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## ESA Position Statement on Pollinator Health

**Approved on July 24, 2015**

*Valid through July 24, 2019*

Pollinators are vital components of natural and agricultural ecosystems, contributing to the fruit and seed production of nearly 90% of flowering plant species<sup>1</sup> including almost three-quarters of our major agricultural crops<sup>2</sup>. Pollinated vegetable, fruit, nut and seed crops have high economic and nutritional value<sup>3</sup>, with pollination services providing \$201 billion in economic value to global agriculture<sup>4</sup>. Managed honey bees (*Apis mellifera*), which are often transported large distances to pollinate large monocropped agricultural landscapes, contribute \$17.1 billion to crop and seed production in the U.S. alone, while non-*Apis* managed and wild bees contribute additional billions of dollars in pollination services<sup>5</sup>.

Populations of many managed and wild pollinators are in decline in the U.S. and worldwide<sup>5</sup>. Declines of managed honey bee populations have been monitored most closely, with U.S. beekeepers losing an average of 30% of their colonies each winter<sup>6</sup>. Wild pollinator populations are more difficult to monitor, but several species show evidence of widespread loss<sup>7</sup>. For example, approximately half of studied U. S. and European bumble bee species have reduced populations, though a smaller percentage show increases<sup>8,9</sup>. Honey bee declines have been associated with numerous factors, including parasites, pathogens, agrochemical use, and habitat loss and land fragmentation, which may also reduce nesting sites for wild species and the nutritional resources they obtain from flowering plants.

Tackling this multifaceted, complex problem requires a large-scale, multidisciplinary, nationwide effort that encompasses fundamental research on pollinator ecology and biology, applied research on sustainable pollinator, horticultural, and integrated pest management practices, and active communication with the public, scientific community, stakeholders, and policymakers<sup>6</sup>. The priority areas below will provide the scientific information and infrastructure to support research-informed policy to effectively and sustainably protect pollinator communities. The Entomological Society of America is in a unique position to inform this discussion because our society comprises researchers, educators, strong private-sector partners, and a broad range of stakeholders committed to the future of pollinators and sustainable plant production.

**(1) Monitor the health of managed and wild pollinator species.** To understand and mitigate the threats to pollinator populations, it is necessary to fully characterize the long-term dynamics of multiple pollinator species in relation to management practices, land-use, infectious-disease dynamics, and climatic and environmental variation. The development of new tools for monitoring (Priority Area 3) and modeling (Priority Area 4) both population dynamics and effects of different stressors can greatly facilitate achieving this objective, as can coordinating these efforts on a nationwide scale (Priority Area 7). Programs to help

beekeepers and land managers monitor stressors, colony health and population health should be created and/or expanded.

**(2) Characterize pollinator foraging and nesting-habitat needs and develop land-management approaches to ensure that essential resources are widely available to pollinators in agricultural, urban, and restored landscapes.** Healthy pollinator communities are best supported by communities of diverse and abundant flowering plant species, as well as a variety of nesting habitats for wild species. To create and manage pollinator-friendly landscapes, more research is needed in the following key areas: determining the nutritional needs of pollinators and the regionally-relevant flowering plant species on which they depend; understanding how bee nutrition interacts with other factors involved in pollinator decline; determining how nest-site availability influences pollinator population dynamics; and ascertaining, how the availability of foraging and nesting habitat resources can be optimized through improved land-management practices.

**(3) Develop molecular tools to better monitor and manage pollinator populations.** Molecular approaches, including genomic methods, have dramatically enhanced our ability to identify and track infectious diseases and parasites in pollinator populations, quantify pollinator population declines, and characterize pollinator communities. Developing these approaches into inexpensive, widely accessible tools that could be readily used by field scientists, beekeepers, and conservationists would greatly improve monitoring and management of diseases and population dynamics in both managed and wild pollinator populations. Genomic approaches also have the potential to provide new tools (RNAi, genetic markers) to improve honey bee health more sustainably than do conventional tools such as synthetic pesticides for parasite control. Finally, these molecular approaches can be used on a large scale to identify the complete pathogenic and beneficial microbial communities of pollinator populations, and to quantify how these microbiomes affect pollinator health in combination with other stressors.

**(4) Develop approaches for efficient and rapid characterization, modeling, and prediction of ecologically-relevant effects of stressors.** Pollinators are exposed to multiple interacting, chronic, and sublethal stressors, the effects of which can vary across pollinator species, life-stages, and environmental conditions. In addition to broader studies of the impacts of these stressors (Priority 1) and development of more efficient diagnostic tools (such as Priority 3), meta-analyses and modeling approaches can provide critical insights into the importance of different stressors and their interactions. This knowledge can lead to the development of efficient predictive approaches that can be broadly applied to improving the management of pollinator populations and developing recommendations to conserve pollinator populations across agricultural, urban, and restored landscapes.

**(5) Improve best-management guidelines for raising, managing, and transporting honey bees.** Honey bee colonies are often transported great distances to provide pollination services in agricultural landscapes where they may experience limited diets, exposure to parasites, diseases, and agrochemicals, and other stressors. Maintaining healthy bees under these conditions can be difficult. To offset losses, beekeepers purchase new queens and colonies from commercial bee breeders and suppliers, provide colonies with artificial diets, apply

chemical treatments to manage *Varroa* mites and other honey bee parasites, and implement other precautionary measures against fungi, viruses, and diseases. Best management practices have been developed to assist beekeepers<sup>7</sup>, but improvements in monitoring, economic treatment thresholds, treatment options, and genetic improvement and maintenance (resulting from Priorities 1-4) can greatly increase their success in maintaining the large numbers of vigorous honey bee colonies needed for crop production. Improving and disseminating these best management practices requires a coordinated effort by university and extension apiculturists, USDA-ARS, and industry experts.

**(6) Develop best-management-practices guidelines for "Integrated Pollinator and Pest Management" (IPPM) of agronomic and horticultural crops and urban landscapes.**

Integrated Pest Management is a proven, sustainable strategy that can improve agricultural profitability while reducing environmental and health risks associated with agrochemical use. The economic value of pollination ecosystem services should be assessed more broadly and included in the IPM decision-making process. Guidelines for assessing field-relevant pesticide and pest management risks to pollinator populations should also be developed and used consistently by researchers, registrants and policymakers. IPPM guidelines should be developed through research and incorporated into crop- and region-specific programs that recommend appropriate pest management solutions and land-management strategies that reduce risk to pollinator populations and enhance pollinator ecosystem services while maintaining profitable crop production. To ensure long-term, viable IPPM programs, increased support for research on IPM practices compatible with pollination ecosystem services and for Cooperative Extension IPM programs to implement these approaches more effectively is needed.

**(7) Facilitate strongly coordinated efforts among stakeholders, universities, and government agencies.** Since Colony Collapse Disorder raised awareness of the critical threats to the health of honey bees and other pollinators in 2006-2007, there has been substantial progress in understanding the factors leading to population declines across the pollination spectrum. However, due to low levels of federal funding for agricultural research and limited communication among researchers, stakeholders, and policymakers, the overall response has been fragmented and constrained primarily to short-term and small-scale studies. Strong partnerships are needed across the scientific community, including universities (with their associated Cooperative Extension services), USDA-ARS laboratories, state and federal regulatory agencies, non-governmental organizations, and other stakeholders. These partnerships can effectively leverage existing national and international intellectual, communication, and financial resources and lead to innovative approaches to pollinator conservation that are compatible with stakeholders' needs.

**(8) Develop academic and professional training programs and public outreach campaigns for pollinator management and conservation.** Educational programs are essential for providing broad integrative training in research, extension, and outreach to researchers at all levels, including undergraduates, graduate students, and postdoctoral scholars – the next generation of scientists, educators, and policymakers who will tackle future pollinator challenges. Similarly, expanded professional training opportunities and outreach programs should be provided to non-research communities engaged in management

of pollinator populations in agricultural, urban, and restored landscapes (such as pesticide applicators, crop consultants, homeowners, landowners, and beekeepers). Both the academic and professional programs should be widely accessible to individuals from different socioeconomic and other backgrounds.

Bees and other pollinators are critical to the function of healthy landscapes and are key contributors to food security. They serve as outstanding exemplars of the role of healthy ecosystems play in supporting a sustainable future.

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