Invasion Biology of the Light Brown Apple Moth

James R. Carey (UC Davis)

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Thank Madam Chair for inviting me to testify to this committee.

I am James Carey, entomologist at UC Davis with specialties in invasion biology, insect demography, and population dynamics. I served on the CDFA medfly scientific advisory panel from 1987 to 1994 and also testified on the medfly crisis in the state to the California Legislature Committee of the Whole17 years ago.

The question regarding the LBAM invasion is not whether we want it eradicated—of course we do. Rather the question is whether it is possible to actually eradicate it.

Although I am not speaking for anyone other than myself, I have talked to eight different UC entomologists about the LBAM problem. Some of these are highly statured scientists within the UC System. Not one of these entomologists believes that the light brown apple moth can be eradicated. Nor do any of them believe that this is a recent invader. *Not one*. But none of these entomologists is willing to speak out because either of fear of retribution from the agencies and/or industry with regard to their research support or out of a feeling that supporting eradication efforts (even if blindly) shows their allegiance to agriculture mission. But given the extent of the LBAM infestation and the lack of control tools, I seriously doubt that there is any entomologist in the country who truly believes that eradicating this pest is possible at this stage.

I would like to first offer my scientific views of the LBAM problem and then make specific suggestions for actionable steps for both the short and long term.

The current distribution of the Light Brown Apple Moth (LBAM) in California, covering 10 counties with a combined area of more than 8,000 to 10,000 square miles (i.e., the size of Connecticut) suggests that this pest is not a recent introduction but has been in the state for many years, perhaps 30 to 50 years or longer. For perspective, the gypsy moth took more than 10 years to spread from the point of introduction in an amateur naturalist's back yard to his neighbor's yard, and over 30 more years to spread to three counties in Massachusetts. The argument that LBAM is a recent invader because no populations were detected by the CDFA in 2005 cannot be reconciled with LBAM's current widespread distribution. This recent invader argument is simply not credible. For the "recent invader" argument to be valid, the assumption would have to be made that the pest is capable of spreading 4,000 to 8,000 square miles annually or, alternatively, from 50 to 100 miles outward per year. However, there is no precedent for this rate of spread for any insect. Not even close.

Likewise the model of LBAM population growth contained in the declaration by CDFA that was signed October 31, 2007 by Dr. Kevin Hoffman not just lacks credibility, it is demographically incredulous. As the author of three books on demography including one on insect demography that is considered by many entomologists in the country as the go-to book for demography, as well as the associate editor of several scientific journals including one on demography, the population growth model presented by CDFA would not be taken seriously by any editor of any entomology or ecology journal in the world. The CDFA model has LBAM growing at a demographic speed of light with one moth producing two thousand trillion moths in 5 generations. This is the equivalent of 50 moths per square inch in Berkeley. As a demographer using actual per generation growth rates of LBAM published in one of the most elite ecology journal in the world (J. Anim. Ecol), my estimates for population growth would not be two thousand trillion moths but from 50 to 100 moths.

The history of eradication programs in which an exotic insect is as widespread as LBAM is in

California suggests that we have little if any chance of success because several key preconditions for conducting a successful eradication program are unmet. These include having:

1. An effective eradication tool. Mating disruption pheromone is a "control" tool and not an eradication tool. There are huge problems even with the use as a control tool. Never in the history of insect eradication has a pheromone ever been used for any eradication program, much less been successful in eradicating any insect population.
2. A monitoring system for delineating the full extent of the infestation at the beginning of the program as well as for identifying small populations in scattered pockets at advanced stages.
3. Strong public support so that ground crews deploying controls can have full access to private property over a sustained period.

Even under the best of circumstances eradication is difficult to achieve for the same reason that cases of advanced metastatic cancer are difficult to cure. That is, there is not one LBAM population but tens of thousands of populations infesting backyards, parks, fields and roadsides. Thus anything short of 100% effectiveness for each of these population pockets must be considered "control" and not "eradication" This because any of a number of residual pockets of LBAM can regenerate the original populations spread over a wide area.

Recommendations:

1. Do a reality check. This pest is so widespread, the control and monitoring tools so ineffective, and public support in urban areas so weak (if not hostile) that eradication is simply not an option. The US Forest Service tried to use DDT in the 1960s to eradicate the gypsy moth spread over an area not much larger than the area occupied by LBAM in California. The program failed, not because of lack of effort but because eradication is so incredibly difficult when pests are widespread, even with effective control tools.
2. Stop considering exotic pest situations as dichotomous—either eradicate or manage. In fact, there are any number of intermediate concepts including containment. Thus we should be considering creating a first rate program of containment of the LBAM rather than launching an eradication program that has no chance of success. Model after the 'slow the spread' program against the gypsy moth on the east coast and Midwest. Explore the concept of 'moth free zones' similar to what is used for fruit flies whereby if moths not captured in region with accepted monitoring protocols, then considered risk free and can ship commodities.
3. Revisit trade policy. Right now the biologists and entomologists at CDFA and USDA have to shoulder the lion's share of the burden for dealing with pests. However, just as some mountains cannot be moved and some cancers cannot be cured, many pests simply cannot be eradicated. Thus need to consider more realistic trade policy consider non-zero risk. It is in the interest of all trading partners since really comes down to an agreement of risk between a buyer and a seller. The same group who is buying today is selling tomorrow and they too may have to deal with reciprocal quarantines if they demand zero risk at every turn.
4. Get University of California involved. UC is the research arm of our state yet the only input UC writ large has to invasive pests is after the fact and picking up the pieces. To have token UC scientists on each panel amounts to little because there can be little independent thought on these panels. Everyone knows that the panel has its marching orders and, because these are technical advisory panels, the input is technical and not strategic. There are 150 ecologists just at UC Davis alone. There are probably 1,000 ecologists across UC system, many of whom are NAS members and elite scientists. This braintrust can be tapped and engaged in helping to deal with exotic pest problems from agriculture and forestry to marine and freshwater systems. UC involvement would provide a much-needed degree of scientific input that is independent and objective and in an early stage of decision making (e.g. before the decision

to launch an eradication program).

5. Help create discipline of 'invasion science'. I consider invasion biology at the same stage now as what conservation biology was 30 years ago—mostly anecdotes and protocol-driven policy rather than policy based on a set of unifying principles. For example, fisheries and wildlife used to be mostly case-studies. Now it has evolved into a more coherent science of conservation biology where many of the same principles for protecting endangered butterflies also apply to endangered elephants. Likewise, right now forest entomologists do not even communicate with crop entomologists about eradication concepts. What needs to evolve and where California can take the lead is to in taking steps for developing a coherent discipline of invasion science where the invasion biology, the monitoring, the trade policies and risk, and exclusion concepts, and intervention tactics are brought together into a more cohesive whole.

In closing, I will note that because I disengaged from invasion biology research and panel membership over 10 years ago, I can see this LBAM problems with both fresh eyes as well as from the perspective of having served on the CDFA medfly panel for 7-8 years. Broadly speaking, virtually nothing has changed operationally since I joined a panel in 1987. The only things that have changed is that emergencies are more frequent and pests the state has been dealing with for 20 or more years are more entrenched and widespread. It is clearly a time to take a hard look at our approach to exotic pests in the state and consider changing the way we do business.

Thank you.