Light Brown Apple Moth (LBAM) Treatment Program: A Critical Review of Its Justification, Biological Impact and Human and Environmental Health Consequences

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Preface

This submission is in response to the United States Department of Agriculture's (USDA) *Environmental Assessment of the Treatment Program for Light Brown Apple Moth in California* (Feb 2008). The organizations and individuals involved in this submission represent more than 100,000 individuals who formally oppose this eradication program almost in its entirety with few caveats. The information was developed and reviewed by a multi-disciplinary team of writers and advisors representing expertise in biology, botany, entomology, horticulture, law, and medicine as well as citizen advocates for human health and the environment. The findings presented reflect as accurately as possible the health, legal, and scientific justifications for our recommendations and are based on primary scientific literature as well expert opinion in these respective fields.

This document is divided into two primary sections; Section 1 deals with the biology of LBAM and the eradication program; Section 2 addresses the potential and observed human and environmental impact of both aerial and ground treatments.

Materials and Methods

The opinions expressed in this portion of the document were developed from a review of the primary scientific literature regarding the biology of LBAM, agricultural journals from Australia and New Zealand, field excursions to New Zealand growing regions, interviews with experts in horticulture, pheromones, biological controls, integrated pest management, communications with agricultural officials worldwide, specific LBAM experts, and a critical review of the CDFA's published documents.

Executive Summary

In 2007, the Light Brown Apple Moth (referred to as LBAM; *Epiphysas postvittana*) was confirmed as being present in the State of California. LBAM is classified as an objectionable pest, which is a pest requiring quarantining and restrictive actions due to a purported ability to negatively affect a large range of agricultural products. This classification was assigned more than 30 years ago. We believe the eradication program was hastily developed with insufficient consultation with true LBAM and invasion biology experts. Moreover, the recommendations of USDA's Technical Working Group (TWG) represented the opinions of a limited rather than broad range of experts in Australia and New Zealand. The resultant LBAM eradication program that was implemented over residential areas of select parts of California exposed approximately 660,000 (Monterey and Santa Cruz Counties) to organophosphates and untested aerial pesticides resulting in severely negative human and environmental impacts, including the near death of a 11-month old boy (Wilcox 2007), 3 other children who suffered primary respiratory attacks with subsequent persistent asthma, and more than 643 human adverse effects (HOPE 2008). If implemented as intended, more than 17.5 million will be exposed to varying concentrations and mixes of these potential toxins.

Environmentally, the death of more than 750 seabirds, directly and immediately temporally associated with the aerial spraying of Santa Cruz county and seemingly severe negative impact on local bee populations all resulted immediately following the spraying. Perhaps most significantly and shamefully, virtually all of these events, including the near death of the 11-month-old Joe Wilcox Jr., went almost completely uninvestigated by State and Federal officials. Perhaps most disturbing is that most all of the human adverse events reported (DPR and OEHHA 2007) and the negative environmental impacts observed are mechanistically plausible and consistent with the toxicological profile of the ingredients and delivery system of the aerial pesticide spray. The fact that the materials used in the aerial spraying portion of the program were exempted from formal safety evaluations by the Environmental Protection Agency (EPA) and that the program was

hastily initiated at the behest of the United States Department of Agriculture (USDA) gives California residents no confidence in any assertions of the supposed experts of USDA, USDA's motivations in initiating this program, and with complicity, no confidence in the implementation by the California Department of Food and Agriculture (CDFA). Our faith that Federal and State Agencies have the best interest of its citizens in mind has been severely shaken.

The very justification upon which this program was initiated was based on dated classifications, worst-case theoretical extrapolations of potential damage, limited input of experts, and no detailed evaluation of the biology of LBAM in the context of current agricultural practices (Findings of Emergency 2007). This veracity of USDA's and CDFA's justification has also been tainted by gross exaggerations and in some cases, complete misrepresentations of the potential damage that can be expected from LBAM. These justifications have been predominantly based on fear not reality, science, or experience. Thus, it is our contention that USDA and CDFA have directly violated the legislative mandate of the Plant Protection Act (PL: 108—498; 2004) that requires that all such programs and quarantines be based in "sound science".

In addition to the basic scientific flaws in the genesis and implementation of this program are the civil issues violated. These are partially individual such as the unalienable right to the pursuit of Life, Liberty, and Happiness and California Constitutional rights of individuals to Defend Life and Liberty, Protect Property, and Pursue and Obtain Safety, Happiness, and Privacy. Issues of State Governance over Federal coercion, as evidenced by representations of USDA to CDFA regarding the need and implementation of this program, provide additional grounds of potential Constitutional violation. Moreover, this program was implemented and is intending to move forward despite widespread and formal opposition by local governments and residents who have been given no voice in this matter, but will be centrally affected by it. This curtailing of individual rights is equally in violation of international law.

There are many facets to this issue. These include the basic justification of whether superficial leaf rollers require trade restrictions, the circumvention of State, Federal, and International laws, regulations, and ordinances designed to secure individual rights and protect public health and that of the environment, the rights of local governments and citizens in self-determination, logistical, legal, and ethical considerations of how such programs should be and have been implemented, short- and long-term health impact on humans and the environment from pregnancy to children, the elderly, and state parks and national sanctuaries, the likely ineffectiveness of the program implemented, and a questioning of the very justification on which the emergency was declared.

The organizations, biological experts, health professionals, legal experts, and citizens who participated in the development of this petition, and who collectively represent more than 100,000 individuals, strongly oppose the LBAM eradication program contending the following:

1. All treatment portions of the LBAM eradication program should be immediately halted pending the fulfillment of the recommendations outlined in this document;
2. LBAM was established as an objectionable pest more than 30 years ago. No formal re-evaluation of this classification has been conducted since then. There should be no recommencement of any part of the treatment portion of this program without a formal and independent evaluation of whether LBAM needs to be classified as an objectionable pest;
3. The fundamental basis on which many aspects of this program were developed are scientifically flawed and violates the legal requirements of the Plant Protection Act to base such programs on "sound science", the primary statute that gives the Federal and State governments the authority to implement such programs;
4. The moth does not truly present the level of emergency as alleged by USDA and CDFA;
5. The program will fail to achieve the intended goal of eradicating the moth but is intending to result in the chronic exposure of 17.5 million residents to organophosphates, other toxic pesticides (e.g. permethrin, Bt), and a potentially toxic pheromone-pesticide solution whose long-term and accumulated effects on human and environmental health are unknown;

6. The circumventing of State and Federal public health and environmental laws regarding safety evaluation of pesticides is not appropriate for any type of pesticide that is to be applied to residential areas;
7. The safety of the long-term, accumulated exposure to pheromone-pesticides to humans and the environment has not been adequately assured;
8. The safety of pheromone-pesticides to pregnant woman has not been established;
9. If the moth is a real threat, alternative, more localized and integrated pest management programs (e.g. use of insect growth regulators) for its control have not been adequately assessed;
10. State and Federal laws requiring written notification of residents prior to spraying were circumvented by the emergency declaration and should not have been;
11. Citizens should have a right to choose whether they want their communities treated with pesticides or not;
12. Such programs should be preceded by the development of public health systems for sufficiently recognizing, monitoring, and reviewing potential adverse effects associated with aerial spraying programs;
13. The State of California and the Federal government should prioritize public rights and public health over the resolution of trade disputes and economics;
14. Citizens who are to be sprayed should have a voice in any decision making process regarding such programs.

This document, a consensus statement jointly developed by biologists, agricultural experts, health professionals, legal counsel, and concerned citizens, addresses the various aspects of the LBAM issue presenting both the publicly stated position of the USDA and CDFA and the opposing opinion of biologists, health professionals, environmental organizations, and citizens who believe the LBAM eradication program has been too hastily developed and poorly implemented. This document deliberately has not provided complete justification for the State and Federal Government positions as their positions have been publicly stated and documentation for CDFA's justification is available (www.cdfa.gov).

1.0. LBAM Eradication program: Justification, LBAM biology, & alternate viewpoints

Introduction

The spraying of residential communities with any type of pesticide is a very serious matter that requires sufficient scientific oversight, critical review, continued reassessment, and accountability. Such requirements are mandated by the Plant Protection Act (PL: 108—498; 2004), which requires that all such programs and quarantines be based in "sound science". We believe the development and execution of the LBAM eradication program lacked these prerequisites and that all parts of the treatment portion of this program be reassessed immediately with new knowledge and experience included in the deliberations.

1.1. Lack of Justification for Any LBAM Eradication Program

A. LBAM As An Objectionable Pest: Need for Reassessment

LBAM seemingly has been categorized as objectionable pest for more than 25 years. The exact history of this classification could not be found through on line searches of the National Agricultural Library or through focused requests of National Agricultural Library staff. Typically, such classifications are a matter of public record including who petitioned for this classification and the justification given. Based on anecdotal feedback form experts in New Zealand, the veracity of which could not be confirmed, LBAM was classified among a group of approximately 30 objectionable pests from Australia and New Zealand. It is unknown whether the original classification was based on economic damage or simply the fact that it was a non-naturally occurring species. In either case, the original justification for classifying LBAM as an actionable pest is lacking. Because LBAM was likely lumped together with other pests, it is doubtful that any individual assessment of the potential impact of LBAM by itself was ever conducted. No formal independent economic review of the actual impact of LBAM on agricultural produce or native flora based on agricultural practices today has been conducted. Rather, all projections provided by CDFA have been theoretical extrapolations that may not accurately reflect the impact of LBAM today.

With today's global trade and travel it is not practical for the US to implement eradication programs for every non-native species that enters the US. The basic biology of the pest and its realistic impact on our environment must be determined scientifically PRIOR to the implementation of any action. This is especially true when a central part of the treatment program includes long-term spraying of residential areas and the use of organophosphates and other pesticides (e.g. Bt, permethrin, spinosad) in residential communities. We believe that only a cursory review of the biology of LBAM and its realistic impact on agricultural commodities and native flora within the context of current agricultural practices was conducted and was grossly insufficient for justifying a residential aerial spraying program. **Therefore, we believe the foremost immediate need is the convening of an expert forum consisting of those representing USDA and CDFA's positions and those who express opposing views, including a wide range of experts form Australia and New Zealand.** We do not believe that either the Technical Working Group convened by USDA or the planned "symposia" of CDFA will provide the broad range of expertise and experience to justify continuation of aerial and ground treatments of residential communities.

B. Findings of Emergency: Lack of Economic Justification

CDFA has estimated a potential for economic damage in California of $133 to $600 million (US) annually based on theoretical extrapolations from reports of $21.1 million in lost production and control costs annually in Australia due to LBAM. The extrapolation by CDFA of these figures to California agricultural products resulted in the CDFA declaring an agriculture emergency (Finding of Emergency 2007). These projections appear to have no basis of support in reality. There has been no meaningful loss to agricultural crops reported by CDFA since 1992. The $21 million used as the basis for the CDFA’s projections were based on costs that are associated with the quarantining of Australian exports in order to meet USDA zero tolerance LBAM standards. These costs were not due to crop loss. Similarly, these projections represent a worst-case scenario of what could theoretically happen if LBAM was left completely unchecked. No pest in any biological system goes unchecked and modern agricultural practices show that LBAM is no exception.

CDFA has also used for justification of their program the need to satisfy LBAM trade restrictions of California trading partners, specifically denoting Canada and Mexico. For decades, countries in which LBAM was present have been required by the US to issue "phytosanitary declarations" ensuring that adequate measures had been taken to ensure LBAM was not present in exported commodities. Subsequent to the positive identification of LBAM in California in March of 2007, Canada and Mexico (Mexico 2007) imposed phytosanitary restrictions on agricultural products originating from areas in California known to have LBAM. While these restrictions did not mandate for eradication to be undertaken, USDA chose eradication as their primary strategy with the host of pesticides previously described used.

Currently, the only economic consequences of LBAM to New Zealand is due to the quarantine restrictions of nations such as the US, Canada, China, Japan, and Mexico who have a zero tolerance for LBAM. Through communications with the Canadian Food Inspection Agency we were informed that the primary consideration for LBAM restrictions in Canada is to satisfy US trade requirements and Canada would review their restriction policies if the US were to change their policies regarding LBAM (CFIA 2008a). Additionally, the same Canadian agriculture officials have stated that they do not consider LBAM to be a significant pest in crops (CFIA 2008b). Similarly, Mexico, in their phytosanitary advisory, stated they would modify or harmonize their policies based on any potential change of policy regarding LBAM that may occur in the US. These clearly show that these two trading partners predominantly classify LBAM as an objectionable pest following the US classification, not because of the inherent concern over LBAM. It also shows that the US has flexibility in how they choose to treat and classify LBAM suggesting that trading partners are amendable to changing their restrictive classifications based on new science and changes in US policy. China often follows US trade protocols when it is to their advantage to do so, whereas Japan has particularly restrictive quarantines against leaf rollers due to the potential negative effect of leaf rollers on tea leaves. Thus, economic restrictions in Japan would likely remain. The economic impact of restrictions imposed by Japan have not been assessed in this report.

In the current market, some negative economic consequences of LBAM on New Zealand exports result from rare instances of shipment rejections due to the "zero-tolerance" requirements against LBAM by the US. These shipments are diverted to other nations, such as those in the European Union, who do not have the same quarantine restrictions against LBAM as the United States. In more than 3000 shipments from New Zealand in 2005 to the US, only 7 were rejected and diverted to other markets. Under current conditions in New Zealand, LBAM is only a pest of economic significance due to quarantine restrictions predominantly imposed by the US. In New Zealand, LBAM is accepted as a naturalized insect with no actual negative consequences on agricultural crops or native flora (Rosendale 2008; personal communication). The lack of economic significance of LBAM as a pest appears to be supported in several years of HortResearch, the primary horticulture and agricultural journal of New Zealand, which gives little coverage to LBAM specifically and little to leafrollers overall.

Therefore, a formal reassessment of the actual damage that can be expected to occur due to LBAM based on current agricultural practices is needed.

C. Effects of LBAM on Native Flora: CDFA's Misrepresentation Justifying Emergency Declaration

The CDFA, in its assessment also alleged that LBAM is a risk to native species of trees, and therefore has included potential damage to native flora as part of its Findings of Emergency. This assertion similarly appears to lack support.

As a superficial leaf feeder, LBAM appears to pose little or no threat to native flora, as the effects of LBAM are superficial and purely cosmetic. While LBAM reportedly can cause damage in experimental populations of conifers by tying the needles, nibbling on shoots, or boring into stems, no negative impact on natural conifer populations has ever been reported. Leafroller damage can occur in nursery or artificial growing settings where the ecological balance does not provide for natural predation of pests. New Zealand has many of the same trees that occur here including coast redwoods, giant sequoias, conifers, and cypresses. According to New Zealand experts including the Ministry of Agriculture and Food (MAF) and the Department of Conservation (DOC), LBAM does not build up in any one host in the wild and does not pose a threat to native flora. Eighty to ninety percent of LBAM larvae are parasitized by natural predators before maturation (Shaw 2008). According to New Zealand Ministry of Agriculture and Food (MAF) and Department of Conservation (DOC) experts, LBAM does not build up in any one host in the wild and does not pose a threat to native forests. Natural predators keep it in check, and it is so rare in the wild that it requires a true expert and meticulous searching to even find any sign of it (Harder and Rosendale 2008).

D. CDFA Misrepresentation of LBAM as a "Defoliator"

The State has described LBAM as a defoliator and therefore suggesting that LBAM can have a negative effect on native oaks (*Quercus* spp.) and other species. The primary definition of "defoliator" is: 1. "to deprive a plant, tree, or forest of leaves; 2. "To cause the leaves of (a plant, tree, or forest) to fall off." LBAM does neither. Technically LBAM is described as a superficial leaf roller or superficial leaf feeder due to the fact that it nibbles on leaves. Defoliation is not a characteristic of superficial leaf rollers and is at odds with its biology. LBAM requires the protection of the leaf for its very survival. Defoliation would cause the LBAM to lose its protective housing exposing its to predators. Practically speaking, there is no evidence in countries where LBAM is endemic that supports the assertion that leafrollers are defoliators or will have a negative effect on native flora in general and oaks, pines, and cypresses specifically. The CDFA, should cease further misrepresentations of this nature as a means to further justify a flawed program. Even the oak moth, which is a true defoliator, does not kill trees and some environmentalists feel such a defoliating effect may be of benefit to the trees.

E. Native LBAM Predators

CDFA has asserted that because LBAM is a recent introduction to the US that native predators have not developed. This goes completely against the biology of LBAM, which is polyphagous rather than being host specific. It is in host specificity where actual agricultural damage can occur to levels of significance warranting eradication versus management. Additionally, the relatively superficial nature of LBAM's feeding patterns causes little more than cosmetic damage, in the relatively rare instances where it causes damage at all. As a generalist, LBAM is susceptible to a general and very large range of pests (HortNet 2008) including ants, beetles, bats, birds, earwigs, spiders, and viruses, all of which exist in California and throughout the US, and wasps, including at least two species of *Trichogramma* (*T. pretiosum, T. platneri*) that are native to California and have already been demonstrated by CDFA to result in larval parasitization.

According to earlier research, in general, tortricid studies show egg parasitism of up to 30%; larval parasitism up to 60%; and pupal to 70% (Van Der Geest and Evenhuis 1991). These findings may be significantly compelling for a high level of parasitism as this was at time when organophosphates were widely used, which would have had a significantly detrimental effect on LBAM predators. The widespread discontinuation of organophosphates would undoubtedly result in greater degrees of parasitism than previously reported. **Thus, it is recommended that detailed study of native predators for all stages of LBAM development be conducted BEFORE suggesting that we do not have natural predators and BEFORE we continue to assert that artificial controls are needed.**

E. Alternatives

There are many alternatives to aerial applications of untested pesticides, organophosphates, and the other toxic pesticides being used by CDFA. All of these have detrimental environmental effects on predators and therefore increase the likelihood of pest outbreaks. The healthier the biological system, the least likely there is that pests will be problematic.

The leading biological control method for control of the leafroller complex in New Zealand are insect growth regulators (IGR). Leafrollers populations are monitored using pheromone sticky traps. If treatment is needed, a single application of IGR at the larval stage is sufficient to control the complex for the season. Tests show IGRs are ovicidal as well as larvicidal and are not toxic to predatory or beneficial insects (Harder and Rosendale 2008). Numerous growers have reported that specific leafroller treatments are not needed as treatments that are used to control other pests often provide sufficient control against LBAM. Pheromone-laced twist ties are also widely used, seemingly with greater mating disruption than pheromone sprays. Intercropping with various weeds (clover, borage) and crops (e.g. buckwheat) in vineyards and apple orchards has also been shown to provide a high level of control against leafrollers in general and LBAM specifically (Begum 2004; Begum et al. 2006; Irvin 1999), with flowering plants offering the greatest control through increased attraction of predators. Proper handling of green waste materials has also been shown to aid in proper management of leaf rollers leading to population reductions. These are only a few of the integrated pest management techniques utilized successfully in New Zealand for management of leaf rollers in general and LBAM specifically.

These alternatives should be investigated prior to use of the toxic compounds being suggested by USDA and CDFA.

1.2. Eradication of Pests with Pheromones—Feasibility

A. Eradication with Pheromones is Infeasible

The USDA and the CDFA believe that because the LBAM only occupies limited areas in California that it is possible to eradicate it using aerial spraying of pheromone-pesticides as the primary eradication tool, alleging that damage due to its establishment to California and US agriculture and native flora could be "severe".

Entomology experts have countered stating that the current spread of LBAM populations over 7000 square miles of California is too great for eradication to be achieved (Carey 2007). Moreover, based on population dynamics of pests such as LBAM, it is likely that LBAM has been in California for decades for these disparate populations to become established. Also, LBAM does not survive well in high temperatures that are indicative of much of California's agricultural areas, preferring temperatures of approximately 56 ˚F with moderate rainfall and moderate to high humidity of approximately 70% (Johnson et al. 2007).

There are also scientific flaws regarding the USDA and CDFA position that eradication of the LBAM with pheromone-pesticides is achievable. First and foremost is that no pheromone treatment has ever been used in the eradication of an entire species and is without precedent (Dowell 2008). There is a single example of eradication of a single strain of LBAM that was resistant to organophosphates in a tiny 200- and 500-hectare (~0.77 to 1.93 square miles) area of New Zealand of a homogenous crop and terrain in 1987. This required multiple and intense treatments and was effective only because of the very small numbers of pests, the uniformity of the crop, and homogeneity of terrain. Comparatively speaking, the USDA and CDFA are attempting to use pheromones as the primary tool to eradicate LBAM over 7000 square miles of diverse terrain and agriculture in California.

Pheromones are behavioral modifying chemicals produced by one member of a species to effect behavior of another member of the species and are designed to disrupt the mating cycle of the particular species. Pheromones do not kill the target pest nor are they 100% effective at preventing the target insects from mating, even when applied in a highly controlled situation, such as an orchard. Rather, pheromones only aid in the suppression of the population primarily by delaying, but not preventing mating of pest populations. Moreover, pheromones will specifically not work when applied to diversely different terrains (canopies, uneven terrains) as breeding populations will not be uniformly affected and therefore left to multiply. According to New Zealand Horticulture Research, for mating disruption to be successful through aerial application of pheromones the following conditions must be met:

- Extensive and complete coverage;
- Uniform blocks of crops (single crop);
- Uniform topography;
- High population density of target pest (not dispersed).

In California, none of these essential conditions are met: use of the pheromone will not be complete (restricted buffer zones along national sanctuaries, waterways, and riparian corridors); pheromone treatments will not be applied over a uniform block of crops they will be applied over mixed canopied forests and native vegetation, houses, schools, roadways, crops, ornamental gardens, etc.; the topography of the California central coast is highly varied and diverse; LBAM populations in these areas are disperse; and existing populations are not at high enough density for effective use of mating disruption pheromones.

B. LBAM Too Well Established in California

Numerous biologists believe that LBAM is so widespread in California that eradication is not feasible regardless of the eradication tool used. The longer a pest is present the greater the likelihood that it has become established and the more difficult or impossible it is to eradicate. In California, the LBAM was originally collected and its identity confirmed in July of 2006. LBAM has been found in 12 counties, encompassing a diverse range of environments from densely urban to heavily forested native habitats, to select agricultural crops. Populations of LBAM cover an area of 7000 square miles, ranging from Sonoma County in Northern California to Los Angeles 750 miles to the south. The moth only travels a very short distance from its hatching location, approximately 100 meters. Therefore the moth populations represent separate introductions. Reintroduction will continue due to limitations of current importation inspections and will continue in the months and years ahead through continued trade of international food commodities. It would be in the best interest of California growers and exporters to take the lead towards the development of least toxic, most environmentally sustainable IPM programs and implement them when they are really needed and not overreact to a pest that may not constitute the threat to agriculture as originally alleged.

The belief that LBAM has been established in the San Francisco Bay Area for a period of time potentially much longer than alleged was noted by USDA entomologist John Brown who reported:

> "By the time Jerry collected this thing in his backyard, clearly it had been established in the Bay Area for a long time… "

Eradication as an achievable end goal was also considered doubtful by entomologist Jerry Powell who found the first LBAM at his home garden and stated;

> *"Because it's a general feeder -- it's polyphagous -- it doesn't seem to me there's much point in quarantining things, especially after they've found it all around."*

The same opinion was echoed by Dr. James Carey, professor of entomology of University of California, Davis and renowned expert on med fly eradication, who contended that eradication of LBAM in California is “virtually impossible”. Professor Carey states:

> *“…even under optimum circumstances, eradication of a species is an enormous challenge. Optimum factors in pest eradication include small, well-delineated populations; effective eradication tools; highly effective monitoring techniques; support of multi-year programs.”*

The demographics of California LBAM populations are neither small nor well delineated, but are rather diverse and widespread. Additionally, an effective control or eradication program requires an effective monitoring system (e.g. sticky traps or twist ties). Sticky traps are predominantly used throughout California. The effectiveness of pheromone sticky traps depends on a centrally concentrated plume of volatizing pheromones to attract the target pest. The pest is caught in the trap and accurate counts can be made. However, once pheromones are aerially sprayed, especially in a manner designed to maintain a constant exposure and ambient concentration of pheromone over an extended period of time (e.g. the projected 30-90 days) the efficacy of the traps is greatly compromised. The ambient pheromone concentration decreases the ability of the male moth to find the trap thus severely compromising the effectiveness of the monitoring system. If the program is unable to effectively monitor the boundaries of the pest's infestation, then appropriate integrated pest management practices or quarantine procedures cannot be applied and the moth will continue to spread.

Professor Carey in his assessment of the CDFA and USDA eradication program concluded:

> *In my view these three factors-extent of spread, a faulty eradication tool (use of pheromone for mating disruption), and difficulty of detection-make it virtually impossible to eradicate the LBAM in California.*

A recent trip to New Zealand by University of Santa Cruz biologist, Dr. Daniel Harder and horticultural expert Jeff Rosendale, reveled similar findings regarding what constitutes the only potential for a successful eradication program using pheromones. According to Dr. Harder:

> *"From the grid map of catches per square mile (USDA 12/5/07) and the type of native and area-wide exotic vegetation (canopy, depth, diversity) along with the no-spray buffer zone restrictions and height of aerial pheromone application, IPM experts in New Zealand predict the eradication program, as currently implemented in California would be virtually impossible. For eradication to be possible with pheromone treatments the treatment must be uniformly applied over a relatively even terrain, the population of target pests must be very low, and it is only plausible to succeed on monocultures not in areas of great diversity, such as exists in California."*

The recommendations of the Technical Working Group (TWG) convened by USDA specifically regarding LBAM similarly suggest the program as implemented will not be effective. The TWG stated:

> *"In pursuing eradication, the short-term strategy would include delimiting and containing LBAM populations. This will require ongoing monitoring of the infestation, suppression at the edges of the populations, and population reduction in areas with a higher-density of LBAM populations. A strong regulatory component must be maintained to ensure that unintentional, human-mediated spread of the insect is minimized. Also, public outreach and education is an important factor contributing to the success of regulatory and control efforts."*

In recommending the need for "population reduction" TWG is saying that eradication is only achievable if more toxic pesticides are used to reduce populations to a sufficient degree for pheromone treatments to be effective. The USDA and CDFA have warned that more toxic pesticides may be needed if the pheromones are not effective at eradication. However, in those areas where LBAM is endemic, the lower the toxicity of the pesticides that are applied the lower is the incidence of LBAM, due to higher concentrations of natural biological predatory factors (ants, earwigs, wasps, etc.). In Oceana, insect growth regulators are the dominant products used for population control against the leaf roller complex, with pheromones only used for monitoring.

If more toxic pesticides were used they would cause extreme damage to California ecosystems and potentially result in more substantial negative human and environmental health effects than have already been reported with the Checkmate LBAM-F pesticide solution (HOPE 2008) (see Health Section). The negative effects on the environment in general and beneficial predators specifically make the use of more toxic pesticides unfeasible, especially in light of the minor impact that LBAM really has with regards to actual crop damage.

Perhaps most importantly, CDFA has never successfully eradicated a species. CDFA has had 274 eradication programs against 11 species of pests since 1982, not including for LBAM. Eradication programs for every one of these pests have continued to be in place until 2006. Thus, in reality, these programs are long-term pest management programs, that, for funding purposes, are defined as eradication programs, thus giving USDA/CDFA access to emergency funds to which they may otherwise not have access. However, it is the "emergency" status of the program that justifies the aerial spraying and use of organophosphates and other toxic compounds, the obviation of the environmental impact reviews, and the seemingly complete disregard for human and environmental health effects. **Therefore, this program should be reclassified from an "emergency" program to a integrate pest management program.**

C. Need For Effective Quarantining

TWG also noted that strong regulatory controls and an effective public education are needed to prevent the transport of potential LBAM host plants. The success of any eradication program depends on effective quarantining and aggressive public outreach to prevent the unknowing spread of moth larvae through commercial consumer transport of produce from area to area. CDFA has specifically exempted from quarantining approximately 27 species of agricultural and commodity plants that are alleged potential LBAM hosts. This allows for continued spread of LBAM larvae despite widespread aerial spraying of residential areas. Preventing pest transport requires robust inspection procedures at agricultural points of entry to prevent moth introductions. To date, none of these avenues of pest spread have been adequately controlled and are insufficient for keeping LBAM from escaping to uninfected counties. Similar inadequacies exist at ports of entry and transport potentially leading to reinfestation on a daily basis. Thus, there is little chance for eradication to be achieved even with a greatly improved program of inspection. What is required is a change in policy from one of eradication to one of IPM for affected agricultural crops. Interestingly, CDFA's reasoning for exempting these commodities is due to the utilization by producers of IPM programs for pests in general, showing, as in New Zealand, that IPM can be successful, whereas eradication is doubtful.

D. Restricted Treatment Areas

Another primary mistaken assumption of the USDA and CDFA is that eradication of the LBAM can be accomplished when primary LBAM breeding grounds are not being treated. Because the Checkmate LBAM-F/OLR-F solutions have the potential for toxicity to marine life if sprayed along waterways or riparian corridors, these areas have not been targeted for spraying. However, these areas are prime breeding habitats for the moth. This leaves populations of LBAM to multiply and reinfest the same or other areas.

E. Wholesale Nurseries and Use of Organophosphates

The long-term management of LBAM, other future pests, and California ecosystems is further compromised by this eradication program by the required widespread treatment with chlorpyriphos of nurseries in which LBAM has been identified. This is a serious ecological concern. Chlorpyrifos is a highly toxic organophosphate pesticide that only kills LBAM larvae hatching from eggs but does not effect eggs directly. In addition chlorpyriphos also kills beneficial insects, such as spiders, earwigs, and wasps, all of which are typical predators of moths and other pests. CDFA currently requires nurseries to spray their entire area with chlorpyriphos if a single LBAM is found. Many nurseries are situated along waterways making such applications especially damaging to local water tables and local environments. Besides the negative environmental consequences of using organophosphates, especially along waterways and in residential areas, the negative impact of such pesticides on beneficial predators reduces the effectiveness of more meaningful and long-term IPM solutions where such predators play a crucial role. Such predators are key to controlling LBAM and other leaf rollers in Australia and New Zealand. According to leading agriculture and entomology experts in New Zealand, since the decline of the use of organophosphate insecticides in New Zealand, LBAM as a pest has subsided to insignificant levels.

F. Pheromone Resistance

In addition to the aforementioned practical reasons of why eradication is likely not achievable is the biological possibility of the male LBAM moths developing a resistance to the synthetic attractant or for the species to develop alternative mating mechanisms through natural selection that will ensure the survival of the species. This is a common occurrence with many insects and has already occurred in a LBAM-related moth, the smaller tea tree leaf roller moth (*Adoxophyes hoonmai; Lepidoptera*) (Tabatta et al. 2007). In this species, the males developed a sensitivity to discern the native female pheromone from the synthetic, even at high concentrations of synthetic attractant. This suggests that an IPM program that focuses on maintaining a healthy ecological balance that promotes predators as the primary management mechanism is the optimal management program for LBAM versus a widespread aerial spraying of pesticide solutions or introduction of further non-native species (see Introduction of Non-native Wasps) with the potential to irreparably disrupt native ecosystems.

G. Use of Native Wasps

The CDFA has proposed to release native *Trichogrammas* at a concentration of approximately 1 million per acre. While the efforts should be applauded, it is not biologically wise to release such high concentrations of any given species without knowing the environmental consequences of doing so. Currently in California there are native *Trichogramma* and a host of other LBAM predators. There is little justification to potentially disrupt native ecologies before it is known that natural predation will not be effective. In fact, it is likely that native predation is what kept LBAM from being detected. To date, neither CDFA nor USDA has conducted any studies of how this introduction may effect endemic populations of wasps and other organisms (e.g. monarch butterfly). To even propose such an action prior to investigation on native populations is irresponsible and threatens to disrupt the normal populations endemic to the area. All introduced natural enemies present a degree of risk to non-target species. Decisions to implement biological control should be made with as complete and transparent assessment of the risks and benefits as is possible (Delfosse 2005).

Therefore, before any release of any predatory species, the level of natural parasitism of those stages particularly attacked by wasps should be evaluated. Further investigation of how such abnormally high amounts of one or two species of wasps will affect naturally occurring wasp populations and monarch butterflies, as well as feeding patterns of birds should be conducted.

H. LBAM Biology and Impact

As with all pests in biological systems, beneficial predator populations track and match the rise in pest populations. As the pest population increases the beneficials increase proportionately; with decreasing pest populations, populations of beneficials decrease accordingly. Thus, good contemporary agricultural practice dictates that this ecological balance must be promoted and maintained.

In New Zealand, LBAM was once considered a pest with a potential to cause economic damage to crops. This was at a time when organophosphates were heavily used and resulted in a loss of beneficial LBAM predators (spiders, earwigs, wasps, etc.). Presently, under New Zealand pest management practices, LBAM is not singled out for damage to crops or need for treatment. LBAM instead is grouped among a leaf roller complex consisting of 5 leaf rollers (lightbrown apple moth *Epiphyas postvittana*, brownheaded leafrollers *Ctenopseustis obliquana* and *C. herana*, greenheaded leaf rollers *Planotortrix octo* and *P. excessana*). Compared to all pests, the leaf roller complex is considered to be of minor significance; and in fact, 99% of pest damage to New Zealand crops is dues to other pests. The leaf roller complex is easily monitored in the early spring (the time of active mating) with a single pheromone trapping and visual inspection. If leaf roller populations appear beyond acceptable thresholds (guidelines at http://www.hortnet.co.nz/key/) a single spray regime of integrated growth regulators (IGR) is applied and provides season-long population control. Moreover, pesticide treatments that are applied for the management and control of other pests (e.g. wooly apple aphid, mealy bugs, scale, and codling moth**)** also provide control over the leaf roller complex making treatment of LBAM specifically a practice of the past, except in rare instances. Current treatments for the same pests in California will likely award the same control and should be a high priority area of study.

New Zealand experts estimate that a worse case scenario with no monitoring or treating for LBAM could potentially result in superficial damage to no more than 1% of potentially affected crops. In practice, this never occurs and many farms have not treated for LBAM in years (Harder and Rosendale 2008). It must be underscored that most of the damage caused by LBAM is superficial and very seldom results in any significant agricultural loss.

In New Zealand, for the past 8 years since the discontinuation of the use of organophosphates and the return of natural LBAM predators, LBAM has not been a pest associated with any crop damage of economic significance. Natural predatory controls result in 80-90% parasitism of LBAM in all of its stages. LBAM can cyclically, but rarely, have population blooms. In such instances, these population blooms are identified through monitoring and are subsequently treated with integrated growth regulators (e.g. Intrepid, Concern; methoxyfenozide, tebufenozide), which are effective at LBAM population control and do not have a significantly negative effect on beneficial predators. In most cases, a single annual treatment provides adequate population reduction.

Relevant to the current status of LBAM in California, the Hawkes Bay region of New Zealand, known as the "fruit bowl of New Zealand" has an environmentally and agriculturally diverse terrain that is very similar to the Monterey Bay region. Growers in both the Hawkes Bay and Nelson regions of New Zealand do not use pheromones for population suppression and only utilize pheromone technologies for monitoring. If warranted, then crops are treated with IGRs.

1.3. Violation of the Plant Protection Act (PL: 108—498; 2004)

A. Plant Protection Act

The Plant Protection Act (PPA; PL: 109—498, 2004), is the primary federal statute that gives the USDA and CDFA their authority to implement quarantines, restrictions, and public programs (e.g. eradication programs) over imported or exported commodities. Specifically the PPA states:

> *Sec 402 (4) decisions affecting imports, exports, and interstate movement of products regulated under this title shall be based on sound science;*
>
> *Sec 411 (b) Requirements For Processes—The Secretary shall ensure that the processes used in developing regulations under subsection (a) governing consideration of import requests are based on sound science and are transparent and accessible.*
>
> *Sec 431 (e) Phytosanitary Issues.—The Secretary shall ensure that phytosanitary issues involving imports and exports are addressed based on sound science and consistent with applicable international agreements*

The PPA specifies that all decisions regarding quarantine restrictions or the development of eradication programs must be based on sound science. This fundamental basis has not been achieved. On the economic side of the justification for the emergency declaration, the estimate potential damage to California crops was based on a single set of figures from Australia that may or may not be extrapolated to US crops. Additionally, the allegations by CDFA that LBAM can negatively affect native flora are completely without rational scientific basis and cannot be considered as part of the justification for the State's declaration of emergency. On the development and implementation of the eradication program, it is clear that pheromones will not be successful at achieving the stated goal of eradicating the LBAM. The reasons for this predicted failure are many and have been stated. With regards to the purported safety of the program as implemented, no federal or state agency has conducted appropriate tests that would lead anyone to believe that the safety of the materials being used, when aerially sprayed on human populations including children, pregnant woman, nursing mothers, and the elderly, as well as on the environment, has been sufficiently determined.

B. TWG Recommendations: Re-evaluation of LBAM Control Program

We believe that significant shortcomings of the CDFA's current eradication program are clear. It is highly unlikely that the program as currently designed and administered can be successful. In their recommendations to CDFA and USDA, the TWG reported:

> *"… the TWG believes that it is important to re-evaluate critical aspects of the program, including the overall strategies and goals, on a regular basis. If significant shortcomings are identified, alternatives to eradication should be considered."*

We believe the time for re-evaluation has passed.

Minimally, in light of current opinions from New Zealand agriculture authorities, a re-evaluation of whether LBAM truly constitutes the destructive pest as originally alleged is warranted. This re-evaluation should include a potential for down grading LBAM from an actionable pest to one in need of management. Similarly, the many deficiencies that exist in the program suggest the program will be ineffective at achieving the goal of eradication, while IPM programs have been demonstrated to provide successful and adequate controls against LBAM infestations.

Thus, a conceptual shift by both the CDFA and USDA from eradication to IPM practices is needed. This can only be achieved through consultation with a broader base of commercially vested and non-commercially vested interests than was previously convened in the TWG.

Conclusion

The broad-based spraying of residential areas with any pesticide, especially those whose safety for application to residential areas has never been tested (see Health and Safety), is a very serious matter. At the very least, an independent analysis of the fundamental basis forming the justification for any such action is warranted. This means the economic damage alleged by the USDA and CDFA must be re-evaluated to see if their estimates of financial loss hold up to independent analyses. In the case of LBAM, most concerns regarding its potential destructive nature are extrapolated from environments where it is native (Australia) and therefore represents the greatest biological threat to crops. Rather, it is more appropriate to review the management of LBAM, or any other pests, in areas that are congruent with the California or US environment. This gives a more realistic understanding of whether LBAM will emerge as a moth of mass destruction or simply meld in with other non-threatening superficial leaf rollers with no undue economic consequences.

There are many deficiencies that are highlighted in the manner in which USDA and CDFA both developed and implemented their eradication program, not the least of which that pheromones have never been used anywhere in the world for eradication of a species and no pheromone has ever been found to be 100% effective at mating disruption. These program deficiencies are so numerous that a critical re-evaluation of these strategies and eradication as an achievable goal is fundamentally warranted. The subjection of residential areas to broad-based and long-term spraying of materials whose application to residents is unprecedented is in serious need of re-evaluation.

The USDA and CDFA's allegations that LBAM will negatively affect native flora and their referral to LBAM as a "defoliator" are unfounded and have been used to exaggerate their economic projections of the potential damage that can be caused by LBAM.

The Plant Protection Act, the federal statute that provides USDA and CDFA with their authority to take such actions requires that sound science drive any program regarding quarantining of agriculture produce or implementation of any pest control program. The very basis USDA and CDFA have used in their justification that the LBAM can be eradicated through the use of pheromone-pesticides is fundamentally flawed as demonstrated. In addition to the relative ineffectiveness of pheromones to disrupt mating of 100% of moths, the fact that prime breeding grounds for the moth are not being adequately treated, the inadequate measures to stop the potential transport of the moth through consumer and commercial transport, and the widespread prevalence of the moth over hundreds of miles, all attest to the implausibility that the USDA and CDFA's program as currently designed and implemented will succeed. Rather, eradication as an option must be abandoned in favor of a robust integrated pest management or containment program.

Living with introduced species is a fact of life that every nation must deal with. There must be conscious and transparent discussions and debates before subjecting residential populations to broad based pesticide programs. All the information provided demonstrate that the USDA and CDFA have not met the Federally and State mandated requirement of "sound science" and suggest that significant shortcomings to their program are evident. We strongly urge the USDA and CDFA to heed the recommendations of their own Technical Working Group who expressed the need for alternatives to eradication need to be considered if significant shortcomings are identified. We believe that such shortcomings are abundantly evident and formally request that USDA and CDFA subject their LBAM management strategies to a formal re-evaluation by both independent and commercially vested parties.

The greatest single flaw in the USDA and CDFA's program is the lack of scientific veracity to their arguments, which have been used to justify a fundamentally flawed strategy with fundamentally flawed tactics. Both Agencies should have been forthright in acknowledging that the need to control LBAM is a trade issue not a true biological crop problem. The citizens of California, be they farmers, nursery growers, or residents, have not been well served.

2.0. Human and Environmental Health Hazards of Aerial Spray of Monterey and Santa Cruz Counties

Preface

The following review provides the toxicology profile of the various products and compounds used in the light brown apple moth (LBAM) eradication program. This program was mandated by the United States Department of Agriculture (USDA) and implemented by the California Department of Food and Agriculture (CDFA). This review shows that most of the compounds used or projected to be used can present a significant health risk to humans and are rated as moderately or highly environmental toxins, especially to ground water and aquatic ecologies and wildlife. This review also shows that a large number of human adverse effects reported after aerial pesticide spraying of Monterey and Santa Cruz counties are consistent with those that would be expected from exposure to the pesticides ad microcapsule delivery system being used.

Materials and Methods

A critical review of the *Consensus Statement of Human Health Aspects of the Aerial Application of Microencapsulated Pheromones to Combat the Light Brown Apple Moth*, which was prepared by the California Department of Pesticide Regulation (DPR) in conjunction with the California Office of Environmental Health Hazard Assessment (OEHHA), was conducted. Additionally, an extensive online literature search was conducted from December 1, 2007 to February 25, 2008. The primary search terms used included the names and synonyms of all of the ingredients disclosed by the USDA or CDFA as used or to be used in the LBAM eradication program. This search accessed peer reviewed literature, governmental documents from the United States (e.g. Environmental Protection Agency) and European Union, environmental and pesticide databases, Material Safety Data Sheets (MSDS) from various sources, and published news reports when applicable. Additional reviews of the human adverse effects that were reported were conducted to determine if the adverse effects reportedly experienced were consistent with those that would be expected from exposure to the various compounds contained in the aerial spray pesticide solution.

For determining the potential for environmental toxicity, a comprehensive literature search of the primary scientific literature was conducted using the same sources as stated above. In addition to general environmental concerns, specific emphasis was given to potential toxicity to marine ecology due to the proximity of the Monterey Bay National Marine Sanctuary. Additionally, interviews with animal rescue personnel in the aftermath of the spray, which was followed by severe negative impacts on water fowls, water sports organizations, and citizens who observed negative environmental impacts were conducted. Lastly, the toxicity studies of Werner et al. (2007) and the Department of Fish and Game's report on the death of the seabirds following the spray were critically reviewed.

An addendum on the toxicological profile of the inert ingredients in the checkmate pesticide solution as well as reviews of the other compounds being used or slated to be used as part of this program is provided in an addendum.

Executive Summary

Before any application of potentially toxic compounds to residential areas adequate safety studies should be conducted. This was not the case in the implementation of the LBAM eradication program. Rather, the Environmental Protection Agency, whose primary responsibility it is to safeguard public and environmental health in general, and ensure the safety of pesticides specifically, exempted the compounds to be used in the spraying of residential areas from formal study. This is the single greatest flaw in the CDFA's unfounded allegations that the material used in the LBAM eradication programs is in fact safe. No such assertion has been made.

The CDFA also uses as documentation of safety the *Consensus Statement of Human Health Aspects of the Aerial Application of Microencapsulated Pheromones to Combat the Light Brown Apple Moth* (hereafter referred to as the *Consensus Statement*), which was prepared by the California Department of Pesticide Regulation (DPR) and the California Office of Environmental Health Hazard Assessment (OEHHA), the conclusions of which imply the aerial spray being used is safe. However, the actual findings of the report are inconsistent with this belief.

In this, the State's primary document establishing safety of the program absolutely no attention or oversight has been given to the other compounds being used in the program, most notably the highly toxic organophosphate chlorpyrifos, which is required for use in wholesale nurseries subject to positive LBAM finds. These and other toxic compounds are to be used in schools, public parks, in private yards, day care centers, and along highly trafficked walkways and thoroughfares where school children will be constantly exposed to the leeching of the chemicals. Similarly, virtually no meaningful attention has been given to the fact that all of these compounds will wash in to the Monterey Bay and ground waters for a period of up to 10 years of treatments and potentially decades of persistent residual runoff. Because of the emergency declaration, all environmental impacts were obviated.

Perhaps most significantly and negligent, is the lack of oversight and attention given in regards to the more than 600 human adverse events that were reported, including the near fatality of a 11-month old boy that was directly associated with the spray. Several other children have suffered severe respiratory attacks, seemingly initiated by the microencapsulated delivery system of the pesticide. No attention was given to the runoff associated with the spray, its accumulation in the Monterey Bay, the death and disorientation of bees, and several hundred dead birds that were immediately and temporally associated with the spray. The single study of the Department of Fish and Game suggesting the spray was not a contributing factor to the bird die off is completely lacking in scientific merit.

Thus, all procedural efforts to ensure human and environmental safety were completely insufficient to achieve this goal to even a modicum of a degree and must be corrected prior to the recommencement of any part of the treatment portion of the LBAM eradication program.

2.1 Checkmate Effects

The adverse health effects reported after the Fall 2007 sprayings in Monterey and Santa Cruz are consistent with the known adverse health effects of most of the ingredients in the Checkmate pesticide solution.

A. Phermones

The compounds making up the synthetic moth pheromones (E)-11-tetrdecen-1-yl acetate, (E,E) -9,11 tetradecadien-1-yl acetate, and (z)-11-tetradecen-1-01 acetate, have not been tested to determine if they exert the adverse effects of other endocrine disruptors. Numerous reproductive adverse health effects, including resumption of menstrual cycles in post-menopausal women, were reported after the sprayings in the Fall of 2007.

Tricaprylyl methyl ammonium chloride (TMAC), also known as methyltrioctylammonium chloride or trade name Aliquat 336, is a surfactant classified as dangerous to the environment by Canada and the European Union (EU). An aquatic toxin, the MSDS for TMAC reports that it is extremely hazardous in case of ingestion, inhalation, skin contact, and eye contact. The surfactant qualities of TMAC may have contributed to the hundreds of seabirds found to have drowned immediately after the Fall 2007 sprayings in Monterey and Santa Cruz counties (surfactants remove oils, so that the natural buoyancy is stripped from feathers); and may have contributed to the record red tide that also ensued. The respiratory, eye, skin, and digestive symptoms reported after the spraying are consistent with TMAC's known adverse health effects. CDFA has repeatedly denied the presence of any surfactant as an ingredient in the Checkmate pesticide solution

B. 1,2-Benzisothiozoli-3-one, also known as BIT, is associated with occupational asthma and dermatitis, and in the EU it is classified as capable of causing serious eye damage. According to data compiled by the Occupational Health and Safety Administration (OSHA), BIT has shown to be a mutagen with genotoxicity to human cells. BIT has also been classified by the EU as dangerous to the environment and very toxic to aquatic organisms; the EU is considers it a hazardous waste. The respiratory, eye, and skin adverse effects reported after the Fall 2007 sprayings are consistent with BIT's known adverse health effects.

C. 2-Hydroxy-4-n-octyloxyybenzophenone, also known as benzophenone 12, is classified by the EU as an irritant to skin, eyes, and respiratory system. Benzophenone 12 is classified as hazardous by OSHA, and has been declared harmful to the aquatic environment by the EU. While its health effects are not conclusively known its related compounds in the benzophenone family have been shown to form estrogenic photoproducts. The unusual menstrual symptoms, interruptions of menstrual cycles, and post-menopausal recommencement of the menstrual cycle are consistent with exposure to endocrine disrupting/estrogenic compounds.

D. Butylated hydroxytoluene, also known as 2,6-Di-tert-butyl-p-cresol or BHT, is classified by the EU as irritating to the eyes, respiratory system, and skin. BHT has been shown to be carcinogenic, hepatotoxic, tumorigenic, mutagenic, and teratogenic in animal and human cells. BHT has estrogenic activity and its MSDS states that chronic exposure may cause adverse reproductive and birth defects. OSHA classifies BHT as an ecological toxin with a specific toxicity to marine life. The respiratory, eye, and skin adverse reactions, as well as the disruptions to the human menstrual cycle, reported in the Fall 2007 sprayings are consistent with the known adverse health-effects of BHT.

E. Sodium phosphate (SP), sodium acid phosphate (SAP or monosodium phosphate), and trisodium phosphate (TSP) --- it is not known which of these forms of sodium phosphate was used in Checkmate formulas sprayed in the Fall of 2007. In general, this family of compounds can cause mild to severe gastrointestinal problems; mild to severe respiratory problems; mild to severe eye irritation; and mild to severe skin problems. These compounds are classified as hazardous substances with detrimental effects on groundwater and aquatic ecosystems, and can contribute to red tides. The adverse health effects reported in the Fall of 2007, and the explosion of red tide immediately following the spray, are consistent with the known effects of this family of compounds.

F. Monoammonium phosphate and diammonium phosphate --- it is not known which of these forms of ammonium phosphate was used in the Checkmate formulas deployed in the Fall of 2007. Both are classified by OHSA as hazardous, and both cause respiratory and gastrointestinal problems consistent with those reported in the Fall 2007 sprayings.

G. Polyvinyl (PVA), considered a plastic resin, has limited data about its toxicity in humans. Animal data has shown it to be tumorigenic, and its MSDS states that inhalation or ingestion may affect blood, metabolism, and mentation. Symptoms of PVA exposure include digestive tract irritation, respiratory irritation, and eye irritation, consistent with the health adverse effects reported in the Fall 2007 sprayings.

H. Crosslinked polyurea polymer or polymethylene polyphony isocyanate (PPI) is used to create the encapsulation polymer contained in Checkmate. While PPI is said by the manufacturer of Checkmate to be used up in the creation of the polyurea shell, the shell itself breaks down into urea, which has been linked to harmful algal blooms which could have contributed to the severe red tide that followed the Fall 2007 sprayings.

I. The microcapsule delivery system itself, as used in Checkmate formulations, has not been evaluated for human and environmental safety. According to researchers at UC-Davis, the microcapsules in the formulation used in the Fall 2007 sprayings ranged in size from 10 microns to 190 microns; the American Lung Association classifies aerosol particles of 10 microns or less as particulate pollution contributing to a host of adverse health conditions. The microcapsules pose an additional environmental hazard as they are the same size as pollen, and can be directly and specifically toxic to bees. Many of the more than 200 negative respiratory effects, including the near fatality of 11-month-old Joe Wilcox Jr. and the several other cases of children with primary respiratory attacks reported could most likely to have resulted primarily from inhalation of these microcapsules as from the ingredients contained therein. It is likely the physical characteristics of these microcapsules that contributed to the death, disappearance, and disorientation of bees as well as forming the thick, yellow, foamy run off observed on land and washed into the Monterey Bay (see Figure 2).

2.2 Potential Hazardous Effects of Pesticides Used in the LBAM Eradication program: Chlorpyrifos, Permethrin, *Bacillus thuringiensis* (B)t, and Spinosad

A. *Bacillus thuringiensis* (Bt)

Bt, while used in organic agriculture, has not been tested for safety as a spray to be used in residential communities. The EPA exempted Bt from ecological safety studies, so its true impact on human health and the environment is not known. Bt can dramatically reduce the number of moth and butterfly species, which in turn has a negative effect on the birds and mammals feeding on these creatures. In particular, Bt can negatively affect the monarch butterflies that migrate to and breed in Santa Cruz. Other beneficial insects, such as naturally occurring LBAM predators, are likely to be harmed through the use of Bt.

B. Chlorpyrifos

An organophosphate with the trade names Dursban, Empire, and Lorsban, chlorpyrifos has had its safety questioned for more than a decade. Banned for use in homes by the EPA in 2001 because of its hazard to children, chlorpyrifos has been the subject of petitions to the EPA by the Natural Resources Defense Council (NRDC), and Pesticide Action Network of North America (PANNA) to have all registrations and approvals revoked. Chlorpyrifos is a neurotoxin, a suspected endocrine disruptor, and suspected reproductive and developmental toxin. It affects the central nervous system, the cardiovascular system, and the respiratory system. Chlorpyrifos is highly toxic to amphibians, and its main breakdown product, chlorpyrifos oxen, is even more toxic to amphibians. Chlorpyrifos is moderately to highly toxic to birds, and poses a serious hazard to honeybees. Chlorpyrifos is also very highly toxic to freshwater fish and aquatic invertebrates, and to estuarine and marine organisms. Due to its high acute toxicity and its persistence in sediments, chlorpyrifos may represent a hazard to sea-bottom dwellers.

Repeated or prolonged exposures to organophosphates such as chlorpyrifos may result in the same effects as acute exposures, effects which include tremor, convulsions, unconsciousness, incontinence, and death.

Chlorpyrifos is currently required to be used in wholesale nurseries if a single sign of LBAM is found. In these cases, the entire acreage must be treated. Multiple applications increase the risks to wildlife and watersheds; many nurseries in Santa Cruz county have been required to dose their entire acreage multiple times within a few months.

C. Permethrin

A neurotoxin classified as a potential human carcinogen by the EPA, permethrin tests on human cells have shown it to be mutagenic. Permethrin is listed as a suspected endocrine disruptor, with estrogen-like effects in animals. Small amounts of permethrin are classified as a severe hazard to waters under the European Administrative Regulation of Substances Hazardous to Water database. Permethrin has strong negative effects on mammalian immune systems, reducing the ability to recognize and respond to foreign proteins.

Permethrin is highly toxic to honeybees, fish, aquatic insects, crayfish, and shrimp. It is particularly toxic to cats, with 96 percent of cats exposed to permethrin developing the symptoms of neurotoxic poisoning, symptoms which include convulsions, twitching, respiratory distress, vomiting, diarrhea, hypersalivation, and death. Permethrin use as proposed by CDFA and the USDA calls for it to be placed in traps on trees and telephone poles at a rate of 3,000 per square mile, in backyards, playgrounds, schools, daycare centers, parks, and streets. Dew, mist, and rain will leach permethrin into the areas surrounding these treated trees and telephone poles, exposing families and animals to this insecticide. Permethrin will eventually wash into Monterey Bay, a protected marine sanctuary, as well as into the estuaries of San Francisco, Marin, and the East Bay.

D. Spinosad

Spinosad is a neurotoxic formulation of 10 related chemicals. Specific formulations recommended by CDFA go by the trade names Conserve and Entrust, manufactured by Dow Agrisciences. Highly toxic to honeybees and beneficial insects such LBAM-predator the *Trichogramma* wasp, spinosad is also highly toxic to oysters and marine mollusks, and moderately toxic to fish.

Conclusion

The LBAM treatment plan proposed by the CDFA and USDA includes many known human and environmental toxins. It also includes many substances that have never been tested for safety in residential populations. Good science and good policy dictate that the CDFA and USDA rethink their LBAM treatment plans and seek out alternatives, such as those offered in Section 1 to discontinue exposing children and the environment to these toxic compounds.

Introduction

The widespread application of any substance over densely populated residential areas, especially pesticides, is a very serious matter. The history of pesticide treatments teach that they can have far reaching effects for both human and environmental health and may take decades or generations to identify or manifest. Aerial spraying of pesticides also goes against general trends to eliminate or minimize the use of pesticides and move to least toxic integrated pest management programs that encourage naturally occurring biological predators as the central control tool.

Knowledge about the potential toxicity of substances in our environment is ever evolving. In the late 1800s, adverse effects associated with asbestos exposure were first observed. However it was more than 60 years before a clear causative association between asbestos and asbestos toxicity was determined. This same history is true for the pesticide dichloro-diphenyl-trichloroethane (DDT). Synthesized in 1874, DDT came into common use after World War II. Its potential danger to human and environmental health was first made known through Rachel Carson's best selling publication *Silent Spring*. Despite this early warning, DDT was commonly used until the 1970s. In the 1960s children used to run behind trucks spewing out clouds of DDT mosquito gas. Official investigations of the toxicity of DDT by the Environmental Protection Agency (EPA) began in 1971. At that time, EPA internal studies reported that DDT was not an imminent danger to human health and wildlife. The findings of the Agency were criticized, as they were performed mostly by economic entomologists inherited from the USDA whom many felt were biased towards agribusiness and tended to minimize concerns about human health and wildlife. Congressional hearings and public pressure led to the enactment of the Endangered Species Act in 1972 and the ban of DDT from general agricultural use, though limited use was maintained.

The significantly toxic effects of DDT to aquatic organisms, birds, and humans were revealed over time, including the almost extinction of the bald eagle as the most publicized result of DDT use. Direct links between DDT exposure and asthma, diabetes, hepatotoxicity, and reproductive effects have been well established in the published literature (Brown 2008; Cueto et al. 1956; Jones et al. 2008; Rogan and Chen 2005). It was not until 1987, 16 years after EPA began researching it for toxicity, that EPA classified DDT as a probable carcinogen. Overtime, insects became resistance to the killing effects of DDT, requiring an abandoning of eradication of mosquitoes as a goal and moving to pest control.

The LBAM eradication program jointly developed and implemented by the USDA and California Department of Food and Agriculture (CDFA), utilizes a combination of directly toxic pesticides such as the organophosphate chlorpyrifos, *Bacillus thuringiensis* (Bt), permethrin, and spinosad, as well as blanket aerial sprays of moth hormonal disruptors (pheromone-pesticide solution) against the target pest. Despite the fact that the LBAM is not a vector for disease, poses no threat to human health, and poses little threat to agricultural crops most of these pesticide treatments are taking place directly in residential areas throughout California, exposing approximately 17,064,502* million children, pregnant woman, nursing mothers, the elderly and immunocompromised, and normal healthy woman and men to these pesticide treatments. Chlorpyrifos, which is required for use against LBAM in wholesale nurseries, many of which are within residential areas and along waterways, is a strong environmental toxin; permethrin is only approved for home use in very limited applications (e.g. flea bombs, lice medications), with strong restrictive warnings, and is deadly to cats; spinosad is highly toxic to aquatic life (e.g. oysters and marine mollusks), pollinators (e.g. honeybees), and beneficial predators (including the primary predator of LBAM *Trichogramma* spp. wasps); and the pheromone pesticides to be used in the aerial spraying were exempted from formal safety studies by the Environmental Protection Agency (EPA) and have never before been applied to residential areas, nor have they been subjected to the studies necessary for determining their safety for residential use.

* Based on 2006 census data from US Census Bureau for affected counties.

From a public health perspective, the potential human and environmental effects of any materials to be used in such a program should be subjected to rigorous scientific investigation with human and environmental health valued over economics. Such studies have not been conducted. However, first and foremost is the need for independent and formal investigations as to whether an eradication program itself is in actuality needed. In the current situation, the LBAM is not a vector for disease nor is it a pest of significant economic impact in those countries where it is naturalized (e.g. Australia, New Zealand, United Kingdom). It is primarily a political, economic, and trade pest with the primary costs incurred for its management, not because of crop damage or loss but due to costs associated with meeting US quarantine restrictions.

Lest history repeat itself, as in the history of asbestos and DDT, it is prudent to cease all aspects of the treatment portion of the eradication program with the exception of monitoring and trapping with pheromone traps until adequate and independent justification for the program is provided and the appropriate safety studies of the materials being used are performed.

2.3 Products Used in the LBAM Eradication Program

The USDA has mandated for the State of California to develop an effective program for the eradication of the light brown apple moth (LBAM). The Technical Working Group (TWG) convened by the United States Department of Agriculture (USDA) mandated that aerial spraying of residential areas with the pheromone-pesticide solution Checkmate OLR and Checkmate LBAM-F (Suterra, Bend, OR) be central to this eradication program. Other pheromone technologies and products were also approved. USDA mandated for the program to be implemented by the California Department of Food and Agriculture (CDFA).

Normally, 20 toxicology tests are required (or conditionally required) to register a pesticide in the US. All of these pheromone products were granted emergency exemptions from formal safety testing by the Environmental Protection Agency (EPA). Instead, EPA reviewed existing data of other pheromone products (different from those being used) from New Zealand in granting these products emergency approvals. The various pheromone products are to be used in a variety of ways with aerial spraying being the primary eradication tool and also using pheromone sticky traps for monitoring, pheromone sticky traps laden with permethrin for attracting and killing the moth, twist ties, and microflake products applied onto telephone poles in residential areas, among others.

Other direct insecticidal pesticides are also being used in the LBAM eradication program including: the highly toxic organophosphate chlorpyrifos (for wholesale nurseries), *Bacillus thuringiensis* (Bt) (for retail nurseries), permethrin (for residential areas), and spinosad (for residential areas). Numerous other products whose ingredients have not yet been disclosed are also being considered for use. Additional strategies include the release of wasps (1 million per acre) and sterile moths.

Under the USDA mandate, CDFA initially reported it will conduct aerial spraying of residential areas for 3 to 4 days every month for up to 10 years. The CDFA has also stated they are considering other products that last in the environment longer than the original materials used so they may reduce the number of spray applications to 3 to 4 per year. The California State legislature originally authorized the use of these treatments for a period of up to 10 years (until 2018) and the State has projected that it will take a minimum of 2 years and up to "several years to accomplish" (CDFA 2008a). There have been significant doubts raised by experienced biologists as to whether eradication of LBAM is required or can be achieved.

Subsequent to the aerial spraying treatments of 2 counties (Monterey and Santa Cruz) a significant number of serious adverse effects were reported including the near fatality of a 13-month-old baby who suffered a primary asthmatic attack and another 8-year old boy who also experienced a primary asthma attack the morning after the first spray in Santa Cruz. Many serious negative environmental consequences have been observed, including 650 dead sea birds temporally associated with the spray. These events and the lack of formal safety studies of the material being used in these programs has caused the California State legislature, as well as numerous cities and counties to call for a moratorium on any recommencement of the USDA's eradication program. This is reflected in numerous resolutions, requested moratoriums, and lawsuits by City, County, and State Representatives.

2.4 Aerial Applications of Pesticides to Residential Areas: Lack of Safety Studies

Of the methodologies used by USDA and CDFA in the LBAM eradication program, the aerial spraying portion, while not the most toxic of the materials used, is the greatest of concern for residents because of its widespread, constant, and long-term exposure to residents. There are a number of primary concerns with this portion of the of the eradication program: 1. A lack of basic safety studies including those that mimic aerial and chronic exposure; 2. A lack of adequate study of the aerial pesticides being used; 3. Concerns regarding the microencapsulated pesticide delivery systems; 4. A lack of adequate study of the *inert* ingredients in the pesticides being used; 5. Potential human toxicity of the other pesticides being used; 6. Environmental impact of pesticides being used.

A. Lack of Safety Studies

The California Department of Pesticide Regulation (DPR) in conjunction with the California Office of Environmental Health Hazard Assessment (OEHHA) developed and released a *Consensus Statement of Human Health Aspects of the Aerial Application of Microencapsulated Pheromones to Combat the Light Brown Apple Moth* in the Fall of 2007 (developed 10/31/07; released 11/16/07). This document reflects the justifications used by the Environmental Protection Agency (EPA) in exempting the pesticide solution being used in the USDA's aerial pesticide residential spraying program from formal testing and reflects USDA’s and CDFA's primary justification for alleging the pesticide solution used in the aerial pesticide spraying of residential areas is safe. Even a cursory review of this document, hereafter referred to as the *Consensus Statement*, shows that safety of the Checkmate OLR and LBAM-F formulations which were applied to Monterey and Santa Cruz counties, respectively, have not been shown to be safe for aerial application to residential areas. Ingredient disclosure and formal safety data for the other approved pesticide solutions is lacking in the *Consensus Statement* (Microflake, Splat LBAM, etc.) and also appears to be lacking in general.

Considerable attention has been given by State and Federal Agencies that the Checkmate LBAM-F pheromone-pesticide solution is not a pesticide in the true sense of the word because pheromones do not kill pests. Suggesting the pheromone-pesticide solution is not a pesticide seemingly is meant to allay public concern for this pesticide program. However, such statements misrepresent the action of this solution from a biological and perhaps legal perspective. According to the Environmental Protection Agency, a pesticide is defined as follows:

“A pesticide is any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest. Though often misunderstood to refer only to insecticides, the term pesticide also applies to herbicides, fungicides, and various other substances used to control pests.” *U.S. EPA Office of Pesticide Programs 14feb97*

In the *Consensus Statement*, the DPR and OEHHA stated that the safety of the pheromone-pesticide spray being used was extrapolated from safety reviews of other pheromones products. They further noted that the toxicity of the individual ingredients of the pheromone-pesticide spray has not been reviewed and that documentation of safety was based on oral administration or skin sensitization tests. The only quasi aerial data available was application of a different pheromone solution applied in localized emitters or aerially sprayed over non-populated agricultural areas, not populated areas, of New Zealand. The *Consensus Statement* reports;

"During more than 10 years of use of lepidopteran pheromones, no adverse effects have been reported. ... The safety record for lepidopteran pheromones has allowed the Agency [EPA] to conclude that consumption of food containing residues of the pheromones presents no risk. ...Adverse effects on non target organisms (mammals, birds, and aquatic organisms) are not expected because these pheromones are released in very small amounts to the environment and act in a select group of insects. ... This statement refers primarily to the pheromone active ingredients generally used in emitter devices or aerial application over agricultural areas rather than aerial application over populated areas (such as in the present situation)."

There are several scientific flaws represented in these assertions. The first is that while the pheromones in the currently used solution may be similar enough to those used elsewhere that a similar safety profile can be expected, the actual solutions used are different. It is scientifically invalid to assume that the safety of one pheromone solution containing one set of ingredients is the same as that of a markedly different pheromone solution. Only if identical solutions are used can such an extrapolation be made. As this is a solution that is to be sprayed over residential areas, playgrounds, expectant mothers, the elderly, and the Monterey Bay National Marine Sanctuary, this is not a supposition that should be made. A second flaw is that EPA used a *lack of reported adverse effects* as the basis for determining safety. It is scientifically implausible to suggest that a lack of adverse effects of one pesticide solution sprayed over non-populated agricultural areas can be used as a determination of safety of a different pesticide solution to be aerially sprayed over residential areas or environments rich with wildlife, especially aquatic ecologies, for extended periods of time. Thirdly, no assessment of safety on non-target organisms can be deduced from a completely different spray applied via emitters in agricultural areas of relative mono-cultures that lack many of the non-target organisms that are present in native habitats or marine ecologies where the spray is being applied. This is of special concern to marine habitats and aquatic ecosystems, which are often among the most sensitive to agricultural chemicals. Moreover, pheromone-based pesticides have never been used anywhere in the world to eradicate a species (CDFA 2008b).

To date no environmental studies have been found that suggest the pheromone-pesticide will not have a negative effect on the environment. Rather, CDFA and USDA have approved of the use of these materials due to a lack of evidence of harm, whereas prudence dictates the application of pesticides to residential areas should require evidence of safety as a pre-requisite.

The *Consensus Statement* additionally acknowledged;

"Chronic toxicity is not addressed in this document because there will not be long-term exposure to the pheromone product."

The microencapsulated delivery system that was originally used in the sprayings of Monterey and Santa Cruz counties is designed to maintain a constant emission of the pheromone-pesticide solution over a period of from 30 to 90 days. The current program proposes a 3 to 4 day spraying period every 30 days for up to 3 years and State authorization to spray for as long as 10 years. This translates into approximately 36 to 48 sprays annually for 3 years or 108 to 144 sprays annually, with a projection of up to 10 years or from 360 to 480 sprays of constant exposure for a period of up to 3560 days. CDFA is currently experimenting with formulas that persist for up to 90 days requiring 3 to 4 sprays annually to maintain constant exposure. The standard medical definition of chronic is something that persists for 90 days or more. Regardless of the formulation used, this spraying program will result in overlapping and increasing concentrations of the pheromone-pesticide with each subsequent spray. The concentration to which the public is exposed will increase exponentially with each increasing spray as the non-degraded portions of the first spray that persists for 30 to 90 days is increased with each new spray. It is unconscionable that CDFA, EPA, OEHHA, and USDA would suggest that the program as initiated will not result in long-term exposure to humans, wildlife, and the environment and have not performed chronic toxicity studies.

Additionally, the long term use of the more toxic substances used in the LBAM eradication program, such as chlorpyrifos, Bt, permethrin, and spinosad all have detrimental effects on the environment in general, marine ecology, beneficial pests, and pets specifically, and are not safe for long term exposure to humans.

The significance of the hasty approval of the pheromone-pesticide solution that is being used is illustrated in the more than 600 human adverse effects and several hundred dead seabirds that were reported after the sprayings in Monterey and Santa Cruz counties (see Human Health Impacts below).

B. Review of the Toxicity of Checkmate Ingredients

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). This is also the case with the Checkmate LBAM-F formulation, which consists of 17.61% moth hormonal disruptors and 82.39% other ingredients.

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 microorganisms (Cox and Surgan 2006). In point of fact, many of the more than 600 human adverse effects reported by victims of the spray in Monterey and Santa Cruz Counties were consistent with the known adverse effects associated with many of the Checkmate ingredients (see Post-Spray Adverse Effects below).

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. However, there is significant concern regarding other ingredients and a comparison of potential health effects listed for the inert ingredients in the Checkmate formulas, with the actual adverse effects reported following the sprayings, indicates a remarkable consistency between the two. CDFA (CDFA 2007) has consistently focused on the safety of only the pheromone constituents, failing to address the preponderance of known toxicity data for the inerts. Only minimal study has been given to the mixture in its complete form, and the few studies conducted were not relevant to aerial application or inhalation.

The CDFA reported that LBAM-F is the primary pheromone product that will be used in the aerial spraying programs. As noted, none of the products were subjected to formal safety studies by Federal or State agencies. The products were specifically exempted from studies by EPA, seemingly justified by an agricultural declaration of emergency. The pheromone products specifically are restricted from being applied to waterways due to a known significant potential for toxicity of Checkmate formulas to aquatic ecology. According to a spokesperson for the product manufacturer Suterra, Checkmate OLR-F is registered for use on California vineyards, but this is the first time Checkmate LBAM-F has been used in California or elsewhere (Renner 12/5/07).

A 2007 CDFA *Questions and Answers* document on the LBAM states that "the ingredients in the formulation are water and biodegradable elements used to delay the release of the active ingredient" and that "the basic biodegradable building block is urea, a normal constituent of the human body that is derived from the breakdown of proteins that we eat." However 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.

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.

Table 1 Ingredients in Checkmate LBAM-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	
Crosslinked 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.

Little public concern has been raised regarding the specific pheromone portion of the pesticide solution, though these are not without concern, especially since they are synthetically derived. While, alleged to be identical to pheromones naturally produced by female LBAMs, there appears to be no documentation of this allegation. Thus, there is a possibility for these ingredients to exert adverse effects in the same manner as other endocrine disruption pesticides. Numerous reproductive adverse effects, including resumption of menstrual cycles in previously menopausal women were reported among the human post-spray adverse effects, suggesting a potential for endocrine disruption in humans. Actual toxicity data of these pheromone components are lacking.

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).

TMAC is an aquatic toxin that is classified as dangerous to the environment by Canada and the European Union. Under Canadian classification it is listed as “material causing immediate and serious toxic effects”. MSDS sheets warn the substance is extremely hazardous in case of ingestion, inhalation, skin contact, and eye contact and that it causes severe skin and eye burns. Symptoms of inhalation exposure include irritation of the respiratory tract, burning pain in the nose and throat, coughing, wheezing, shortness of breath, and pulmonary edema. Symptoms of eye exposure include redness, watering, itching, eye burns, and possible corneal injury. Symptoms of skin exposure include inflammation characterized by itching, scaling, reddening, and occasionally blistering. European labeling warns against releasing the substance into the environment, cautioning that it may cause long-term adverse effects in the aquatic environment.

Following the sprayings in Monterey and Santa Cruz counties, hundreds of dead or dying seabirds were found along the coastline adjacent to spray zones. Many of these birds were found to be covered with a yellow sticky substance, which was originally identified as a surfactant protein. According to SIMoN (Sanctuary Integrated Monitoring Network for the Monterey Bay) surfactants act like a detergent to reduce the waterproofing ability of feathers. This same protein has also been associated with the recent red tide in the Monterey Bay (SIMoN website). CDFA has erroneously publicly stated that there is no surfactant in the Checkmate formulation, completely disregarding the presence of TMAC (CDFA 2008c).

Respiratory symptoms reported following the sprayings in Monterey and Santa Cruz counties included asthma, bronchial irritation, difficulty breathing, shortness of breath, coughing and wheezing, sore throat, nasal congestion, sinus bleeding, lung soreness, lung congestion, and chest pain and tightness. Intestinal pain, diarrhea, nausea, blurred vision, eye irritation, and mild to severe skin rashes were also reported (HOPE 2008).

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 similarly 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.

BIT is classified as dangerous to the environment and as very toxic to aquatic organisms in the European Union 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 8^{th} and 9^{th} were followed by a significant rainfall on November 10^{th} and 11^{th}. 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.

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.

Following the sprayings in Monterey and Santa Cruz counties, several women reported unusual menstrual symptoms including cramping, interruption of menstrual cycle, and postmenopausal recommencement of the menstrual cycle, which would be consistent with exposure to endocrine disrupting/estrogenic compounds. A wide variety of mild to serious respiratory symptoms, as well as eye irritation and skin rashes were also reported (HOPE 2008).

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)

Following the sprayings in Monterey and Santa Cruz counties, several women reported unusual menstrual symptoms including cramping, interruption of menstrual cycle, and postmenopausal recommencement of the menstrual cycle. A wide variety of respiratory symptoms, as well as blurred vision, eye irritation, and skin rashes were also reported (HOPE 2008).

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, most especially blue gill sunfish, rainbow trout, crustaceans, mollusks, and in 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 (see Environmental Impact).

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).

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 a 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.

Crosslinked Polyurea Polymer and Polymethylene Polyphony lsocyanate (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).

C. Potential Respiratory Toxicity of Microcapsule Delivery System

In addition to the potential for toxicity directly associated with the Checkmate portion of the LBAM spray, there are unknown safety consequences potentially associated with the delivery system, the safety of which has not been evaluated at all. Of greatest concern is the lack of safety data on one class of carriers used in the spray known as microcapsules. Regarding the safety of the microcapsules, the DPR and OEHHA in their *Consensus Statement* (DPR-OEHHA 2007) acknowledged they performed no inhalation safety studies and stated:

> *"The microcapsule particles are very large by inhalation standards (25 micrometers in diameter or larger) and unable to reach the deep lung. As a result, an inhalation toxicity study, which is designed to examine systemic effects resulting from inhalation into the lung, would not be useful and was not conducted. If inhaled, because of the large size, these microcapsules are not likely to reach the pulmonary (air exchange) region of the lung. However, such large particles are likely to be deposited in the nasal passages, pharynx, larynx, and tracheo-bronchial region and are either absorbed or moved to the larynx and swallowed. If a sufficient amount of large particles (regardless of composition) is inhaled, it is plausible that it could cause irritation of the throat, coughing, sneezing, and excess mucus production in the upper respiratory system."*

In 2007, Werner et al. (2007) researchers at the University of California at Davis published a CDFA-sponsored study, the conclusion of which revealed that the microcapsules in the LBAM formula ranged in size of from 10-190 microns, versus the minimum 25 micron size reported in the *Consensus Statement*. The American Lung Association classifies aerosol particles of 10 microns in size as particulate pollution (known as PM10) that contribute to a host of adverse health conditions, mostly, but not exclusively, respiratory in nature. A large number of adverse effects reported for the Checkmate aerial spray were respiratory or mucus membrane related. The *Consensus Statement* reports that respiratory symptoms are plausible, even at their mistaken estimates of the 25-micron particle size, suggesting that the incidence of respiratory disturbances will be much greater than originally estimated by DPR and OEHHA.

Additionally, the microcapsules are a potential environmental hazard as they are the same size as pollen and therefore can be directly and specifically toxic to bees (see Environmental Impact).

D. Post-Spray Adverse Effects

Subsequent to the aerial pesticide spraying in Monterey and Santa Cruz Counties, numerous adverse effects were collected from a variety of sources. A total of 643 individual reports were collected, many reports consisting of multiple individuals, such as a family of 4. Totaling all individuals included in the reports, more than 1000 individual adverse events were experienced. Underreporting of such events is very common for a multiple of reasons (Heeley et al. 2001). The *Consensus Statement* acknowledged:

> *"DPR's surveillance system, like others, under detects pesticide illnesses for various reasons, including that pesticide illnesses may mimic other illnesses and that physicians and patients may not ascribe symptoms to pesticide exposure."*

A comparison of potential health effects listed for the inert ingredients in the Checkmate formulas, with the actual adverse effects reported following the sprayings, indicates a remarkable consistency between the two. In fact the *Consensus Statement* (DPR/OEHHA 2007) states the following:

- *"The toxicity data on the pheromone active ingredients as well as on microencapsulated pheromone product formulations suggest that exposure to a high dose of airborne Checkmate microcapsule particles could cause eye, skin, or respiratory irritation."*

- *"The toxicological information on the Checkmate product indicates that exposure to high levels of the applied material would be consistent with many of the reported symptoms. However, because the application rate was extremely low, it is likely that exposure occurred at levels below those that would be expected to result in health effects."*

- *"However, because not all health effects can be predicted and because the general population includes susceptible populations, such as children, the elderly, and those with chronic diseases, we cannot provide a definitive cause for their symptoms."*

Following the sprayings in Monterey and Santa Cruz counties, 643 individual reports of adverse reactions in more than 1000 individuals were documented by various governmental agencies, physicians, the health department, and citizen groups (see Table 2). The adverse reactions ranged form mild discomfort, to skin and mucosal irritation to a near fatality. As all adverse effects from varying substances go underreported, by as much as 90% (Heeley et al. 2001) the actual numbers of adverse effects that were experienced is undoubtedly much greater than those reported. Of particular note is the reporting of several children experiencing a primary asthma attack (never before having asthma), including a 13-month-old boy who almost died the night of the Monterey spray and the occurrence of a severe complete body rash in an elderly woman requiring hospitalization.

The *Consensus Statement* acknowledged:

> *"DPR's surveillance system, like others, under detects pesticide illnesses for various reasons, including that pesticide illnesses may mimic other illnesses and that physicians and patients may not ascribe symptoms to pesticide exposure."*

A comparison of potential health effects listed for the inert ingredients in the Checkmate formulas, with the actual adverse effects reported following the sprayings, indicates a remarkable consistency between the two. In fact the *Consensus Statement* (DPR/OEHHA 2007) states the following:

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- *"However, because not all health effects can be predicted and because the general population includes susceptible populations, such as children, the elderly, and those with chronic diseases, we cannot provide a definitive cause for their symptoms."*

Table 2 Primary post spray adverse effects experienced by residents of Monterey and Santa Cruz Counties

asthma attacks	intestinal pain and diarrhea
body tremors	lung congestion and soreness
bronchial irritation	menstrual cramping, an interruption to menstrual cycles, and in some cases a recommencement of menstrual cycles after menopause
chest pains and tightness	muscle aches
coughing or "wheezing"	nasal congestion
difficulty breathing and shortness of breath	nausea
dizziness	sinus bleeding
eye irritation	skin rashes (sometimes severe)
feelings of lethargy and malaise	sore throats
headaches (sometimes debilitating)	swollen glands and lymph nodes in neck and under arms
heart arrhythmia and tachycardia (irregular and rapid heartbeat)	vision blurred
inability to concentrate and focus	

Considering that neither the Checkmate solutions, nor the other products to be used in the aerial spray portion of the program had ever been tested or formally approved for use over residential areas, and in the wake of the numerous adverse effects reported, prudence dictates a moratorium on all aerial spraying until adequate safety studies can be conducted.

2.5 Toxicity Review of Other LBAM Pesticide Treatments

The aerial spraying of the pheromone-pesticide is the central component of the USDA's LBAM eradication program. Additionally, numerous other treatments have been approved or projected to be used. These include; *bacillus thuringiensis* (Bt), the organophoshate chlorpyrifos, permethrin, and spinosad.

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. In addition, a number of beneficial insects are adversely impacted by Bt. It is a healthy ecosystem with an abundance of natural predators relative to pests that is optimum for long term management of pests. Disturbing this by killing off beneficial insect predators makes it all the more difficult to control pests and is setting the system up for future pesticide use.

Bt is less toxic to mammals and shows fewer environmental effects than many synthetic insecticides. However, this is no reason to use it indiscriminately. Its environmental and health effects as well as those of all other alternatives must be thoroughly considered before use. Bt should be used only when necessary, and in the smallest quantities possible. It should always be used as part of a sustainable management program. The EPA reports that Bt may give rise to secondary toxins that can effect non-target species. However, EPA exempted Bt from being subjected to the typical ecological safety studies that are required. Therefore, the true impact of Bt on the environment are not known.

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 the 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. 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.

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 (Wyatt et al. 2006). Another study demonstrated a correlation between prenatal chlorpyrifos exposure and lower weight and smaller head circumference of infants at birth (Wyatt 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 to organic diets (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. 2002). 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 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 honeybees.

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 (*Rosenberg et al. 1999 as cited EPA -TEACH 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 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).

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; Tillman and Mullrooney 2000 as cited by USDA 2002).

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.

2.6 Environmental Impact

In the State of California, the State or Federal government is typically required to conduct an Environmental Impact Review (EIR) prior to the implementation of any program that is to expose residents to widespread and continued application of pesticides. Because the USDA considered LBAM to represent a serious threat to California crops with the potential to infest 80% of the US, a declaration of emergency was made and all environmental impact requirements were waived in a manner similar to EPA waiving the need for safety testing of the materials being used in the aerial spraying. This lack of environmental oversight has resulted in substantial negative environmental impact.

The Birds, The Bees & The Water

A. The Birds

The aerial pesticide spraying of Santa Cruz County took place on Thursday evening Nov 8, 2007 at approximately 8 pm until 5 am Friday morning (Nov 9). On the morning of November 9, people taking their morning walks on various beaches immediately started finding dead or injured seabirds by the dozens. On Friday evening Santa Cruz had a relatively small rain followed by a torrential downpour on Saturday November 10. People walking along the beach observed a yellow foamy substance coming from the drains from the rivers and runoff that created a thick layer of yellow foam 1.5 miles along the area of the drain pipes in areas such as West Cliff Beach, a foot or more thick, and about 100 feet wide (see photographs attached). Other people reported seeing what they described as yellow gunk running down their windows and on their decks, in planter boxes in their yards during the rain. One gentleman had a kayak in his backyard uncovered during the spray; after the rain, it filled with water and a similarly described yellow sticky material filled his kayak. It took him two hours to clean it out. A similarly described yellow sticky material was evident on many of the recovered dead or injured birds.

By the third day after the spray, native animal rescue agencies in Santa Cruz had received 248 dead or injured seabirds whose feathers seemed to have been stripped of their oil and were starving, drowning, and freezing. Most of these birds died. A percentage of these birds had the same yellow sticky stuff on them, which was originally reported by Dr. Dave Jessup, a senior Fish and Game veterinarian as a surfactant. At last count, according to a Santa Cruz Sentinel report a total of 750 dead or injured birds had been reported. The Department of Fish and Game reported 650 dead birds. The actual number of birds submitted to the various agencies and animal rescue agencies is unknown and as is typical of such environmental events, the actual number of injuries or fatalities is significantly under reported (Armstrong et al. 1978; Furphy et al. 1971).

According to various news articles the death of these birds were sequentially attributed to: 1. An unknown surfactant; 2. Red tide; 3. An anomalous protein; 4. A mystery spill; 5. Cause unknown. On March 10, 2008 the Department of Fish and Game issued a formal report concluding that the aerial spraying was not associated with the death of the seabirds and that the death was consistent with red tide. However, based on the data provided in the report, no causality can be determined, red tide cannot be definitively determined to be causative, and causation or contribution of Checkmate in these deaths cannot be ruled out (see Table 1).

CDFA and Fish and Game contend these events may have been associated with red tide, and though they may be incorrect in this assertion, they fail to acknowledge that ammonium phosphate, sodium phosphate, and urea, all ingredients of Checkmate LBAM-F, are known to feed microplankton that gives rise to red tide. CDFA further continues to misrepresent that Checkmate LBAM-F does not contain a surfactant as a way to discount the potential association between the spray and this toxic environmental event. Checkmate LBAM-F does in fact include the surfactant tricaprylyl ammonium chloride among its ingredients.

Regarding an association with red tide, generally speaking, there is a considerable time period between red tide and actual observance of dead or injured birds. This is because the cause of injury is due to eating fish and other marine life that is contaminated with the red tide pathogens. These pathogens (e.g. *Gonyaulax tamarensis, G. catanella*) must work their way through the food chain over time until accumulation occurs in the bird's food source. Thus, a connection between red tide and effects on sea birds is not immediate and is often overlooked (Shumway et al. 2003). Similarly, the cause of death of birds due to red tide is neurological causing paralysis in the affected birds. The cause of injury and death were very different as the affected birds were stripped of their oils causing drowning and freezing. This is not consistent with red tide events. Moreover, the material that many of these birds were covered with has not been identified but is similar in appearance to the yellow oily material observed by numerous individuals as being associated with the spray.

Red tide was evident in Santa Cruz approximately 1 week prior to the spray and no birds were being submitted to animal rescue. Typically, with normal surf, red tide dissipates within a week of its bloom. According to Santa Cruz residents acutely familiar with red tide (e.g. surfers, kayakers) the red tide had begun to abate immediately prior to the spray (November 6-7, 2008). Santa Cruz was sprayed November 8 & 9. Submission of dead and injured birds began immediately following the spray on the morning of November 9. Immediately following the spray (November 8 and 9), and the rains on November 9 and 10, which were accompanied by the yellow sticky runoff, the waters around Santa Cruz experienced one of the worst red tides ever observed in the Monterey Bay. Additionally, when the particularly concentrated red tide came on a few days after the spray it appeared to persist in a more concentrated way and for a longer period of time than usual. This effect could possibly have been associated with the actual microcapsules that are designed to break down in 30-90 days mixed with the emulsifiers that cause a dissolution of other compounds along solid surfaces in the runoff and keep the microcapsules suspended in water.

Also, in the 25 years of experience of native animal rescue organizations in Santa Cruz, in the worst red tide only 30 injured birds are typically submitted. Within 2 days after the spray there were a total of 248 submitted to one animal rescue organization alone and the cause of death, drowning, starvation, and freezing was not consistent with other red tide events observed. It should also be noted that such toxins have an effect on cats through pet owners feeding their pets scraps from fish contaminated with red tide toxins.

Despite the lack of known causality, insufficient testing, the presence of surfactant on the birds, the flawed Fish and Game report, and the mechanistic plausibility that Checkmate ingredients can contribute to red tide, CDFA continues to publicly state that the spray had no relationship to the dead birds (CDFA 2008d) though the temporal association was immediate and the events anomalous.

Before any further treatments are done, environmental assessments on the impact on all parts of the LBAM eradication treatment products on water fowl should be conducted and these studies should be based on long term exposure of these materials and include all ingredients of the products being used.

Table 3 Critical Review of Pesticide Laboratory Report; Department of Fish and Game

• The report states no surfactant was found on the feathers. The original reports cited the presence of a surfactant. This discrepancy should be addressed.

• The reports state that only the feathers were tested for the presence of ingredients in Checkmate. Seemingly, no systemic autopsies were performed. Therefore, systemic effects of the spray cannot be ruled out either as contributory or causative.

• The report states no "active" ingredients of Checkmate were found. No mention of inactives or microcapsules was made and significantly detracts from the scientific credibility of this investigation.

• The report states the cause cannot be determined but notes it was not associated with the aerial spray. These two statements are incongruent. Unless one definitively knows the cause of death one cannot rule out if other factors are causative or contributory.

• The report concludes that the "Analytical results are consistent with an algal bloom as being the potential cause of the incidents." This is a completely invalid conclusion. The only analytical tests performed according to the report were chemical analyses of various compounds. The absence or presence of compounds on feathers may or may not have any correlation with a biological cause of death and it is predictable that sea birds would have compounds associated with red tide.

• The cause of death of marine birds due to red tide is neurological; the birds become paralyzed and die. These birds were stripped of their oils and drowned and froze. This cause of death is not consistent with red tide.

• While attributing the death of the birds to red tide, the report makes no mention that three ingredients in the aerial spray solution Checkmate, urea, ammonium phosphate, and sodium phosphate, can feed the microplankton that gives rise to red tide. Similarly, no mention is given to the correlation with the spray and the most severe red tide ever experienced in Santa Cruz.

• Table 1 makes reference to a "Mystery Spill" yet no mention is given in the report of any spill and detracts from the accuracy in describing the event.

• No attention was given to the yellow foamy run off that was observed after the spray and the yellow sticky material on the birds.

• Typically, in the area of Santa Cruz, red tide only results in the death or injury of 20-30 birds. Within 2 days of the spray more than 300 birds were reported and by 6 days more than 650 dead had been reported.

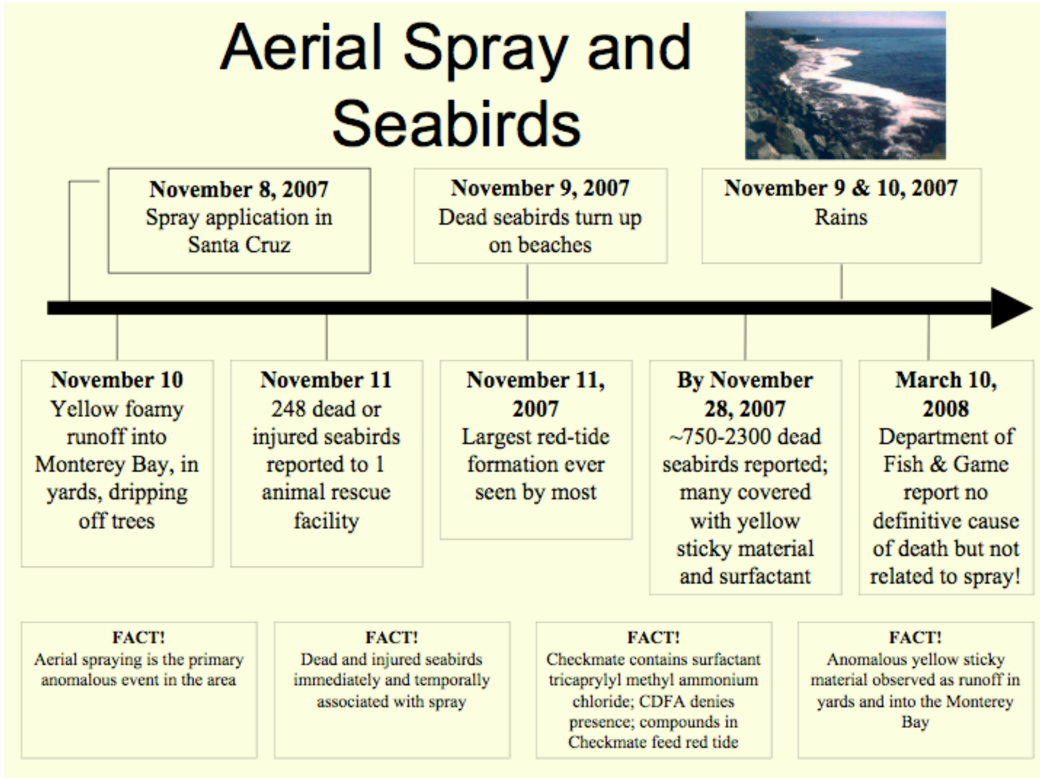

Figure 1 Temporal association between the aerial pesticide spray Checkmate, dead seabirds, and yellow, sticky, foamy runoff

B. The Bees

In addition to the reports of the several hundred dead birds many reports were made regarding dead and displaced bees. Honeybees are needed for the pollination of many fruit and vegetable crops, as well as for native plants that maintain a healthy ecosystem rich with biological predators against pests, such as LBAM. According to the USDA, one-third of the human diet is derived from insect-pollinated plants and that honeybees are responsible for 80% of this pollination. A 2000 Cornell University study concluded that the direct value of honeybee pollination to U.S. agriculture is more than $14.6 billion. In California specifically, at least 21 fruit and nut crops produce larger yields when pollinated by honeybees. These fruit, nut, and vegetable crops were worth $4.4 billion in 2002 - a value approximately 35 times greater than the income generated directly by the beekeeping industry. Bees are specifically critical to California almond crops, which yield in excess of $2.5 billion annually, as well as alfalfa and hay, which support a $4.5 billion dairy industry. Including the "indirect" value of honeybee pollination (meat, dairy products, vegetables, hay, etc.), honeybees are responsible for nearly half of California's agricultural production (cash receipts for farm marketing). Thus, honeybee pollination is actually worth in excess of 400 times the intrinsic earning power of the bees to beekeepers (Mussen 2004). Bee pollination itself is a $10-$14 billion business. Bees produce honey and beeswax, bringing in $285 million dollars annually. Additional bee products such as pollen, propolis, royal jelly, and bee venom, all contribute significantly to the world's economy (GLW 2007).

Among bees, the workers are those primarily affected by pesticides. The symptoms of poisoning can vary depending on the developmental stage of the individual bee and chemical to which they are exposed (see Table 3) (Sanford 2003).

Table 3 Developmental Stage of Bee Maturity

Development of adult: It takes worker bees about twenty-one days to develop from egg to adult. During this process, each individual passes through a larval (feeding) stage followed by a pupal (transformation) stage. The larval stage is the most susceptible to pesticide poisoning during development. **House bees:** These bees are emerged worker adults up to twenty-one days of age. They care for the brood, process pollen and nectar gathered in the field by older workers, and clean the nest. Eventually, they too will become field bees. House bees are usually poisoned by contaminated pollen, which is collected in the field, brought back and stored in the hive. As house bees are killed, there are fewer bees to tend the brood and further decline in population results. **Field bees:** These bees are workers twenty-one to approximately forty-two days of age. There appears to be no greater risk in bee society than to be a field bee. Should the insect avoid all the potential pitfalls due to predators like spiders, toads or skunks, it is still vulnerable at all times to the numerous pesticides applied in commercial agriculture, mosquito control, and home gardens. Most times, field bees are killed by contact with pesticides in the field, but other times they collect contaminated nectar and pollen and contribute to poisoning their sisters in the colony. If field bees are killed, then young bees are forced into the field earlier than normal, disrupting and thus disorienting the colony.

The importance of bees to the worlds agriculture supply and to the California economy cannot be overstated. Likewise, taking active steps not to decimate bee populations is equally critical in the face of emerging *Colony Collapse Disorder,* which is resulting in a loss of more than 1/3 of honeybee colonies in 2005. Some states have lost more than 90% of their bee colonies (GLW 2007). 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 (COA 2007).

Numerous Santa Cruz residents reported both direct kills as well as apparent disorientation of honeybees in gardens. Some reported gardening on Thursday November 8 the day of the evening spray and having their plants filled with honeybees. They then reported gardening the very next day in similar weather and the bees either gone or seeing thousands struggling on the ground and on plants.

The use of microencapsulated delivery systems for pesticides is much more toxic to honey bees than any formulation thus far developed and present a very distinct and serious threat to them to bees (Sanford 2003; Tarpy 2008). Microcapsules are the exact same range of size as pollen grains (15-100 micron) (Kelly et al. 2002; Ferrel and Aagard 2005; NPARU 2008). The microcapsule size in the Checkmate delivery system is 10-190 micron (Werner et al. 2007). Because of their size, these capsules are carried back to the hive where it is combined with pollen that is being stored as food. Even if the microcapsules due to their stickiness and weight do not harm the collecting bees they have the potential to kill the immature brood and young adults as they are fed with the pesticides. Even at small concentrations the negative effects to hives can be significant.

Microencapsulated delivery systems are inherently designed to release their chemical contents slowly over a period of days or weeks and entire hives have been killed due to such delivery systems (Adams 2008). The microcapsule delivery system for the Checkmate solution is designed to last from 30-90 days, longer than the normal lifecycle of honeybees and the State is experimenting with other solutions that are longer lasting. From an environmental perspective, microencapsulated pesticides should never be used if there is any chance bees might collect the microcapsules (Sanford 2003).

While the USDA and State have alleged the concentrations of the potentially toxic inert ingredients are too low to negatively effect humans and marine life, they failed to perform any studies that would suggest the concentration of inerts being slowly released over time in the hive would not harm pollinators such as bees.

Additionally, there is a marked potential for damage to bees, as well as other predators and insects (e.g. monarch butterfly) with the microcapsule solution itself, regardless of any gross toxicology of the ingredients. The Checkmate LBAM-F is a cocktail of chemical toxins, pheromone, surfactant (tricaprylyl methyl ammonium chloride; aka Aliquat 336), plastic resins, 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. The moths mate higher in the air not at ground level. This sticky material can simply adhere to the wings and bodies of bees and butterflies making it difficult or impossible to fly. Microencapsulated pesticide solutions have the potential to negatively affect thousands of different insects with untold ecological disturbances.

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.

Before any further treatments are done, environmental assessments on the impact on all parts of the LBAM eradication treatment products should be conducted as to their impact on bees and potential contribution to *Colony Collapse Syndrome* and these studies should be based on long term exposure of these materials. For bees these studies should include both physical effects of the microcapsules and sticky solution as well as systemic effects on all stages of the bees life.

C. The Water

As noted, the first two nights following the aerial spraying there were two nights of rain. This resulted in a runoff of sticky yellow material down windows, in planter boxes, on decks and cars, in backyards, from trees, and the same sticky yellow material running into the Monterey Bay via drain pipes (see Figure 2). Similar accumulation was seen in the rivers. No formal analysis of this material was made. Through observation under a standard microscope round beads described in a manner similar to microcapsules were clearly seen. This same yellow sticky material was observed on a small percentage of the dead and injured birds. No identification of this material was ever made and it was erroneously reported to have occurred due to red tide, without any explanation of the presence of this material on land and in trees. The planned spraying is to take place 30-4 days every 30 days for up to 10 years. If the eradication of LBAM follows CDFA's other eradication programs it could last 26 years. **Before any further treatments are done, environmental assessments on the impact on all parts of the LBAM eradication treatment products on the Monterey Bay National Marine Sanctuary and other waterways should be conducted and these studies should be based on long term exposure of these materials with specific effects on marine ecology, especially threatened or endangered species. Further, investigations of the previous run off should be made to determine conclusively that the material that ran off into the Monterey Bay was the aerial pesticide solution.**

Figure 2 Thick yellow foamy runoff accumulated in the Monterey Bay National Marine Sanctuary along West Cliff Beach, Santa Cruz, CA immediately following the aerial spray. This material we observed to runoff from the rivers and drainpipes into the Bay. Official reports reported this was due to red tide without explaining its occurrence on land, in yards, and on houses. Microcapsules were observed in this material. It is highly likely this is a mixture of billions of tiny microcapsules that mixed with surfactant (aliquat 336) and emulsifiers into this thick froth. No official report of the analysis of this material was ever released by USDA, Department of Fish and Game, EPA, or CDFA. Photograph Jefferey Vance, Santa Cruz.

D. Environmental Epilogue

It is likely that no causality between either the spray, red tide, the yellow sticky material, dead and injured birds, foamy water on land and in the Monterey Bay, missing, dead and injured bees, and this environmentally toxic event can be definitively determined because no State or Federal Agency took interest in any of these occurrences at the time they happened. However, all of these events, dead birds, yellow runoff, yellow foam in the water, dead bees, yellow foam in yards in the spray zones, and the vicious red tide were anomalous and the most anomalous potentially precipitating factor that was immediately temporally associated with these events was the pesticide spray. In addition, to the temporal association of the spray with these environmental events is the mechanistic plausibility associated with the inert ingredients of the pesticide solution used; ability to feed red tide, the presence of a surfactant, the sticky matter on the birds; the potential effects that microcapsules, surfactants, and emulsifiers can have in liquid mediums in causing the foamy solution on land and water, and on bees.

While these observations do not constitute scientific evidence of causality, they never the less warrant immediate concern and need for investigation as the Emergency Declaration of the State obviated the Environmental Impact Review (EIR) with potentially severe consequences. Any EIR proposed by the CDFA or USDA must be conducted retrospectively to determine as best as can be ascertained the ecological impact of the previous sprays on the environments of Monterey and Santa Cruz Counties.

If any further treatments are done, adequate personnel should be available to systematically catalogue any and all temporal negative environmental events so that appropriate samples, autopsies, and investigations can be performed at the time of the event.

Conclusion

As citizens concerned about our health, we believe that any material that is to be aerially sprayed on residential areas, as well as the other various toxic pesticides that are to be used within our communities need to be shown to be safe before application. We find it unconscionable that the United States Department of Agriculture and State of California would require citizens to carry the burden of proof in showing these materials to be potentially harmful. Rather, we believe it is the responsibility of State and Federal agencies to prove these materials, in the complete composition and manner in which they will be dispensed are safe. These tests as well as the justification for the program itself must be conducted prior to any aerial spraying, prior to the placement of toxic traps, and prior to the application of toxic compounds on telephone poles in residential areas. These toxins will be in our playgrounds, backyards, parks, walkways, hiking trails, jogging and bicycle paths where people will inevitably come into direct contact with all of these pesticides. When it rains, all of these toxins will wash into our ground water, wells, and the ocean affecting all residents, children, pregnant and nursing women, the elderly, those immunocompromised, pets, and wildlife.

We believe the assertions we have made accurately reflect the state of the scientific data, the direct observations of Santa Cruz residents, and justify the recommendations put forth. We respectfully ask that you please recognize that the concerns we raise are legitimate, and that there is adequate justification to call for a halt to the recommencement of any part of the treatment portion of the LBAM eradication program, minimally until the prerequisite safety and environmental studies are conducted. We respectfully request that you read all of the comments in the HOPE health review, as well as the other enclosures we have provided. Please take the time to review the data provided. We believe that if you do this sincerely, you will reach the same conclusions that we have and will agree that it is inappropriate to be subjecting pregnant women, nursing infants, children, the elderly, immunocompromised, the population in general and our environment to this very broad and very toxic pesticide treatment program. Every individual and every living thing in our communities will be affected by these chemicals for years. The consequences may continue for decades or generations. Please call for a stop to this eradication program immediately.

Notes on Databases

GESTIS: Information system on hazardous substances of the Berufsgenossenschaften (German institutions for statutory accident insurance and prevention) with support of: Bundesverband der Unfallkassen (Central federation of public sector accident insurers) and Bundesverband der landwirtschaftlichen Berufsgenossenschaften (National federation of agricultural professional associations).

The GESTIS-Substance Database contains information for the safe handling of chemical substances at work, e.g. health effects, necessary protective measures and such in case of danger (incl. First Aid). Furthermore the user is offered information upon important physical and chemical properties for these substances as well as special statutory regulations and regulations of the Berufsgenossenschaften. The available information relates to approximately 8,000 substances. Data are updated immediately after publication of new official regulations or after the issue of new scientific results.

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