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 facing ecosystems and societies. The accompanying environmental changes are profoundly disruptive to both natural and managed ecosystems, with implications for economic sectors relevant to human health and food security, including agriculture, fisheries, forest management, and urban development.

The impact of climate change on insects and related arthropods, given their centrality to most terrestrial habitats on the planet, will inevitably have far-reaching environmental consequences. More than three-quarters of all known species are arthropods, and these extremely diverse organisms are both critical to healthy ecosystems and key indicators of climate change impacts. From the human perspective, climate change is already negatively affecting beneficial insects such as pollinators, natural enemies of pests, and nutrient recyclers. Meanwhile, climate change is altering the distribution and prevalence of harmful insects, including those that spread disease and invasive crop pests, and indirectly increasing the risk of outbreaks of pest insects and vector-borne disease by contributing to the degradation of agricultural, urban, and forested areas. Public health depends on environmental health—and both depend on healthy beneficial insect populations. Specific challenges include:

Insect Distribution:
For species specialized to live in cold or alpine areas, warming temperatures are causing suitable habitats to disappear and ranges to contract. This is especially concerning because many of the affected species include native pollinators that play an important role in agricultural production.[1] Simultaneously, climate-related factors are also enabling certain invasive pests to expand their ranges, such as *Aedes aegypti*, the mosquito that spreads dengue, Zika and yellow fever. *Aedes aegypti* is not native to the U.S., but it has reached our shores and is projected to continue expanding as the southern U.S. experiences warmer winters that enable the species to continue to thrive and spread northward. These same climate factors are expanding the ranges of other insects and ticks that transmit disease.

Biomass and Biodiversity Loss:
Climate change is contributing to an overall reduction in insect diversity and abundance, with one study showing a 75 percent decline in the biomass of flying insects in a 27-year period.[2] In another, records over 110 years across Europe and North America document climate-driven global declines in bumble bee populations.[3] Due to their climate sensitivity and large ecological footprint, insects collectively serve as "canaries" in a vast number of proverbial coal mines, providing advance notice of the forthcoming impacts of climate change on other organisms such as the plants that depend on them for pollination and the larger animals that depend on them for food.

[1] It is estimated that pollinators contribute $29 billion annually in economic value to the U.S. agricultural sector.
[2] http://www.plantphysiol.org/content/172/2/929
[3] https://science.sciencemag.org/content/349/6244/177.full?ijkey=JrOeY0oC2IvKw&keytype=ref&siteid=sci

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Changes in Food Web Interactions:
Climate change indirectly affects insect food plants, predators, parasites, and microbes. For example, the timing of seasonal life cycles of pollinating insects and the plants 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. Such shifts also carry profoundly negative consequences for overall ecosystem health.

RECOMMENDATIONS

The demonstrable ecological effects of climate change demand immediate action. Below are recommendations for leveraging the entomological sciences to respond to current problems and mitigate future impacts:

Support Research on Ecosystem Health:
ESA recommends that the federal government commit to increasing investment in research on longitudinal changes in arthropod populations and the impact of climate change to 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 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 in an operational environment to promote and constrain insect population growth and the climate factors that contribute to these patterns.

Fully Fund Legislation that Addresses Vector-Borne Diseases:
Climatic factors are contributing to the spread of invasive species and expanding the range of disease-carrying vectors including ticks and mosquitoes. To better support vector surveillance, management, and research, ESA strongly encourages the Administration to work with Congress to ensure that the Centers for Disease Control and Prevention (CDC) Regional Centers of Excellence in Vector-Borne Disease, which were authorized under the *Kay Hagan TICK Act*, are fully funded. In addition, ESA encourages CDC to foster collaboration between these Centers and NSF—which already has a robust focus on foundational research in modeling and simulation—on the development of climate-aware predictive analytics for optimizing vector-control strategies.

Apply Climate-Friendly Pest-Control Methods:
Adaptation strategies are required for agricultural ecosystems to continue functioning despite climate change. This includes the use of novel, nontraditional methods of pest control. One such approach is Integrated Pest Management (IPM), which uses science-based, environmentally conscious, comprehensive methods to take effective management action against pests, often resulting in lower costs and a more judicious use of pesticides. IPM practices help slow climate change by enabling soil to capture and store carbon dioxide. ESA recommends that the federal government incentivize the broader adoption of IPM by promoting related research at USDA and expanding our nation's ability to predict, mitigate, and respond to threats from agricultural pests that are already benefiting from a warming climate

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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