Invasion Biology of the Light Brown Apple Moth

James R. Carey (UC Davis)

to

California Senate Environmental Quality Committee

The Marin Civic Center

March 13, 2008

Thank Mr. Chairman 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 the voices of these and virtually all other entomologists in the state are conspicuous by their absence. They are reluctant to speak out because many are either beholden to CDFA, USDA or industry for funding or they believe that supporting the agriculture industry means supporting CDFA's decisions regardless of their own scientific views. 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.

For perspective, please see Slide #2 in handout where I have plotted the spread of the gypsy moth on the east coast and used it as a frame of reference for the LBAM spread. Note that this pest to required at least 40 years to spread to 10,000 square miles from 1870 to 1910. Thus using the gypsy moth as a model I back-projected the current LBAM distribution to a starting point 40 years ago. Although the LBAM is not the gypsy moth, this is exactly how science is done—use the rates of another species to approximate the one you are interested in. If CDFA doesn't like the gypsy moth model, then they need to use another species for a model. But they cannot simply do science by assertion. They should be asked to present to the Senate Committee both a scientific paper and a credible model of spread that would stand up to peer review in a scientific journal.

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 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 (2,000,000,000,000) but 50 to 100 moths. Again, CDFA should be required to present to the Senate Committee a scientific paper (vetted by an independent scientists I might add) any species that has ever grown at the rate they claim in the declaration.

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.

Once again, CDFA should be required to present to the Senate Committee a scientific paper showing that a pest population on the scale of the LBAM population in our state can be eradicated using mating disruption.

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 (please see Slide #4 in handout). 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. Involve University of California. 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

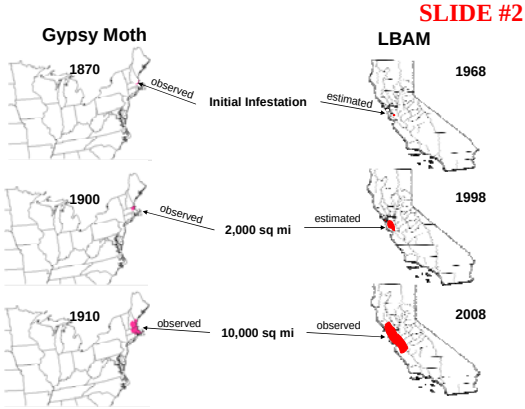
amounts to little because there can be little independent thought on these panels. Everyone knows that the panel has its marching orders and, because these are technical advisory panels, the input is technical and not strategic. There are 150 ecologists just at UC Davis alone. There are probably 1,000 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. 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.

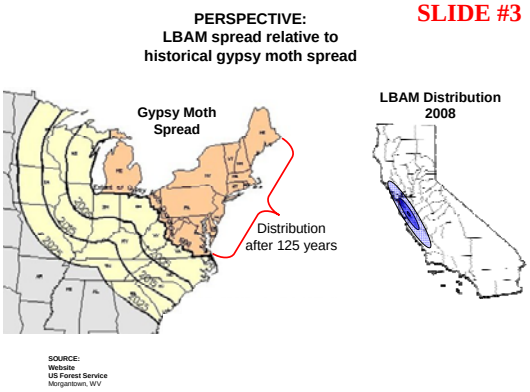
In closing, I will note that because I disengaged from invasion biology research and panel membership over 10 years ago, I can see this LBAM problems with both fresh eyes as well as from the perspective of having served on the CDFA medfly panel for 7-8 years. Broadly speaking, virtually nothing has changed 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.

SLIDE #2

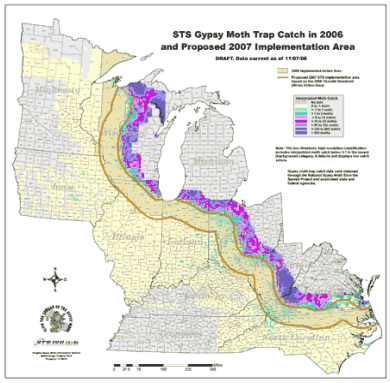


SLIDE #3



'Slow the Spread' Program of Gypsy Moth

SLIDE #4



JAMES R. CAREY
Professor of Entomology
University of California, Davis

EDUCATION/TRAINING

Ph.D.	Entomology	University of California, Berkeley	1980
M.S.	Entomology	Iowa State University	1975
B.S.	Fisheries and Wildlife Biology	Iowa State University	1973
Special Student	Population Biology	Harvard University	1977-78

MAJOR POSITIONS/EXPERIENCE/HONORS

2007-08	Vice-Chair (chair-designate), UC Systemwide University Committee on Research Policy	
2006	Smithgroup Distinguished Lecturer, University of Illinois Beckman Center	
2005	MaxNet Distinguished Lecturer, Max Planck Institute for Demographic Research (Germany)	
2003-present	Director, NIH-funded lifespan program (Stanford, UC Berkeley, UC Davis, Arizona)	
2003	Fellow: Gerontological Society of America	
2000	Fellow: American Association for Advancement of Science (AAAS)	
1997-99	Vice Chairman	UC Davis, Department of Entomology
1996-present	Senior scholar	Center for Demography of Aging, UC Berkeley
1992-present	Professor	University of California, Davis
1987-92	Associate Professor	University of California, Davis
1980-87	Assistant Professor	University of California, Davis

BIOSKETCH:

JAMES R. CAREY is Professor and the former Vice-Chair in the Department of Entomology at the University of California, Davis with research interests in insect demography, mortality dynamics, and insect invasion biology. He received his BS and MS degrees from Iowa State University (1973; 1975), Ph.D. from UC Berkeley (1980), and spent the 1977-78 academic year enrolled as a visiting graduate student at Harvard University to study with population geneticists Richard Lewontin and Richard Levins. He is the author of three books including "*Demography for Biologists* (Oxford University Press 1993), *Longevity* (Princeton University Press, 2003), and *Longevity Records: Life Spans of Mammals, Birds, Amphibians and Reptiles* (Odense, 2000) and the author of over 160 scientific publications on insect demography, aging and invasion biology. Eleven of these papers, letters, or technical comments have appeared in the journal *Science*. One of these was a life table study of 1.2 million medflies considered by many to be a landmark in aging research because it was one of the first studies to show definitively that mortality slows at advanced ages (1992 Science 258, 457). Professor Carey is the Principal Investigator of a project on fruit fly aging that is part of a National Institute on Aging-funded international research consortium on lifespan. He served on the editorial board of the journal *Evolution* from 1995-98, currently is on the editorial boards of *Demographic Research* and *Aging Cell*, was an invited expert for the National Research Council on "biodemography of longevity" in 1996-97, and served as co-convenor of the German-American Academic Council 1997-98 summer institutes on "*Social and Biological Determinants of Longevity"* held at UC Davis and the Max Planck Institute for Demographic Research in Rostock. He is a senior scholar at the Center for the Economics and Demography of Aging at UC Berkeley as well as a member of the AAAS (elected Fellow in 2000), Population Association of America (PAA), International Union for the Scientific Study of Populations (IUSSP), Worldwide Fruit Fly Working Group, and the Gerontological Society of America (GSA—elected Fellow in 2003). Dr. Carey served on the California Department of Food and Agriculture's Medfly Scientific Advisory Panel from 1987-1994, testified to the California Legislature "Committee of the Whole" in 1990 on the Medfly Crisis in California, authored the paper "*Establishment of the Mediterranean Fruit Fly in California*" (1992, *Science* 258, 457). He has previous or on-going research programs on tephritid fruit flies in Greece, Hawaii, Pakistan, China, La Reunion Island, and Mexico and an on-going research project on the life history and ecology of butterflies in Kibale National Park, Uganda. He was one of the main organizers of and senior editors for three international workshops and proceedings including "*Invasion Biology*" held at UC Davis in 1995, "*Eradication Revisited*" held in Sacramento in 1999, and "*Life span: evolutionary, ecological and demographic perspectives*" held in Santorini, Greece in 2001. Dr. Carey has also served on and/or chaired several major university committees at UC Davis including the College of Agriculture and Environmental Sciences Executive Committee, the UCD University Council (to the Chancellor), and the Academic Senate Affirmative Action Committee (Chair). He is currently vice chair and chair-designate of the UC-wide Academic Senate University Committee on Research Policy (UCORP).