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Marketing and Regulatory Programs

Animal and Plant Health Inspection Service

Treatment of Light Brown Apple Moth in the Seaside Area in California

Environmental Assessment
July 2007

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I. Introduction

A. Biology of Light Brown Apple Moth

The light brown apple moth (LBAM) (*Epiphyas postvittana*) is native to Australia where it is an economically important pest on many fruit crops. The LBAM attacks a wide variety of plants including over 200 agronomically important crops and other non-crop plant species that occur in 120 plant genera (appendix A). In addition to Australia, LBAM has also been found in New Zealand, New Caledonia, Hawaii, and the British Isles. The moth lays eggs in overlapping masses preferably on leaves but also on fruit and stems of the host plant. The larvae hatch and then pass through six stages of growth reaching approximately 18 mm in length before pupation. Young larvae are pale yellow while the mature larvae are pale green (Mo, 2006). Larvae will feed on leaves and fruit from susceptible host plants. In all stages, larvae will construct silken shelters at the feeding site which is where pupation occurs. Both female and male adults are light brown in color. The females are distinguished by a dark spot in the center of the front wings when folded. The number of LBAM generations produced in a growing season varies from one to over four depending on environmental conditions (Danthanarayana, 1983; Mo et al., 2006). In cases where multiple generations occur in a season, the population can build to economically important thresholds quickly.

B. History of Infestation in California

In February 2007, LBAM was found near Berkeley in Alameda County, California. In response, pheromone-baited traps were placed in Alameda and Contra Costa counties in March 2007.

On March 16, 2007, the Agriculture Research Service Systematic Entomology Laboratory in Washington, DC, confirmed that the original finds were positive for LBAM. On April 20, 2007, California Department of Food and Agriculture (CDFA) issued a quarantine of at least 182-square miles in Alameda, Contra Costa, San Francisco, Marin, and Santa Clara Counties.

The United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS) issued a Federal Quarantine Order on May 2, 2007, requiring inspection and certification of all nursery stock and host commodities from the quarantine area. The quarantine area includes the following counties: Alameda, Contra Costa, Los Angeles, Marin, Monterey, Napa, San Francisco, San Mateo, Santa Clara, Santa Cruz, and Solano. The Federal Quarantine Order mandates trapping at a rate of one trap per 5 acres and imposes

additional conditions on the movement of host material to prevent the spread of LBAM.

Since March 2007, more than 34,500 traps have been placed throughout the State of California (CDFA, 2007a). The traps are baited bimonthly and serviced biweekly. There have been over 5,200 positive detections in 11 counties. Most of the captures (99%), however, are from traps located in two specific geographical areas. The first area, representing 92% of all LBAM captures, encompasses southern Santa Cruz and northern Monterey Counties. The second area, which represents approximately 7% of captures, includes contiguous portions of northwest Alameda, western Contra Costa, and northern San Francisco Counties. The remaining 1% is from isolated populations, mostly represented by single trap captures. Thus far, approximately 35 to 40 isolated populations have been identified and it is anticipated that additional ones will be discovered.

CDFA began treating two isolated populations during June 2007 in order to begin eliminating isolated populations and reduce the opportunities for LBAM to expand its range in California. An environmental analysis of treatments of isolated populations indicated that such treatments would not result in a significant impact to the environment (USDA, 2007a; USDA, 2007b). The two isolated populations where treatment has begun are in Napa (Napa County) and Oakley (eastern Contra Costa County). Both sites were treated via ground equipment with *Bacillus thuringiensis kurstaki*, (Btk), a biologically based pesticide that is effective against early larval stages of most lepidopterans, including LBAM. It is expected that each of these sites will receive between three and six treatments of Btk followed by treatments with pheromone dispensers. Treatments of additional isolated populations will start in the near future. It is anticipated that these future sites will use the pheromone dispensers.

C. Purpose and Need

APHIS is responsible for taking actions to exclude, eradicate, and/or control plant pests under the Plant Protection Act (7 United States Code (U.S.C.) 7701 et seq.). Therefore, it is important that APHIS take the steps necessary to eradicate LBAM from areas in California to prevent its spread to susceptible host plants throughout the United States. A team of scientific experts on LBAM was assembled in May 2007 to develop an eradication strategy. Their recommendations have been received and APHIS, in cooperation with CDFA, is developing an eradication program for LBAM. When the plan is finalized, an environmental assessment (EA) will be completed for the plan.

In the interim, treatment of small isolated populations of LBAM (less than 10 moths per trap) is believed to be a desirable strategy to limit the spread of the moth until an eradication program can be implemented. An EA that evaluated the potential impacts from eradication of small, isolated populations of LBAM was completed so that eradication of those populations could begin before LBAM could increase their populations in that area and spread to other areas making eradication more problematic (USDA, 2007b).

APHIS and CDFA believe that an important aspect for containing LBAM populations and not permitting them to expand their range is to limit the southern expansion of the Seaside area population center. The results of trapping thus far indicate that the LBAM population in the Seaside area is relatively sparse and that it is separated from the main population center further to the north in Soquel, California. This being the case, it should be possible to employ a mating disruption strategy to limit southward expansion of LBAM and to begin eradication in the Seaside area. Because several generations of LBAM can occur annually, it is important to begin this action before the populations expand beyond the ability of using mating disruption alone to control it. Therefore, this EA will consider the use of mating disruption for the treatment of LBAM in the Seaside area prior to an eradication plan being implemented. When the LBAM eradication plan is finalized, an EA will be completed on the eradication plan.

This EA has been prepared consistent with the National Environmental Policy Act of 1969 (NEPA) and APHIS' NEPA implementing procedures (7 Code of Federal Regulations (CFR), part 372) for the purpose of evaluating how the proposed action, if implemented, may affect the quality of the human environment. We are providing a 30-day public comment period for response to this EA, however, because of the nature of the LBAM infestation, treatment may need to begin prior to conclusion of this period. Regardless, all comments received during the comment period will be considered and if they result in changes to the eradication actions, the public will be notified.

D. Affected Environment

The treatment area includes approximately 38,000 acres encompassing the Seaside area in Monterey County, California (see appendix B). The Seaside area is the coastal region that includes the city of Marina to the north and the cities of Monterey and Seaside to the south. Seaside is an ocean-side community of approximately 33,450 residents 115 miles south of San Francisco, California. The city of Marina is located north of Seaside along State Route 1, approximately 100 miles south of San Francisco, California. Marina is the fastest growing

community in the Monterey Bay region and has approximately 20,000 residents. The city of Monterey has a year-round population of 30,000 and accommodates up to 60,000 people during peak tourist season. Visitors from around the world come to Monterey to experience its natural beauty, cultural resources, and rich historic past. The area has a mild Mediterranean climate with temperatures staying between 50 and 70 ºF year round.

The treatment area contains a mix of natural coastal beach, dune, and scrub communities, as well as developed commercial and residential areas. The western portion of the treatment area is a coastal beach area with sand dunes and native vegetation between the ocean and Route 1. To the east of Route 1 lie the developed residential and commercial properties of Seaside Marina. The city of Monterey, California consists of commercial and residential properties as well as some recreational parks. Marinas are located on the coast surrounding Monterey Bay.

The eastern-most portion of the treatment area is within the boundary of Fort Ord, an Army training center that was closed in 1994. Fort Ord has become the first nature reserve in the United States created for the conservation of an insect, the endangered Smith's blue butterfly. *Euphilotes enoptes smithi*. With the closure of the base, portions of the land were donated to California State University–Monterey Bay, and another portion was transferred to the Bureau of Land Management (BLM) which has been designated to protect and manage 35 species of rare plants and animals and their native coastal habitats. The land also has more than 50 miles of trails for the public to explore on foot, bike, or horseback. Agricultural fields growing a variety of minor-use crops are located in the northern part of the treatment area.

Del Monte Lake, Roberts Lake, and Laguna Del Rey Lake are in the southern end of the treatment area just south of Seaside, California. The treatment area also contains Monterey Peninsula Airport to the south and Fritche Federal Aviation Administration Airport to the north. A portion of the Salinas River is within the northern section of the treatment area.

The Monterey Bay National Marine Sanctuary (MBNMS) is a federally protected marine area offshore of California's central coast. Stretching from Marin to Cambria, MBNMS encompasses a shoreline length of 276 miles and 5,322-square miles of ocean. Supporting one of the world's most diverse marine ecosystems, it is home to numerous mammals, seabirds, fishes, invertebrates, and plants in a remarkably productive coastal environment. MBNMS was established for the

purpose of resource protection, research, education, and public use of this national treasure.

II. Alternatives

This EA analyzes the potential environmental consequences of the proposed action to eradicate populations of LBAM from Seaside and Marina, California, where they have been detected. Two alternatives are being considered: (1) no action by APHIS to eliminate LBAM, and (2) treatment of LBAM using applications of a pheromone for mating disruption.

A. No Action

The no action alternative consists of maintaining the current Federal order without further action by APHIS. Private landowners would manage LBAM infestations as appropriate.

Pursuant to the Federal Order, the following regulated articles would not be moved interstate from a quarantine area except in accordance with this Order:

- Nursery stock;
- Cut flowers, garlands, wreaths, or greenery of any plants;
- Trees and bushes, including cut Christmas trees;
- Greenwaste;
- Fruits and vegetables;
- Hay, straw, fodder, and plant litter;
- Bulk herbs and spices;
- Any other products, articles, or means of conveyance of any character whatsoever, when it is determined by an inspector that they present a hazard of spread of LBAM.

B. Treatment Alternative

The treatment alternative consists of maintaining the Federal Quarantine Order to prevent the artificial spread of LBAM, as well as using an insect pheromone to treat the Seaside area. Insect pheromones are compounds that are naturally produced by females for the purpose of attracting males of the same species. Distribution of pheromone throughout an area makes it difficult for the male to locate the female, thus disrupting mating for the species. For several lepidopteran pest species, including LBAM, the pheromone has been isolated and synthetically reproduced where it can be used to attract moths and disrupt reproduction. There are two pheromones available

to treat LBAM; a general tortricid pheromone that is attractive to species of the family Tortricidae (leafrollers) and an LBAM-specific pheromone. The LBAM-specific pheromone will be used when available.

Pheromone can be applied by hand in a dispenser suspended from the ground, or applied by ground or aerial application equipment in microencapsulated capsules. When used at efficacious levels, the pheromone reduces the ability of male LBAM to locate and mate with females. The dispensers are used at a rate of 250 dispensers per acre and are effective for 90 days before they need to be replaced. The microencapsulated pheromone is effective for 30 days. Therefore, several applications may be needed per year. Due to the size of the area to be treated, the initial application of pheromone is anticipated to be an aerial application of the microencapsulated pheromone. The eradication program is expected to extend to subsequent years if LBAM is found in the area after the initial round of treatments.

III. Environmental Impacts

A. No Action

Under the no action alternative the current Federal Order would remain in place without the application of pheromone. The use of insecticide applications would only occur by private individuals who need to control LBAM. This would leave infested non-agricultural areas with susceptible plant hosts without a coordinated treatment plan. Agricultural areas that had been previously treated for LBAM would be susceptible to re-infestation from adjacent untreated but infested sites. Re-infested sites would require additional pesticide applications thus increasing pesticide loading to the environment. Alternative pesticides may have higher use rates and increased risk to human health and the environment. In addition to environmental impacts, the economic costs to California agriculture could exceed $133 million dollars in lost production and control costs based on the gross value of crops in 2005 for apples, pears, oranges, grapes, apricots, avocados, kiwifruit, strawberries, and peaches (CDFA, 2007b). Potential costs could be higher if costs to nurseries and other host crops are included. The loss of revenue from international and domestic imports is currently unknown but could be significant if LBAM becomes established in California. In 2003, California shipped over $7.2 billion in food and agricultural commodities around the world (CASS, 2004).

B. Treatment Alternative

As mentioned previously, there are two types of synthetic pheromones available to treat LBAM. The leafroller pheromone contains a compound that female leafrollers emit naturally to attract male moths. The LBAM-specific compound contains both the general female leafroller chemical as well as a chemical produced solely by the LBAM female. The LBAM-specific pheromone consists of, (E)-11-tetradecen-1-yl acetate and (E,E)-9,11-tetradecadien-1-yl acetate. Both compounds have been identified in extracts of female LBAM and are active as a coalitive pair when combined (Bellas et al., 1983). The pheromone can be applied in individual dispensers, or, for larger areas, ground or aerial equipment can be used to broadcast spray the material.

The dispensers utilize the LBAM-specific pheromone that is contained within a sealed polyethylene tube containing 163.25 mg of (E)-11-tetradecen-1-yl acetate and 6.74 mg of (E,E)-9,11-tetradecadien-1-yl acetate. A wire is fused inside the plastic so that the dispenser can be twisted around a branch. The pheromone is released into the surrounding area and disrupts the ability of male LBAM to locate females. This treatment method has been shown to be an effective means of LBAM control in citrus, grapes, apple, and apricot orchards when adequate numbers of dispensers are used (Mo et al., 2006).

Over larger areas, pheromone can be applied in a biodegradable 80 to 150 µm microencapsulated polymer which has been shown to be an effective method of application when applied appropriately (Wilkins, 1990; Knight and Larsen, 2004; Mihou et al., 2007). The microencapsulated pheromone can be applied either by ground or aerial equipment and can consist of either the leafroller pheromone or the LBAM-specific pheromone.

1. Toxicity

Based on available toxicity data, both pheromones have low acute oral and dermal toxicity in rats with median lethal dose ($LD_{50;}$ i.e. the dose required to kill 50% of a test population) values of greater than 5000 mg/kg and 2000 mg/kg, respectively. Acute inhalation toxicity is also low based on the acute inhalation median lethal concentration ($LC_{50;}$ i.e. the concentration required to kill 50% of a population) value of greater than 5.25 g/L. These values are consistent with the toxicity profile for other lepidopteran pheromones that have been tested (OECD, 2002; Weatherston and Stewart, 2002). Available data suggests that lepidopteran pheromones have very low chronic toxicity to mammals (OECD, 2002; EPA, 1996). The pheromone is considered a slight to moderate dermal irritant and is not considered to be carcinogenic or mutagenic (Pacific Biocontrol Corporation, 2007).

Data for structurally similar pheromones indicate there is very low acute toxicity to birds with LD_{50} values greater than 2,000 mg/kg (Weatherston and Stewart, 2002). Toxicity to aquatic organisms is unknown for these two pheromones specifically; however, data for other pheromones suggests low acute toxicity to fish and moderate toxicity to aquatic invertebrates with fish LC_{50} values greater than 100 ppm, and aquatic invertebrate toxicity values in the upper ppb to low ppm range (Weatherston and Stewart, 2002; PMRA, 1994; Inscoe and Ridgway, 1992).

In summary, there are no reported adverse effects to humans, domestic or other nontarget animals, or the environment from the use of these pheromones.

2. Exposure and Risk

Lepidopteran pheromones are sensitive to ultraviolet radiation and oxidation where they breakdown rapidly in terrestrial and aquatic environments. The rapid breakdown and volatilization of lepidopteran pheromones and their mammalian toxicological profile have resulted in the Environmental Protection Agency (EPA) waiving the requirement of a food tolerance when applications do not exceed 150 g active ingredient/ac/year (EPA, 2007). In addition to rapid degradation, lepidopteran pheromones have very low solubility, or are insoluble in water suggesting low aquatic residues (OECD, 2002). The pheromone is reported to be insoluble in water (Pacific Biocontrol Corporation, 2007).

Exposure to humans, domestic and other nontarget animals, and the environment is expected to be minimal. In the case of the dispenser application, the pheromone is inside a plastic tube that is suspended in a tree; therefore, no human-related exposure from residues or drinking water is expected. The same would also be true for terrestrial nontarget organisms where exposure would be expected to be minimal. Exposure to aquatic organisms would not be expected when dispensers are used because label language prohibits discarding dispensers in surface water.

Pheromone that would be applied in open and residential areas as a microencapsulated material would not pose a risk to human health due to the known mammalian toxicity profile for lepidopteran pheromones and their environmental fate. Based on the known toxicology data for the pheromone, as well as similar types of compounds, acute and chronic effects do not occur at the highest concentrations tested, and none of the pheromones to date have shown any potential mutagenic or carcinogenic activity (Touhey, 1990; EPA, 1996; OECD, 2002). In addition to the lack of known toxicological effects, the exposure potential for humans is very low. No dietary exposure from food is

expected due to the volatility of the pheromone. Incidental exposure through drinking water sources or swimming pools is expected to be minimal since the pheromone is insoluble in water and would remain at the surface volatilizing and dispersing rapidly into the atmosphere. Both the low toxicity and lack of significant exposure result in minimal risk to human health from pheromone applications.

The only nontarget species that may be impacted by the use of pheromones could be native (or exotic) leafrollers that may be present and that could have their mating disrupted by the use of leafroller pheromone. Any impact to leafrollers would be minimal and temporary as populations would quickly recover due to immigration of leafrollers from adjacent, untreated areas. The use of LBAM-specific pheromone would only affect LBAM and no nontarget species would be impacted.

The microencapsulated pheromone will also pose minimal risk to aquatic organisms. This is based on the known toxicology data on the specific pheromones used in this alternative as well as similar types of compounds as discussed above. In addition, the pheromone will not be applied directly to open water per label instructions.

Based on the above information, the three small lakes, Del Monte Lake, Roberts Lake, and Laguna Del Rey Lake, in the southern end of the treatment area in Seaside, California and the Salinas River in the northern area are unlikely to experience a decrease in water quality due to the use of pheromone in the treatment area.

Likewise, the two protected nature areas (Fort Ord and NMNBS) will have no negative environmental effects because of the low rates of application, and favorable environmental fate and toxicity profile for broadcast applications of the related pheromone products. MBNMS has regulations prohibiting low-flying aircraft within certain zones in several areas along the coast. The treatment areas are not within these no-fly zones and, therefore, will not be affected.

C. Cumulative Effects

Cumulative effects from potential pheromone use over 2 or more years are not expected to occur based on the known toxicity data, the specificity of the pheromones to LBAM and leafrollers, and their minimal risk to human health and the environment. Cumulative impacts to nontarget butterflies and moths from the use of pheromones are also not anticipated because the pheromones are selective for LBAM and leafrollers.

Treatments of isolated populations of LBAM have begun in the Napa and Oakley areas. These treatments consist of using a combination of Btk and pheromone. Approximately 35 to 40 isolated populations of LBAM have been identified but there is potential of other isolated populations outside the main areas of concentration. There will not be any negative cumulative impacts from treatments in the Seaside area in combination with treatment of the isolated populations due to the fact that the pheromones only target leafrollers or LBAMs and the isolated population areas exist outside the Seaside treatment area.

An eradication plan is in development and, if implemented, will likely call for the use of pheromone treatments alone or in conjunction with other chemical treatments. The environmental effects of implementing an eradication plan will be analyzed in a separate EA once the plan has been completed. However, given the limited effects of the pheromone in use in this project, we can determine that there will be no cumulative effects from the combination of treatments in the Seaside area, treatments of isolated populations, and treatments that may be associated with the implementation of an eradication plan. The pheromones are specific to Tortricid leafrollers or LBAM and, as such, are unlikely to be affect nontarget organisms. The most likely impact would be eradication of LBAM in California.

D. Threatened and Endangered Species

Section 7(a)(2) of the Endangered Species Act (ESA) and its implementing regulations require all Federal agencies to insure their actions are not likely to jeopardize the continued existence of endangered or threatened species or result in the destruction or adverse modification of critical habitat. CDFA and APHIS are working with the U.S. Fish and Wildlife Service (FWS) and National Marine Fisheries Service (NMFS) to insure that treatment activities considered in this EA do not affect listed species or their designated and proposed critical habitats. No treatments will occur in Seaside until CDFA and APHIS have completed a determination of effects on listed species and their habitats and, if necessary, Section 7 consultation with FWS and/or NMFS has been concluded.

APHIS has designated CDFA as its non-Federal representative for the purpose of conducting informal consultation with FWS and NMFS on APHIS activities associated with the LBAM eradication program in California and will work with CDFA to develop all necessary consultation documents. Legally, APHIS retains ultimate responsibility for compliance with Section 7 of the ESA.

CDFA and APHIS will continue to work in close cooperation with NMFS and FWS during implementation any LBAM eradication efforts to insure that potential impacts to listed species and their designated critical habitats are avoided or minimized to the extent possible and are consistent with the statutory and regulatory requirements of Section 7 of ESA.

E. Other Considerations

Executive Order (EO) 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations," focuses Federal attention on the environmental and human health conditions of minority and low-income communities and promotes community access to public information and public participation in matters relating to human health or the environment. This EO requires Federal agencies to conduct their programs, policies, and activities that substantially affect human health or the environment in a manner so as not to exclude persons and populations from participation in or benefiting from such programs. It also enforces existing statutes to prevent minority and low-income communities from being subjected to disproportionately high or adverse human health or environmental effects. APHIS has determined that the environmental and human health effects from the proposed applications for treatment of LBAM in California are minimal and are not expected to have disproportionate adverse effects to any minority or low-income populations.

EO 13045, "Protection of Children from Environmental Health Risks and Safety Risks," acknowledges that children, as compared to adults, may suffer disproportionately from environmental health and safety risks because of developmental stage, greater metabolic activity levels, and behavior patterns. This EO (to the extent permitted by law and consistent with the agency's mission) requires each Federal agency to identify, assess, and address environmental health risks and safety risks that may disproportionately affect children. Care will be taken to minimize exposure of children to pheromone treatments, although the low toxicity of the pheromone minimizes any potential risk to children.

IV. Listing of Agencies and Persons Consulted

U.S. Fish and Wildlife Service
Ventura Fish & Wildlife Office
2493 Portola Road, Suite B
Ventura, CA 93003

National Marine Fisheries Service
Southwest Regional Office
501 West Ocean Blvd, Suite 4200
Long Beach, CA 90802–4213

U.S. Department of Agriculture
Animal Plant Health Inspection Service
Plant Protection and Quarantine
Emergency and Domestic Programs
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U.S. Department of Agriculture
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California Department of Food and Agriculture
Plant Health and Pest Prevention Services
1220 N Street
Sacramento, CA 95814–5607

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Appendix A. Light Brown Apple Moth Host List

Abies grandis (grand fir)
Acacia spp. (acacias)
Achillea millefolium (common yarrow)
Actinidia chinensis (Chinese gooseberry)
Actinidia deliciosa (kiwifruit)
Adiantum spp. (maidenhair ferns)
Alnus glutinosa (black alder/European alder)
Amaranthus spp. (amaranths)
Apium graveolens (celery)
Aquilegia spp. (columbines)
Arbutus spp. (madrone, strawberry tree)
Arctotheca spp. (capeweeds, cape dandelion)
Arctotis stoechadifolia (African daisy)
Artemesia spp. (mugwort, sage brush, tarragon, worm wood, etc.)
Astartea spp.
Aster spp. (asters)
Baccharis spp. (coyote brush, desert broom)
Boronia spp. (boronias)
Brassica spp. (broccoli, cabbage, cress, mustard, radish, turnip, etc.)
Breynia spp. (snow bush)
Buddleia spp. (butterfly bush)
Bursaria spp. (black thorns)
Calendula spp. (calendula)
Callistemon spp. (bottle brush)
Camellia japonica (camellia)
Campsis spp. (trumpet creeper, trumpet vine)
Capsicum frutescens (chile pepper)
Cardus nutans (musk thistle)
Cassia spp. (golden shower, pink shower, rainbow shower, gold medallion tree)
Ceanothus spp. (buck brush, wild lilac)
Cedrus spp. (cedar)
Centranthus spp. (fox's brush/heliotrope/valerian)
Chamaecyparis lawsoniana (Lawson's cypress)
Chenopodium album (fat-hen)
Chimonanthus sp. (wintersweet)
Choisya spp. (Mexican orange)
Chrysanthemum spp. (chrysanthemums)
Chrysanthemum x *morifolium* (mums)
Cirsium arvense (Canada thistle)
Cirsium vulgare (bull thistle)
Citrus spp. (citrus)
Clematis spp. (clematis, virgin's bower, lather flower, vase vine)
Clerodendron spp. (bleeding heart vine, bowers, tubeflower, Turk's turban)
Conyza bilbaoana (a fleabane)
Cordyline australis (cabbage tree)
Correa spp. ((Australian fuchsia)

Cotoneaster spp. (cotoneaster)
Crataegus spp. (hawthorn)
Crocosmia spp. (montbretia)
Cryptomeria japonica (Sugi)
Cucumis sativus (cucumber)
Cucurbita spp. (pumpkin)
Cupressus sp. ((cypress)
Cydonia spp. (quince)
Cyphomandra betacea (tree tomato)
Cytisus scoparius (Scotch broom)
Dahlia spp. (dahlia)
Datura spp. (angel's trumpet, Jimson weed, thorn apple)
Daucus spp. (carrot, Queen Anne's lace)
Dodonaea spp. ((hop bush, hopseed bush)
Diospyros spp. (persimmon)
Erica lustanica (Spanish heath)
Eriobotrya spp. (loquat)
Eriostemon spp. (wax flower)
Escallonia spp. (escallonias)
Eucalyptus spp. (eucalyptus, gum trees)
Euonymus spp. (euonymus)
Feijoa sellowiana (feijoa, pineapple guava)
Forsythia spp. (forsythias)
Fortunella spp. (kumquats)
Fragaria spp. (strawberry)
Fraxinus velutina (velvet ash)
Gelsemium spp. (Carolina jessamine)
Genista spp. (brooms)
Gerbera spp. (Transvaal daisy)
Gypsophila paniculata (baby's breath)
Grevillea spp. (hummingbird bush, grevilleas)
Hardenbergia spp. (lilac vine)
Hebe spp. (hebe)
Hedera spp. (ivy)
Helianthus tuberosus (Jerusalem artichoke)
Helichrysum spp. (curry plant, licorice plant, straw flower)
Humulus lupulus (hops)
Hypericum androsaemum (sweet-amber)
Hypericum calycinum (Aaron's beard)
Hypericum humifusum (trailing St. John's wort)
Hypericum perforatum (St John's wort)
Ilex sp. (holly)
Jasminum spp. (jasmine)
Juglans spp. (California black walnut, butternut)
Kunzea ericoides (white tea tree)
Lagunaria patersonii (Norfolk Island hibiscus)
Lathyrus spp. (sweet pea)
Lavendula spp. (lavenders)
Leptospermum spp. (tea trees)
Leucodendron spp. (silver tree)
Ligustrum spp. (privet)

Linum spp. (flax)
Litchi chinensis (litchi)
Lonicera spp. (honeysuckles)
Lupinus spp. (lupines)
Lycopersicum spp. (tomatoes)
Macadamia spp. (macadamia)
Malus spp. (apple)
Mangifera spp. (mango)
Medicago sativa (alfalfa)
Melaleuca spp. (honey myrtle, bottlebrush)
Mentha spp. (mint)
Mesembryanthemum spp. (ice plant)
Metrosideros excelsa (New Zealand Christmas tree)
Michelia spp. (michelia)
Monotoca spp. (broomheaths)
Myoporum spp. (myoporum)
Olea europaea (olive)
Oxalis spp. (lady's sorrel, redwood sorrel, wood sorrel)
Parkinsonia aculeata (Mexican Palo Verde)
Parthenocissus spp. (woodbine, Virginia creeper)
Passiflora edulis (passionfruit)
Passiflora mollissima (banana passionflower or passionfruit or poka)
Pelargonium spp. (florist's geraniums)
Persea americana (avocado)
Persoonia spp.
Petroselinum spp. (parsley)
Phaseolus vulgaris (common bean)
Philadelphus spp. (mock orange)
Phormium tenax (New Zealand flax)
Photinia spp. (photinia)
Picea spp. (spruce)
Pieris japonica (Japanese pieris or andromeda)
Pinus spp. (pines)
Pisum sativum (pea)
Pittosporum spp. (pittosporums)
Plantago lanceolata (narrowleaf plantain)
Plantago major (common plantain)
Platysace spp. (native parsnip)
Polygala spp. (milkworts)
Polygonum spp. (fleece flower, knotweed, smartweed)
Populus spp. (cottonwood, poplar)
Prunus amygdalus (almond)
Prunus armeniaca (apricot)
Prunus avium (sweet cherry)
Prunus domestica (plum)
Prunus persica (peach)
Prunus persica var *nectarina* (nectarine)
Pseudopanax sp. (lancewood)
Pseudotsuga japonica (Japanese Douglas-fir)
Pseudotsuga menziesii (Douglas-fir)
Pteris spp. (brake, dish fern, table fern)

Pulcaria spp.
Pyllanthus spp.
Pyracantha spp.(fire thorn)
Pyrus spp. (pear)
Quercus spp. (oak)
Ranunculus spp. (buttercups, crowfoot)
Raphanus spp. (wild radish)
Reseda spp. (mignonette)
Rhododendron spp. (rhododendron)
Ribes spp. (currant)
Robinia pseudoacacia (black locust)
Rosa spp. (roses)
Rubus spp. (blackberry, boysenberry, raspberry)
Rumex acetosa (garden sorrel, spinach dock)
Rumex acetosella (common sheep sorrel)
Rumex pulcher (fiddle dock)
Rumex crispus (curled dock)
Rumex obtusifolius (broadleaf dock)
Salix spp. (willow)
Salvia spp. (sages)
Senecio spp. (dusty-miller, groundsels)
Sequoia sp. (redwood)
Sida spp. (Virginia mallow)
Sisymbrium spp.
Smilax spp. (greenbrier, Jacob's ladder, wild sarsaparilla)
Solanum tuberosum (potato)
Solidago canadensis (Canada goldenrod)
Sollya spp. (Australian bluebells, bluebell creeper)
Sonchus asper (spiny sowthistle)
Sonchus kirkii (shore sowthistle)
Sonchus oleraceus (common sowthistle)
Thuja plicata (Western red cedar)
Tithonia spp. (Mexican sunflower)
Trema spp.
Trifolium spp. (clover)
Triglochin spp. (arrow grass)
Ulex europaeus (gorse)
Urtica spp. (nettles)
Vaccinium sp. (blueberry)
Viburnum spp. (arrowwoods)
Vicia faba (broad bean)
Vinca spp. (periwinkles)
Vitis spp. (grape)
Weinmannia racemosa (kamahi)
Zea mays (corn)
Zelkova serrata (Japanese zelkova)

Source: CDFA, 2007. Light Brown Apple Moth Pest Profile. http://www.cdfa.ca.gov/phpps/pdep/LBAM_profile.htm. Accessed June 26, 2007.

Appendix B. Treatment Locations for the Seaside Area