ADDRESSING CLIMATE CHANGE AND BIODIVERSITY THREATS THROUGH ENTOMOLOGY

ESA Transition Document

OVERVIEW

The societal risks posed by climate change are real and threaten our national health, economy, and security. The Entomological Society of America (ESA) firmly believes that the current situation can and should also be viewed as an opportunity to leverage research and innovation—particularly through the entomological sciences—to produce informed policy solutions for addressing climate-related challenges.

CHALLENGES

Global climate change is one of the greatest threats to world food security and human and animal health. The accompanying environmental changes are profoundly disruptive to both natural and managed ecosystems, with implications for economic sectors relevant to vector-borne diseases and human health, agriculture, fisheries, forest management, and urban development.

The impact of climate change on insects and related arthropods will have far-reaching environmental consequences given their centrality to most terrestrial habitats. More than three-quarters of all known species are arthropods, and these extremely diverse organisms are critical to healthy ecosystems and key indicators of climate change impacts. Climate change is already negatively affecting beneficial insects such as pollinators, natural predators of pests, food sources for a variety of higher-level animals like birds and fish, and nutrient recyclers. Meanwhile, climate change is altering the distribution and prevalence of harmful insects, including those that spread disease and impact crops. This is exacerbated by land-use changes and degradation of agricultural, urban, and forested areas.

Insect Distribution: For species specialized to live in cold or alpine areas, warming temperatures are causing suitable habitats to disappear and ranges to contract. Many of the affected species include native pollinators that play an important role in agricultural production. Simultaneously, warming temperatures are also expanding the habitat range of insects native to warmer or tropical climates, enabling the introduction and spread of insects that carry diseases such as *Aedes aegypti*, the mosquito that spreads dengue, Zika and yellow fever. *Aedes aegypti* is not native to the United States, but it's now here and is projected to continue expanding as warmer winters occur in the south, enabling the species to thrive and spread northward. Additionally, the majority of tick species that spread diseases in the United States have expanded outside of their historic range. Blacklegged ticks, which can carry Lyme disease and were traditionally found in New England, have been moving further south and west. The lone star tick, which can cause an allergy to red meat and other animal products, is commonly found in the southeastern United States but has been spreading farther north and west. As ranges rapidly expand, clinicians are often unaware of the new diseases and vectors in their area, causing diseases to be misdiagnosed or missed, leading to poor outcomes for patients.

Biomass and Biodiversity Loss: Insect biodiversity is essential for pollination, food security, pest control, nutrient cycling, soil formation, and many other ecosystem functions. Current annual rates of global declines for terrestrial insects are estimated to be 1-2 percent, with some regions experiencing rates of annual losses of more than 5 percent. Principal stressors include habitat destruction, agricultural intensification, and climate change. Rising planetary temperatures have myriad impacts to insect biodiversity in the form of increasing storm intensities, more variable weather patterns, more frequent and intense droughts and floods, increased fire pressure, and diminished snow cover. These changes are already reshaping global biological interactions such as those between various insects and plants, which have evolved to emerge together but are now out of sync larger animals that depend on them for food.

Changes in Food Web Interactions: Climate change indirectly affects the plants, prey, parasites, and microbes on which insects feed. For example, the timing of seasonal life cycles of pollinating insects and the plants

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they depend upon (and which depend on them) can become disjointed due to variations in temperature, precipitation, and atmospheric carbon dioxide. This can devastate crops and other plants by disrupting pollination and at the same time encourage the spread of certain agricultural pests that benefit from an expanded seasonal life cycle. Changes in these complex ecosystems also directly influence vector-borne disease transmission. For example, water level drops caused by drought can cause biodiversity loss in the aquatic food web and lead to the loss of mosquito-eating fish, causing an increase in West Nile Virus risk.

RECOMMENDATIONS

Below are recommendations to leverage the entomological sciences to respond to current climate-related impacts and mitigate future risks:

Enable Effective Early Detection and Rapid Response Efforts for Invasive Species. Invasive species represent a major threat to our agriculture and public health systems in the United States, and climate change continues to exacerbate our risk of introduction and successful establishment of novel invasive species. ESA recommends the development and implementation of an intentional, coordinated system for early detection and rapid response of invasive species. This system would be led through the Department of the Interior and guided by the National Invasive Species Council, involving all other federal agencies with authority over invasive species management. As part of this effort, a rapid response fund should be established to supplement ongoing and existing efforts to combat invasive pests. This would allow state, local, and Tribal governments to better respond to the emergence of invasive insects or arthropods that could be potentially devastating to the agricultural sector, biodiversity, or human health.

Support Research on Ecosystem Health. The federal government should increase investment in research on longitudinal changes in arthropod populations and the impact of climate change on ecosystem stability. The intersection between these fields of inquiry has major implications for interconnected issues such as pollinator health and the spread of invasive species. ESA also encourages the National Science Foundation (NSF) to establish collaborations with other federal agencies, including the Department of the Interior and U.S. Department of Agriculture (USDA), to ensure that foundational research in these areas is more seamlessly translated into methods and tools that can be deployed to promote or constrain insect populations and the climate factors that contribute to these patterns.

Fully Fund Programs that Address Vector-Borne Diseases. Climate change is contributing to the spread of invasive species and expanding the range of disease-carrying vectors including ticks and mosquitoes. To better support vector surveillance and management, ESA encourages the Administration work with Congress to ensure that the Centers for Disease Control and Prevention (CDC) Regional Centers of Excellence in Vector-Borne Disease and the training and evaluation centers are fully funded and support the objectives in the "National Public Health Strategy to Prevent and Control Vector-Borne Diseases in People." In addition, ESA encourages the CDC to foster collaboration between these centers and the NSF to develop climate-aware predictive analytics for optimizing vector control strategies.

Promote Climate-Friendly Pest-Control Methods. Adaptation strategies are required for agricultural ecosystems to function. This includes the use of novel, nontraditional methods of pest control. Integrated pest management (IPM), which uses science-based, environmentally conscious, comprehensive methods to effectively manage pests, often results in lower costs to farmers and more judicious pesticide use. Given the current challenges with insecticide resistance, it is crucial to return to the historic levels of investment in IPM. ESA recommends that the federal government incentivize broad adoption of IPM by promoting related research at USDA and the Environmental Protection Agency (EPA) and expanding our nation's ability to predict, mitigate, and respond to threats from pests that are proliferating due to a warming climate. To this end, USDA should support restoring its IPM Coordinator position within USDA's Office of the Chief Scientist to oversee the agency's IPM research portfolio and promote its adoption and facilitate sharing of best practices for IPM. ESA also recommends increasing support for the EPA's IPM-focused programs to raise awareness of IPM practices.

The Entomological Society of America is the largest organization in the world serving the needs of entomologists and other insect scientists. ESA stands as a resource for policymakers and the general public who seek to understand the importance and diversity of earth's most diverse life form—insects. Learn more at www.entsoc.org.

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