provides valuable information, even if the scenario is not "normal use."

Reviewer Comment: On page 13, the middle paragraph discusses the work by Riley et al. (2007) who attributed increased incidents of severe notoedric mange in bobcats to anticoagulant exposure. They found a significant correlation between the severity of mange and the concentration of brodifacoum in the bobcats. However, correlation is not cause and effect, and it

is possible that both the mange and the increased amounts of brodifacoum were both responding to another cause – the increased proximity of the bobcats to urban/suburban developments. In doing so, the bobcats would be simultaneously exposed to the rodenticide and to domestic cats with mange. Therefore, the relationship between mange and rodenticides would be correlative, but not causal.

DPR Response: DPR stated that there was an "association to mange" indicating that there was a correlation, not a causal link. However, the language was changed so that it is clear that it was not a causative link, but a correlative link.

Reviewer Comment: On page 13, later in the middle paragraph, the statement is made that "This [the increased mange in bobcats] indicates that a reduced immune response to pathogens and parasites, and an increased reaction to trauma, are possible sequels of anticoagulant exposure." There is no citation for this statement, which appears to be speculative. The mechanism for how anticoagulants that act on the Vitamin K (1)-epoxide cycle would interfere with an immune response is not intuitively obvious nor has it been stated or explained either here or in Riley et al. (2007). At this point, it remains a hypothesis and until appropriate scientific studies are done to accept or reject it, it should not affect any decision regarding the regulation of rodenticides.

DPR Response: Notoedric mange is a rare and highly contagious disease of cats and kittens, which primarily affects domestic felids. In wild felids, both captive and naturally occurring, mange is less likely to occur (when compared to domestic felids) and is thought to be unlikely to be fatal unless there are other factors, such as environmental stress, immune deficiency, and/or other stressors (Merck Sharp & Dohme Corp (2011), Scofield et al (2011), Riley et al (2005)).

Per the U.S. Fish and Wildlife Service (2010), "Even in cases where the proximate cause of death has been identified as automobile strike, predation, or disease, toxicologists and pathologists have attained sufficient toxicological evidence to conclude that rodenticide-induced blood loss increased animal vulnerability to the proximate cause of death (U.S. EPA 2008)." However, the paragraph was rearranged to increase precision.

Reviewer Comment: On page 13, the remainder of the middle paragraph describes symptoms that SGARs generate in various animals when they are exposed to less-than-lethal (but obviously toxic) levels of the chemical. However, it is not clear what is meant by the phrase "may contribute to the disease process." While the conclusion is true that sub-lethal exposures may ultimately contribute to mortality (i.e., an acutely ill animal is more likely to die than a healthy animal), there is no context provided. We think it is important to explain that these clinical signs are seen at markedly lower-than lethal doses. We feel it is equally important to explain how many of the animals that exhibit these signs ultimately die anyway, even in a laboratory setting.

DPR Response: Based upon the comments, this section was divided into two paragraphs to clarify that many of the symptoms were seen in the laboratory setting. Additionally, the last sentence was reworded to remove the phrase "disease process."

Reviewer Comment: On page 13, the last paragraph, the statement "Because mg/kg is equivalent to ppm" is not clear. If this means that "parts per million" is describing a concentration, that is more properly described as mg/kg (or µg/g), then this is true. However, it is not true that the LD50 expressed as mg/kg-body weight is the same as mg/kg tissue concentration (or diet concentration).

DPR Response: The paragraph was clarified to state "The concentration of brodifacoum in the liver (which is in ppm), while not always an accurate reflection of the amount of brodifacoum ingested (which is in mg/kg), demonstrates exposure and when a necropsy is conducted, is often used in conjunction with everything else to assess the potential mortality based on the liver residues of the rodenticide."

Reviewer Comment: The logical analysis that then follows the last paragraph on page 13 and the data in Table 7 are confusing. An LD50 (the amount in a single dose exposure expressed as amount of chemical per kg of body weight) is not equivalent to a liver concentration. The only way to use these two values together would be to ask: If the LD50 of a given species is "x" mg/kg body weight, and that animal ate another animal's liver, would there be sufficient amount in the liver of the other animal to kill it? There is not a one-to-one correspondence between an LD_{50} (mg/kg-body weight) and amount in the liver (mg/kg-liver). In fact, the paragraph goes on to present data showing that the amount in the liver (a) is proportional to the amount in the food (or in the dosing solution) and (b) depends upon how long after the exposure the residue analysis was conducted. Studies by Rattner et al. (2012) show that the duration of feeding (for example, single versus multiple doses) also influences the toxicity and how much is stored in the liver).

On page 14, Table 7 is not clear why these data are included in the report. Is the point that if the liver residues are above the LD_{50}, the animal necessarily died from the rodenticide exposure? If so, this is not correct (see above). Or, is the point that there are a number of livers that have high enough concentrations to kill a predator that eats the liver? If so, then the predator must necessarily weigh 1 kg if the comparison is being made with the LD_{50} and the mass of the liver must be sufficient to achieve the required dose (an LC_{50} comparison with liver concentration would be more appropriate).

DPR Response: Table 7 includes 4 rows per rodenticide (number and percent of samples with no residues, number and percent of samples with residues, number and percent samples with measurable residues, and number and percent of samples above the most sensitive LD_{50}) and 3 columns (avian, mammal, and total).

The LD_{50} provides a clear and concise number that has been well vetted and is reasonable. While it might not be an exact match to the situation at hand, it provides a reasonable number for comparison. It is not being used to determine mortality, but merely to show the number of samples above the most sensitive LD_{50}. The statement is then made that liver residues indicate that some animals could die, but it requires a necropsy to confirm the cause of death.

Reviewer Comment: On page 16, the first paragraph, the description of the data in Table 7 seems to assume that if the liver residue is above the LD_{50}, then the animal died from the chemical. As stated above, this is not a correct assumption. In the second paragraph, as per the arguments made above, the statement "While residues above the LD_{50} indicates [sic] that some of these animals could have died due to the concentrations of the rodenticide seen in their liver, …" is not true. If Table 7 and the preceding paragraphs were included to illustrate this false point, we strongly recommend that these be removed from the final document. For a more accurate discussion of liver thresholds, see Thomas et al. (2011). Determination of diagnostic concentrations in livers of non-target animals remains an open question.

DPR Response: As is illustrated by Dowding et al (1999), five rabbits that were found dead had liver brodifacoum concentrations of 0.05 to 2.01 ppm and 29 non-target birds had liver concentrations of 0.12 to 2.31 ppm. While a liver concentration below the LD_{50} does not guarantee that the animal might not die from rodenticide toxicity, it is more likely that an animal "with residues above the LD_{50}… *could* have died due to the concentrations of the rodenticide seen in their liver, it is difficult to definitely correlate exposure to the cause of death of an individual, without evidence of coagulopathy at necropsy." DPR is not relying solely on liver concentrations, but can only declare a "most likely cause of death" in causes when a necropsy and liver residues are presented to DPR.

Reviewer Comment: On page 16, the first paragraph under the "Necropsies" section, the statement that the necropsies "were assessed accordingly" is not clear. Were the data qualified in some manner? Were those necropsies conducted by veterinarians with advanced training in pathology used differently than the reports prepared by veterinarians without advanced training in pathology? How did these distinctions influence the final conclusions?

DPR Response: The assessment was based on the qualification of the person conducting the necropsy, the tests that were conducted, the analytical analysis that was provided, and any and all additional information that was provided. See below for how they influenced DPR's conclusions.

Reviewer Comment: On page 16, the second paragraph under the "Necropsies" section, the commenter expressed concerns about who ascribed the cause of death. Did each report author assign cause of death, or did DPR make this assignment based on liver residue values and Table 7, or based on some other metric? If the cause of death was assigned by DPR, then attribution would be questionable. If the former, were all pathologists (whether veterinary pathologists,

veterinary generalists, or non-veterinarians) given the same weighting for correctly ascribing cause of death?

DPR Response: In some, but not all cases, the person who conducted the necropsy assigned a cause of death (COD). If the person who conducted the necropsy assigned the death, DPR did not assign the COD. Even with assigned CODs, DPR would sometimes down-grade the COD from "rodenticide toxicity" to "unknown." DPR never upgraded the COD from "unknown" to "rodenticide toxicity." DPR was more likely to change the COD from rodenticide toxicity to unknown when COD was assigned by non-veterinarians or those who provided limited information, whereas CODs assigned by veterinary pathologists (provided all analytical tests were conducted) were more likely to have their diagnosis left intact.

Reviewer Comment: On page 17, Table 8, the table summarizes the number of animals that died from SGAR poisoning. What is meant by "based on necropsy results?" See above comment.

DPR Response: The phrase has been changed, based on the comment, to "Based on the analysis of the necropsies."

Reviewer Comment: On pages 17-19, the entire "Animal Descriptions and Habitat" section, is a very nice summary of the diets of various carnivores that are known to be exposed to SGARs. Perhaps a more appropriate title for this section would be "Animal Diets and Habitats."

DPR Response: This section includes more than animal diets and habitats. For instance, in describing the Barn Owl and Great Horned Owl, DPR stated "The Barn Owl and the Great Horned Owl are nocturnal raptors. The Barn Owl prefers to hunt in open country and along the edges of woods (in rural and natural areas), but also lives in urban and suburban areas. They primarily eat rodents, but will also eat other small mammals, birds, and invertebrates." This section includes when they are awake (nocturnal), what type of bird they are (raptor), where they prefer to hunt, where they prefer to live, what they prefer to eat, and what they will eat. However, based on the comments, the section title was changed to "Animal Information, Diet, and Habitat."

Reviewer Comment: On page 19, under the "Location and Land Use" section in the first paragraph, the commenter had questions about the data presented. First, who provided the locations and how did they differentiate among land use? The paragraph states "based on population and/or land use," but this is rather vague. What is the population density that determines urban versus rural?

DPR Response: Each author (Lima and Salmon, CDFW, and multiple papers by Riley et al) provided the location where the animal was found. Land use was differentiated by each author and the exact method that they used was provided to DPR.

Reviewer Comment: Second, the paragraph states that DPR also looked at the locations to see if they "represent California as a whole." What does this mean? And again, how were urban, rural, or natural "wild areas" defined? Does "looking at the location" mean looking on Google Earth?

DPR Response: In response to the comment, DPR amended the document..

Reviewer Comment: On page 20, the paragraph below the figure, the commenter is not clear why the statement citing Lima and Salmon's (2010) data on SGARs in raptors in San Diego County and in the Central Valley is included. Is it referenced here to show that raptors with SGARs are found in both urban and rural areas, or that they are found more often in urban areas? Furthermore, on the next page, the statement is made that within San Diego County there was no difference between urban and rural, which would seem to contradict the statement on page 20.

DPR Response: DPR presented the data and a brief explanation of every set of data within Table 13, with Lima and Salmon (2010) first. DPR stated that the data "indicates that there is no significant difference between the percentages of animals found to have residues of second generation rodenticides (individually) in rural versus urban environments.

Reviewer Comment: With regard to page 23, the top paragraph, the commenter stated "see previous comment about the correlation of mange and rodenticides.

DPR Response: DPR stated that there was an "association to mange." The word "association" was replaced with "correlated."

Reviewer Comment: How certain are the sales data on page 28, the first and second paragraphs? Are they likely to be biased high or low?

DPR Response: The sales data presented are based on the sales reported to DPR for purposes of mill assessment. Registrants, dealers and brokers are required to quarterly report the amount of pesticides sold, both in dollars and quantity sold. There is unlikely to be any statistical bias (bias is defined as a calculation in such a way that is systematically different from the population parameter of interest). However, the data could be inaccurate due to either inaccurate reporting by registrants, dealers and brokers and/or inaccurate data input by DPR. However, after the issuance of the draft assessment, DPR staff reviewed the sales figures reported for rodenticides. Updated information was located and the table was corrected.

Reviewer Comment: DPR is correct in stating on page 29, the first paragraph of the "Uncertainties" section that sales and use data are not directly related to each other, nor is it possible to differentiate industrial, institutional, home/garden, etc. There also is no way to track the amount that is misused. While DPR is to be commended for attempting to make all these

connections from the pesticide use report data, it is obvious that the uncertainties are far too great to use the information in a decisional context.

DPR Response: The comments are appreciated and noted.

Reviewer Comment: On page 29, the paragraph of the "Summary" section, the statement is made that, "Based on the data provided, DPR believes that the exposure of wildlife to SGARS *is a problem* in both urban and rural areas" (italics added for emphasis). This is biased language when summarizing conclusions of the data. What is meant by "a problem?" Simply that the animals are exposed? That one or more may die in a given time frame? That the populations are being impacted by these chemicals? Simply measuring residues does not mean that there is "a problem" to the animal; most of these animals probably also have measurable concentrations of mercury, lead, PCBs, PBDEs, dioxins, and other chemicals in their livers. How do you know that those are not what is causing "a problem?" The commenter suggests rewriting this sentence to read: "Based on the data provided, DPR believes that the exposure of wildlife to second generation rodenticides *is occurring* in both urban and rural areas."

DPR Response: Based on the data in the report, DPR believes that there is widespread exposure to and potential and actual take of an endangered species due to SGARS in both urban and rural areas. Brodifacoum is extremely toxic to both mammals and birds, with a half-life in the liver of 113.5 to 350 days. It accounts for 7% of the use yet is found in 68% of the animals, was likely involved in approximately 13% of animal mortalities, and was solely responsible for 9% of animal mortalities, including 9 federally protected birds and a federally endangered San Joaquin kit fox. Bromadiolone is extremely toxic to mammals and moderately toxic to birds, with a half-life in the liver of 170 to 318 days. It accounts for 13% of the use yet is found in 36% of the animals, and was likely involved in approximately 3% of animal mortalities. Difethialone is extremely toxic to both mammals and birds, with a half-life in the liver of 126 days. It accounts for approximately 1% of anticoagulant rodenticide sales and was found in approximately 8% of the animals analyzed. Difenacoum was first registered with the DPR in 2008. It is extremely toxic to mammals and moderately toxic to birds, with a half-life in the liver of 118 days. It appears to be most similar to bromadiolone and has been involved in 8 to 36 wildlife incidents per year in England.

These figures can be compared to figures from first generation anticoagulant rodenticides. Chlorophacinone is extremely toxic to mammals and moderately toxic to birds, with a half-life in the liver of less than 2 days. It accounts for 16.4% of the use, yet was found in 4% of the animals and was likely involved in approximately 1% of animal mortalities. Diphacinone is extremely toxic to mammals and moderately toxic to birds, with a half-life in the liver of 2 to 3 days. It accounts for 55.9% of the use, yet was found in 11% of the animals and was likely involved in approximately 2% of animal mortalities. Warfarin is extremely toxic to mammals and

moderately toxic to birds, with a half-life in the liver of 7 to 23 days. It accounts for 7.5% of the use, yet was found in 1% of the animals.

Reviewer Comment: On page 31, the first paragraph, the commenter noted that the conclusion of sub-lethal effects is not really as strong as stated here – for example, see previous comments about Riley et al.'s (2007) conclusion of the correlation of mange with rodenticide exposure. The other studies that indicate residues in bobcat fetus and the dog puppies are not sufficient to support a blanket statement that "The sub-lethal effects of rodenticides reduce the fitness of wildlife" – for example, see previous comments about the increased reproductive rate of kit foxes in Bakersfield, even in the face of exposure of nearly all of the females. Perhaps this merely suggests that more research is needed in this area. Furthermore, Knopper et al. (2007) showed no effects on breaking strength of bird bones as a result of anticoagulant exposures, an endpoint that was chosen as it is likely to be the most sensitive to a chemical that affects calcium metabolism. Effects of anticoagulants on avian reproduction probably are negligible. Mineau et al. (2005) conducted a standard avian reproduction study with mallards and found no effects on number of eggs produced, hatchability, or survival of the young. The study by Naim et al. (2011) cited in the current document is a field study of barn owls in Malaysia. However, it is difficult to interpret the results as sample size is not provided, although it appears to be small. If there are only a few nests comprising one sample, then reduced hatching success in a single nest can make a significant percentage change. Furthermore, the authors state that the results could be confounded by the effects of different densities of rats on the various treatment plots, since rats were both the target species of the rodenticide baiting and the primary food source for the owls. Therefore, for these and other similar problems with the study design, the Naim reference should not be used as an indicator of avian reproductive effects of SGARs.

DPR Response: In biology, fitness is defined as a relative measure of reproductive success of an organism in passing its genes to the next generation. Klein Sereiys (2012) showed that SGARS could cross the placenta. The study by Munday and Thompson (2003) indicated that fetuses could be affected even when the dam appeared healthy, resulting in the death of over half of the puppies (8 of 13). SGARS have also been shown to cause abortion in both sheep and rats (Brakes and Smith (2005)).

Naim et al (2011) compared the breeding performance of Barn Owls in Oil Palms. The study included untreated controls, and owls treated with warfarin, brodifacoum, or a bio-rodenticide (*Sarcocystis singaporensis*, a parasitic protozoon). Brodifacoum resulted in hatchling and fledgling success rate of 43% and 10%, while the control resulted in a rate of 84% and 78%. Even if there was confounding and/or small numbers in each treatment plot, this experiment was performed in three successive seasons, and brodifacoum lowered hatchling and fledgling success in a statically significant manner ($p<0.05$). This indicates that the study had enough animals to run statistical analysis. While Barn Owls primarily eat rodents, they will also eat other small mammals, birds, and invertebrates. Therefore, even a substantial reduction in rats should not

have significantly affected them. In particular, the number of available rats would not have affected their hatching rate. At that point, adult owls do not need additional food as their young have not yet hatched. In addition, another way to reduce fitness (e.g., decrease ability to mate and/or reproduce) is through ill health or death. Therefore, it can be said that brodifacoum reduces the fitness of wildlife.

Reviewer Comment: On page 31, Conclusions, until DPR defines what is meant by "impacts" to non-target wildlife, this conclusion is not supportable. The conclusion that a high percentage of wildlife is exposed to, and some die from, SGARs is certainly true; but whether this has an "impact" on the wildlife populations is not known. The paragraph should also include the previously stated conclusion that "there is no significant difference in the occurrence of SGARs in rural, urban, and natural areas" and that the pathway(s) for exposure remain unknown.

DPR Response: DPR defined impacts throughout the assessment and in this document.

Reviewer Comment: In order for DPR to make comprehensive decisions, the commenter believes that there are additional issues and unanswered questions that need to be addressed prior to adopting mitigation measures that could adversely impact the ability of Californians to effectively deal with the real public health impacts of rodents. Assessments of other rodenticide classes beyond the SGARs, such as the FGARs and neurotoxins such as bromethalin, are needed to ensure that DPR appropriately understands the impacts that mitigation of one class of compounds would have on the continued use of rodenticides by Californians. Rodenticides are a necessary component of the pest management programs that citizens must use to tackle the serious public health hazards caused by rodent infestation. So any mitigation considered by DPR must include an understanding of all pest management components.

DPR Response: DPR's SGAR assessment document is not intended to address specific mitigation measures. Thank you for your comments.

Reviewer Comment: DPR should assess the potential impacts of increased use of FGARs. SGARs were developed in response to evidence of increasing resistance to FGARs that resulted in decreased efficacy problems in rat and mouse control from the end of the 1950s onward. Mitigating the use of SGARs for residential consumers through bans could cause an unnecessary burden on the environment through the application of ineffective pesticides (including FGARs), increase the application of other non-anticoagulant potentially hazardous pesticides without an antidote, such as bromethalin, and support the spread of anticoagulant resistant rodent populations, causing problems of public health significance (page 4).

DPR Response: DPR's SGAR assessment document is not intended to address specific mitigation measures. Thank you for your comments.

Reviewer Comment: DPR needs to evaluate and summarize the impacts of alternate rodenticides on public health. The increased use of non-anticoagulant rodenticides will likely result in an increase in the severity of exposure outcomes, as there is no effective antidote for bromethalin or zinc phosphide. In addition, products such as zinc phosphide are inherently caustic and thus pose a risk to the airway and throat (McCluskey, 2011: page 2-3).

DPR Response: DPR's SGAR assessment document is not intended to address specific mitigation measures. Thank you for your comments.

Reviewer Comment: Until DPR defines what is meant by "impacts" to non-target wildlife, the impacts of bait stations cannot be made. The conclusion that a high percentage of wildlife is exposed to, and some die from, SGARs is certainly true. The role of bait stations in contributing to any impacts needs to be addressed from the facts available.

DPR Response: DPR's SGAR assessment document is not intended to address specific mitigation measures. Thank you for your comments.

Reviewer Comment: The economic impact of any proposed mitigation of rodenticides, particularly on the less economically privileged consumers in our state's urban areas, should be carefully addressed by DPR.

DPR Response: DPR's SGAR assessment document is not intended to address specific mitigation measures. Thank you for your comments.

Reviewer Comment: Rodent control is a serious public health concern. While community-wide control of rodents is generally managed by local and state health departments, effective rodent control requires homeowner actions and community-wide public health intervention. DPR must be extraordinarily careful in considering and implementing any mitigation on rodenticides, a key component of this public health battle.

Households headed by minorities and those with below-poverty level incomes are more likely to have rodent infestations—particularly rats—than are other U.S. households. In turn, members of households with rodent infestations are more likely to suffer from rodent-related health impacts. DPR's decisions regarding rodenticides must be developed with maximal care.

DPR Response: DPR's SGAR assessment document is not intended to address specific mitigation measures. Thank you for your comments.

Reviewer Comment: What is the relative proportion of primary poisoning of wildlife in residential areas versus commercial urban areas or public use areas? What is the concentration of

rodenticide in small mammals that are prey for predators/scavengers? Is this the same in residential areas and commercial/public areas? What is the proportion of rodenticides used by consumers versus that used by licensed pest control operators (PCOs)?

DPR Response: DPR addressed the above questions in its assessment, to the extent available data allowed.

Reviewer Comment: What proportion of consumers use rodenticides outdoors (versus solely indoors)? What are the types of wildlife most at risk to be poisoned, either secondarily or primarily in urban versus rural areas? Residents vs. migrants: Which animals are present in the area, either because they migrate through the area or reside there, etc.? What are the diets of the species that are most likely in these areas? For the secondary consumers, are they likely to feed on target rodents?

DPR Response: DPR addressed the above questions in its assessment, to the extent available data allowed.

Reviewer Comment: Do house mice move outside when they are poisoned? Data being developed in this area recently would conclude that this response by treated rodents does not occur. How does pharmacokinetics impact the presumptions made on the interpretation of the incidence data?

DPR Response: DPR's SGAR assessment document is not intended to address specific mitigation measures. Thank you for your comments.

Reviewer Comment: DPR notes that there is insufficient data on the relative contributions of the different rodenticide use-patterns (consumer, agricultural, industrial, and commercial) to the incidents on NTOs. Though there is sufficient data to illustrate that SGAR use can lead to adverse effects on non-target animals, the commenter stated that its inadequate understanding of what the important contributors are to those incidents is a major weakness in its ability to determine the proper balance in mitigating rodenticide exposures of concern. DPR's mitigation should focus on the use patterns of concern.

DPR Response: DPR's SGAR assessment document is not intended to address specific mitigation measures. Thank you for your comments.

Vince Guise
Contra Costa County Agricultural Commissioner

Reviewer Comment: DPR's draft assessment paper on SGARs is very complete and well done. The analysis and conclusions are well thought out and accurate. On page four, Table 1, the commenter feels that the listing of the half-life in liver for diphacinone as "2<x<3," would be more consistent if identified as "2 to 3".

DPR Response: It is written as 2<x<3 for two reasons. First, because it was presented as 2<x<3 in the reference document (Fisher et al (2003) <http://www.doc.govt.nz/documents/science-and-technical/dsis139.pdf>). Secondly, unlike other references where the numbers are from a number of different studies, this number comes from a single study. Therefore, DPR presented it in this manner as well. However, the commenter is correct that presenting the number as 2 to 3 would be more consistent with other entries.

Reviewer Comment: Page four, Table 1 contains a number of "NA"'s. What do they stand for? Would it be better to replace the "NA" with "No Data," "Not Tested," or "Not Applicable"?

DPR Response: DPR amended the assessment to add a footnote stating "NA" means data not available. This does not mean that the tests have not been conducted, but that DPR was unable to locate the data after an extensive search.

Reviewer Comment: On page 18, squirrels are listed along with rabbits and rodents as examples of prey for the great horned owl. In fact, though a squirrel may be eaten by the great horned owl, my understanding is that this is fairly rare, at least in regard to ground squirrels. The reason is basic since squirrels are diurnal and the great horned owl hunts at night, rarely do their paths cross. The great horned owl does commonly eat rats and even skunks. Perhaps one of those can be inserted in the place of "squirrels." The reason this is important is that members of the public, including Audubon Society, have suggested that the County needs owl boxes for ground squirrel control. We have to explain that barn, and screech owls, do not take ground squirrels and even though great horned owls are large enough to take them, it is very rare that they do because of the diurnal/nocturnal differences in the animal's behavior.

DPR Response: Data indicate that only 2-3 % of a Great horned owl's diet is made up of ground squirrels; therefore, the reference to squirrels has been removed. Data indicate that 0.2% to 1.5% of a Great horned owl's diet is made up of skunks, so DPR will not be adding skunks, even though skunks are a food item that Great horned owls consume more frequently than most other raptors. References: Ganey and Block ((2005), Hawk Mountain Sanctuary (2013), Murphy (1997), Woodman et al (2005)

Reviewer Comment: The commenter also indicated that they would like to see more data from 2011 and 2012 in the report. They agreed that such data was unlikely to change the conclusion.

DPR Response: Thank you for your comment. The data in the report reflects the data available to DPR at the time it drafted the report.

Reviewer Comment: This is from personal experience last year. I had one or possibly a few roof rats in my garage last summer. It could have been a family but I seriously doubt that there were more than 3 or 4, if that. I had a lot of furniture stored in the garage so it made for good habitat. The first day I put out two loose bait blocks that were about 1"x1" in size, 2nd generation active ingredient. The next day the two bait blocks were gone. I put out two more and they were gone the next day. I repeated this for five days. The sixth day there was a little of the two blocks from the previous day along with some scattered crumbs. The seventh and eighth day there was less eaten and then the feeding stopped. From subsequent reading I now surmise that the roof rats likely got a lethal dose on the first or possibly the second day. However, the feeding lasted for eight days. So as your report indicates, they had ingested multiple lethal doses before they stopped eating and before dying sometime later. Why do I bring this up? One reason is a confirmation from my observation (not scientific) that roof rats at least will continue eating for many days until eventual death occurs. Another point is that a bait station, though good when considering safety to children and possible exclusion of direct feeding of non-target animals, would not have stopped this from occurring. Also the homeowner (or PCO) hopes that the target animals will die outside of the house (or at least in an area where you can find the dead animal(s)). In my case, at least one roof rat died in the attic of the house. We thought it was in a heater duct, but in any case, was not able to find and retrieve it, which resulted in living with the dead animal odor for about 6 weeks (I will now use kill traps instead of bait). From what I understand with second generation products, after the target animal receives a lethal dose (or multiple lethal doses), it will have a tendency to wander around outside were it is vulnerable to take by non-targets, such as owls, raptors, etc. With the first generation materials, besides not getting mega-doses, the affected animals have a tendency to die in their burrows at least ground squirrels do as we find an extremely low number of above ground dead squirrels in our post treatment surveys that we perform in our county ground squirrel program. In regard to my garage experience, I feel confident that there were very few roof rats present because we have since moved most of the furniture and household items out of the garage and have found very little evidence (fecal pellets).

DPR Response: Thank you for your comments. DPR's SGAR assessment document is not intended to address mitigation measures.

Reviewer Comment: Making second generation anticoagulants state restricted use pesticides will solve the problem of these materials being available to homeowners. If state restricted, they will still be available to licensed PCOs, agencies, and growers. Though this will only partially solve

the problem in that there will be less illegal use as well as less use in general, target animals treated by PCOs, agencies, and growers, will still wander outside where they will be taken by non-target species. Homeowners will still have alternatives such as traps and glue boards available to them and can have work done by a licensed PCO that uses bait if they so choose. I would suspect PCOs will be in favor of this approach for two reasons: 1) There will be a reduction in non-target kills which could save second generation anticoagulants as a tool, and 2) they should gain more business as a result of making these materials restricted.

DPR Response: Thank you for your comments. DPR's SGAR assessment document is not intended to address mitigation measures.

Reviewer Comment: I feel a strong consideration should be given to requiring manufacturers to study and reduce the concentration of second generation anticoagulants that is in the formulated bait. This will decrease the amount of active ingredient that an individual target animal consumes. Though the animal may have to feed a couple days to receive an initial lethal dose, it will consume less active ingredient in the eight or nine days that it takes for them to die. Possibly a .01% material is also effective at .005% or even less. This would result in the target animal having less material in their tissues and stomach. Non target animals will still be exposed but to a lower concentration. This approach may require action of U.S. EPA and that should be explored.

DPR Response: Thank you for your comments. DPR's SGAR assessment document is not intended to address mitigation measures.

Reviewer Comment: The commenter suggested that there may be a way to restrict the amount of bait that is placed out for the rodents. For example, if the label only allows the bait to be out for two days after there are signs that it is being consumed, then the rodents will not get the mega multiple doses. This is a difficult approach because a homeowner/ PCO/ grower/ agencies would have to monitor to determine when the feeding has started and then would have to be honest enough to pull the bait. Also bait stations are currently opaque so unless they were made transparent or partially transparent, it would be difficult to tell when feeding starts. And then transparent plastic would have a tendency to get yellow, crack and get dirty making visibility difficult.

DPR Response: Thank you for your comments. DPR's SGAR assessment document is not intended to address mitigation measures.

John Young
Yolo County Agricultural Commissioner

Reviewer Comment: The white paper identifies the half-life of the second generation anticoagulant rodenticides. What are the associated concentration levels that can be expected to be in the livers of the target species?

DPR Response: Although DPR focused primarily on non-target animals, in general, as Table 1 indicates, at the time of their liver half-life (i.e., 4 months to 1 year), the second generation anticoagulant rodenticides would be expected to be at approximately half of their original concentration. However, given that the half-life of the anticoagulant rodenticides varies based on a variety of factors (including the rodenticide itself, the starting concentration of the rodenticide, the species, the individual, etc.) and that many non-target animals were found with multiple second generation anticoagulant rodenticides in their livers, it would be difficult to predict the exact concentration in the liver in a given target or non-target animal at the half-life of a given rodenticide.

Reviewer Comment: In order to develop mitigation measures, DPR will need to understand the foraging behavior of the urban edge wildlife identified, as well as the behaviors of the target rodents. DPR did address some of the non-target species in the white paper and can expand upon those that were already addressed in the paper.

DPR Response: Thank you for your comments. DPR's SGAR assessment document is not intended to address mitigation measures.