Report from ICE 2016: A Movement to Improve the Human Condition through Insect Science

On 27-28 September 2016, as approximately 6,800 entomologists gathered in Orlando, Florida, USA, for the XXV International Congress of Entomology (ICE), nearly 200 members of the global entomological leadership community gathered for a policy summit aimed at sparking a movement to build a strong future for the science of entomology in service to society in the 21st century.

Hosted by the Entomological Society of America (ESA)—the largest entomological society in the world, with more than 7,000 members, of whom approximately 16 percent hail from more than 70 nations outside the United States—the leadership summit discussed global challenges and how entomology can meaningfully contribute to meeting them. Three challenges were identified as areas where entomology could have a unique and lasting impact. They are:

- Sustainable agriculture, in the context of global food security and natural resource conservation
- Public health, related to vector-borne diseases (VBD)
- Invasive insect species, affecting global trade and biodiversity

These topics were chosen because of their breadth, urgency, and relevance to the entomological sciences. Experts and opinion leaders were identified and invited to attend this 11-hour summit that included researchers, government leaders, academicians, public health officials, corporate executives, non-governmental organizations and agency leaders, authors, and pest management experts. The primary objective of the summit was to serve as a forum for discussion to construct the framework for creating partnerships and opportunities for multilateral and sustained international efforts to confront these challenges. Through a series of keynote addresses, facilitated panel discussions, breakout sessions, posters, and micro-talks, several key themes emerged across the three challenge areas.

The key findings that relate to all three challenge areas are:

THE IMPORTANCE OF COMMUNITY

Entomology is a global discipline, and the cross-border nature of all the life sciences makes it essential for scientists to communicate and collaborate. From Europe to South America, from East Asia to Africa, representatives from the world's most active entomological societies agree that individual nations can no longer afford to work in intellectual isolation; collaboration is a 21st

century necessity. Summit attendees called for the creation of a framework to facilitate communication among members of the global entomological community. Options include:

- **The creation of an international working group to address these and other challenges that emerge in the coming decade.** The ICE Council, the governing body that oversees the quadrennial ICE meeting, has, in the wake of the summit, initiated discussions about forming such a group, which would be considered be a major outcome of the summit. Whether the community coalesces under the ICE banner, one national Society's leadership, a coalition of the world's entomological societies, or any other aegis, the momentum clearly favors increasing entomological collaboration and communication.
- **The consideration, development, and promotion of joint position statements and policy documents**, which could be issued and addressed to global leaders on the importance of these challenges and the responses for which the entomological community advocates. Multinational documents such as these would increase the effectiveness and impact of single-source policy documents. Consensus builds confidence, particularly in the policy arena.
- **Continuing the momentum of this grand challenge movement via the quadrennial ICE meeting**, which provides a natural forum for updates, new discussions, and advocacy efforts that will drive the science. Attendees agreed at a minimum that this agenda should be revisited every four years at ICE.
- **Ongoing symposia and other checkpoints on the progress of the entomological community in addressing these challenges.** In addition to ICE, many other annual or biannual important scientific meetings were specifically identified by attendees as opportunities for updates, including the Brazilian Congress of Entomology (Gramada, Brazil, 2018), the European Congress of Entomology (Naples, Italy, 2018), and the next ESA Annual Meetings (Colorado, USA 2017 and Vancouver, Canada, 2018).

Community is defined more broadly than communication between entomological societies, however. Open dialogue and strong working relationships with corporate partners, funding agencies, government administrators, and representatives from sister organizations are all critical for this initiative to succeed. Social and professional web-based apps and forums now provide opportunities for immediate and transparent global communication and networking and can facilitate community-building efforts.

THE IMPORTANCE OF EFFECTIVE SCIENCE COMMUNICATION

Examples abound of innovative research leading to new knowledge and real-world applications:

- Scientists have demonstrated their ability to alter a mosquito's genetic code so that they can transmit *Wolbachia* bacteria to their brethren, rendering males incapable of siring offspring and females unable to transmit disease-causing viruses in the field.
- Drones have been equipped with mosquito capture devices that also determine the species and gender of the insects trapped with 91 percent efficacy.

But so much of the scientific enterprise is just background noise to many people in today's busy story-of-the-minute news cycles. Until communities understand the nature of and potential benefits from scientific breakthroughs, the ability to carry out innovative research and to implement new technologies will be seriously compromised. Scientists must learn how to convey the importance of their work not only to their colleagues but also to political leaders,

funding agencies, and the public at large. As a discipline, entomology must include in its mission explaining research findings and their importance to the public. It is essential to recognize:

- **STEM education.** An early and sustained focus on public STEM education is critical. Educators must be given the tools they need—be it information, funding, or other resources—to engage today's young people (and tomorrow's leaders) in science literacy programs, from primary through secondary school. This requires moving beyond sound-bites and tweets into full and mature conversations about the importance of scientific investment and study. Educators must be provided with detailed and age-appropriate materials for their use.
- **Access to expertise.** The public needs accurate and timely news and information to allow informed decision making. This requires the development of a shared, mutually comprehensible language; the identification of common interests; and, ultimately, putting aside individual differences for the common good. Summit attendees called for the creation of an Entomology Communications Network with Entomology Ambassadors for rapid responses to fast-breaking news. As an example of this need, Naled (a mosquito pesticide) was sprayed in South Carolina, USA, in response to reports of the presence of potential Zika vectors in early September 2016, resulting in a large honey bee die-off due to non-target exposures. Within three business days of the news breaking, ESA issued a rapid response statement on the importance of proper training of pesticide applicators. This statement was shared with U.S. Congressional offices with whom ESA has strong ties. It was also posted on the ESA website and the *EntomologyToday* blog. Rapid communication of this type is an important tool in keeping legislative representatives as well as the public informed in a timely fashion.
- **Shared, responsive agendas.** Research goals need to be clear yet flexible. The societal problems must be clearly defined so the public and private partners can work together for a project that leverages their various expertise, resources, and infrastructure. For research, a circular model whereby government or industry identifies needs or problems and relates these to academia, which responds in consultation with government and industry, creates a continuous feedback loop to ensure that the research is carried out in a way that allows pressing problems to be addressed more successfully.
- **Crowdsourced collaborations.** Public engagement is needed in a full community partnership. All interested stakeholders must identify as a part of this community. Scientists must engage all citizens in dialogue to leverage expertise from both the private and public sectors, sharing successes as well as challenges, and engaging the public as partners in progress. This collaborative and partner-based working style can reduce risks of confusion and minimize the influence of special interest groups that benefit from misrepresenting scientific positions, leading to distrust of science and scientists among the public at large. An informed and concerned public needs the opportunity to participate fully, through crowdfunding, citizen scientist initiatives, and other means.
- **Involved scientists.** Continued government-relations advocacy should be a part of the job description for more professional scientists. Advocacy is another form of communication. Policymakers must be kept informed of the latest developments in the life sciences so that research and implementation receive adequate funding. One way to achieve this goal, as suggested by summit attendees, is to work on creating international collaborative committees that work across geopolitical boundaries, much like a United Nations for entomology. This group would draft policy statements and scientific summaries, facilitating a unified response. Additionally, in some cases international

agreements already exist that simply need to be supported more fully, and this multinational working group would be well-suited to advocate for robust support of international treaties, such as those relating to climate change, pollution prevention, and conservation of biological diversity, among many others. Meanwhile, programs like the ESA Science Policy Fellows program, which trains entomologists in science advocacy and communication, can foster the growth of politically engaged scientists.

Scientists have often eschewed engaging in politics and public office. However, the dearth of scientists advocating from a position of elected power for policy informed by scientific evidence and federal funding support for research only hinders the research enterprise. Scientists should be encouraged to envision themselves as politicians, holding high-ranking office and administrative positions. Future collaborative opportunities may consider workshops or webinars on engaging in civic positions. Cross-disciplinary training for scientists in ethics, media, and communications is an important step towards being effective advocates on science policy.

Science must be responsive to emerging societal needs while maintaining core, long term research. Above all, science and scientists must be credible. While some of today's challenges can be anticipated (re-emergence of insect resistance), others arise without forewarning. The scientific community must be ready with sufficient resources to invest in areas where knowledge gaps exist or arise. From funding basic research, to training citizen scientists, to developing innovative solutions to seemingly intractable problems, the scientific community must work together to protect the integrity of science.

THE NEED TO RETHINK SCIENTIFIC FUNDING

Other than in magnitude, research funding has not changed appreciably for decades, with federal governments and large NGOs funding research projects through a competitive grant process. While this funding approach works well and is certain to continue, new technologies and innovations allow the exploration of alternative funding models that will allow for multidisciplinary research to be funded that is then brought to market. These have typically been left unfunded under a grants-only model. Private foundations today tend to take a more business-oriented approach to funding and defining "success." Today's grant application may look more like a business plan—with definite timelines, milestones, hard stops, and clearly defined deliverables. Funding agencies are willing to take significant financial risks on innovative research but need to know, in advance, the potential rewards for such risks. They also realize that there may be a vast gulf between scientific discovery and the practical implementation of effective programs. Options for innovation in the funding process include:

- **Crowd-funded options** such as Experiment.com and other programs allow for small projects to seek and receive funding. Advantages of this model include the democratization of the sciences.
- **Large-scale grand challenge funding platforms,** such as the X-Prize and other models, bring together collaborators with innovative solutions who may otherwise have never considered attempting to solve these scientific problems.

THE IMPORTANCE OF TRAINING, JOBS, AND CREDENTIALING

In today's economy, employment gaps exist where trained entomologists are required. As an example, as the US Centers for Disease Control and Prevention (CDC) attempts to build rapid

response teams for combating the Zika virus, they have encountered difficulties finding qualified medical entomologists to staff their teams. At the same time, academic employment for entomologists is contracting. Corporate mergers and other reorganizations in the private sector are putting other pressures on employment opportunities. A need exists to train tomorrow's workforce for the jobs of the future as well as the present and to ensure that those seeking employment have a full understanding of the workplace challenges they will face. Summit attendees advocate for:

- **Working collaboratively to identify the training and employment needs for the scientific community of the future**, and then working with the educational system to ensure that students are being prepared sufficiently for gainful and meaningful employment in the near future.
- **Using existing resources to provide non-traditional training of entomologists**, including media training, public outreach, international relations, science advocacy, and other activities.
- **Developing and continuing IPM-focused certification and credentialing programs** designed to educate individuals who work with insects but may not necessarily have the formal academic training of an entomologist, including pest management professionals, apiculturists, crop consultants, and landscape professionals, among others.

Leadership meetings such as the Grand Challenges Entomology Leadership Summit held within ICE 2016 will have a lasting impact only if the conversations continue and the community begins to coalesce around the issues and solutions addressed. Scientific collaboration needs to be more than a catch phrase, and attendance at the summit must be more than a line on a participant's CV.

THE NEED FOR COORDINATION OF INSECT SCIENTISTS

Entomology may be the most important discipline that most people have never heard of. This is the challenge and opportunity for all entomologists. We must become better stewards of our profession and advocates for future relevance and growth. We must seek ways to work together to advocate for change. Funding agencies realize that it is very difficult to find a single laboratory that can handle all stages of the process from research to implementation, and therefore are looking for collaborative proposals that can effectively match innovators with proven development and implementation organizations.

What is needed now is a movement for change. Movements are groundswells of opinion, manifested in a directional change for society. They are engines of social change. A movement will start when enough people feel that the status quo no longer suffices and new approaches are needed.

Summit attendees have recognized that this movement is needed now. The entomological community calls for the formation of an international working group to increase the communication, training, collaboration, and future for the discipline. Leaders of this movement aim to convene conversations among entomologists that will result in long-term employment prospects, collaborations, and partnerships to address these grand challenges and enhance the general welfare of the global community.