

Strategic Plan for Endemic and Invasive Pests and Diseases (EIPD) Initiative 2017

2017 Authors: EIPD Strategic Initiative Panel: Elizabeth J Fichtner, Matteo M. Garbelotto, Jeremy James, Rachael Long, Maurice Pitesky, Rick Redak, Sharif Aly, Emily Symmes, Becky Westerdahl, Cheryl Wilen

[Based on 2012 Strategic Plan: Authors: John Adaska, Rich Breitmeyer, Kassim Al-Khatib, Rick Bostock, Kent Daane, Beth Grafton-Cardwell, Glenn Nader, Bob Timm, Georgios Vidalakis, and Rob Wilson]

Background and Introduction

As a basis for determining the primary areas of inquiry for the Endemic and Invasive Pests and Diseases (EIPD) initiative, the 2012 Panel used the ANR *Strategic Vision 2025* (UC ANR 2009) and the supporting document entitled *The Evolution of California Agriculture: An Outlook for 2029* (Alston et al. 2008). The 2016 Panel supplemented these references and used information gathered from ANR Program Team discussions and Workgroups and the School of Veterinary Medicine to update the Strategic Plan.

Five teams contributed to the development of *Strategic Vision 2025* by focusing on the future for 1) demographics and infrastructure of California; 2) agriculture and food production; 3) natural resources; 4) health and nutrition; and 5) human development. Within the ANR Strategic Vision, nine initiatives were identified with goals to:

- **Improve Water Quality, Quantity, and Security**
- **Enhance Competitive, Sustainable Food Systems**
- Increase Science Literacy in Natural Resources, Agriculture, and Nutrition
- **Ensure Sustainable Natural Ecosystems**
- Enhance the Health of Californians and California's Agricultural Economy
- **Ensure Healthy Families and Communities**
- Ensure Safe and Secure Food Supplies
- **Manage Endemic and Invasive Pests and Diseases**
- Improve Energy Security and Green Technologies through Innovative Science Linking Engineering, Agricultural, Biological, and Environmental Sciences

Among these nine initiatives, five (bolded above) are the current focus of the ANR Initiative Advisory Panels. These are Sustainable Food Systems; Sustainable Natural Ecosystems; Healthy Families and Communities; Endemic and Invasive Pests and Diseases; and Improve Water Quality, Quantity, and Security.

Goals

The goals of the Endemic and Invasive Pests and Diseases (EIPD) strategic initiative are to advance knowledge and implement research on exclusion and management of pests and pathogens that are important to agriculture, natural and urban systems. Wildlife and insects transmitting human or livestock diseases are also addressed in this initiative.

The ANR Strategic Vision 2025 describes the importance of the EIPD initiative as follows:

“The speed and frequency of international travel today combined with the volume of imported food, commodities and materials has increased the introduction of invasive pests and diseases into the state.”

In addition, the Strategic Vision notes that “California... must constantly update the exclusion, detection, eradication and control of invasive pests and diseases.”

These pests and diseases have “direct and indirect costs to agriculture and the livestock industries as well as to fisheries and water delivery systems” and are a “threat to biodiversity.”

The Endemic and Invasive Pests and Diseases initiative plan is very broad and interrelated to all 9 ANR Strategic Vision initiatives. Additionally, this plan is designed to be flexible to accommodate environmental and policy changes, for example, climate change, public health, and changes in regulations as well as societal concerns such as microbial resistance and alternatives to pesticides. This initiative also supports the goal of the *National IPM Program* which is to “improve the economic benefits of adopting IPM practices and to reduce risks to human health and the environment caused by the pests themselves or by pest management practices” and that of the *National Invasive Species Council* including “fostering the scientific, technical, and programmatic innovation necessary to enable Federal agencies and their partners to prevent, eradicate, and/or control invasive species, as well as recover species and restore habitats and other assets, in a timely and cost-effective manner with negligible impacts to human and environmental health.”

Panel Role

The role of the EIPD panel is to justify, define, prioritize, and recommend for implementation the portions of the ANR Strategic Vision related to Endemic and Invasive Pests and Diseases based on a five-year horizon for planning and deliverables. The overarching criteria used to determine the key areas of inquiry were:

- Consistency with ANR Strategic Vision,
- Current expertise within the ANR network (AES, CE Specialists, and Advisors) that integrates research, innovation, and extension,
- Ability to attract or leverage additional non-ANR funding, and
- A high potential to support science-based decisions involving public policy or behavioral change.

Areas of Research and Extension

The EIPD initiative is focused on exclusion, emerging and re-emerging pests and diseases and integrated pest management. Many agricultural, natural and urban systems are affected by endemic and invasive pests and diseases. Within all of these areas, the focus is on research and extension as well as the development and implementation of innovative technologies. Projects that bridge the gap between research and application and deliver concrete management options will have the most likelihood of having a positive impact. Rapid advances in solving problems often require a multidisciplinary approach involving a specialized team with the skills and organization to tackle the complex issues.

Key areas of inquiry and emerging issues are formally updated at ANR workgroup and Program Team meetings and through non-formal communication.

1. Exclusion of pests and pathogens

Exclusion of pests, pathogens and diseases includes diagnostics, detection, interception, response and mitigation. Lack of early detection may result in expensive pest and disease management costs in the long-term, disruption in commerce and industry prosperity, and human and animal health impacts if

diseases are involved. However, eradication of pests and diseases may be feasible if an early detection system is in place.

Possible areas for research, extension, and innovation:

- Proactive methodologies for predicting introductions of new pests
 - Improved diagnostic techniques and methods
 - Identification of solutions (including biocontrol) before pests arrive
 - Methodology for prediction of establishment of organisms that have not arrived in California
- Identification of key introduction, inspection, and treatment points
 - Trace forward and back
 - Sampling and surveys of pests and pathogens
 - Determine pest response to spatial, temporal and environmental changes
 - Development and evaluation of active and passive surveillance systems
 - Develop or improve first detector education

Policy Issues addressed

- Import, export, and movement of agricultural products
- Federal, state and local quarantine and management regulations and response plans
- Economic and ecological impacts of various mitigation strategies
- Provide science-based recommendations to governments and agencies
- Prediction of new pests and diseases based on climate change
- Public awareness programs
- Prioritization of resources

Deliverables

- Improve development and delivery of information transfer and new technologies
- Coordinated public awareness programs
- Reliable diagnostic techniques and methods
- Development of emergency preparedness plans
- Risk assessment and response plans
- Predictive models for invasion based on climate change

2. Emerging and Re-emerging Pests and Diseases

Emerging problems can arise from endemic or newly established invasive species and these must be addressed to minimize their impacts on agriculture, natural resource, and urban systems. In contrast, *re-emerging* pests and diseases are those that were once major problems and then declined dramatically but are again becoming significant problems whose impact is increasing due to human activities or climatic and ecological changes (National Institutes of Health). This includes: a) pests and pathogens whose host and/or geographic range is still in significant expansion, and possibly undergoing adaptive changes to better colonize California hosts ("established and evolving"), and b) pests and pathogens that, although not of recent introduction, undergo frequent endemic and epidemic cycles, and thus require longer and repeated studies to be fully understood ("re-emerging"). This priority also includes emerging threats from native species with the increasing potential to be classified as pests due to human activities or climatic and ecological changes.

Possible areas for research, extension, and innovation:

- Surveillance and monitoring
 - Develop or improve surveillance, early detection tools, assays, diagnostics, and first detector education
 - Sampling and surveys of pests, pathogens or practices that affect them
 - New or improved monitoring tools to detect low levels of pests or pathogens
 - Determine the ability of pests to respond to spatial, temporal, and environmental changes
- Management
 - Operational plans for intervention and rapid response
 - Impacts of climate change (including drought) on pest establishment and management
 - Development of integrated pest management programs or other practices to avoid the spread or impact of emerging or re-emerging pests
 - Survey and evaluation of biological control agents
 - Analysis of economic and environmental impacts resulting from pests or their management tactics

Policy Issues addressed

- Prioritization of pests and diseases based on agriculture and natural resources, economics, public health, animal welfare
- Export regulations
- Science-based advancements in regulatory programs (e.g. eradication, mitigation, certification)
- Address pest and pesticide concerns of end-users
- Biosecurity plans that address California needs
- Protection of beneficial organisms and pollinators
- Prediction of spread and impact of pests and diseases based on climate change

Deliverables

- Prediction models for spread of new and emerging pests and diseases
- Management plans for emerging pest problems
- New tools to enhance control and eradication plans
- Reliable diagnostic techniques and methods
- Improvements in regulatory control (quarantines, certification, management actions)
- Strategies that reduce trade-inspection retaliations
- Risk factors associated with a pest population's expansion, spread, and impacts
- Programs that link with state and national early detection networks

3. Integrated Management of established and evolving, and re-emerging threats

Integrated management approaches are used to reduce the impact of pests and diseases on agriculture, natural resources and urban systems through the development of science-based pest management programs that are economically and environmentally sustainable, and socially appropriate. This priority addresses threats established in California. These approaches should address conventional and organic systems on both large and small scales. This priority also addresses "Neglected threats", those pests and pathogens that have a recognizable significant impact on natural, agricultural, and animal resources in

California but that historically have not been sufficiently studied due to technical limitations (e.g. causal agent was unknown until recently or technically difficult to investigate) or due to their distribution in underserved areas (due to lack of UC research teams) or spatially limited portions of the State.

Areas for research, extension, and innovation:

- Develop knowledge of pest and pathogen biology, epidemiology and ecology
- Develop decision support models for pest and disease management
 - Use of Big Data: Data generation and analysis
 - Develop predictive models for pest and crop phenology
- Develop or improve tactics for prevention or management of pests and diseases that minimize impacts to the environment
 - Non-chemical tactics
 - Precision agriculture tools
 - Improved monitoring and diagnostic tools and techniques
 - Breeding for pest resistance
 - Use of biocontrol agents
- Pesticide impact and mitigation
 - Effects on honeybees and other pollinators
 - Effects on natural enemies
- Develop or improve tactics for pesticide and anti-microbial drug resistance prevention and management
- Facilitate adoption of integrated pest management practices
- Develop system approach (“One Health”*) to management where multiple pests, thresholds, habitat, and behavior and other ecosystem components are considered
- Economics of pest management

Policy Issues addressed

- Management recommendations for pests and diseases
- Food supply security
- Ecosystem services
- Address pest and pesticide concerns of end-users, general public, and other stakeholders
- Risk management and toxicology of pesticides
- Health, water, and air quality as affected by pesticide use
- Compatibility of pest management practices with environmental and food safety concerns and regulations
- Pesticide and antimicrobial drug use and trends for state and federal regulations
- Maximum Residue Levels of pesticides on food products (MRLs) as part of global trade regulations

Deliverables

- Effective integrated management practices
- Sustainable management practices
- Reliable diagnostic techniques and methods
- Reduction of commodity losses from pre- and post-harvest pests and diseases
- Improved management recommendations for pests and diseases
- Publications, outreach, and education tools for clientele (end users)

- Predictive models and information for mitigation practices, pest distribution, and alternative production practices

* The One Health approach addresses complex health problems on a platform that recognizes that the health of domestic animals, wildlife, and people are inextricably linked with each other and the environment.

Initiative Components

In addition to the above core **Areas of Research and Extension**, the EIPD initiative will

- Make recommendations for AES, CE Specialists and Advisor Academic positions
- Interact with other programs and agencies
- Identify and encourage opportunities that are cross-cutting issues among initiatives
- Identify and encourage Internal funding opportunities and opportunities for leveraging outside funding
- Provide outreach and communications through ANR Communications, EIPD web site (http://ucanr.edu/sites/StrategicInitiatives/Endemic_and_Invasive_Pests_-_Diseases/), and other appropriate means
- Coordinate activities and goals with Program Teams, working groups, and conferences

References

Alston, J.M., M. Fujii, E.E. Grafton-Cardwell, S.L. Varea Hammond, D. Putnam, and D. A. Sumner. 2008. The evolution of California Agriculture: an outlook for 2029. Future Agricultural and Food Systems Strategic Planning Working Group (available only on PC website)

Battles, J., B. Frost, M. Kelly, R. Moll, K. Tate, M. Yates. 2008. Future Structure of California: Natural Resource Systems 2025. White paper commissioned by UC ANR Strategic Planning (available only on PC website)

Marcos Kogan. 1998. Integrated Pest Management: Historical Perspectives and Contemporary Developments. *Annu. Rev. Entomol.* 43:243–70.

National Institutes of Health (US); Biological Sciences Curriculum Study. Bethesda (MD): National Institutes of Health (US); 2007 <http://www.ncbi.nlm.nih.gov/books/NBK20370/>

National IPM Roadmap <http://ipmcenters.org/Docs/IPMRoadMap.pdf> and <https://nifa.usda.gov/program/integrated-pest-management-program-ipm>

National Invasive Species Council <https://www.doi.gov/invasivespecies/>

Paine, T., I. Fung, S. Wheeler, J. London, D. Roland-Holst, and S. Handy. 2009. Future Structure of California THE SETTING/Visioning: What will California look like in 2025. White paper commissioned by UC ANR Strategic Planning (available only on PC website).

University of California, Agriculture and Natural Resources [UC ANR]. 2009. Strategic Vision 2025. 52p. <http://ucanr.org/files/906.pdf>

UC ANR Pest Management Program Team available on UC ANR Collaborative Tools <https://ucanr.edu/collaborate/posts.cfm?cluster=9780>

Wearing, C. H. 1988. Evaluating the IPM implementation process. *Ann. Rev. Entomol.* 33:17-38.