

Responses to “Clear, Present, Significant, & Imminent Danger: Questions for the California Light Brown Apple Moth (*Epiphyas postvittana*) Technical Working Group”

Rebuttal to Carey and Harder

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The recent publication of Carey and Harder (2014) in the January issue of *American Entomologist* is deeply disturbing. The paper rambles through a multitude of sensational innuendos, aiming to condemn the Light Brown Apple Moth (LBAM) Technical Working Group (TWG), but their material is full of misleading statements and devoid of scientific substance. Needless to say, this type of attack hardly seems appropriate for a scientific journal and I have to question the judgment used by the editors of *American Entomologist* in publishing this manifesto.

I am not a member of the LBAM TWG, but I was unlucky enough to be one of those targeted by Carey and Harder. Though it is not clear why they chose me, they quoted a statement that I made during a conference: “When I heard about the decision to use mating disruption to eradicate LBAM, I thought to myself ‘How progressive!’”¹ Carey and Harder (2014) go on to equate

my comment with criticisms of Rachel Carson’s *Silent Spring* made in the 1950s by lovers of agrochemicals.

Carey and Harder’s attack on me was not only wrong, but also deeply offensive. The choice I made many years ago to study entomology was motivated out of concern about the adverse effects of pesticides in the environment and the need for alternatives. The search for co-existence between humanity and insects without the use of carcinogenic compounds has been a dominant personal inspiration for my career. To be accused of having no regard for public health or the environment is thus something that is very painful and unjust.

I believe that the use of semiochemicals, such as through mating disruption, is indeed a “progressive” approach to managing insect problems. Insect pheromones are naturally occurring compounds. The application of exceedingly low concentrations of a naturally occurring compound (pheromone) proposed for the LBAM program strikes me as a vastly safer approach to eradicating a potentially damaging pest than application of either chemical or microbial insecticides, which inevitably impacts

¹ Carey and Harder actually published a different, incorrect quote and, by the way, violated ESA publication rules in the process.

non-target organisms. Furthermore, mate-finding is typically a limiting factor in the persistence of low-density insect populations (Liebhold and Tobin 2008) and exploiting this “weak link” in the invasion process is logical. Thus, I contend that the use of mating disruption—in lieu of chemical or biological pesticides—is indeed a “progressive” approach to eradicating low-density populations.

If Rachel Carson were alive today, I think she’d agree that the problem of biological invasions is one of the most serious environmental problems of this century. An inadvertent side effect of globalization, the international movement of insects has been facilitated through accidental transport in cargo and inadvertent movement by international travelers. We are experiencing the establishment of an ever-increasing number of non-native insects, many of which have had catastrophic impacts on both natural and human-dominated ecosystems.

“If Rachel Carson were alive today, I think she’d agree that the problem of biological invasions is one of the most serious environmental problems of this century. An inadvertent side effect of globalization, the international movement of insects has been facilitated through accidental transport in cargo and inadvertent movement by international travelers.”

Many of these species have effectively destroyed complex natural ecosystems that provided a host of ecosystem services. Other species have had direct impacts on human health, while others have had tremendous impacts on agriculture. Their establishment often results in dramatic increases in pesticide use, leading to a variety of indirect environmental impacts as well as effects on human health.

Considering the enormity of impacts caused by invading insects, action is needed to prevent more species from inflicting these types of damages. While progress has been made in identifying and closing invasion pathways via quarantine and inspection (e.g., Leung et al. 2014), these methods are limited and will never be totally effective. Given the inevitable globalization of the world’s economy and concomitant increases in imports and travel, damaging species will continue to arrive, despite the best efforts of government agencies. Though invasive species cannot be totally excluded, surveillance and eradication can be an effective approach to excluding species establishment and consequently bring enormous ecological and economic savings (Simberloff 2009). As with quarantines, surveillance and eradication are rarely easy, but there are hundreds of instances in which invading insect species that have been successfully eradicated (Pluess 2012a, 2012b, Tobin et al. 2013).

Because arrival of alien species is associated with human

trade and travel, nascent populations of invading species are often initially found in urban centers (Colunga-Garcia et al. 2010, Koch et al. 2011). Consequently, a disproportionate fraction of eradication programs take place in areas where people live and work. Residents in these areas, however, may not be aware of the potential damage that could be caused by a specific invader nor understand the magnitude of the larger biological invasion problem. Consequently, residents may be adverse to government programs targeting eradication of invading populations. Social scientists have described this problem and acknowledged that regional control of biological invasions requires collective efforts by residents and other stakeholders (Epanchin-Niell et al. 2010, García-Llorente et al. 2011). Accomplishing this is not easy, but a critical component of building a collective effort is sharing credible, objective information about how society is impacted by invading species and also on how management tactics function and affect the environment.

Thus, there is a crucial need for educating the public about the invasive species problem and how the establishment of invasive pest species adversely affects their lives (Krasny and Lee 2012). This is further complicated because there is often a long lag between detection of an established population of an invader and the timing of discernable impacts that are noticed by residents (Crooks 2005).

Entomologists carry a heavy responsibility to educate society. Not only can entomologists play a key role in explaining to people how biological invasions affect their lives, they can also help explain how programs to manage invasions work and benefit society. In the case of the aborted LBAM eradication, this is an area where there was great failure. Not only were educational programs lacking, but a few individuals such as Carey, Harder, and colleagues provided grossly inaccurate information to residents via media and public hearings. This disinformation served to fuel suspicion about programs to manage the LBAM invasion. Below, I list a few examples of such incorrect and misleading statements that were made to the public about the LBAM eradication program:

“Moreover, use of broadcast pheromone spray to eradicate or control the moth is not effective because female moths issue a more concentrated scent plume than the dispersed pheromone scent of an aerial spray application, so male moths are able to find the females”

(Harder and Rosendale 2008). <http://www.pesticidefreezone.org/HarderNZReportFINAL.pdf>

In fact, there are literally hundreds of scientific papers about mating disruption, many of which document clear success in reducing insect abundance (Carde and Minks 1995, Suckling et al. 2014).

“Pheromone has never been used in any other eradication program. Entomologists know that it is simply not a tool that can be used in eradication because it’s ineffective even as a control tool. There aren’t exceptions.”

Testimony by James Carey, City of San Francisco hearing, 25 April 2008. <http://www.fogcityjournal.com/wordpress/363/panel-exposes-health-risksof-light-brown-apple-moth-chemical-spray>

As with the previous statement, the author appears to be unaware of the substantial body of literature on the successful use of mating disruption for control of insect pest populations. Carey also appears to be unaware of both published and unpublished records documenting the successful use of mating disruption in insect eradication programs.

“Eradication of populations of exotic insect species is especially difficult for the same reason that metastatic cancer is so difficult to cure—anything short of 100% elimination is control (management) and not eradication (cure). Thus even a 99% success in the elimination of metastases is ultimately a failure in the sense that small residual pockets of insects can regenerate the entire population.”

James R. Carey, declaration to Federal Court, 20 November 2007. http://www.lbamspray.com/00_Legal/JamesCareyDeclaration.pdf

This statement reflects a lack of understanding of the population biology of invading insect populations. There is a considerable body of literature on the role of Allee dynamics in invasion biology (Liebhold and Tobin 2008, Tobin et al. 2011, Ricciardi 2013). For sexually reproducing insect populations, Allee dynamics dominate at low densities and eradication can be accomplished via reducing a population below specific threshold densities (e.g., Liebhold and Tobin 2008, Boukal and Berec 2009). Thus, it is not necessary to kill 100% of a population in order to eradicate it.

These examples in which Carey, Harder, and colleagues disseminated incorrect information illustrate not only their lack of knowledge about these subjects, but also a lack of good judgment to refrain from speaking as an “expert” on matters for which these have limited knowledge. I realize that this is a harsh accusation, but I believe this is an important issue that must be addressed.

Though it is clear that considerable misinformation was disseminated to the public during the course of the aborted LBAM eradication program, there are legitimate questions that can be debated among entomologists about whether LBAM should or could have been eradicated. Addressing this subject is important because it may influence how invasions of other insect species are handled in the future. It is inevitable that new species will continue to arrive and some of these species have the potential to cause devastating economic and/or ecological damage. Should we sit back, take no action, and accept the degradation of natural ecosystems, loss of agricultural productivity, and decline in human health? Should we place greater emphasis on early detection of high-risk species so that eradication is less expensive and more likely to succeed? If we are to be more aggressive with efforts to survey and eradicate potentially damaging invasive species, we must also accept the important role of public education. When citizens are provided with objective information about the consequences of the establishment of an invasive pest, the benefits of eradication, and accurate, credible information about the tactics and strategies being employed, these citizens are likely to support their governments in making sound decisions (García-Llorente et al. 2011). Above all else,

scientists have a great responsibility to communicate accurate information to the public.

References Cited

- Boukal, D. S., and Berec, L. 2009. Modelling mate-finding Allee effects and populations dynamics, with applications in pest control. *Population Ecology* 51: 445-458.
- Carey, J. R., and Harder, D. 2013. ISSUES IN ENTOMOLOGY: Clear, Present, Significant, & Imminent Danger: Questions for the California Light Brown Apple Moth (*Epiphyas postvittana*) Technical Working Group. *American Entomologist* 59: 240-247.
- Carde, R. T., and Minks, A. K. 1995. Control of moth pests by mating disruption: successes and constraints. *Annual review of entomology*, 40: 559-585.
- Colunga-García, M., Magarey, R. A., Haack, R. A., Gage, S. H., and Qi, J. 2010. Enhancing early detection of exotic pests in agricultural and forest ecosystems using an urban-gradient framework. *Ecological Applications* 20(2): 303-310.
- Crooks, J. A. 2005. Lag times and exotic species: the ecology and management of biological invasions in slow-motion. *Ecoscience* 12: 316-329.
- Epanchin-Niell, R.S. M. Hufford, C. Aslan, J. Sexton, J. Port, and T. Waring. 2010. Controlling invasive species in complex social landscapes. *Frontiers in Ecology and the Environment* 8: 210-216.
- García-Llorente, M., Martín-López, B., Nunes, P. A., González, J. A., Alcorlo, P., and Montes, C. 2011. Analyzing the social factors that influence willingness to pay for invasive alien species management under two different strategies: eradication and prevention. *Environmental Management* 48: 418-435.
- Koch, F. H., Yemshanov, D., Colunga-García, M., Magarey, R. D., and Smith, W. D. 2011. Potential establishment of alien-invasive forest insect species in the United States: where and how many? *Biological Invasions* 13: 969-985.
- Krasny, M. E., and Lee, S. K. 2002. Social learning as an approach to environmental education: lessons from a program focusing on non-indigenous, invasive species. *Environmental Education Research* 8(2): 101-119.
- Leung, B., Springborn, M. R., Turner, J. A., and Brockerhoff, E. G. 2014. Pathway-level risk analysis: the net present value of an invasive species policy in the US. *Frontiers in Ecology and the Environment* 12: 273-279.
- Liebhold, A. M., and Tobin, P. C. 2008. Population ecology of insect invasions and their management. *Annu. Rev. Entomol.* 53: 387-408.
- Pluess, T., Cannon, R., Jarošík, V., Pergl, J., Pyšek, P., and Bacher, S. 2012a. When are eradication campaigns successful? A test of common assumptions. *Biological Invasions* 14: 1365-1378.
- Pluess, T., Jarošík, V., Pyšek, P., Cannon, R., Pergl, J., Breukers, A., and Bacher, S. 2012b. Which factors affect the success or failure of eradication campaigns against alien species? *PLoS one* 7(10): e48157.
- Ricciardi, A. 2013. Invasive Species, pp. 161-178. *In Ecological systems* (Leemans, R. ed.). Springer, New York.
- Simberloff, D. 2009. Eradication—preventing invasions at the outset. *Weed Science* 51: 247-253.
- Suckling, D. M., Stringer, L. D., Stephens, A. E., Woods, B., Williams, D. G., Baker, G., and El-Sayed, A. M. 2014. From integrated pest management to integrated pest eradication: technologies and future needs. *Pest Management Science* 70: 179-189.
- Tobin, P. C., Berec, L., and Liebhold, A. M. 2011. Exploiting Allee effects for managing biological invasions. *Ecology Letters* 14: 615-624.
- Tobin, P. C., Kean, J. M., Suckling, D. M., McCullough, D. G., Herms, D. A., and Stringer, L. D. 2014. Determinants of successful arthropod eradication programs. *Biological Invasions* 16: 401-414.

Response to Liebhold's Rebuttal

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We stand by all of our public statements regarding the LBAM eradication program. We dismiss Dr. Liebhold's personal attacks, criticisms of Dr. Carey's science, and issues concerning the judgment of the *American Entomologist* editor and others for the decision to publish our article.

We offer four comments on his response. First, Liebhold's original perspective at the 2010 ESA meeting in San Diego about how enlightened were those entomologists who advocated spraying chemical pheromone was in reference to a proposed government program involving many years of monthly aerial treatments over 500,000 acres of dense human populations with the express purpose of eradication. In his response in *American Entomologist*, he switches perspectives by promoting the use of chemical pheromone in smaller-scale IPM contexts (i.e., suppression/control) as strategically "enlightened." His comment that "In fact there are literally hundreds of scientific papers about mating disruption, many of which document clear success in *reducing* insect abundance" misses and distorts the point. *Reducing* insect abundance does not equal *eradication*. In fact, it is precisely not *eradication*.

Second, Liebhold's comment that "Carey also appears to be unaware of both published and unpublished records documenting the successful use of mating disruption in insect eradication program" offers no evidence. Show us the records. Why hasn't he listed citations to support his claim? What are the specifics of those examples where mating disruption ended in permanent eradication over large areas? Was it an "agency" definition of eradication—three life cycles/a few days, followed by another quarantine several months later for the same pest in the same place? Why are the unpublished records still unpublished if this is such a novel and effective way to eradicate?

Third, conspicuous by its absence in Liebhold's response is any reference to the title of his presentation at the 2010 ESA symposium—"The Triumph of Hysteria over Science." What is Dr. Liebhold's evidence that "hysteria" was the primary driver

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"His comment that 'In fact there are literally hundreds of scientific papers about mating disruption, many of which document clear success in *reducing* insect abundance' misses and distorts the point."

for 30,000 people signing petitions against aerial spraying, for some groups to spend hundreds of thousands of dollars in legal fees, for other groups to pass 32 city/country resolutions, and for local, regional, and state politicians to propose seven pieces of legislation? He must be aware that Bay Area residents are among the most educated and informed in the country, especially on environmental issues (e.g., many residents are employees of Apple, Facebook, Twitter, Stanford, UC-Berkeley, and the Naval Postgraduate School) and that the Bay Area is also the home to one of the most progressive and informed environmental groups in the nation—the Sierra Club.

Fourth, Liebhold's statement that "Carey, Harder, and colleagues disseminated incorrect information" fails to acknowledge that some of Carey and Harder's "colleagues" who contributed opinions and information about the LBAM program included a former USDA laboratory director, the current ESA president, and two National Academy of Science members, one of whom is the in-coming ESA president as well as the newest recipient of the U.S. National Medal of Science.

We close by agreeing with Dr. Liebhold's statement, "Above all else, scientists have a great responsibility to communicate accurate information to the public." That is what our meticulously researched "Issues" paper in the *American Entomologist* does.

Final Response to Carey and Harder

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I thank Dr. Carey and Dr. Harder for their response to my earlier comments. However, their affirmation that they stand by their earlier public comments on the LBAM eradication program strikes me as odd considering that they do not offer direct support for their statements that I identified as incorrect and misleading.

For example, they do not offer an explanation for Dr. Carey's testimony that eradication requires 100% mortality in target populations. As I pointed out, this statement reflects a lack

of understanding of the population biology of invading insect populations, something that I would have expected, at least from Dr. Carey.

In response to my critique of Dr. Carey's testimony that mating disruption has never been used in any insect eradication programs, Carey and Harder re-assert the validity of this statement, apparently still unaware of the documentation of such programs. I can suggest that Dr. Carey and Dr. Harder start by querying the

GERDA international online eradication database (<http://b3.net.nz/gerda>) as well as a summarization analysis of GERDA provided by Tobin et al. (2011) (cited in my earlier response) as a starting point to the documentation contradicting Dr. Carey's testimony.

I was also disappointed that Carey and Harder apparently failed to understand my description of why I felt (and still feel) that the selection of mating disruption was a progressive approach to eradication. The point that I made is that mating disruption directly enhances Allee effects that naturally limit the establishment of sexually reproducing organisms, such as LBAM. As such, mating disruption not only offers a diminished environmental impact compared to microbial and chemical

pesticide treatments, but may also be considerably more effective in eradicating invading insect populations. Thus, the selection of mating disruption for eradicating LBAM struck me as an enlightened decision that I applauded.

Finally, I must point to the approach taken by Carey and Harder in deflecting criticism by implying that my critiques of their statements are actually attacks on other individuals such as the incoming and outgoing ESA presidents, the citizenry of the San Francisco Bay Area, and the Sierra Club. This is certainly not the case and their attempt to make this association is perhaps another example of their tendency to foment "hysteria" rather than a scientific discussion of knowledge.