WORKSHOP ON INVASIVE PEST POLICY IN AGRICULTURE

TITLE: Toward a 21st-century invasive pest policy: Reconceiving the strategic framework

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SPONSOR: College of Agriculture and Environmental Sciences, UC Davis

DATES: TBA

VENUE: Buehler Alumni Building, Founder's Board Room

SPECIFIC AIMS

The broad goal of the proposed workshop is to assemble approximately a dozen key thinkers in invasive pest policy, exclusion, and trade from the USDA, CDFA, and academia to reconceive the policy framework within which invasive pest protocols and action guidelines are developed. The specific aims include: (1) Discuss and ultimately reframe the major components of invasive pest policy (i.e., exclusion, monitoring, intervention, trade); (2) Publish a position paper in a high-impact journal such as *Science* (in the Policy Forum section) and (3) create a plan to move the overall framework forward with series of topic-specific workshops (e.g. detection; quarantine) followed by a synthesis colloquium involving academia, industry and state and federal agencies.

OVERVIEW

Although there is near-universal agreement among agency administrators, academic scientists, and industry representatives that invasive pests represent some of the most pressing problems for California agriculture, the response to this widely acknowledged threat has focused more on improving details of protocols that were developed several decades ago and less on revisiting the broad strategic framework.

Breathtaking and revolutionary advances during the past decade in many areas of *data-intensive science*, including genetics, genomics, molecular biology, informatics, and modeling, could be applied to make invasive species policy more cost- and resource-efficient, more effective in preventing physical damage and satisfying economic and trade concerns, less burdensome and disruptive to farmers, and less dependent on widespread chemical intervention and therefore potentially more acceptable to the public. The scientific and technological advances of the past 10 years call on us to take stock, not just of specific tactics and protocols that are currently being used, but of the entire invasive pest paradigm, from monitoring and intervention to quarantine and trade. The whole and not just the individual components of overall invasion policy need to be rethought to enhance its congruency and the complementarity as well as to respond to pressure from an increasingly sophisticated public.

The current approach of identifying high-risk or "Class A" pest has outlived its usefulness for a number of reasons. First and perhaps most important, eradication programs, once conceived of as temporary or at most intermittent, have become continuous for a number of these pests, such as the medfly and oriental fruit fly. Agencies can only expend so many resources for so long on perpetual eradication programs for even a small number of species. As global warming, increasing global trade, and other pressures increase the numbers of introduced species arriving in the U.S., it will become impossible for agencies to mount the financial and human resources to carry out eradication programs for scores of species (Myers et al. 2000). In addition, some of the key "Class A" pests like the medfly have almost certainly become established and will continue to spread, requiring broader and more costly and disruptive treatment programs. Add to this the growing academic literature on "sleeper pests" that can be present in an ecosystem for decades before they finally naturalize and then spread rapidly, becoming major pests. It is, in short, not feasible to exclude, monitor, and eradicate or manage all of these pests. A new approach is needed. The concept of an "actionable" pest needs to take into account a multiplicity of criteria, and any proposal to undertake eradication needs to consider feasibility (how widespread the pest is), tools available and their cost, socio-economics, the likelihood of reintroduction year after year, and many other factors.

With the goal of re-envisioning the entire invasive pest paradigm, this workshop would encompass a variety of subjects such as the following, which are examples of the types of research topics that would form part of a 21st-centry invasion policy:

1. **Dichotomous residency policy**. Currently, policy considers pest residency as dichotomous; that is, a pest is either present or absent (or on the way to eradication). In reality, there are degrees of residence along a "residence spectrum," from a sole individual that dies without ever finding a mate to a resident continuously-breeding population. Zero tolerance is too extreme in many cases, for many reasons, including the economic infeasibility of enforcing such a standard. Therefore, management policy must be based on risk assessment. The key trade risk is the likelihood that an affected locality might EXPORT the pest in question. That risk is of course also impacted by the quarantine and biosecurity measures of the export partner (destination). This topic is directly related to the *Grower and Trade* topic below.

2. **Genetic observatories**. Although genetics is now being used to identify source regions for invasive agricultural pests of California, there are far greater potential uses for genetic information that could enable agencies to develop a more solid basis for pest strategies (Davies et al 1999.; Bohonak et al. 2001). Research initiatives are needed to build 21st-century "genetic observatories" that could provide unparalleled insight into the population dynamics of invasive (as well as other) species. These observatories could provide crucial empirical data on why some introductions lead to outbreaks (i.e., move up the residency risk spectrum) while others just peter out. Imagine a real-time visualization of the genetic flux of insects across a geographic area over many years, with vegetation, climate, and human activities (roads, ports, land-use) overlaid on it and algorithms for dynamically assessing risk to commerce (trade to specific destinations) and production/conservation (locally). Such a system could start relatively simply and increase in sophistication over time. It would provide an "eco-intelligent" strategic basis for USDA and CDFA to develop policies and establish appropriate monitoring infrastructure for application of these policies.

3. **Control tools.** Endosymbotic bacteria can provide a genetic modification (GM)-like approach, which is sometimes considered biocontrol, making it easier to gain acceptance and permits. Lethal semen is one candidate strategy that could kill females on mating rather than simply rendering them sterile as with current sterile insect technology (Lung et al. 2002). These and other advances in the molecular biology of *Drosophila* have yet to find their way into the applied literature.

4. **Arrival time of invasive pests.** Determining the arrival time of invasive pests is critical not only for understanding the biology of invasions but also to guide decisions for management and control (Carey et al. 1996). Estimating arrival time is typically difficult for several reasons, including: the size of invasive populations is often small; invasive species populations can grow in size undetected; and many species considered invasive here are also invasive in many other places, making it difficult to track invasion pathways based only on ecological presence/absence data. New "next-generation" DNA genotyping tools (for a review, see Metzker 2010) should allow us to estimate, at least qualitatively and perhaps also quantitatively, demographic parameters such as time since colonization, as well as founding population size and current population size. Previously, these tools have been available only for model organisms such as humans and *Drosophila*, but they are now becoming accessible at reasonable cost for the study of non-model species, such as invasive pests (Roderick 1996).

5. **Invasion lags and "sleeper" pests.** Two important new concepts have emerged in the general invasion biology literature that have direct relevance to invasive agricultural pest research and policy. The first is time lags which can be found throughout the invasion process, including in the arrival, establishment, and impacts of invaders (Crooks and Soule 1999; Crooks 2005). Exotics can exist in relatively low numbers for decades before exploding, or invaders can become more aggressive over time and increase their numbers dramatically. Invasion-related lags are critical for efforts to manage invaders because they may lead us to make inaccurate assessments of the risks posed by invaders as well as miss critical windows for action. Recognition of the phenomenon of long lags before sudden changes in invader dynamics also suggests that

we adopt a strict precautionary principle: long periods of seemingly consistent behaviour (e.g. extremely small populations) can be poor predictors of what invaders will do in the future. A complementary concept has emerged in the invasive weed literature referred to as "sleeper weeds" defined as a sub-group of invasive plant species whose population sizes are known to have increased significantly more than 50 years after they became naturalized (Groves 2006). The literature on invasive insects has yet to recognize these concepts and, in turn, integrate them into research and intervention policy.

6. **Grower and trade**. A revisited invasive pest policy would consider placing more responsibility with and power in the hands of the growers. Agreements between a buyer and a seller could, for example, be based on a minimum number of traps or detection counts that are defined as low risk, allowing the grower to ship. Or quarantine compliance could be based on inspections of shipments rather than farmers' fields, such as is done for some imported produce. Placing the responsibility in growers' hands is where pest policy is moving, of necessity. Government agencies have neither the funding nor the infrastructure to manage the likely increase in the number of invasive species that will accompany both global warming and the ever-increasing movement of invasive pests around the world. Strategies such as low-risk agreements, backed by the types of scientific research described in the subsections above, will minimize health and environmental impacts of pesticides, and, in this scenario, if pesticides must be used, their use by individual farmers will be "rifle" rather the wide-area "shotgun" approach of an agency carrying out a regional program. Farmers can also avail themselves of sterile flies for applicable species, as Mexican mango growers use for Mexfly. Allowing each farmer to determine the strategy that makes most sense for his or her circumstances means that farmers whose produce might be devalued in the eyes of consumers if certain types of treatments are used will be able to make the choices that are best for their clientele. Trade policy in this scenario would involve certification from USDA/APHIS that a region is pest free (low risk) based on criteria worked out with a grower cooperative and could involve state-by-state and/or state-by-country agreements (i.e., conditional on agreed-upon risk level).

WORKSHOP FORMAT

The 2 ½-day workshop will involve approximately a dozen invitees (plus observers) and will be held at the UC Davis Buehler Alumni Center Board Room at a date to be determined. Prior to the meeting a 3- to 5-page white paper will be developed on the topic of reconceiving the invasive pest paradigm. This paper will be developed by UC Davis scientists participating in the workshop, in consultation with CDFA and USDA participants. The white paper will be used as a discussion framework for the workshop. The first two days of the workshop will consist of short presentations on state-of-science and -policy developments relevant to invasive pests and eradication programs, frank discussions of concerns about existing policies and their constraints, and brainstorming sessions on rethinking policy in each of the key relevant domains (i.e., exclusion, monitoring, intervention, and trade). The last half-day will focus on plans for finalizing the position paper for publication and planning the next steps in making the various recommendations and ideas operational.

TENTATIVE POOL OF INVITEES

Name	Affiliation
Douglas Luster	USDA ARS
Phillip Berger	USDA APHIS
David Kaplan	USDA/APHIS
Isi Siddiqui	USDA/APHIS
Karen Ross	CDFA Director
James Carey	UC Davis (entomology)
Frank Zalom	UC Davis (entomology)
Michael Parrella	UC Davis (entomology)
Daniel Sumner	UC Davis (ag econ)
May Berenbaum	Illinois (entomology)
George Roderick	UC Berkeley (invasion genetics)
Neil Davis	Morrea Field Station (genetics)
Mark Davis	Invasion Biology (Minnesota)
Richard Rominger	CDFA/USDA (retired)
Rick Bostock	UC Davis (plant path)
Additional candidates	Academia and/or USDA/CDFA

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