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The Not-So-Hidden Dangers of Invasive Species

ESA Position Statement on Invasive Species

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Geographic borders are becoming increasingly porous, not only to people and goods, but to other organisms as well. Although not all new species introductions result in establishment and spread, many do and these can become a significant threat to US national interests by undermining food security, trade agreements, forest health, ecosystem services, environmental quality and public health and recreation. Without a sustained federal effort–including additional research, legislative intervention, interagency coordination, and public awareness–the United States will continue to incur incalculable losses from all types of invasive species.

Invasive species may be plants, microbes, or animals. They are those organisms that establish and spread in new, non-native, environments and cause harm. The detrimental impacts of invasive species are many and significant, including the elimination or harm to native species, devastation to agricultural crops, transmission of disease to crops, livestock, humans and/or wildlife, damage to buildings and other structures, infestation of stored goods, and attacks to forests and parklands.

Some recent examples of invasive insects include:

A. The oriental fruit fly (*Bactrocera dorsalis*) in Florida and California led to the quarantine of agricultural areas in both states. This pest of over 400 fruits, vegetables, and nuts has devastating effects on yield, costs of production and export marketability.
B. The Asian citrus psyllid (*Diaphorina citri*) vectors the bacterium that causes Huanglongbing disease - a pathogen that is devastating the $10.7 billion USD citrus industry in Florida.
C. The brown marmorated stink bug (*Halyomorpha halys*) is a nuisance urban pest that also damages agricultural crops and ornamental plants. In 2010, this invasive was responsible for losses in excess of $37 million USD to mid-Atlantic apples and 100% losses to peaches in Maryland.
D. The Asian tiger mosquito (*Aedes albopictus*) is now widespread across the US and invasive *Aedes* threaten to set-off pandemics of dengue, chikungunya, and Zika. Invasive urban *Culex* mosquitoes already vector West Nile virus, an invasive pathogen.
E. The emerald ash borer (*Agrilus planipennis*) is now in 26 US states and responsible for the death of tens of millions of native ash trees. The total cost to treat, remove, and replace infested trees is estimated to be $10 - 25 billion by 2019.

While some invasive species garner public attention, many invasives cause damage to the US infrastructure and economy with little or no public notice.

Although the exact number of invasive species already in the US is unknown, those that cause damage number in the thousands. Invasive species continue to arrive in the US at a high rate, with an enormous and increasing impact on the economy, food security, environmental health, and human health. *Invasive insects alone incur control costs of over $2.5 billion in the U.S. per year and cause losses to crops, lawns, forests, and pastures totaling at least $18 billion per year, cost estimates that do not include the impacts to natural systems or human health and well-being.*

How invasions begin and spread

Introductions of invasive insects and other arthropods happen in a number of different ways: naturally, through deliberate introductions, and as accidental introductions as hitchhikers in trade and travel. When species move from their native range to new areas, they are frequently introduced without their natural enemies and local plants or animals may not have defenses against them, favoring their establishment and enhancing their competitiveness. Without natural checks and sometimes by continuing to hitchhike with people, populations of invasive insects and other arthropods can quickly spread through the landscape and eventually reach levels that cause significant ecological, economic, and/or social damage. Importantly, current and future climatic conditions will have a significant impact on the frequency and course of invasions.

Stemming the tide

The scientific study of the introduction, colonization and spread of non-indigenous organisms into new regions and of their economic, medical or environmental importance is known as invasion biology. Understanding the mechanisms of biological invasions requires focusing research on the processes that underlie new arrivals, establishment, spread, and invasive impact. The aim is to improve prevention, early detection and rapid response, as well as providing a realistic assessment of the potential for eradication. Ultimately, if establishment occurs, such knowledge will inform development of Integrated Pest Management programs as well as restoration efforts. Additionally, there is a need to develop education and outreach strategies to inform the public about the impact of invasive species and actions that can slow their occurrence and spread.

- **Invasion Biology** – There is a need to understand the common patterns and principles that apply to many pest invasions. Research and efforts to understand the fundamental drivers of invasion would benefit from interdisciplinary research conducted at universities and within government agencies by entomologists, ecologists, geneticists, economists, systems scientists and social scientists. **There is currently no dedicated competitive funding available for such research.**
    - Research outcomes: *Better understanding of how and under what conditions certain insects and other arthropods will ultimately become invasive and pests of economic, medical or environmental importance informing future decisions on prioritization of scarce resources to address new invaders.*
    - Operational outcome: *Improved decision-making to minimize the damage from invasives.*

- **Prevention** – The most cost-effective strategy for the management of invasive insects and other arthropods is preventing their arrival. Prevention is achieved through pest risk assessment, quarantines, and strict biosecurity measures. However, the challenge is massive and ever-increasing with global trade and movement of people. Additional resources are needed to ensure

that classical inspection and identification/taxonomic expertise, enhanced by new technologies, are sufficient to keep up with the increasing pace of insect introductions in the U.S. and worldwide. More efficient ways to transfer technology to benefit agencies responsible for intercepting pests at their borders are also needed.

- Research outcomes: *Better understanding of the probability of invasion through risk assessment, modeling, biological, evolutionary and ecological research; discovery of new pathways for arrivals of new pests.*
- Operational outcome: *Fewer invasive species establish in the US annually.*

- **Early Detection** – If prevention fails and an incursion occurs, the next most effective option is early detection and rapid response. Early detection requires the development of pest risk maps to help direct field surveys to high risk areas, a variety of lures, attractants, and traps to capture those species when they are present, and diagnostic tools, including molecular tools, to detect and confirm the identity of the species. International collaboration and public education are key to successful early detection particularly in the early stages of the invasion process, when the numbers of invaders are typically very small and hard to detect, so there is a need to develop and use accurate and highly sensitive approaches.

  - Research outcomes: *Innovative methods for trapping, detection, identification of origins and strategies to stop further introductions.*
  - Operational outcome: *More pests are detected before successful establishment and spread*

- **Rapid response** includes eradication or containment to prevent future damage. Because newly-established insects and other arthropods often have very low and patchy abundance within the landscape, immediate and focused control increases the likelihood of eradication. However, once introduced, non-natives that find suitable climates and food sources can be challenging to eradicate in agricultural or urban settings, and even more difficult in natural environments.

  - Research outcomes: *Better risk assessment to determine the potential high costs but also large benefits of early eradication or containment versus the impacts resulting from their establishment and limited, long-term management using an IPM approach. New techniques for rapid action and improved strategies to control invasive insects and other arthropods including partnerships with insecticide registrants and EPA with emergency use registrations in-place.*
  - Operational outcome: *More pests are eradicated or kept from spreading; resources will be directed to highest risk invaders with the greatest chance for eradication or containment*

- **Adaptive Management partnerships** (*i.e.*, Federal, State, Land Grant institutions, private industry, non-government organizations and other stakeholders, including international organizations) are essential to create and maintain sustainable resource systems to mitigate harm from all invasive insects and other arthropods, not just those that may impact agriculture.

  - Research outcomes: *New management tactics that have reduced non-target, environmental and human health impacts.*

- Operational outcome: *Less impact from invasive species and the tactics used to manage them.*

Funding to continue the fight

Federal funding is instrumental for the successful prevention, early detection, and eradication of and management programs for new invasive insects and other arthropods. Increased funding for competitive research should focus on better understanding the biology of invasive insects and other arthropods and all steps of the invasion process, and include emphasis on systematics and identification (taxonomy), pathway management, ecology, evolution, risk assessment, pest management and social science. Only through investment in research will we save billions of dollars currently lost to invasive arthropods that threaten valued resources and public health.

Competitive funding allocated specifically for the management of invasive insects and other arthropods should be increased to research universities, non-government organizations and those government agencies currently responsible for the prevention, detection and rapid-response to new incursions so that they will be able to effectively implement the new technologies (*e.g.* US Department of Agriculture, US Department of Homeland Security, US Department of Interior, US Department of Commerce, US Department of Defense, US Environmental Protection Agency, US Department of Transportation, US Department of State, US Department of Health and Human Services, National Aeronautics and Space Administration, US Agency for International Development).

The Entomological Society of America and its members are well poised to help these agencies achieve national and regional goals for the management of invasive insects and other arthropods.

The world has never been more connected than it is today. People are providing unprecedented opportunities for organisms to become established in new areas. Without strong funding initiatives, legislative defense barriers, and increased public awareness, the economic impact of invasive species will continue to grow. Only through truly coordinated efforts among university, private industry, non-government organizations, and the state and federal governments will we be able to stem the tide and prevent or manage invasive species.