Light Brown Apple Moth (LBAM) Eradication Program: Post-Spray Effects on Animals and Pets

Summary Report Prepared by

Roy Upton
LBAM Liaison
Citizens For Health
Soquel,

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Introduction

In the Fall 2007, the California Department of Agriculture (CDFA) on demand by the United States Department of Agriculture (USDA) instituted a aerial pesticide spraying program of residential areas of the Central coast of California in an attempt to eradicate the light brown apple moth (LBAM). Alleging that the pesticide used was a “pheromone” and therefore was safe, the sprays, first in Monterey and then in Santa Cruz counties, were followed by several hundred human adverse effects, the most severe sea-bird die-off experienced in the area, dead and disoriented bees, and numerous dead or injured pets including cats, dogs, fish, birds, and rabbits. Most of these events went completely uninvestigated by State and Federal officials.

The moth has been identified as being present in 12 California counties. Agriculture officials intend to continue the pesticide spraying as well as the use of highly toxic compounds in private and public areas including in residential backyards, parks, schools, day care centers, along hiking and biking trails, and city streets throughout these counties, 3-4 days every month for as long as 2018 or until the moth is eradicated. However, independent scientists and entomologists as well as USDA officials have called into question the very justification of the program, stating the moth does not represent the danger to agriculture as alleged, and that the goal of eradication will not succeed. Most importantly, the materials used in this program have not been subjected to formal safety studies by the Environmental Protection Agency (EPA) but were rather exempted from such studies under claims the moth represents an agriculture emergency. Further, no environmental impact review was ever conducted. Therefore, the short-and long-term effects of the myriad of pesticides used in this program are unknown but have at least been partially revealed in the wake of the spray.

Methodology

These reports of dead animals and pets were gathered from those who observed these events directly and includes pet owners and animal rescue volunteers. Specific observations of the detrimental effect of exposure of the Checkmate pesticide spray solution in Monterey and Santa Cruz counties will be discussed, as well as the basic toxicology of the ingredients in solution and the toxicity of the other pesticides used or projected to be used.

Sea Bird Die-off

The most significant impact to animals due to the pesticide spray was a massive die-off of seabirds that began the morning after the all-night spraying that occurred in Santa Cruz County. Residents were sprayed with the pesticide Checkmate on Thursday November 8, 2007. Birds began being found on the beaches the morning of Friday November 9. Within two days of the spray, more than 248 dead or injured birds were submitted to native animal rescue organizations. Within 7 days more than 650 dead or injured birds had been found. The birds were freezing, drowning, and starving from trying to maintain buoyancy. The sprays were followed by a torrential downpour that resulted in a massive concentration of pesticide runoff into the Monterey Bay, a nationally protected marine sanctuary. Many of the birds were covered in this runoff and eventually died. Few were able to be released back into the Bay. Two days after the spray, and associated with the runoff, was an explosion of harmful red tide that was described by experts at the Santa Cruz County Environmental Health Services as “one of the more dramatic ones in recent memory”. Santa Cruz surfers reported this red tide as the worst seen in 30 years. Redtide occurs from a microplankton that creates a bacteria that fish eat and gets into shellfish and eventually works its way up the food chain to birds which then die of paralysis. A number of the chemical ingredients in the Checkmate pesticide solution, sodium phosphate, ammonium phosphate, urea, and tricaprylyl methyl ammonium chloride feed the plankton that can give rise to red tide. The only report conducted by the State, while scientifically flawed, attributed the death of the birds to red tide but failed to disclose that

components of the Checkmate pesticide solution can contribute to red tide. The die-off appeared to dissipate as the pesticides that ran off into the Monterey Bay dissipated in concentration.

Dead and injured birds were also observed by many people after the spray in Monterey. However, attempts to communicate these findings to Fish and Game and various State wildlife departments went unanswered and apparently uninvestigated, though the observation of these birds was reported in local newspapers. To date, not investigation of the bird die-off in Monterey has been done nor reports published. One note of interest is that high concentrations of dead and injured birds were found at the mouths of fresh water rivers (e.g. Aptos Creek in Santa Cruz and Salinas river in Monterey), suggesting that, as in Santa Cruz, run-off was a potential major factor in these events.

"On November 10, 2007, on our usual Saturday morning beach walk, my daughter and I came across some sea birds sitting on the sand at the water line. Since I am aware that pelagic birds do not come on shore unless there is a problem, I stopped to see what was wrong. I was unsure of the problem, so we found some old towels and got two birds in a make shift cage. We took them to Native Animal Rescue in Santa Cruz. At the rescue center, we were informed that some birds had come ashore the previous day, which was November 9.

Upon returning to the beach in Capitola we found the birds washing up in droves. They were soaking wet, shivering and frightened. We inspected them for oil, since the Cosco-Busan spill had happened a few weeks prior, but there was no sign of oil. The next round of birds proved to be too much for Native Animal Rescue, so they asked us to take any more birds to the Dept of Fish & Game in Santa Cruz. We did. And for another week we, along with just a few others, spent most of our non-work hours picking up sick or dead birds.

There were some tests conducted by the Dept of Fish & Game, but none were conclusive. The only answer we got was that the birds' feathers were stripped of weather and water-proofing by a mysterious waxy substance. The 'staying' substance used in the LBAM pheromone/pesticide is believed by the majority to be the culprit of the birds' struggle. At some times there were birds, Grebes, Loons & Scoters, literally drowning before our eyes. They were unable to make it all the way to shore, so they just sank. It was awful to watch.

Pet Smart donated 20 cardboard kitty carriers so my daughter and I could transport many birds at once. We have a small car, but we managed to get up to 8 birds per trip to Dept of Fish & Game. The impending doom of this happening again in June and thereafter, for 9 months of the year for up to 10 years is hard to imagine. These pelagic bird population may not survive this moth eradication attempt.

Jacquie R, Santa Cruz

Loss of Song Birds

Immediately following the sprayings, numerous residents in Monterey, Santa Cruz, Soquel, and Scotts Valley reported a lack of songbirds in their communities that lasted for up to two weeks before seemingly returning to normal. The following testimonies were collected.

"On the morning of Nov. 8 (the day before the spray), I observed over 100 birds active in my yard near Lighthouse field in Santa Cruz. They included three large flocks of songbirds, and various others of different varieties. Many more birds were evident around the neighborhood. The next morning, after the pesticide attacks, there were none. This was the first time I have ever seen a total absence of bird life in the almost 30 years that I have owned this home. This lasted for weeks. Over the course of the next two weeks, I observed 16 dead songbirds and one dead pigeon either on my property, or around my immediate neighborhood. I have never seen anything like this before."
Keith A, Santa Cruz

"After the spray the birds disappeared from our back yard. It was eerily silent. It was during our Indian summer, very warm. The birdseed suddenly went untouched. The birds didn't return for many weeks."
Kathy K, Monterey-Pebble Beach

"All birds disappeared from my neighborhood and garden (I live in Felton and there were many winter birds I was feeding and seeing prior to the spray). They did not return for over 2 weeks. There are fewer birds this year and hardly any insects."
Martine, Felton

“Each morning I awake I am very conscious of the song birds in our backyard. They are always here because we have one of the larger yards in the neighborhood and we have feeders and a bird bath. The night of the spray, the planes seemed to literally be going over all night long like dive bombers. The next morning and persisting for at least 2 weeks, there were no song birds at all in our yard in the mornings.”
Diana S, Soquel

“We have 3 bird feeders and 3 bird baths and enjoy hundreds of birds each day in our yard. We have counted up to 15 different species. We live in Scotts Valley, and were just at the limit of the spraying zone, outside of it, yet we could see the planes spraying a few blocks away. The day after the spraying, we did not see ANY bird. The following day we saw 2 birds. (The bird’s area is just in front of our office windows) For 3 weeks, we did not see more than a couple of birds a day. Now end of April 2008, almost 5 months after the sprayings, we still have not seen any finches, they seem to have been wiped away. Usually at this time of the year, April 26, we have a lot of humming birds, also because we have lots of humming bird plants. None, absolutely NONE this year.”
Geoffrey M, Scotts Valley

Dead Rabbits

“I have a friend whose single rabbit died. The owners had it for about 6 mos. It was still young. No health problems. It was found dead in its outdoor cage the morning after the spraying. The rabbit had no prior symptoms. The owner, who lives on a hill at 850 ft elevation, said the helicopter (not plane) was so low it was level with and vibrating their house. They don't know if the rabbit died of fright or poisoning. I also have a friend whose goat died. I do not have specific information for that. I'll try to get the goat story ASAP.
Nancy B, Santa Cruz

“I had no idea the spray was going to happen, I have 30 rabbits in my fenced yard. They were out during the spray because I did not know. The very next morning, 22 of my litter was dead.”

Testimony at Monterey City Council

Dead and Sickened Cats and Dogs

“My wife and I have 3 cats, had 3 cats! The night of the spray we brought all 3 inside to avoid exposure. At about 3 am we heard scratching on the door and one of the cats had gotten out. She was covered with the spray. We immediately toweled her down and got everything off that we could see. Three days later, she dropped dead in the backyard with no injuries. Up until that moment she had been a very healthy cat. It was the only one of our three that got exposed and died. I do not think it was a coincidence.”
Tom D, Santa Cruz

I have a adult female cat who is typically very active. Immediately following the spray she became sluggish and lethargic. She would sleep all day and not want to move or eat. For about 5-6 weeks after the Checkmate aerial spray, when she would go outside, especially if it was windy she would get lethargic again and seem to forget where her food bowl was. She had never behaved like this.”
Jaquie G, Santa Cruz

“Despite the fact that we closed our windows as we were warned, poisonous fumes seeped under the doors at 2:00 am. After the pass of
the first plane over our house I developed a pounding headache, blurred vision, burning eyes, and could not breathe, sinuses closed. An elderly friend with fragile heath died. One of my neighbors had bleeding sinuses. The governor’s office did not respond to emails complaining about Checkmates spray effect on children. My youngest daughter awoke crying about burning eyes while visibly shaking. All of my children, including friends and neighbors children had bloodshot puffy eyes. Imagine the pain of birds out flying getting sprayed directly in
the eyes by planes infusing the air with poison. Our cat vomited 3 times. She was so freaked out that she scratched me on my face immediately after the spraying. She had never done that before. One of our neighbor’s cats also vomited.”
Anonymous, Santa Cruz

“One of my dogs got sick. In order to avoid the spray I left town with my dogs to stay with a friend in Los Gatos. I boarded my dogs in Oakland, at Happy Hound, until I felt it was safe to bring them home. We live in the
Jewel Box in Capitola. Since it rained so hard on the day after the spray I felt a bit more secure to return myself. I left the dogs a little longer. When I brought them home, Boomer, my healthy 5-year-old mixed breed developed an awful cough, I just assumed it was kennel cough (that's what the vet thought, as well). But, he has always had his medication for that regularly and this is a very well regarded kennel that they've been to 3 times before without any sickness and it did not occur until I brought him back to Santa Cruz. I will definitely sell and move if the spraying is not canceled for good.”
Linda, Santa Cruz

“Big Cat had not adopted us yet at the time of the spraying. He was a "neighborhood cat". We noticed after the spraying he developed a wheeze, but he didn't adopt us until the rains came this winter. He wheeze got worse, last month he began coughing. We kept him in thinking it would help but it didn't. Soon his breathing seemed labored and he was coughing a lot. Although we do not know who owns Big Cat, he thinks he owns us so we decided to take him to our Vet. The Vet did not find evidence of an infection, tests came back normal. She said he did not test positive for asthma. She decided to treat him with antibiotics. His cough is much better now. There is no wheeze. We asked the Vet if she thought was caused by the spray. She said she could not say for sure, but it is possible it was caused by the spray.”

Janis D, Monterey

“We own a black male cat, extremely healthy, spoiled, muscular -lean - indoor and outdoor cat. Hunts, plays and sleeps. After the spray - we thought he was getting old – he didn't want to get up, slept alot. Only until the spray was months gone, did he return to normal. I'd say his "new lazy ways" lasted a few months.”
Kathy K, Monterey

“Our house was sprayed the night of Nov. 8. It seemed that the plane was going over our house about 10 times. It seemed like over kill. This was late at night and early in the morning. The last pass was around 1 or 2 am. At 3 am our very healthy Sharpei went out to go "potty" in the back yard. We have an electric dog door so she went out on her own.
On Nov. 14 she collasped in the back yard and was rushed to the Emergency Vet and her kidneys and liver had shut down and her blood wouldn't clot. The first thing that they ask was was she poisoned or did she get into anything poison or did she eat wild mushrooms? She had done none of the above. After being put on fluids,oxygen, antibiotics to fight the poison we lost her. They did CPR on her when she went into cardiac arrest but that didn't help. We had her to our Vet a couple of weeks before for her Checkup and Physical exam and her vaccines and there was no sign of sickness in anyway. They only thing we can connect to her death is the spraying.”
Tom M, Santa Cruz

Dr. Haferman, I want to express thanks to you and Dr. Knepp for your clearly written and well reasoned analysis concerning particle size distribution of CheckMate. You have made an extraordinary contribution to the debate and the citizens of this community are lucky to have you.

I live on the north boundary of Marina. During the night of both the initial sprayingand the second round of spraying I was awakened when, after seven low passes over my house, I sensed a strong chemical taste in my mouth and had a burning sensations in my nose and mouth which lasted through the next day. I also developed some chest pains that were brief and transient for about 2 months. I had stayed indors with windows closed during the hours advised. The next morning, on both occasions, there was a very strong chemical odor outdoors around my house and throughout my neighborhood. I am only 57, am in good physical condition, and have never smoked. My dog, who only goes out on the lawn briefly and stayed indoors until after 8 am developed shortness of breath that lasted 2 months and an enlarged heart identified on x-ray in mid-October. I did not report my symptoms, and am not among the 600 or so being questioned. I am among those ridiculed by the Mayor of Marina when we tried to complain to the Marina City Council.

I am convinced of the toxicity of the chemicals through my own direct experience. I was not surprised to learn of errors in the application procedure which caused dumping of higher

concentrations over some neighborhoods. I am convinced that my neighborhood was below the "extra dump" from the plane.

It is deplorable that there had to be a public outcry and proof of harm already done before monitoring of the flight record data was allowed. It is deplorable that citizens who claimed their right to be free of an insult to their health were ridiculed in the press and scorned by their fellow citizens and some of their elected officials. It is deplorable that under the Bush administration there has been a culture of purposeful neglect and disregard of science. It is deplorable that our health has been at the mercy of decisions made by an appointee to the office of Agricultural Commissioner of the State of California who has so little scientific training that he was not able to determine valid criteria for assessing health risk. It hasbecome clear that we must invest in science education at the high school level in order to produce a citizenry and public officials who appreciate the meaning of valid empirical investigation.

Again, thank you for your time, effort, and dedication in bringing into public service your most valuable assets, your intelligence, keen reasoning, and belief in the right of the citizens to be protected from risks to our health. I commend you and thank you. I only wish you lived in Marina and were serving in city government here.

Dead and Injured Fish

"My wife has a outdoor goldfish pond in the backyard of our home in **Monterey.** They had lived in the pond for several years. They all died a few days after the spray."
Jeff H. Monterey

"I have a fish pond in my yard. The morning after the spray the pond was covered with a foamy substance. I first moved it out of the way to feed the fish but they did not want to come to the surface at all, which is completely unusual. I immediately caught them all up and then drained the pond to clean it. They did not die but they were very lethargic for days after."
Marita H, Aptos

"I have had goldfish for years living in my old hottub and after the aerial
Checkmate spray, there was a film on the water and the fish did not want to swim up for their food. I tried to absorb it and get it off. One goldfish developed a fungus and died. That has not happened ever before."
Jaquie G, Santa Cruz

Bee Die-off

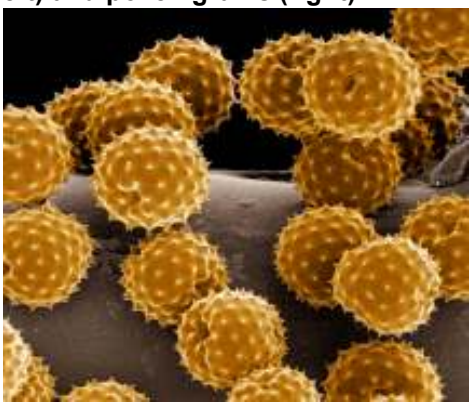
Pesticides can severely impact bee colonies and are considered to be one of the four primary stressors on bee colonies. Yet, the EPA only requires that pesticides be assessed for adult bees, neglecting any effect pesticides may have on the brood and immature bees (COA 2007). In the case of the pheromone pesticide solutions approved for use in the LBAM eradication program, no tests on bees were performed. Moreover, individual pesticides may not be found to be injurious to bees but when bees are exposed sequentially to an array of pesticides that may be in the environment, these collective pesticides may become lethal. Moreover, a relatively recent study from Canada reported that low level exposure of pesticides to bees while in the larval development stage has an adverse effect on the adults that are not detected with current tests required by regulatory agencies (Morandin et al. 2005).

Pesticides delivered in microencapsulated delivery systems are reported as being among the most insidiously dangerous to bee colonies as the capsules are exactly the same size as pollen grains. The bees get these caps stuck to their wings and bodies, which impairs their flying. Then they gather the caps, thinking they are pollen, carry it back to the hive where they feed the brood, queen, and emerging adults with the pesticide content which breaks down over a period of 30 to 90 days.

"A person told me she saw bees, laying on her patio table struggling and going no where, but as if trying to survive but dying, almost like they couldn't breathe, and lying sideways and fluttering."
HCP, Santa Cruz

“I was in my yard gardening the day of the spray. My rosemary was filled with bees as it usually is. The next day the bees were floundering on the ground and some were even flying into the bush and falling like they were drunk. Many seemed to be dying on the ground.”
Julia, Santa Cruz

Figure 1 Example of microcapsule delivery system (left) and pollen grains (right)



Review of Toxicity of Checkmate Aerial Pesticide Solution

The Checkmate LBAM-F is a cocktail of chemical toxins, 2 pheromones, surfactant (tricaprylyl methyl ammonium chloride; aka Aliquat 336), plastic resins, an antioxidant, and emulsifier. The solution is designed to hang in the air to maintain an ambient saturation of pheromone and to stick to surfaces, lest it all fall to the ground, which would render it ineffective as a pheromone disruptor. The moths mate higher in the air not at ground level.

When testing pesticide solutions, only the active ingredients are often tested. However, research suggests that the so-called “inert” ingredients in a pesticide are often among the most toxic. The word “inert” as used on a pesticide label is commonly mistaken to mean inactive or benign. However the EPA states that “although the term “inert” may connote physical, chemical or biological inactivity, use of the word “inert” to describe a component in a pesticide product means only that the substance is not intended to exert a pesticidal effect in that product. The “inert” ingredient may have biological activity of its own, “it may be toxic to humans, and it may be chemically active” (EPA 2002). Typically, pesticide formulations are comprised largely of inert ingredients. A review of 100 agricultural pesticide products found that the formulations contained on average 50% inert ingredients, with many containing 90% or more (NCAP 2006). The majority of safety tests required to register a pesticide are performed with the active ingredient alone, not the complete formulation (Cox and Surgan 2006). The Checkmate LBAM-F formulation consists of 17.61% moth hormonal disruptors and 82.39% other ingredients (see Table 2).

Numerous studies have shown that inerts can increase the toxicity of pesticides to body systems such as the nervous, cardiovascular, and hormonal systems, the mitochondria, and genetic material. Inerts can also interact with other chemicals in pesticide formulations, to increase human exposure levels to the active pesticide. Additionally, inerts have been shown to raise the ecotoxicity of pesticide formulations, increasing the severity of toxic effects to plants, animals, and non-target organisms (Cox and Surgan 2006).

State and Federal Agencies have alleged that the Checkmate LBAM-F formula, consisting of pheromones as active ingredients, is an environmentally safe product with no known negative human or environmental effects because pheromones are abundantly available in the environment. It is correct that pheromone based pesticides are more environmentally sound than organophosphate pesticides and that natural insect pheromones are abundant in nature. However, the pheromone being used is a synthetic product that mimics the effects of the natural pheromone so while the synthetic may be considered similar to the naturally produced pheromones it cannot be considered identical as moths relatively quickly learn to distinguish true from synthetic pheromone. The greatest concern regarding the safety of the pheromone portion of the formulation is that it has not been tested with regards to what effects it may have on non-target organisms. CDFA has noted that at least 5 moths other than LBAM are being found in the LBAM traps suggesting a potential effect on non-target species, to what degree is unknown. There is significant concern regarding the so-called “inert” ingredients in the Checkmate formula, most of which have a detrimental effect on bees, aquatic ecology, and animals higher on the food chain. A review of the available data for these chemicals indicates a high potential for toxicity for many of the ingredients labeled as inert, even at low concentrations. Moreover, the degradation products of a number of the Checkmate

inert ingredients are more toxic than the parent compound. In addition, all of the other treatments being used in the LBAM eradication program are highly toxic to the environment in general and aquatic ecology specifically. Because, CDFA declared this program an emergency, environmental impact reviews were not conducted so the environmental consequences of the combination of pesticide products being used is completely unknown.

The following toxicological information was derived from database reviews, primary published scientific literature, and Material Safety Data Sheets (MSDS). A MSDS is designed to provide workers and emergency personnel with the proper procedures for handling or working with potentially toxic substances. MSDSs include information such as physical data (melting point, boiling point, flash point etc.), toxicity, health effects, first aid, reactivity, storage, disposal, protective equipment, and information regarding environmental accidents such as spills or accidents. The information presented provides a partial overview of the toxicity of the compound with any known effect specifically reported about ecological toxicities.

Table 2 Ingredients in Checkmate LBAM-F and OLR-F

Water	
(E)-11-Tetradecen-1-yl acetate	16.9% (pheromone)
(E,E) -9,11 Tetradecadien-1-yl acetate	0.71% (pheromone)
(z)-11-Tetradecenyl acetate (pheromone)*	
11-Tetradecen-1-ol acetate (pheromone)	
Tricaprylyl methyl ammonium chloride (syn. methyltrioctylammonium chloride)	
Sodium phosphate	
Ammonium phosphate	
1,2-benzisothiozoli-3-one	
2-hydroxy-4-n-octyloxybenzophenone	
Butylated hydroxytoluene	
Polyvinyl alcohol	
Cross linked polyurea polymer	
Polymethylene polyphenyl isocyanate*	

* The actual presence of this compound in the solution has been questioned. It may be used as a building block for the crosslinked polyurea polymer. (z)-11-Tetradecenyl acetate is a component of Checkmate OLR-F.

a. Tricaprylyl Methyl Ammonium Chloride (synonym methyltrioctylammonium chloride): CAS Number: 5137-55-3 (TMAC)

Also known by the trade name Aliquat 336 (Acros MSDS; de Oliveira and Bertazzoli 2007; Sigma-Aldrich MSDS) tricaprylyl methyl ammonium chloride (TMAC) is a low-foaming surfactant that keeps polymer beads from sticking together. Surfactants in general allow other compounds to dissolve in water and change the surface tension of water (Abraham 2007; Gyenge and Oloman 2001; de Oliveira and Bertazzoli 2007). This effect on water can affect zooplankton and even at low doses can significantly impact amphibians such as frogs (Abraham 2007). European labeling warns against releasing the substance into the environment, cautioning that it may cause long-term adverse effects in the aquatic environment. Surfactants can increase the systemic toxicity of substances through increased absorption.

b. 1,2-Benzisothiozoli-3-one (synonym BIT); CAS Number: 2634-33-5

1,2-Benzisothiazolin-3-one is a preservative associated with occupational asthma. Multiple accounts of occupational dermatitis have been reported with exposure to the chemical. In the European Union, it is classified as irritating to the skin and as a potential risk of causing serious eye damage. Canadian authorities list it as causing skin sensitization in humans. BIT is a known dermal irritant at levels as low as 0.1% concentration and individuals with dermal conditions should avoid repeated exposure to BIT (Damstra et al. 1992; Muhn and Sasseville 2003; Roberts et al. 1981; Taran and Delaney 1997). Individuals with chronic pulmonary or asthmatic conditions or chronic skin conditions are warned to avoid repetitive exposure to BIT. Symptoms of exposure include respiratory tract and mucous membrane irritation, severe eye irritation, skin irritation, and dermatitis. According to data compiled by the Occupational Safety and Health Administration (OSHA) BIT has been shown to be a mutagen with genotoxicity to human cells.

In the European Union BIT is classified as dangerous to the environment and as very toxic to aquatic organisms with specific negative effects against mollusks, fish, and zooplankton. It is highly toxic to green algae and can disturb aquatic ecosystems. According to the EPA, it has a low to moderate toxicity to birds and mammals, a moderate toxicity to fresh water fish and invertebrates (starfish, crabs, insects), and is highly toxic to estuarine and marine habitats. European labeling warns against releasing the substance into the environment. It is classified as “hazardous waste” by the European Waste

Catalogue Ordinance and as a “hazard to waters” by the European Administrative Regulation of Substances Hazardous to Water. Domestic MSDS sheets for BIT warn that water polluted with the substance should not be discharged into sewage or natural areas. Documents of the EPA on BIT state that it is highly toxic to green algae and other invertebrate species. The EPA also states that if it is used outdoors, BIT may possibly move with soil during rainfall events and potentially reach surface waters. The Santa Cruz county sprayings on November 8th and 9th were followed by a significant rainfall on November 10th and 11th. The rainfall was associated with an anomalous yellow runoff from the land into the Monterey Bay via several drainpipes. This runoff was yellow and sticky and left a thick layer of foam on top of the water for miles along the Santa Cruz shore. No testing of this runoff was performed by State or Federal Agencies.

c. 2-Hydroxy-4-n-octyloxybenzophenone (synonym benzophenone 12); CAS Number: 1843-05-6
2-Hydroxy-4-n-octyl benzophenone is a UV light absorber of unknown health impact, however related compounds in the benzophenone family have been shown to form estrogenic photoproducts, upon exposure to UV or sunlight (Hayashi et al. 2006). In the European Union it is classified as an irritant that may cause sensitization upon skin contact and is irritating to the eyes, respiratory system, and skin. Symptoms of exposure include reddening and irritation of the skin and eyes, mucous membrane irritation, and upper respiratory tract irritation.

2-Hydroxy-4-n-octyl benzophenone is classified as harmful to aquatic organisms and may cause long-term adverse effects in the aquatic environment. European labeling warns against releasing the substance into the environment. It is classified as hazardous by OSHA.

d. Butylated Hydroxytoluene (BHT) (synonym 2,6-Di-tert-butyl-p-cresol): CAS Number: 128-37-0
Butylated hydroxytoluene (BHT) is classified as irritating to the eyes, respiratory system, and skin in the European Union. Allergic contact dermatitis and contact urticaria are associated with exposure to BHT (HAZ-MAP). Studies have shown BHT to be carcinogenic, hepatotoxic, tumorigenic, mutagenic, and teratogenic in animals as well as in human cells (Sigma-Aldrich MSDS). Studies have also confirmed BHT to have estrogenic activity (Miller et al. 2001; Wada et al. 2004) and MSDS sheets state that chronic exposure to BHT may cause adverse reproductive and birth defects (Acros MSDS). BHT is classified by OSHA as an ecological toxin with specific toxicity to marine life. It is a known eye and skin irritant and can cause a multitude of respiratory symptoms (e.g. cough, sore throat).

e. Sodium Phosphate
Sodium Phosphate (SP) (Disodium Phosphate): CAS Number: 7558-79-4
Sodium Acid Phosphate (SAP) (Monosodium Phosphate): CAS Number: 7558-80-7
Trisodium Phosphate (TSP) (Sodium Phosphate): CAS Number: 7601-54-9
There are a number of different forms of sodium phosphate. The exact type of sodium phosphate used in the Checkmate formulas has not been publicly disclosed, and therefore it is not possible to give a precise description of potential adverse effects. However, a review of the most common forms of sodium phosphate share similar toxicity profiles and it would be expected that the range of exposure symptoms would vary from mild to severe depending on the specific type of sodium phosphate used in the formula. Symptoms of exposure to the various kinds of sodium phosphate would range from mild to severe gastrointestinal effects (varying degrees of gastrointestinal irritation, abdominal pain/cramping, vomiting, diarrhea, nausea, abdominal discomfort, burning sensation), mild to severe respiratory symptoms (throat irritation, respiratory tract/mucous membrane irritation, coughing, sneezing, choking, difficulty breathing, pulmonary edema), mild to severe effects on the eye (irritation, redness, pain, conjunctival edema and corneal clouding followed by subsequent cataract formation could occur) eye burns, and mild to severe skin symptoms (skin/mucous membrane irritation, dermatitis, local skin destruction, burning pain, skin burns, blisters).

Environmentally, these compounds are classified as hazardous substances with potential detrimental effects on ground water and aquatic ecosystems. These most especially affect blue gill sunfish, rainbow trout, crustaceans, mollusks, and phyto- and zooplankton that can contribute to red tides (Feyzioglu and Ogut 2006), which in turn are toxic to marine habitats.

Sodium Phosphate (SP): Classified as a hazardous substance on California Director's List of Hazardous Substances & CERCLA (Science Lab MSDS). May cause irritation of the digestive tract and may cause purging. It is slowly absorbed. Expected to be a low ingestion hazard for usual industrial handling. Ingestion of large doses may affect behavior/central nervous system. If a significant amount of phosphate is absorbed, hypophosphatemia will occur (Science Lab MSDS). SP is extremely caustic to eyes.

Sodium Acid Phosphate (SAP): Considered a low hazard for usual industrial handling and systemic reactions are unlikely when ingested (because they are slowly and incompletely absorbed in the intestinal

tract). The most frequently seen effect is gastrointestinal irritation with abdominal pain and cramping, vomiting, diarrhea. If a significant amount of phosphate is absorbed. The following symptoms may occur: mineral imbalance in the body, adversely affecting the osmotic pressure of body fluids resulting in hyperphosphatemia, hypocalcemia, hypomagnesemia (Science Lab MSDS).

Trisodium Phosphate (TSP): Classified as "hazardous waste" under the European Waste Catalogue Ordinance (AVV) (Gestis Database); classified as a hazardous substance on California Director's List of Hazardous Substances, CERCLA, and OSHA (Science Lab MSDS). May be harmful if swallowed and may cause severe gastrointestinal (digestive) tract irritation with severe nausea, vomiting, abdominal discomfort, violent purging, diarrhea, and burning sensation. Ingestion of large amounts may induce hypocalcemia or hyponatremia characterized by tetanus-like spasms, due to the sequestration of calcium ions by the phosphate moiety. It may also cause caustic burns of the mouth oropharnyx, esophagus, or gastrointestinal tract. TSP is extremely caustic to the eyes.

In general, sodium phosphate is a pH buffer. If runoff concentrations are high enough sodium phosphate could contribute to a change in water pH and lead to algal blooms (Abraham 2007) that can give rise to red tide. Increased phosphate levels are known to be a contributing factor in the occurrence of red tides (Feyzioglu and Ogut 2006). It may also be hazardous to drinking water when large quantities get into groundwater.

Following the sprayings in Monterey and Santa Cruz counties, a large number of the reported human adverse effects reported were consistent with the adverse effects profile of these various compounds. Similarly, a harmful algal bloom (red tide) described by a water specialist with the Santa Cruz County Environmental Health Services as "one of the more dramatic ones in recent memory", occurred in the Monterey Bay (Ragan 2007) four days after the spray. More than 650 dead seabirds were found from the day immediately following the spray to the several days following the spray including the days associated with this dramatic red tide. The temporal association and mechanistic plausibility between the actual spray and the dead and injured sea birds suggests more than a coincidental occurrence.

f. Ammonium Phosphate
***Monoammonium Phosphate*: CAS Number: 7722-76-1**
***Diammonium Phosphate*: CAS Number: 7783-28-0**
The exact type of ammonium phosphate used in the Checkmate formulas is currently unspecified, and could be either *monoammonium phosphate* or *diammonium phosphate*.

Monoammonium phosphate can cause mild respiratory tract irritation, nausea, vomiting (after inhalation of high concentrations of dust), coughing, shortness of breath, mild irritation, redness, and pain of eyes. Classified as hazardous by OSHA (Science Lab MSDS).

Diammonium phosphate is toxic to lungs and mucous membranes and can cause irritation to the respiratory tract, coughing, shortness of breath and eye inflammation characterized by redness, watering, itching, and pain. Characterized in Canada as very toxic. Repeated or prolonged exposure can produce target organ damage and cause damage to lungs and mucous membranes. Classified as hazardous by OSHA; long term degradation products may arise and products of degradation are more toxic than the parent compounds (Science Lab MSDS). May be a hazardous to drinking water when larger quantities get into groundwater (Gestis Database).

Following the sprayings in Monterey and Santa Cruz counties there were numerous reports of respiratory symptoms including asthma, bronchial irritation, difficulty breathing, shortness of breath, coughing and wheezing, lung congestion/soreness, and chest pain/tightness. Nausea, blurred vision, eye irritation, and skin rashes were also reported (HOPE 2008).

g. Polyvinyl Alcohol (PVA)
CAS Number: 9002-89-5
Polyvinyl Alcohol (PVA) is an emulsifier that allows other compounds to mix together and may keep the microcapsules suspended in water. The Society of Plastics Industry considers it a plastic resin. There is limited human data regarding the toxicity of polyvinyl alcohol. Animal data has shown it to be tumorigenic (Science Lab MSDS). Inhalation or ingestion of PVA for a prolonged period of time may affect blood, metabolism, and behavior (Science Lab MSDS). Symptoms of PVA exposure include digestive tract irritation, respiratory irritation or cough, and red/irritated eyes.

According to the National Institute of Occupational Safety and Health (NIOSH) polyvinyl alcohol may be hazardous in the environment, with special attention given to fish. It may also be hazardous to ground water (Gestis Database). It is considered to be harmless in isolation, but PVA could potentially dissolve other compounds on impervious surfaces into runoff.

Following the sprayings in Monterey and Santa Cruz counties there were numerous adverse effects reported, including nausea, diarrhea, coughing, wheezing, and eye irritation (HOPE 2008) as well as an anomalous runoff of yellow sticky substance that was observed coming from runoff drain pipes, in back yards, the rivers, and which accumulated in the Monterey Bay in the form of a thick yellow foam floating on top of the water along West Cliff Beach. Dead and injured birds were found with this sticky substance. It is possible this thick yellow sticky substance was an accumulation of the billions of microcapsules that were dispensed, mixed with the surfactants and emulsifiers that can dissolve other compounds on impervious surfaces (oils, other chemicals, pollutants) during the rainfall and keep them in suspension in the water, which is a function of emulsifiers.

h. Crosslinked Polyurea Polymer and Polymethylene Polyphony Isocyanate (PPI)*
CAS Number: information not available
According to Checkmate manufacturer Suterra, polymethylene polyphenyl isocyanate is used to create the encapsulation polymer that makes up the shell of the microcapsule that contains the Checkmate solution. The PPI starter compound is reported by the manufacturer to be used up during the reaction (Renner 2007). The *Consensus Statement* states that the polyurea shell biodegrades into urea. Research has linked urea to the occurrence of harmful algal blooms (HAB's), also known as red tides. Following the spraying, a harmful algal bloom (red tide) described by a water specialist with the Santa Cruz County Environmental Health Services as "one of the more dramatic ones in recent memory", occurred in the Monterey Bay (Ragan 2007).

If the impact of these pesticide treatments were to even have a marginal negative effect on the vitality of California bee colonies, the associated costs would dwarf any damage that could be realistically expected from LBAM and have negative effects on California wild flora for decades.

Review of Toxicity of Other Pesticides Used in the LBAM Eradication Program

In addition to the basic toxicity of the inert ingredients in the sprays that were applied and are projected to be applied (e.g. Checkmate LBAM-F), there are tremendous potential environmental consequences in the other products that are being used or, are projected to be used, as part of the LBAM eradication program. Most of these other products are directly insecticidal and directly toxic pesticides, most of which are known to be extremely toxic to an array of insects, marine life, birds, and cats.

a. *Bacillus thuringiensis* (Bt)
Bacillus thuringiensis (Bt) is a naturally occurring bacteria used in the control of a variety of pests though its effects against LBAM appear to be limited. It is approved for use on organic produce. The primary concern with Bt is its potential environmental effects and effects against beneficial insect predators. Large-scale applications of Bt can have far-reaching ecological impacts. Bt can reduce dramatically the number and variety of moth and butterfly species, which in turn impacts birds and mammals that feed on caterpillars. In addition to negatively effecting food chain of wildlife, there is a potential for Bt to negatively affect the large populations of monarch butterflies that migrate and breed in Santa Cruz each year. While Bt is broadly reported to be non-toxic to bees, an international body of experts reported that mortality in bees has been observed after exposure to foods genetically modified to contain Bt (as a natural deterrent) (UNEP 1999). These types of foods has resulted in massive die-offs of butterflies and pollinators who eat the genetically modified foods and are poisoned.

Bt is less toxic to mammals and shows fewer environmental effects than many synthetic insecticides. The EPA reports that Bt may give rise to secondary toxins that can affect non-target species. CDFA has announced intentions to treat residential areas with Bt.

b. Chlorpyrifos
CAS number: 2921-88-2
EPA: 738-F-01-006
Chlorpyrifos is a toxic crystalline organophosphate insecticide that inhibits acetylcholinesterase and is used to control insect pests. Product names include Dursban, Empire, and Lorsban. Cholinesterase inhibition in humans can result in over stimulation of the nervous system causing nausea, dizziness, confusion, and at very high exposures (e.g., accidents or major spills), respiratory paralysis and death. In 2001, EPA banned chlorpyrifos use in homes because of hazards to children. Approximately 2 million pounds of chlorpyrifos are used for agricultural purposes each year. The safety of chlorpyrifos has been questioned for more than a decade. In 1995, Dow Chemical was fined $732,000 for not sending to the EPA reports it had received on 249 poisoning incidents associated with the product Dursban. In 2003, Dow agreed to pay $2 million, the largest penalty ever in a pesticide case, to the state of New York, in response to a lawsuit filed by the Attorney General to end Dow's illegal advertising of Dursban as "safe".

Concern over the safety of chlorpyrifos continues. On July 31st, 2007, a coalition of farm worker and advocacy groups filed a lawsuit against the EPA seeking to end agricultural use of chlorpyrifos. The suit claims that the continued use of chlorpyrifos poses an unnecessary risk to farm workers and their families (Earth Justice 2007). Additionally, the Natural Resources Defense Council (NRDC) and Pesticide Action Network of North America (PANNA) have formally petitioned the EPA to revoke all registrations and approvals for the use of chlorpyrifos. USDA has opposed this reclassification. Chlorpyrifos is not approved for home use except in ant and roach baits. As part of the LBAM eradication program, chlorpyrifos is currently required to be used in wholesale nurseries if a single sign of LBAM is found. In such cases, the entire acreage is required to be treated. This requirement presents a significant environmental health hazard as many of these nurseries are in residential areas, are along waterways, and are in close proximity to agricultural areas that utilize pollinators.

Chlorpyrifos is a neurotoxin and suspected endocrine disruptor that is classified by EPA as moderately toxic to humans (Class II). It predominantly affects the central nervous, cardiovascular, and respiratory systems and has been associated with asthma (AOEC Exposure Codes), reproductive and developmental toxicity. The OEHHA has prioritized chlorpyrifos to review as a potential reproductive toxin.

Chlorpyrifos is also a skin and eye irritant. While some organophosphates are readily absorbed through the skin, studies in humans suggest that skin absorption of chlorpyrifos is limited. Symptoms of acute exposure to organophosphate or cholinesterase-inhibiting compounds may include the following: numbness, tingling sensations, incoordination, headache, dizziness, tremor, nausea, abdominal cramps, sweating, blurred vision, difficulty breathing or respiratory depression, and slow heartbeat. Very high doses may result in unconsciousness, incontinence, convulsions, and death.

Recent research indicates that children exposed to chlorpyrifos while in the womb have an increased risk of delays in mental and motor development at age 3 and an increased occurrence of pervasive developmental disorders such as ADHD (Whyatt et al. 2006). Another study demonstrated a correlation between prenatal chlorpyrifos exposure and lower weight and smaller head circumference of infants at birth (Whyatt et al. 2004).

Persons with respiratory ailments, recent exposure to cholinesterase inhibitors, cholinesterase impairment, or liver malfunction are at increased risk from exposure to chlorpyrifos. Some organophosphates may cause delayed symptoms beginning 1 to 4 weeks after an acute exposure, which may or may not have produced immediate symptoms. In such cases, numbness, tingling, weakness, and cramping may appear in the lower limbs and progress to incoordination and paralysis. Improvement may occur over months or years, and in some cases residual impairment will remain.

Repeated or prolonged exposure to organophosphates may result in the same effects as acute exposure including the delayed symptoms. Other effects reported in workers repeatedly exposed include impaired memory and concentration, disorientation, severe depressions, irritability, confusion, headache, speech difficulties, delayed reaction times, nightmares, sleepwalking, and drowsiness or insomnia. An influenza-like condition with headache, nausea, weakness, loss of appetite, and malaise has also been reported. A measurable change in plasma and red blood cell cholinesterase levels was seen in workers exposed to chlorpyrifos spray. Human volunteers who ingested 0.1 mg/kg/day of chlorpyrifos for 4 weeks showed significant plasma cholinesterase inhibition.

A body burden study conducted by the Centers for Disease Control and Prevention (CDC) found TCPy—a metabolite specific to chlorpyrifos—in the urine of 91% of people tested (CDC 2005). An independent analysis of the CDC data claims that Dow has contributed 80% of the chlorpyrifos body burden of people living in the US (PANNA 2004). A 2008 study found dramatic drops in the urinary levels of chlorpyrifos metabolites when children switched from conventional diets to diets consisting of higher amounts of organically cultivated foods (Lu et al. 2008).

Air monitoring studies conducted by the California Air Resources Board (CARB 1996) have documented chlorpyrifos in the air of California communities (Stein and White 1993). Analyses of the CARB data indicate that children living in areas of high chlorpyrifos use are often exposed to levels of the insecticide that exceed levels considered acceptable by the EPA (Kegley et al. 2003; Lee et al. 2004). Recent air monitoring studies in Washington and Lindsay, CA yielded comparable results (Dansereau et al. 2006; Kegley et al. 2006). Grower and pesticide industry groups have argued that the air levels documented in these studies are not high enough to cause significant exposure or adverse effects (Hansen 2007), but a follow-up biomonitoring study in Lindsay, CA has shown that people there have higher than normal chlorpyrifos levels in their bodies (Fischer 2007).

Chlorpyrifos is highly toxic to amphibians. A recent study by the United States Geological Survey (USGS) found that the main breakdown product in the environment, chlorpyrifos oxon, is even more toxic to amphibians than the primary compound (Science Daily 2007). When pure chlorpyrifos was fed to dogs for 2 years, increased liver weight occurred at 3.0 mg/kg/day. Signs of cholinesterase inhibition occurred at 1 mg/kg/day. Rats and mice given technical chlorpyrifos in the diet for 104 weeks showed no adverse

effects other than cholinesterase inhibition. Two-year feeding studies using doses of 1 and 3 mg/kg/day of chlorpyrifos in rats showed moderate depression of cholinesterase. Cholinesterase levels recovered when the experimental feeding was discontinued. Identical results occurred in a 2-year feeding study with dogs. Occupationally, a single application of chlorpyrifos poses risks to small mammals, birds, fish and aquatic invertebrate species for nearly all registered outdoor uses.

Multiple applications increase the risks to wildlife and prolong exposures to toxic concentrations. Many nurseries in Santa Cruz County have been required to treat their entire acreage multiple times in only a few month-period.

Effects on birds: Chlorpyrifos is moderately to very highly toxic to birds. Its oral LD50 is 8.41 mg/kg in pheasants, 112 mg/kg in mallard ducks, 21.0 mg/kg in house sparrows, and 32 mg/kg in chickens. The LD50 for a granular product (15G) in bobwhite quail is 108 mg/kg. At 125 ppm, mallards laid significantly fewer eggs. There was no evidence of changes in weight gain, or in the number, weight, and quality of eggs produced by hens fed dietary levels of 50 ppm of chlorpyrifos.

Effects on bees: Chlorpyrifos is rated as highly toxic to bees, which means exposure can kill more than 1000 bees per hive daily. Exposure of hives to chlorpyrifos have resulted in 85 to 100% mortality in colonies (Bianu et al. year unknown).

Effects on aquatic organisms: Chlorpyrifos is very highly toxic to freshwater fish, aquatic invertebrates and estuarine and marine organisms. Cholinesterase inhibition was observed in acute toxicity tests of fish exposed to very low concentrations of this insecticide. Application of concentrations as low as 0.01 pounds of active ingredient per acre may cause fish and aquatic invertebrate deaths. Chlorpyrifos toxicity to fish may be related to water temperature. The 96-hour LC50 for chlorpyrifos is 0.009 mg/L in mature rainbow trout, 0.098 mg/L in lake trout, 0.806 mg/L in goldfish, 0.01 mg/L in bluegill, and 0.331 mg/L in fathead minnow. When fathead minnows were exposed to Dursban for a 200-day period during which they reproduced, the first generation of offspring had decreased survival and growth, as well as a significant number of deformities. This occurred at approximately 0.002 mg/L exposure for a 30-day period. Chlorpyrifos accumulates in the tissues of aquatic organisms. Studies involving continuous exposure of fish during the embryonic through fry stages have shown bioconcentration values of 58 to 5100. Due to its high acute toxicity and its persistence in sediments, chlorpyrifos may represent a hazard to sea bottom dwellers. Smaller organisms appear to be more sensitive than larger ones (EXTOXNET 1996).

Effects on other organisms: Aquatic and general agricultural uses of chlorpyrifos pose a serious hazard to wildlife and pollinators.

c. Permethrin

CAS Numbers:

- 52645-53-1 (mixed isomers)
- 54774-45-7 (cis-isomer)
- 51877-74-8 (trans-isomer)

Permethrin is one of a class of insecticides known as pyrethroids. It inhibits respiration in a manner similar to other neurotoxic drugs (Gassner et al. 1997 as cited by Cox 1998). Like other pyrethroids, permethrin kills insects by strongly exciting their nervous systems. In mammals it has been shown to cause a wide variety of neurotoxic symptoms including tremors, incoordination, elevated body temperature, increased aggressive behavior, and disruption of learning (Cox 1998). In an EPA summary of 17 medium-term and long-term laboratory studies that exposed test animals to permethrin, effects on the liver were noted at the “lowest effect level” in all of them (EPA 1997 as cited by Cox 1998).

Permethrin is classified as a “potential human carcinogen” by the EPA, and tests with human cells have shown it to be mutagenic. It is listed as a suspected endocrine disruptor, and both estrogen-like and antiandrogen-like effects have been observed in test animals. Endocrine disruptors are among the most insidious and damaging of pesticidal substances having been linked to breast and prostate cancer and a variety of reproductive disorders that can take decades to manifest and can effect multiple generations.

Studies have shown that pyrethroid exposure may be neurotoxic during development and that human newborns and children may be more sensitive to permethrin than adults. Children exposed to permethrin have developed immune-mediated respiratory and dermal irritation. Recent investigations of permethrin exposure of children have reported immunotoxic effects following exposure to pyrethroids, with increased incidence of anti-nuclear antibodies associated with autoimmune disease (EPA 2007).

Experiments with laboratory animals indicate that the immune system appears to be a sensitive target for permethrin activity. Ingestion of permethrin reduces the ability of T-lymphocytes to recognize and respond to foreign proteins (Cox 1998). Even small doses equivalent to 1/100 of the LD_{50}, have been shown to inhibit T-lymphocytes by more than 40% (Cox 1998). Permethrin ingestion has also been shown to reduce the activity of natural killer cells by about 40 percent (Blaylock et al. as cited by Cox 1998).

Both the EPA and World Health Organizations have reported that permethrin increased the frequency of lung tumors in female mice, and increased the frequency of liver tumors in male and female mice (EPA 1997; WHO 1990 as cited by Cox 1998).

The toxic effects of permethrin are often greatly increased when combined with other chemicals. Several studies have linked a variety of health problems (commonly referred to as Gulf War Syndrome) reported by 30,000 veterans who served in the Persian Gulf War, with exposure to a combination of permethrin, the anti-nerve gas drug pyridostigmine bromide, and the insect repellent DEET.

Permethrin is highly toxic to a wide variety of animals including honeybees (and other beneficial insects), fish, aquatic insects, crayfish, and shrimp. It is especially toxic to cats. The potential toxicity of permethrin to beneficial insects is of specific concern with regards to the long term management of pests as a healthy ecosystem that fosters, not destroys, beneficial predators is the most effective, environmentally sound, and sustainable manner of controlling pests, including the LBAM.

In addition to toxic effects on beneficial insects needed for pollination of crops and a healthy ecosystem of natural predators, permethrin is highly toxic to both fresh water and estuarine aquatic organisms and can pose a serious threat to the Monterey Bay, a nationally protected marine sanctuary.

Studies have shown that most cats (96%) exposed to permethrin develop toxic effects, including excitability, twitching, tremors, convulsions, muscular weakness, respiratory distress, vomiting, diarrhea, hypersalivation, and death.

The State of California and the USDA intends to apply permethrin to pheromone traps and place tens of thousands of these traps in residential areas, the yards of private residents, schools, city parks, around day care centers, and on telephone poles throughout neighborhoods (3000 telephones per square mile). Dew, fog, mist, and rains will cause these toxins to leach into the surrounding areas, potentially acutely exposing families, playing children, and animals to this highly toxic compound and, in Monterey and Santa Cruz, eventually washing into the Monterey Bay, a protected marine sanctuary, as well as other estuaries in San Francisco, Marin, and other areas. Even small amounts of permethrin are classified as a “severe hazard to waters” under the European Administrative Regulation of Substances Hazardous to Water (Gestis Database).

Effects on bees: Permethrin is rated as highly toxic to bees, which means exposure can kill more than 1000 bees per hive daily.

d. Spinosad
CAS Numbers

- 131929-60-7 (Spinosyn A)
- 131929-63-0 (Spinosyn D)
- 168316-95-8 (used in WHO Acute Hazard list) (*PAN Database*)

Spinosad is a mixture of compounds formed from the fermentation of the soil organism *Saccharopolyspora spinosa.* The mixture is composed of approximately 10 related chemicals, with a variety of compounds derived from the fermentation process. Two closely related compounds, spinosyn A and spinosyn D, comprise about 88% of the composition of spinosad and are responsible for most of its insecticidal activity (JMPR 2001b). It kills insects through activation of the acetylcholine nervous system through nicotinic receptors. Continuous activation of motor neurons causes insects to die of exhaustion (USDA 2002).

The Dow Agrosciences products *Conserve* and *Entrust*, are the specific formulations recommended by the CDFA on its *Light Brown Apple Moth Approved Treatments for Nurseries and Host Crops* list. Both products contain spinosads (spinosyns) A & D as well as a variety of "inerts". *Conserve* includes propylene glycol (see separate toxicity review below) and *Entrust* includes porcelain clay, along with other unspecified inerts.

Spinosad is known to be highly toxic to honeybees as well as to beneficial parasitoid insects such as the *Trichogramma* wasp, which both provides biological protection against a host of pests and acts as a food source for other organisms within the ecosystem. Spinosad is also highly toxic to oysters and other marine mollusks, moderately toxic to fish and marine invertebrates, and slightly toxic to birds. Adverse impacts against beneficial organisms are a particular concern; fresh sprays could kill honeybees and other parasitoids (Bret et al. 1997; Suh et al. 2000).

Spinosad is known to be highly toxic to honeybees as well as to beneficial parasitoid insects such as the *Trichogramma* wasp. It is also highly toxic to oysters and other marine mollusks.

Effects on bees: Spinosad is rated as highly toxic to bees, which means exposure can kill more than 1000 bees per hive daily. Spinosad was previously believed to be relatively safe to bees but a recent study by Canadian researchers demonstrated that bees in larval stage exposed to spinosad resulted in disruption of the ability of the adult bee to forage and that high degrees of exposure caused rapid colony collapse.

Animals as Bioindicators of the Environment

Animals are often the “canaries in the coal mine” for humans. Negative health effects observed in animals are often a prelude to eventual sickness in humans. This was clearly shown with exposure of the pesticide DDT to animals and eventually DDT’s human adverse health effects became known resulting in its ban. Bees, aquatic life, rabbits, and cats are particularly sensitive models that can forewarn of dangers of exposure to various stressors, including pesticides. Rabbits, because of a particularly sensitive respiratory system, are used by the military as a biological monitoring system to detect chemical warfare. Similarly, bees are considered primary bioindicators of healthy or disease ecosystems. Toxicity to bees has an incredible impact on human life as 1/3 of the world’s food population depends on pollination. Bees are particularly sensitive to pesticides and so the residual effects of destroying bees is the destruction of a huge percentage of the food supply with drastic consequences both in terms of public health and well-being and the economy.

Before any further pesticides treatments are conducted for the eradication of the LBAM, environmental assessments on the impact on all parts of the LBAM eradication treatment products should be conducted as to their impact on the ecosystems and those who inhabit those systems, which along with humans includes pets, beneficial insects, marine habitats, and wildlife. Most importantly, independent review of the true impact of LBAM on agriculture is required as evidence and expert opinion suggest that there is little scientific justification for this eradication program.

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