

*California Ornamental Research Federation/ UCCE*

*Watsonville, CA, April 21, 2009*

# Light Brown Apple Moth Biology

Frank Zalom

Dept. of Entomology

University of California

Davis, CA 95616



**UCDAVIS**  
UNIVERSITY OF CALIFORNIA

# Light Brown Apple Moth

## *Epiphyas postvittana*

First detected in California  
March, 2007 in Berkeley

It has since been detected in  
Alameda, Contra Costa, Los  
Angeles, Marin, Monterey,  
Napa, San Benito, San  
Francisco, San Mateo, Santa  
Barbara, Santa Clara, Santa  
Cruz, Solano, Sonoma and Yolo  
counties



# Light Brown Apple Moth

Native to Australia,  
specifically the southeastern  
quarter of Australia

Introduced into Tasmania, New  
Zealand, United Kingdom,  
Ireland, New Calendonia, and  
Hawaii

LBAM has been recorded from over 2,000 plants in over 50 families and 290 genera with some indication of preference for plants in the aster (Asteraceae), legume (Fabaceae), knotweed (Polygonaceae), and rose (Rosaceae) families....  
..... and Proteaceae



# Light Brown Apple Moth

In Australia, it is considered a major pest of apples, pears, oranges and grapes.

Estimated annual value in lost production and cost of control for these 4 crops in Australia is about AU\$21.1 million.

In California, production costs on these same 4 crops has been estimated at \$70.2 million, and a total of \$133 million when considering the impacts on all crops and nursery production.



# Light Brown Apple Moth

Order: Lepidoptera "scale wings"

Butterflies and Moths

Holometabolous - complete metamorphosis

4 life stages - egg, larva, pupa, adult

Larva and adult have very different ecological roles and behaviors;

Larvae - have chewing mouthparts and are plant-feeders; some species are major pests.

Adults - have siphoning mouthparts, and are nectar feeders.

# Light Brown Apple Moth

Family: Tortricidae

Leafrollers -

Called 'leafrollers' because larvae roll a leaf (or leaves or a leaf and fruit) together with webbing, and they feed inside.



## Family: Tortricidae

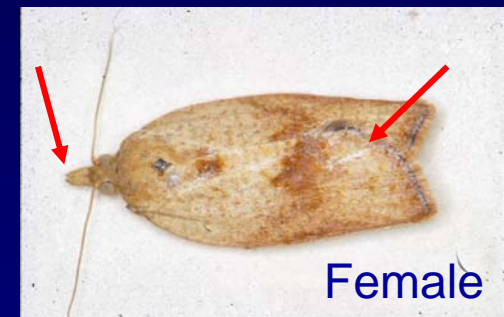
### Leafrollers -

Adults hold their wings over their abdomen in a bell shape when at rest, and have protruding mouthparts that resemble a snout.

Antennae are usually threadlike (filiform)

Adults have a 0.25-1.25 inch wingspan

Adults are usually gray, tan, or brown with dark bands or mottled areas; some species have metallic spots

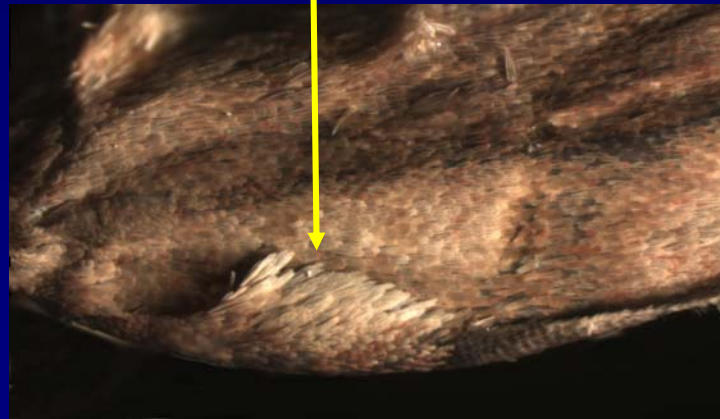


# Light Brown Apple Moth

Males - 0.3 inch (8 mm) long, with a range of 0.23 to 0.4 inch (6–10 mm)

Female - 0.27 to 0.5 inch (7–13 mm) long

Males have a fold along the outer edge of the forewing called the costal fold





# Family: Tortricidae

## Leafrollers -

Eggs laid in masses on leaves, described as 'shinglelike' or like fish scales.



Omnivorous Leafroller egg mass

# Light Brown Apple Moth

Eggs are white to light green when newly laid, broadly oval and flat, and are laid slightly overlapping each other.

An egg mass may contain up to 170 eggs, but typically has 20 to 50.



Photos from: <http://www-staff.it.uts.edu.au/>

# Family: Tortricidae

## Leafrollers -

Larva has chewing mouthparts - this is the damaging stage.

Larva goes through a series of molts - each time shedding its exoskeleton and becoming larger.

Anal comb located at the end of the abdomen.

Larvae wriggle vigorously backwards when disturbed.



Oriental Fruit Moth

UC Statewide IPM Project  
© 2000 Regents, University of California

# Light Brown Apple Moth

There are 5 to 6 larval instars .

Mature larva - 0.4 to 0.7 inch (10–18 mm) long.

The head is yellow-brown and the prothoracic shield (segment behind the head) is light greenish-brown with no dark markings. The body is medium green. The hairs on the body are whitish.



Larvae of the light brown apple moth often have three distinct darker bands running the length of the body

Family: Tortricidae

Leafrollers -

Pupa is quiescent, and does not feed.

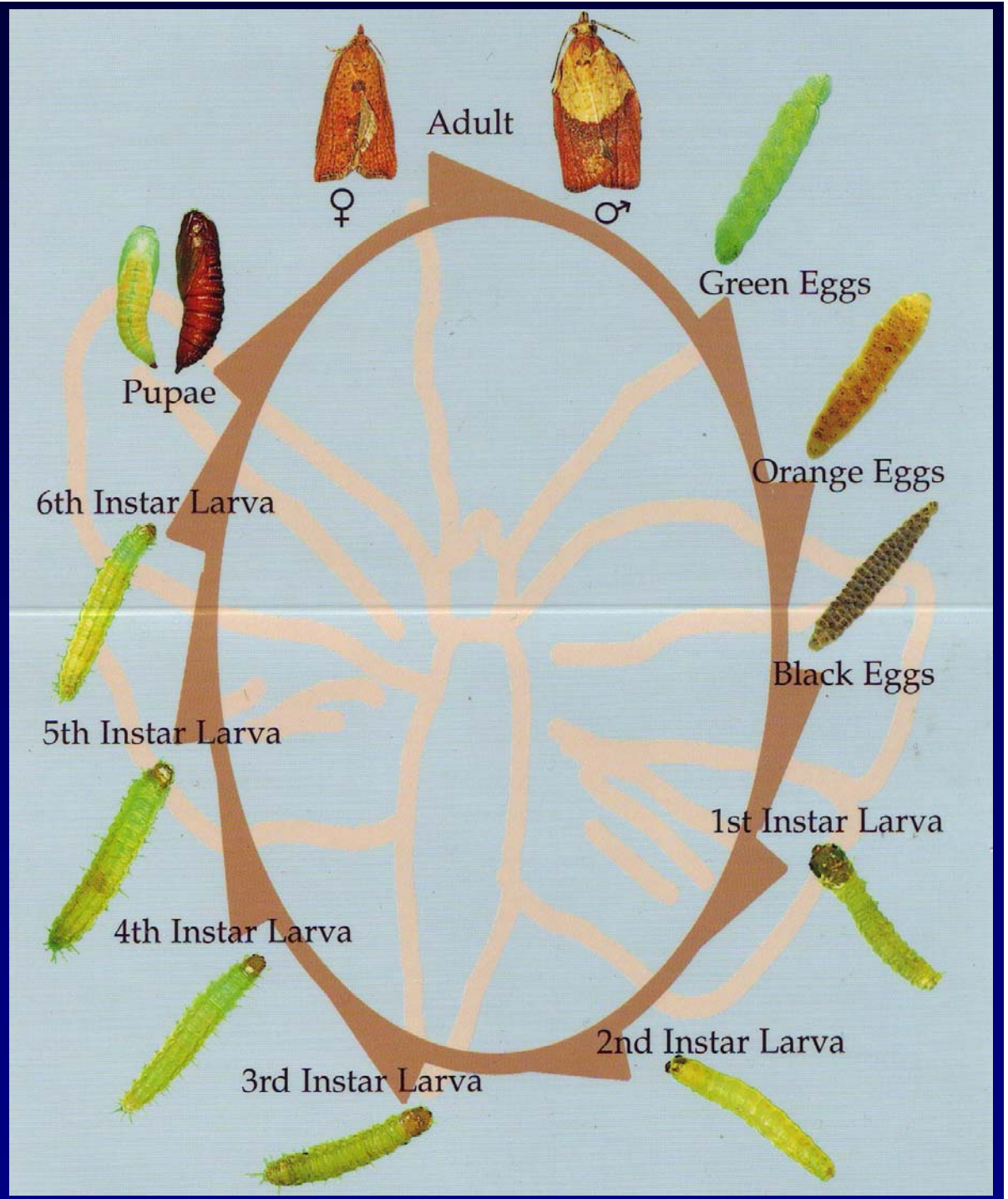
Obtect: Wings and appendages of the pupa are pressed against the body



This LBAM pupa has emerged from a cocoon spun at the calyx of an apple.

# LBAM

## Life Cycle -



# Light Brown Apple Moth

Development is continuous with no diapause, rather, development is slowed under cold winter temperatures.

Overwintering occurs in the larval stage.

In Australia, there are typically 2-3 generations per year.



# Light Brown Apple Moth

Physiological development - **an insect's developmental rate is based on temperature - the development time is faster at warmer temperatures.**



Measured by degree-days - **cumulative heat between developmental thresholds**

**Lower and upper developmental thresholds for LBAM are 45° and 88°F.**



# Light Brown Apple Moth

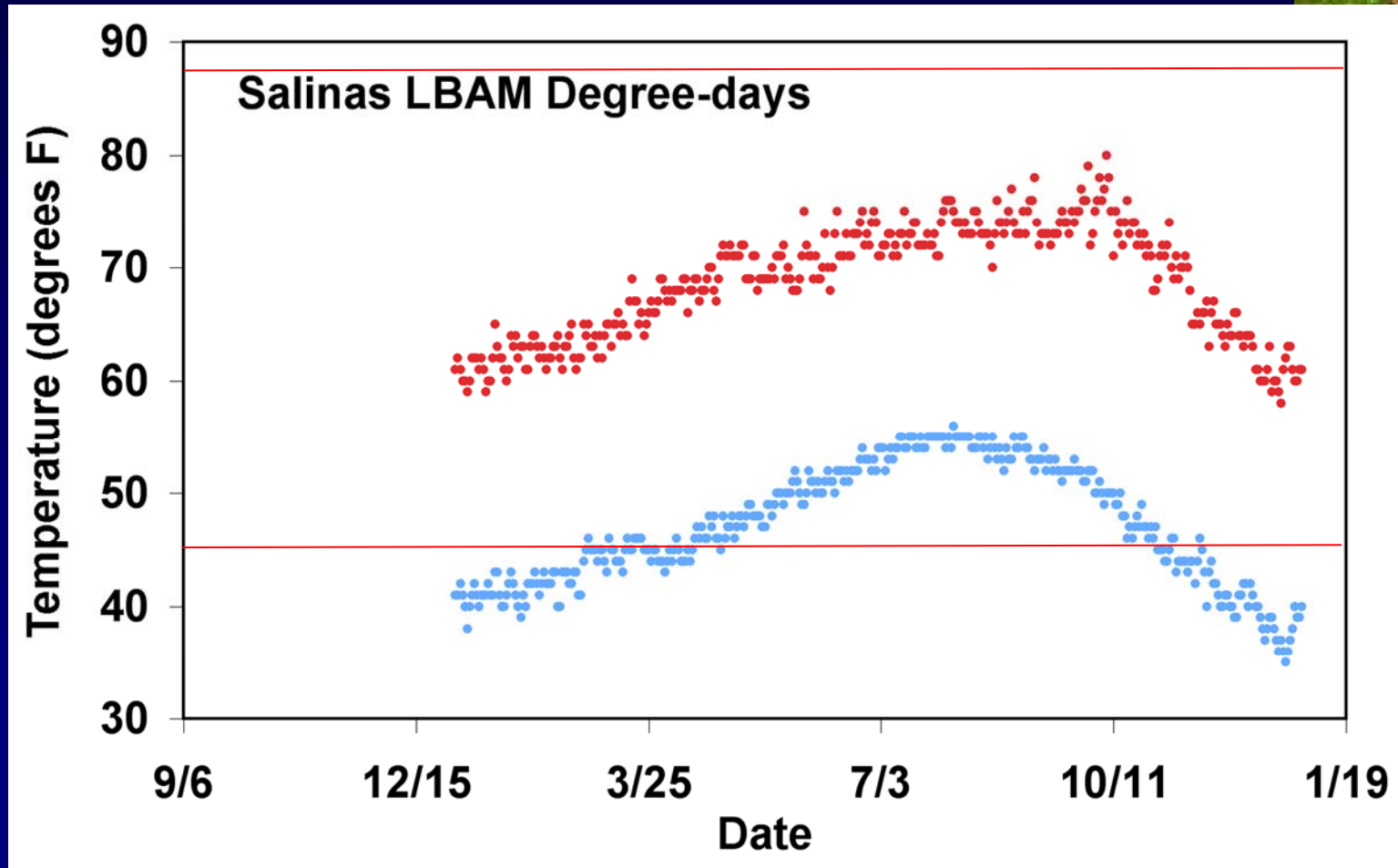
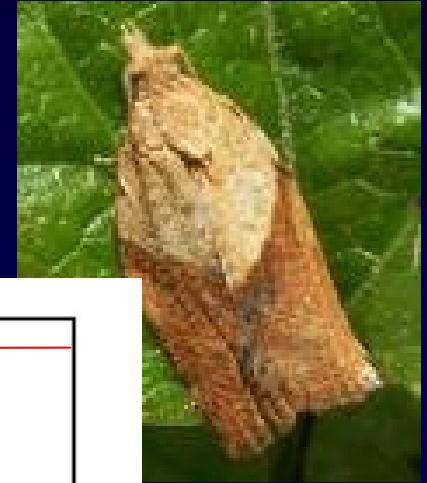
Lower threshold is 45°F

Upper threshold is 88°F

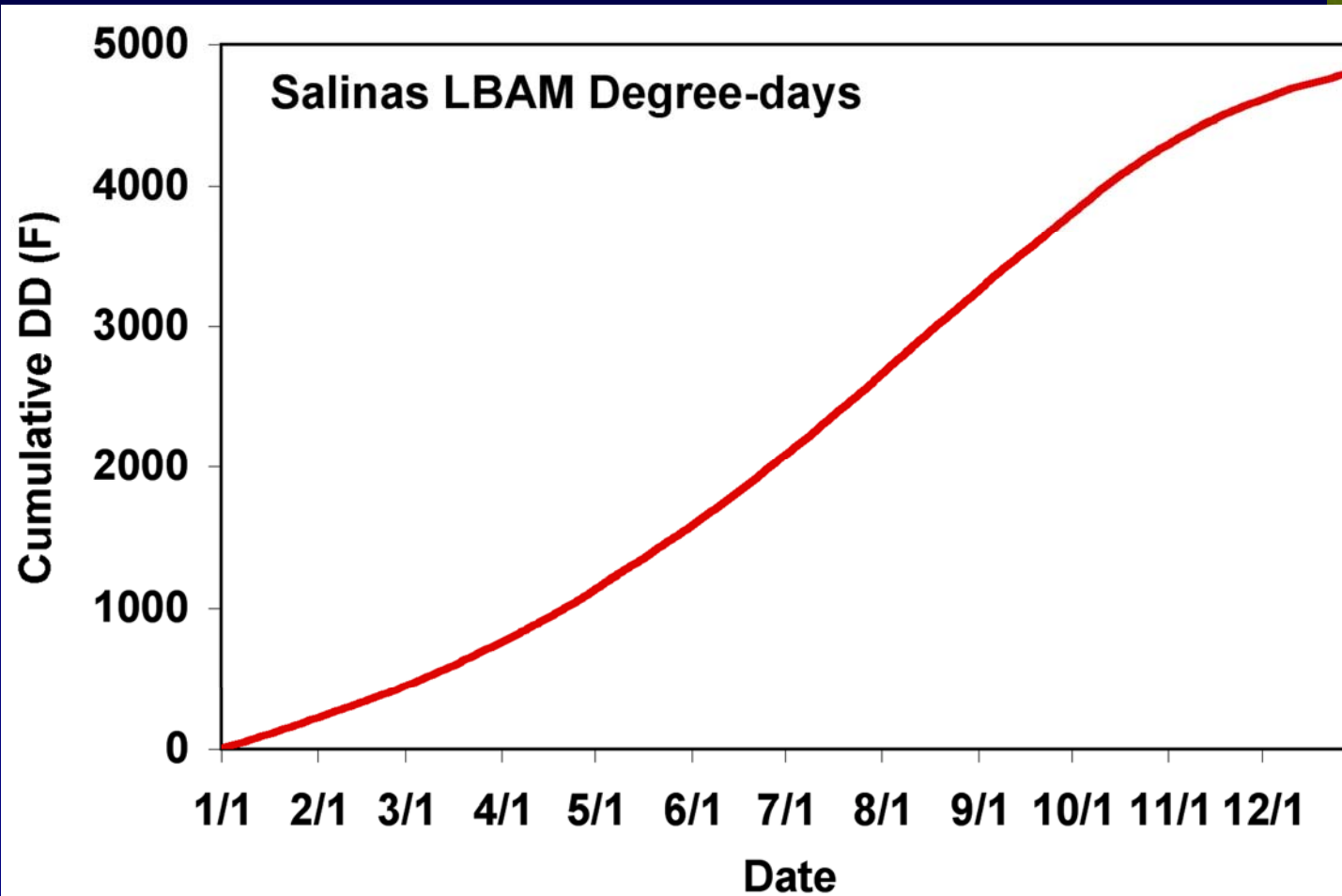


| Life Stage                            | Degree-days<br>(°F) |
|---------------------------------------|---------------------|
| Egg                                   | 236                 |
| Larva                                 | 685                 |
| Pupa                                  | 238                 |
| Adult (preoviposition)                | 54                  |
| Adult (Eclosion to 50%<br>egg-laying) | 149                 |
| Egg to first egg                      | 1117                |
| Egg to 50% egg-laying                 | 1212                |

# Light Brown Apple Moth

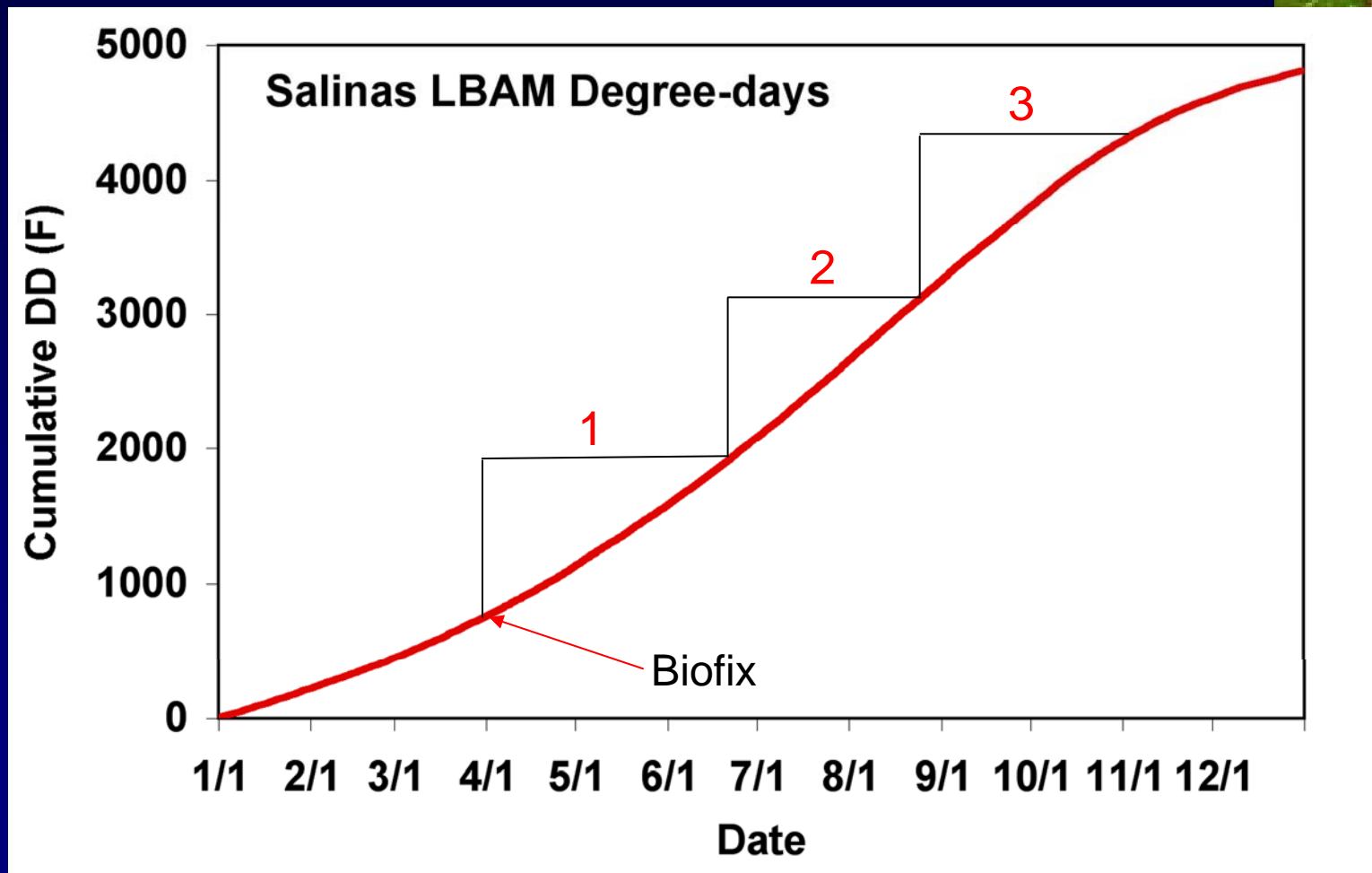


# Light Brown Apple Moth



# Light Brown Apple Moth

Generation times based on degree-days



# Light Brown Apple Moth

## Characteristics observed -

It is more abundant during the second generation.



It is a more serious pest in cooler areas with mild summers, moderate rainfall (~ 29 inches), and moderate-high humidity (~70%).

Hot, dry conditions may significantly reduce populations.

# Light Brown Apple Moth

Stage-specific biology - Adults

Moths are quiescent during the day and are found on foliage of hosts.

Flight occurs at dusk in calm conditions.

Females produce a pheromone to attract the males.

Females lay eggs for up to 21 days after mating, and can survive for up to 33 days.



# Light Brown Apple Moth

Stage-specific biology - Adults

Pheromone - chemical produced by the female to attract a male of the same species.



LBAM pheromone - ~95:5 mixture of (E)-11-Tetradecenyl acetate: (E,E)-9, 11-Tetradecadienyl acetate

(E)-11-Tetradecenyl acetate is the principle component of the pheromones of a number of leafroller species (including OLR) - so the precise blend of chemicals is important

# Light Brown Apple Moth

Stage-specific biology - Adults

Moths are unlikely to disperse from areas with abundant, high-quality hosts.

Males disperse farther than females:

In a mark-recapture study, 80% of recaptured males and 99% of recaptured females were within  
100 m of the release point.





# Light Brown Apple Moth

Stage-specific biology - Larvae

1st instar larva spins a silken tunnel, usually on the underside of a leaf, and feeds from the shelter.

2nd and later instars create feeding shelters by rolling leaves or webbing multiple leaves together.

Fruit are not a preferred feeding site, so feeding on fruit is believed to happen by chance.



# Light Brown Apple Moth

Stage-specific biology - Larvae

Larvae overwinter by locating sheltered niches which may be mummified fruit, ground vegetation, or leaf litter.



Larvae may survive winters without feeding for up to 2 months.

Sanitation - remove fruit mummies and overwintering host sites.

# Light Brown Apple Moth

At this point, LBAM is widely distributed in landscape plantings and natural landscapes.



# Light Brown Apple Moth

Monitoring is important!

Monitor with pheromone traps, and by looking for larvae and leafrolls - **the degree-day model can help to predict when flights will be occurring and to time pesticide treatments against younger instars which are easier to control and are less sheltered.**

Identification of other leafrollers -

# Other common leafrollers

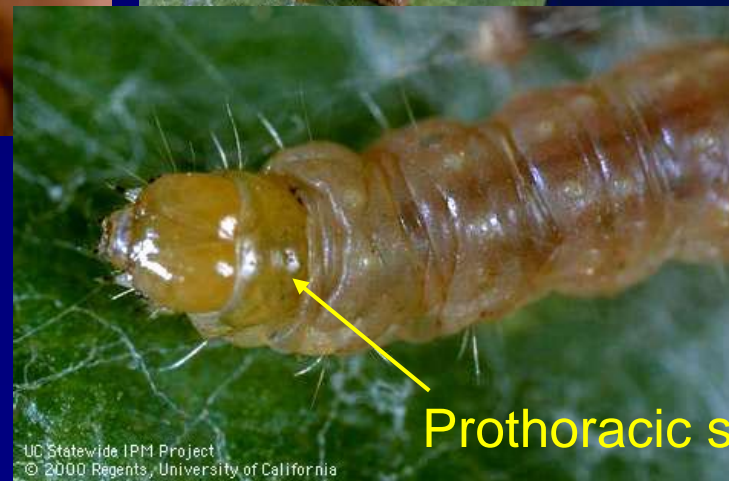
Omnivorous leafroller: *Platynota sultana*



# Other common leafrollers

Orange tortrix: *Argyrotaenia franciscana*

3 generations per year



Prothoracic shield

# Other common leafrollers

Apple Pandemis, *Pandemis pyrusana*  
2-3 generations per year



Garden Tortrix, *Ptycholoma peritana*  
2-4 generations per year  
Found in orange tortrix traps

# Other common leafrollers

Fruittree Leafroller, *Archips argyrospila*  
1 generation per year

Green larva with dark brown head and  
a tan plate behind the head





# Other common leafrollers

Obliquebanded Leafroller, *Choristoneura rosaceana*  
2-3 generations per year  
Greenish yellow larvae with dark heads



# Other common 'leafrollers'...don't roll leaves

Oriental Fruit Moth, *Grapholita molesta*  
5-6 generations per year



# Other common 'leafrollers'...don't roll leaves

Codling Moth, *Cydia pomonella*

3-4 generations per year

White caterpillars with black or brown heads

Eggs are laid singly on leaves, fruits, and nuts



The 'other' moth in  
the apple!

# *Other common leafrollers...are not Tortricids*

Grape leafroller (Family Pyralidae)

*Desmia funeralis*



# Light Brown Apple Moth

## **What if it is not eradicated?**

Management would probably similar to omnivorous leafroller or orange tortrix:

Monitoring - traps and degree-days; assess risk

Sanitation - remove overwintering sites in crops

# Light Brown Apple Moth

## Controls:

*Bacillus thuringiensis kurstaki* (various formulations of Bt), spinosad (Entrust and Success), spinetoram (Radiant), methoxyfenozide (Intrepid), tebufenozide (Confirm) and a number of organophosphates, pyrethroids and carbamates are reported to control LBAM. Other IGRs and Lep materials will probably work as well if they are registered.

Pheromone mating disruption - for chronic problems

Biological control - parasitoids, when some LBAM and damage can be tolerated

*California Ornamental Research Federation/ UCCE*  
*Watsonville, CA, April 21, 2009*

# Light Brown Apple Moth Biology

Frank Zalom

Dept. of Entomology

University of California

Davis, CA 95616



**UCDAVIS**  
UNIVERSITY OF CALIFORNIA