

**Annual Report - 2018**

**Award ID:** 1068676

**Institution:** North Carolina State University

**Title:** IGERT- Genetic Engineering and Society: The Case of Transgenic Pests

**Principal Investigator(s)**

**Name:** Fred L. Gould

**Project Years Active:** 2011-2012, 2012-2013, 2013-2014, 2014-2015, 2015-2016, 2016-2017, 2017-2018

**Co-Principal Investigator(s) or Trainee/Associate Advisor(s)**

**Name:** Andrew R. Binder

**Project Years Active:** 2012-2013, 2013-2014, 2014-2015, 2015-2016, 2016-2017, 2017-2018

**Role in Project:** Trainee/Associate Advisor

**Name:** Matthew M. Booker

**Project Years Active:** 2012-2013, 2013-2014, 2014-2015, 2015-2016, 2016-2017, 2017-2018

**Role in Project:** Trainee/Associate Advisor

**Name:** Zachary S. Brown

**Project Years Active:** 2013-2014, 2014-2015, 2015-2016, 2016-2017, 2017-2018

**Role in Project:** Trainee/Associate Advisor

**Name:** Hannah J. Burrack

**Project Years Active:** 2014-2015, 2015-2016, 2016-2017, 2017-2018

**Role in Project:** Trainee/Associate Advisor

**Name:** Yasmin J. Cardoza

**Project Years Active:** 2013-2014, 2014-2015

**Role in Project:** Trainee/Associate Advisor

**Name:** Jason A. Delborne

**Project Years Active:** 2013-2014, 2014-2015, 2015-2016, 2016-2017, 2017-2018

**Role in Project:** Trainee/Associate Advisor

**Name:** John R. Godwin

**Project Years Active:** 2012-2013, 2013-2014, 2014-2015, 2015-2016, 2016-2017, 2017-2018

**Role in Project:** Trainee/Associate Advisor

**Name:** Kevin Gross

**Project Years Active:** 2013-2014, 2014-2015, 2015-2016, 2016-2017, 2017-2018

**Role in Project:** Trainee/Associate Advisor

**Name:** Nick Haddad

**Project Years Active:** 2011-2012, 2012-2013, 2013-2014, 2014-2015, 2015-2016, 2016-2017, 2017-2018

**Role in Project:** Co-PI and Trainee/Associate Advisor

**Name:** Nora Haenn

**Project Years Active:** 2011-2012, 2012-2013, 2013-2014, 2014-2015, 2015-2016, 2016-2017, 2017-2018

**Role in Project:** Co-PI and Trainee/Associate Advisor

**Name:** William C. Kimler

**Project Years Active:** 2013-2014, 2014-2015, 2015-2016, 2016-2017, 2017-2018

**Role in Project:** Trainee/Associate Advisor

**Name:** William Kinsella

**Project Years Active:** 2011-2012, 2012-2013, 2013-2014, 2014-2015, 2015-2016, 2016-2017, 2017-2018

**Role in Project:** Co-PI and Trainee/Associate Advisor

**Name:** Jennifer Kuzma

**Project Years Active:** 2013-2014, 2014-2015, 2015-2016, 2016-2017, 2017-2018

**Role in Project:** Trainee/Associate Advisor

**Name:** Alun Lloyd

**Project Years Active:** 2011-2012, 2012-2013, 2013-2014, 2014-2015, 2015-2016, 2016-2017, 2017-2018

**Role in Project:** Co-PI and Trainee/Associate Advisor

**Name:** Marce D. Lorenzen

**Project Years Active:** 2012-2013, 2013-2014, 2014-2015, 2015-2016, 2016-2017, 2017-2018

**Role in Project:** Trainee/Associate Advisor

**Name:** Lisa McGraw

**Project Years Active:** 2013-2014, 2014-2015, 2015-2016, 2016-2017, 2017-2018

**Role in Project:** Trainee/Associate Advisor

**Name:** Carolyn R. Miller  
**Project Years Active:** 2013-2014, 2014-2015, 2015-2016  
**Role in Project:** Trainee/Associate Advisor

**Name:** Melinda S. Morrill  
**Project Years Active:** 2012-2013, 2013-2014, 2014-2015, 2015-2016  
**Role in Project:** Trainee/Associate Advisor

**Name:** Nils Peterson  
**Project Years Active:** 2013-2014, 2014-2015, 2015-2016, 2016-2017, 2017-2018  
**Role in Project:** Trainee/Associate Advisor

**Name:** Mitch A. Renkow  
**Project Years Active:** 2013-2014, 2014-2015, 2015-2016, 2016-2017, 2017-2018  
**Role in Project:** Trainee/Associate Advisor

**Name:** Mark D. Robinson  
**Project Years Active:** 2013-2014  
**Role in Project:** Trainee/Associate Advisor

**Name:** Max J. Scott  
**Project Years Active:** 2012-2013, 2013-2014, 2014-2015, 2015-2016, 2016-2017, 2017-2018  
**Role in Project:** Trainee/Associate Advisor

**Name:** Walter N. Thurman  
**Project Years Active:** 2012-2013, 2013-2014, 2014-2015, 2015-2016, 2016-2017, 2017-2018  
**Role in Project:** Trainee/Associate Advisor

## Trainees

**Name:** Timothy D. Antonelli  
**Total number of months funded:** 24  
**Project Years Active:**  
2012-2013 Project Year - Trainee supported for 11 months  
2013-2014 Project Year - Trainee supported for 12 months  
2014-2015 Project Year - Trainee supported for 1 months  
2015-2016 Project Year - Trainee supported for 0 months

**Name:** Gregory A. Backus  
**Total number of months funded:** 24  
**Project Years Active:**  
2013-2014 Project Year - Trainee supported for 11 months  
2014-2015 Project Year - Trainee supported for 12 months  
2015-2016 Project Year - Trainee supported for 1 months  
2016-2017 Project Year - Trainee supported for 0 months

**Name:** Jennifer F. Baltzegar  
**Total number of months funded:** 36  
**Project Years Active:**  
2014-2015 Project Year - Trainee supported for 12 months  
2015-2016 Project Year - Trainee supported for 12 months  
2016-2017 Project Year - Trainee supported for 12 months  
2017-2018 Project Year - Trainee supported for 0 months

**Name:** Jessica C. Barnes  
**Total number of months funded:** 36  
**Project Years Active:**  
2014-2015 Project Year - Trainee supported for 12 months  
2015-2016 Project Year - Trainee supported for 12 months  
2016-2017 Project Year - Trainee supported for 12 months  
2017-2018 Project Year - Trainee supported for 0 months

**Name:** Sarah K. Barnhill-Dilling  
**Total number of months funded:** 12  
**Project Years Active:**  
2014-2015 Project Year - Trainee supported for 0 months  
2015-2016 Project Year - Trainee supported for 0 months  
2016-2017 Project Year - Trainee supported for 12 months  
2017-2018 Project Year - Trainee supported for 0 months

**Name:** Johanna E. Elsensohn  
**Total number of months funded:** 36  
**Project Years Active:**  
2014-2015 Project Year - Trainee supported for 12 months  
2015-2016 Project Year - Trainee supported for 12 months  
2016-2017 Project Year - Trainee supported for 12 months  
2017-2018 Project Year - Trainee supported for 0 months

**Name:** Nicole E. Gutzmann  
**Total number of months funded:** 36  
**Project Years Active:**  
2014-2015 Project Year - Trainee supported for 12 months

2015-2016 Project Year - Trainee supported for 12 months  
2016-2017 Project Year - Trainee supported for 12 months  
2017-2018 Project Year - Trainee supported for 0 months

**Name:** Molly S. Hartzog

**Total number of months funded:** 36

**Project Years Active:**

2012-2013 Project Year - Trainee supported for 11 months  
2013-2014 Project Year - Trainee supported for 12 months  
2014-2015 Project Year - Trainee supported for 12 months  
2015-2016 Project Year - Trainee supported for 1 months

**Name:** Michael S. Jones

**Total number of months funded:** 36

**Project Years Active:**

2014-2015 Project Year - Trainee supported for 12 months  
2015-2016 Project Year - Trainee supported for 12 months  
2016-2017 Project Year - Trainee supported for 12 months  
2017-2018 Project Year - Trainee supported for 0 months

**Name:** Sheron N. King

**Total number of months funded:** 24

**Project Years Active:**

2014-2015 Project Year - Trainee supported for 12 months  
2015-2016 Project Year - Trainee supported for 12 months

**Name:** William A. Klobasa

**Total number of months funded:** 18

**Project Years Active:**

2012-2013 Project Year - Trainee supported for 11 months  
2013-2014 Project Year - Trainee supported for 7 months

**Name:** Caroline Leitschuh

**Total number of months funded:** 38

**Project Years Active:**

2013-2014 Project Year - Trainee supported for 11 months  
2014-2015 Project Year - Trainee supported for 12 months  
2015-2016 Project Year - Trainee supported for 12 months  
2016-2017 Project Year - Trainee supported for 3 months  
2017-2018 Project Year - Trainee supported for 0 months

**Name:** Andrew C. Ludvik

**Total number of months funded:** 13

**Project Years Active:**

2013-2014 Project Year - Trainee supported for 11 months  
2014-2015 Project Year - Trainee supported for 2 months

**Name:** Elizabeth A. Pitts

**Total number of months funded:** 38

**Project Years Active:**

2013-2014 Project Year - Trainee supported for 11 months  
2014-2015 Project Year - Trainee supported for 12 months  
2015-2016 Project Year - Trainee supported for 12 months  
2016-2017 Project Year - Trainee supported for 3 months

**Name:** John P. Roberts

**Total number of months funded:** 11

**Project Years Active:**

2015-2016 Project Year - Trainee supported for 0 months  
2016-2017 Project Year - Trainee supported for 11 months  
2017-2018 Project Year - Trainee supported for 0 months

**Name:** Megan E. Serr

**Total number of months funded:** 38

**Project Years Active:**

2013-2014 Project Year - Trainee supported for 11 months  
2014-2015 Project Year - Trainee supported for 12 months  
2015-2016 Project Year - Trainee supported for 12 months  
2016-2017 Project Year - Trainee supported for 3 months  
2017-2018 Project Year - Trainee supported for 0 months

**Name:** Jayce Sudweeks

**Total number of months funded:** 36

**Project Years Active:**

2014-2015 Project Year - Trainee supported for 12 months  
2015-2016 Project Year - Trainee supported for 12 months  
2016-2017 Project Year - Trainee supported for 12 months  
2017-2018 Project Year - Trainee supported for 0 months

**Name:** Rene X. Valdez

**Total number of months funded:** 27

**Project Years Active:**

2013-2014 Project Year - Trainee supported for 11 months

2014-2015 Project Year - Trainee supported for 12 months  
2015-2016 Project Year - Trainee supported for 1 months  
2016-2017 Project Year - Trainee supported for 3 months  
2017-2018 Project Year - Trainee supported for 0 months

**Name:** Michael R. Vella

**Total number of months funded:** 22

**Project Years Active:**

2015-2016 Project Year - Trainee supported for 0 months  
2016-2017 Project Year - Trainee supported for 10 months  
2017-2018 Project Year - Trainee supported for 12 months

**Name:** Amanda C. Walsh

**Total number of months funded:** 24

**Project Years Active:**

2012-2013 Project Year - Trainee supported for 11 months  
2013-2014 Project Year - Trainee supported for 12 months  
2014-2015 Project Year - Trainee supported for 1 months  
2015-2016 Project Year - Trainee supported for 0 months

**Name:** Sophia H. Webster

**Total number of months funded:** 36

**Project Years Active:**

2012-2013 Project Year - Trainee supported for 11 months  
2013-2014 Project Year - Trainee supported for 12 months  
2014-2015 Project Year - Trainee supported for 12 months  
2015-2016 Project Year - Trainee supported for 1 months  
2016-2017 Project Year - Trainee supported for 0 months  
2017-2018 Project Year - Trainee supported for 0 months

**Name:** Gabriel L. Zilnik

**Total number of months funded:** 36

**Project Years Active:**

2012-2013 Project Year - Trainee supported for 11 months  
2013-2014 Project Year - Trainee supported for 12 months  
2014-2015 Project Year - Trainee supported for 12 months  
2015-2016 Project Year - Trainee supported for 1 months

## Associates

**Name:** Maria E. Adonay

**Project Years Active:** 2015-2016, 2016-2017, 2017-2018

**Name:** Alonzo Alexander

**Project Years Active:** 2016-2017, 2017-2018

**Name:** Arun Babu

**Project Years Active:** 2014-2015, 2015-2016, 2016-2017, 2017-2018

**Name:** Brandon Baker

**Project Years Active:** 2017-2018

**Name:** Sarah A. Cash

**Project Years Active:** 2012-2013, 2013-2014, 2014-2015, 2015-2016, 2016-2017, 2017-2018

**Name:** Zachery DeVries

**Project Years Active:** 2014-2015, 2015-2016, 2016-2017, 2017-2018

**Name:** Rebecca M. Edman

**Project Years Active:** 2012-2013, 2013-2014, 2014-2015, 2015-2016, 2016-2017, 2017-2018

**Name:** Dalton George

**Project Years Active:** 2017-2018

**Name:** Marie Gibbons

**Project Years Active:** 2016-2017, 2017-2018

**Name:** Meredith Hawley

**Project Years Active:** 2016-2017, 2017-2018

**Name:** Brian Hollingsworth

**Project Years Active:** 2016-2017, 2017-2018

**Name:** Eli Hornstein

**Project Years Active:** 2017-2018

**Name:** Dona Kanavy

**Project Years Active:** 2013-2014, 2014-2015, 2015-2016, 2016-2017, 2017-2018

**Name:** Rosemary Keane

**Project Years Active:** 2014-2015, 2015-2016, 2016-2017, 2017-2018

**Name:** Ashley R. Kelly  
**Project Years Active:** 2012-2013, 2013-2014, 2014-2015, 2015-2016, 2016-2017, 2017-2018

**Name:** Meagan Kittle Autry  
**Project Years Active:** 2012-2013, 2013-2014, 2014-2015, 2015-2016, 2016-2017, 2017-2018

**Name:** Vassili Koupryanov  
**Project Years Active:** 2016-2017, 2017-2018

**Name:** Arina Loghin  
**Project Years Active:** 2012-2013, 2013-2014, 2014-2015, 2015-2016, 2016-2017, 2017-2018

**Name:** Kate Maddalena  
**Project Years Active:** 2012-2013, 2013-2014, 2014-2015, 2015-2016, 2016-2017, 2017-2018

**Name:** Tina Ndoh  
**Project Years Active:** 2014-2015, 2015-2016, 2016-2017, 2017-2018

**Name:** Steven Reyna  
**Project Years Active:** 2016-2017, 2017-2018

**Name:** Michael A. Robert  
**Project Years Active:** 2012-2013, 2013-2014, 2014-2015, 2015-2016, 2016-2017, 2017-2018

**Name:** Stacy Roberts  
**Project Years Active:** 2012-2013, 2013-2014, 2014-2015, 2015-2016, 2016-2017, 2017-2018

**Name:** Hyeongyul Roh  
**Project Years Active:** 2016-2017, 2017-2018

**Name:** Lauren Roland  
**Project Years Active:** 2014-2015, 2015-2016, 2016-2017, 2017-2018

**Name:** Julian Sass  
**Project Years Active:** 2016-2017, 2017-2018

**Name:** Jeremy Slone  
**Project Years Active:** 2016-2017, 2017-2018

**Name:** Katherine Swoboda-Bhattarai  
**Project Years Active:** 2014-2015, 2015-2016, 2016-2017, 2017-2018

**Name:** Brittany White  
**Project Years Active:** 2016-2017, 2017-2018

**Name:** Megan Williamson  
**Project Years Active:** 2016-2017, 2017-2018

## **Accomplishments and Contributions of the IGERT**

### **Interdisciplinary Research Achievements**

**First Achievement:** IGERT-associated faculty John Godwin, Chase Beisel, Alun Lloyd, Max Scott, Jason Delborne, and Jennifer Kuzma received a \$3.2 million funding award from the Defense Advanced Research Projects Agency (DARPA). The project, "Restoring Ecosystems and Biodiversity through Development of Safe and Effective Gene Drive Technologies" is part of DARPA's Safe Genes program. This 2-year attempt to develop and test a gene drive system that would reduce populations of invasive mice on islands to help conserve threatened seabird populations is renewable for an additional \$3.2 million in funding. Reversibility of the gene drive construct is also an important part of the work. The grant is a direct product of preliminary findings, interdepartmental, intercollegiate, and international collaborations made possible by the NCSU IGERT program community. Caroline Leitschuh and Megan Serr (both Cohort 2) are working to bring these female-lethal gene drive systems from the lab and testing arenas to the wild.

**Second Achievement:** IGERT faculty Jason Delborne and Zack Brown, Mike Jones (Cohort 3), and Paul Mitchell (UW-Madison) were awarded \$100,000 from the US Dept. of Agriculture (USDA) - National Institute of Food and Agriculture. This project, "Assessing Public Perceptions of Gene Drives for Invasive Species and Pest Control", runs July 2017 - June 2018. Trainee Mike Jones presented their preliminary findings at our weekly Colloquium this January. They found that a majority of the U.S. public supports gene drive use for non-native agricultural pest species with controls to limit how far the drive can spread. Over 70% of respondents sought additional information on 'possible risks' of drives and overwhelmingly ranked health and ecological uncertainties as top priorities to resolve. Likely applications of limited drives may receive majority support, but market risk for alternative production systems and a prioritization of resolving challenging questions of ecological risk may set a high bar for acceptance.

**Third Achievement:** Jessica Barnes (Cohort 3), Katie Barnhill-Dilling (1 Year Fellow), Dr. Elizabeth Pitts (Cohort 2, Pitt), and IGERT faculty member Jason Delborne have collaborated across traditional departmental boundaries to write "Genetic Engineering," in the Cambridge Handbook of Science, Technology, and Society. An invited contribution spearheaded by the three IGERT fellows, this chapter details how genetic engineering disrupts taken-for-granted distinctions between nature and culture, between human and nonhuman, and between the production of knowledge and the production of commercially viable products. They highlight

some of the ways in which scholarship in STS and adjoining fields makes sense of the troubled past, rapidly evolving present, and highly anticipated future of genetic engineering. The Handbook will be a reference for researchers, graduate students, and scholarly-minded practitioners, not for a general audience.

### **Education Achievements**

**First Achievement:** Our Colloquium has continued meeting weekly for the full duration of the 2017-2018 academic year. Our colloquia involve faculty, staff, students and postdocs from 4 different colleges at NCSU encompassing numerous disciplinary distinctions. In response to a changing political and social climate, this year we focused our collective attentions on the perception and situation of genetically modification technologies in the US and beyond. Understanding the impact of doing GM research on the world as well as the researcher themselves and being able to communicate with a wide variety of stakeholders to facilitate said research are critical skills for our students and tools that make them uniquely competitive as they head towards graduation and a hostile job market. Speakers such as Sarah Evanega, Steven Druker, Dan Charles, and David Hawthorne forced our IGERT community to really evaluate deeply held internal and institutional beliefs and their impacts on presenting advancing technologies.

**Second Achievement:** This year we added another course, GES Discussion, in order to provide our graduate fellows and associates with additional time dedicated to the digestion of the ideas presented by our Colloquium speakers. The Discussion course is headed up by IGERT faculty member Jason Delborne and meets weekly. The enrolled students nominate papers to read and analyze that build on the topics introduced by that week's Colloquium speaker. All Colloquium members are invited to attend, faculty included, though the course is primarily devoted to the intellectual development of our graduate trainees. In our pilot semester, we have a core of eight students who attend regularly with more coming depending on the topic. They represent six different departments among four different colleges. The feedback from our participants has been overwhelmingly positive and we are undertaking the process of making both this course and the Colloquium course permanent offerings in the N.C. State University course catalog.

**Third Achievement:** This year has seen our community grow by leaps and bounds as we look forward to maintaining our program beyond the cessation of IGERT funding. In order to sustain our GES course offerings and graduate minor, we have begun construction of an undergraduate pipeline by partnering with the Honors College at N.C. State University (See Barriers to Implementation). We've opened our weekly Colloquium to these advanced undergraduates and their participation has greatly enriched our community. The benefit to our graduate students has also been significant as they are gaining valuable insight in to interacting with their future student demographic as they progress from PhD candidate to professor. Though many of our trainees have TA experience within their own departments, our program allows them to interact with undergraduates from a wide variety of backgrounds and majors, which adds another dimension to their already significantly developed scientific communication skill set.

### **Trainee Achievements**

**First Achievement:** Jennifer Baltzegar (Cohort 3, Genetics) won 1st place in the research poster competition at the Entomological Society of America's 2017 Annual Meeting. Her experience in the IGERT program has allowed her to gain a deeper understanding of emerging genetic strategies to control pest populations in a biological, social, and regulatory framework. Currently, she focuses on elucidating the fine-scale population structure and the evolution of insecticide resistance in *Aedes aegypti*, the Yellow Fever Mosquito, to facilitate mathematical modeling of new control methods. Her poster "Temporal and spatial patterns of knockdown resistance in *Aedes aegypti* in Iquitos, Peru" detailed the international component of her research. This study explores the evolution of two SNPs (single nucleotide polymorphisms, F1534C and V1016I, that have been shown to be important in Central and South America) across a 17-year period in Iquitos, Peru, which includes all years of pyrethroid insecticide use in the city.

**Second Achievement:** Jessica Barnes (Cohort 3, FER) won 1st place in the poster contest at the American Chestnut Foundation's 2017 Annual Meeting. Her poster "Anticipating the biogeography of blight-resistant American chestnut" details significant shifts in climatically-suitable habitat for these organisms across the United States and Canada. Efforts to restore these trees focus on the introgression of blight-resistance through both backcross-breeding and biotechnology, but while these approaches may allow the trees to co-exist with the fungus, ecologists have raised fitness concerns about contemporary and future climatic conditions within their historical environments. This project used species distribution modeling (SDM) to understand the climate requirements of American chestnut and predict the availability of future suitable habitat, highlighting the importance of long-term perspective for species reintroductions as the organisms may be best adapted for conditions outside of their historical range.

**Third Achievement:** Sophia Webster (Cohort 1, Entomology) won first place for her poster presentation at N.C. State's Graduate Student Research Symposium, held March 2018. More than 200 poster presentations were judged by faculty. The goals of the symposium were to showcase the outstanding quality and diversity of graduate-level research at NC State, in addition to providing students with the opportunity to practice and enhance their communication

skills with those outside of their discipline. Sophia presented "Gene Drive in the Zika Mosquito *Aedes aegypti*", detailing her work creating a gene drive system, that when coupled with an anti-viral gene, can be used to reduce disease incidence through mosquito population replacement. She has successfully established an initial killer-rescue gene drive system in *Aedes aegypti* as well as *Drosophila melanogaster* and is beginning laboratory cage experiments to test the efficacy of the system to drive the desired genes through a population.

### **International Opportunities: Achievements**

**Research/Educational Achievement 1:** Due to IGERT support, Megan Serr (Cohort 2) was able to attend the 2017 Island Invasives Conference in Dundee, Scotland, from July 7-15, to gain insight into the conservation gains made by performing invasive species eradications on islands. The conference had a global representation of professionals who practice the removal of invasive alien species on islands and have first hand knowledge of the skills and management that go into such operations. Megan not only presented her work assessing the reproductive competitiveness between wild and laboratory mice, she was the first speaker to discuss the novel idea of using of gene drives for conservation. She was also able to make valuable international connections for future collaborations with individuals who also work on mate-choice in mice as well as gene drives, namely Anna Lindholm (University of Zurich), James Russell (University of Auckland), and Tim Harvey Samuel (The Pirbright Institute).

**Research/Educational Achievement 2:** Mike Jones and Jennifer Baltzegar (both Cohort 3) produced promising preliminary research data from their Summer 2016 trip to Mexico. According to Mike's analysis, maize weevil activity reduces quantity (and quality) of the crop for consumption and sale, increases protection expenses and forces early stock liquidation. In the study areas within Oaxaca and Chiapas, small producers growing many varieties predominate, with median maize production of 958kg. Six months post-harvest, the average farmer still has 46% of production in storage and 75% of those who store maize used protectants like phosphine tablets or 'pastillas', hermetic silos, or malathion powder. Mean annual expenses on protectants are \$4-5 USD, while full economic loss valuation was not possible from the study design. Small farmers store longer and likely face (proportionally) greater MW impacts than large farmers, who report that post-harvest loan obligations mitigate MW risk by forcing them to sell earlier. (See below).

**Research/Educational Achievement 3:** Over the past year, Jennifer Baltzegar (Cohort 3, see above) has produced a genetic linkage map for the maize weevil, *Sitophilus zeamais*. This map contains 1,121 SNP markers and is 1,421.6 cM in length. It also contains 11 linkage groups, which correspond to the 10 autosomes and 1 X chromosome. She has performed a ddRadSeq analysis on 4 of the populations sampled in Mexico. One high elevation and one low elevation site from each state visited (Oaxaca and Chiapas). These preliminary results indicate that there is moderate population genetic differentiation between sampled sites. In addition, pairwise genetic differentiation increases with increasing distance between sample sites. Moving forward, Jen and Mike (see above) will combine the economic context of maize production, storage, and trade movement with data on population genetics to make statements about how human-mediated processes may impact the genetic diversity of this key pest in a planned journal publication.

### **Outreach Activities**

**Title:** "Can Scientists Convince the Public to Accept CRISPR and Gene Drives?" Article

**Media Outlet/Organization:** Scientific American

**Activity Date:** 10/17/2017

**Description:** IGERT faculty mentor Dr. Jason Delborne was quoted in this media article: <https://www.scientificamerican.com/message-control>

**Title:** "Clinical Trials for Disease Vectors" Talk

**Media Outlet/Organization:** National Institutes of Health

**Activity Date:** 05/07/2018

**Description:** IGERT Co-PI Dr. Fred Gould gave a talk at the NIH-NIAD meeting on clinical trials for disease vectors.

**Title:** "Communicating Conservation: Aiming for Consensus on the Use of New Conservation Technologies" Blog Post

**Media Outlet/Organization:** Switzer Foundation Grant Programs

**Activity Date:** 11/16/2017

**Description:** IGERT faculty mentor Dr. Jason Delborne contributed to this blog post, <https://www.switzernetwork.org/network-innovation-proposal/communicating-conservation-aiming-consensus-use-new-conservation>

**Title:** "Could Genetic Engineering Save the Galapagos?" Article

**Media Outlet/Organization:** Scientific American

**Activity Date:** 11/01/2017

**Description:** IGERT faculty mentors Drs. Jason Delborne, Jennifer Kuzma, Fred Gould & John Godwin were profiled in this article, <https://www.scientificamerican.com/article/could-genetic-engineering-save-the-gal-aacote-pagos/>

**Title:** "Emerging Plant Disease Threaten Food Security: The Need for Biosurveillance" Talk  
**Media Outlet/Organization:** NASA Goddard Space Flight Center  
**Activity Date:** 12/18/2017  
**Description:** IGERT associate faculty Dr. Jean Ristaino gave this talk to a public audience at the NASA Center.

**Title:** "Facing our Future" Article  
**Media Outlet/Organization:** North Carolina State University College of Agriculture and Life Sciences Alumni Magazine  
**Activity Date:** 10/25/2017  
**Description:** Trainees Johanna Elsensohn & Mike Jones were the 2 grad students, out of 50 nominated, selected for a roundtable discussion with the CALS Dean. She was quoted in this article: <https://cals.ncsu.edu/news/the-deans-round-table-facing-the-future/>

**Title:** "Food Evolution" Screening and Panel Discussion: Meredith College  
**Media Outlet/Organization:** Meredith College  
**Activity Date:** 03/22/2018  
**Description:** IGERT Co-PI Dr. Fred Gould participated in the screening of and following panel on the film "Food Evolution" at Meredith College.

**Title:** "Food Evolution" Screening and Panel Discussion: The Carolina Theater  
**Media Outlet/Organization:** The Carolina Theater  
**Activity Date:** 10/05/2017  
**Description:** IGERT Co-PI Dr. Fred Gould participated in a panel along with the film's director following a public screening of "Food Evolution" at The Carolina Theater in downtown Raleigh, NC.

**Title:** "Gene Drives are too Risky for Field Trials, Scientists Say" Article  
**Media Outlet/Organization:** New York Times  
**Activity Date:** 11/16/2017  
**Description:** IGERT faculty mentor Dr. Jason Delborne was quoted in this article, <https://www.nytimes.com/2017/11/16/science/gene-drives-crispr.html>

**Title:** "Genetically Engineering the Natural World, it Turns Out, Could Be a Disaster" Article  
**Media Outlet/Organization:** Gizmodo  
**Activity Date:** 11/16/2017  
**Description:** IGERT faculty mentor Dr. Jason Delborne was quoted in this article, <https://gizmodo.com/genetically-engineering-the-natural-world-it-turns-out-1820493131>

**Title:** "How Genetically Modified Mice Could One Day Save Island Birds" Article  
**Media Outlet/Organization:** Audubon Magazine  
**Activity Date:** 07/11/2017  
**Description:** IGERT faculty Drs. Fred Gould & Jennifer Kuzma are quoted in this article, which tells the story of how IGERT faculty Dr. John Godwin & trainee Megan Serr became part of the GBIRD (Genetic Biocontrol of Invasive Rodents) partnership.

**Title:** "Is This Tomato Engineered? Inside the Coming Battle Over Gene-Edited Food" Article  
**Media Outlet/Organization:** The Wall Street Journal  
**Activity Date:** 04/15/2018  
**Description:** IGERT faculty mentor Dr. Jennifer Kuzma was quoted in this article, <https://www.wsj.com/articles/is-this-tomato-engineered-inside-the-coming-battle-over-gene-edited-food-1523814992>

**Title:** "La Subida y Caída de un Alimento Industrial" Talk  
**Media Outlet/Organization:** National Institute of Ecology (INECOL)  
**Activity Date:** 08/02/2017  
**Description:** IGERT faculty mentor Dr. Matthew Booker gave this invited talk in Coatepec, Mexico.

**Title:** "Late Blight and other emerging disease of potato" Talk  
**Media Outlet/Organization:** NC Potato Growers Association  
**Activity Date:** 12/14/2017  
**Description:** IGERT associate faculty Dr. Jean Ristaino gave this talk at the NC Potato Growers meeting in Elizabeth City, NC.

**Title:** "New Model Warns about CRISPR Gene Drives in the Wild" Article  
**Media Outlet/Organization:** Quanta Magazine  
**Activity Date:** 11/16/2017  
**Description:** IGERT faculty mentor Dr. Jason Delborne was quoted in this article, <https://www.quantamagazine.org/new-model-warns-about-crispr-gene-drives-in-the-wild-20171116/>

**Title:** "Playing God: are we prepared to use gene drive technology?" Article  
**Media Outlet/Organization:** The Western Producer  
**Activity Date:** 12/14/2017  
**Description:** IGERT trainee Johanna Elsensohn was quoted in this article: <https://www.producer.com/2017/12/playing-god-prepared-use-gene-drive-technology/>

**Title:** "Process of Elimination" Article  
**Media Outlet/Organization:** Wired  
**Activity Date:** 02/20/2018  
**Description:** IGERT Co-PI Dr. Fred Gould was quoted in this article, <https://www.wired.com/story/crispr-eradicate-invasive-species/>



**Title:** "QnAs with Rodolphe Barrangou" Article  
**Media Outlet/Organization:** Proceedings of the National Academy of Sciences USA  
**Activity Date:** 07/03/2017  
**Description:** IGERT associate faculty, Rodolphe Barrangou was interviewed by science writer, Prashant Nair about his work on CRISPR-Cas systems for volume 114, issue 28, pp. 7183-7184. DOI: 10.1073/pnas.1710348114

**Title:** "Scientist to the Senators" Article  
**Media Outlet/Organization:** North Carolina State University College of Agriculture and Life Sciences News Bulletin  
**Activity Date:** 12/19/2017  
**Description:** IGERT trainee Johanna Elsensohn was featured and quoted in this article:  
<https://cals.ncsu.edu/news/scientist-to-the-senators-ph-d-student-johanna-elsensohn/>

**Title:** "Synthetic species made to shun sex with wild organisms" Article  
**Media Outlet/Organization:** Nature Magazine  
**Activity Date:** 01/16/2018  
**Description:** IGERT Co-PI Dr. Fred Gould was quoted in this article on gene editing, <https://www.nature.com/articles/d41586-018-00625-1>

**Title:** "The Rise of Aquaculture & Resurgence of the Oyster Industry in the Southeast" Talk  
**Media Outlet/Organization:** Terra Vita Festival  
**Activity Date:** 10/20/2017  
**Description:** IGERT faculty mentor Dr. Matthew Booker gave a talk for a public audience at a festival that brings together top chefs, brewers, educators, & industry luminaries from across the Southeast to celebrate culinary excellence and sustainability in food.

**Title:** "The State of Diversity in Government and Public Service" Talk  
**Media Outlet/Organization:** Public Administration and Policy School of Public & International Affairs, University of Georgia  
**Activity Date:** 11/02/2017  
**Description:** IGERT associate faculty Dr. Jade Berry-James was invited to speak about "The State of Diversity in Government and Public Service" at the Public Administration and Policy School of Public & International Affairs at the University of Georgia.

**Title:** "Tracking evolutionary relationships of the Irish famine pathogen *Phytophthora infestans*" Talk  
**Media Outlet/Organization:** North Carolina Museum of Natural Sciences  
**Activity Date:** 09/16/2017  
**Description:** IGERT associate faculty Dr. Jean Ristaino gave this talk to a public audience as part of the TRICEM Showcase in Raleigh, NC.

**Title:** "Tracking worldwide migrations, evolutionary relationships and reemergence of *Phytophthora infestans*: A threat" Talk  
**Media Outlet/Organization:** Global Food Security International Potato Center  
**Activity Date:** 11/13/2017  
**Description:** IGERT associate faculty Dr. Jean Ristaino gave this talk to a public audience in Lima, Peru.

**Title:** "Trump's agriculture department reverses course on biotech rules" Article  
**Media Outlet/Organization:** Science Magazine  
**Activity Date:** 11/06/2017  
**Description:** IGERT faculty mentor Dr. Jennifer Kuzma was quoted in this article in Science Magazine,  
<http://www.sciencemag.org/news/2017/11/trump-s-agriculture-department-reverses-course-biotech-rules>

**Title:** "USDA scraps overhaul of GMO and gene edited crop regulations that biotech advocates viewed as 'unscientific'" Blog Post  
**Media Outlet/Organization:** Genetic Literacy Project Blog  
**Activity Date:** 11/17/2017  
**Description:** IGERT faculty mentor Dr. Jennifer Kuzma was quoted in this blog post by Paul McDivitt;  
<https://geneticliteracyproject.org/2017/11/07/usda-scraps-proposed-overhaul-gmo-gene-edited-crop-regulations-biotech-advocates-viewed-unscientific/>

**Title:** 4-H Statewide Competition  
**Media Outlet/Organization:** NC State Fair  
**Activity Date:** 10/22/2017  
**Description:** IGERT trainee Johanna Elsensohn volunteered as a judge for 4-H Statewide Competition held during the North Carolina State Fair held Raleigh, NC.

**Title:** AGES: The Untold Story of GMO Pioneers Event  
**Media Outlet/Organization:** Genetic Engineering and Society Center  
**Activity Date:** 09/26/2017  
**Description:** IGERT faculty Drs. Matthew Booker, Jean Ristaino, Fred Gould & Jennifer Kuzma participated in this event for the public unveiling of the GES Center's, with NC State Libraries & History Dept., oral history Archive of Agricultural Genetic Engineering.

**Title:** BioLunch Seminar Series Coordination  
**Media Outlet/Organization:** North Carolina State University  
**Activity Date:** 08/31/2017  
**Description:** IGERT trainee, Nicole Gutzmann, served as Coordinator for the NC State University BioLunch Seminar Series from January 2016 - August 2017. She wrote a grant to get the 2017 series funded, managed meetings & poster sessions, & trained replacements.

**Title:** BugFest  
**Media Outlet/Organization:** North Carolina Museum of Natural Sciences  
**Activity Date:** 09/16/2017  
**Description:** IGERT trainee Johanna Elsensohn volunteered at Raleigh's annual BugFest. Many of our faculty and fellows attended along with over 35,000 members of the public who come annually to interact with entomologists and other scientists.

**Title:** CAALS 3D Program

**Media Outlet/Organization:** North Carolina State University

**Activity Date:** 07/26/2017

**Description:** Trainee Jennifer Baltzegar volunteered for NCSU's Creating Awareness of Agriculture and Life Sciences Disciplines, Degree Programs, and Discoveries (CAALS-3D) Summer Research Experience, a week-long summer program for minority high school students.

**Title:** CEFS Summer Internship

**Media Outlet/Organization:** North Carolina State University

**Activity Date:** 06/07/2017

**Description:** IGERT trainee Johanna Elsensohn (Cohort 3) volunteered during the Summer Internship Program for undergraduates, which ran from Wednesday, June 7 until Wednesday, July 26, 2017 and was based at the CEFS' 2000-acre Field Research and Outreach Facility.

**Title:** Communication, Engagement, and Biotechnology Workshop

**Media Outlet/Organization:** US-China Agricultural Biotechnology Safety Administration

**Activity Date:** 10/04/2017

**Description:** IGERT faculty mentor Dr. Jason Delborne organized this workshop on NC State's campus.

**Title:** Cultivating Cultures of Ethics Focus Group Moderation

**Media Outlet/Organization:** Genetic Engineering and Society Center

**Activity Date:** 06/06/2017

**Description:** IGERT trainees Jennifer Baltzegar (cohort 3) and Sophia Webster (cohort 1) co-moderated focus groups with stakeholders from outside of NCSU on ethics in STEM and responsible innovation to discuss what those topics meant to them.

**Title:** Eclipse Day

**Media Outlet/Organization:** North Carolina State University

**Activity Date:** 08/21/2017

**Description:** IGERT trainee Caroline Leitschuh (cohort 2) participated in NCSU's College of Sciences' Eclipse day during which she helped attendees safely view the eclipse and execute citizen science experiments tracking changes in weather and animal behavior.

**Title:** Emory University Forum: Community Engagement

**Media Outlet/Organization:** Emory University

**Activity Date:** 02/23/2018

**Description:** IGERT Co-PI Dr. Fred Gould participated in Emory University's Forum on Community Engagement.

**Title:** Emory University Forum: Genetic Pest Management

**Media Outlet/Organization:** Emory University

**Activity Date:** 02/24/2018

**Description:** IGERT Co-PI Dr. Fred Gould participated in Emory University's Seminar on Genetic Pest Management.

**Title:** Engineering Resilience Workshop

**Media Outlet/Organization:** CSIRO (Australia) and Revive and Restore

**Activity Date:** 09/11/2017

**Description:** IGERT faculty mentor Dr. Jason Delborne participated in this workshop by invitation as a member of the Stakeholder Engagement Working Group to aimed at identifying synthetic biology solutions to conservation problems caused by environmental change.

**Title:** Farm to Fork Festival

**Media Outlet/Organization:** Center for Environmental Farming Systems

**Activity Date:** 06/02/2017

**Description:** IGERT trainee Johanna Elsensohn volunteered at the 2017 Farm to Fork Festival in Pittsboro, NC, hosted by the Center for Environmental Farming System, which is focused on raising money to fund farmer apprentices and internships.

**Title:** Gates Foundation Meeting Moderation

**Media Outlet/Organization:** Gates Foundation

**Activity Date:** 07/12/2017

**Description:** IGERT Co-PI Dr. Fred Gould was the meeting moderator on strategies for testing gene drives in Africa for malaria control at the Gates Foundation Meeting.

**Title:** Genetic Pest Management Seminar: Iowa State University

**Media Outlet/Organization:** Iowa State University

**Activity Date:** 04/03/2018

**Description:** IGERT Co-PI Dr. Fred Gould gave a seminar on Genetic Pest Management at Iowa State University.

**Title:** Genetic Pest Management Seminar: University of Idaho

**Media Outlet/Organization:** University of Idaho

**Activity Date:** 09/19/2017

**Description:** IGERT Co-PI Dr. Fred Gould gave a seminar on Genetic Pest Management at the University of Idaho.

**Title:** Genetic Pest Management Seminar: University of North Carolina at Charlotte

**Media Outlet/Organization:** University of North Carolina (UNC) at Charlotte

**Activity Date:** 03/23/2018

**Description:** IGERT Co-PI Dr. Fred Gould gave a seminar on Genetic Pest Management at UNC Charlotte.

**Title:** Interdisciplinary Research Talk: North Carolina State University  
**Media Outlet/Organization:** North Carolina State University  
**Activity Date:** 04/25/2018  
**Description:** IGERT Co-PI Dr. Fred Gould gave a presentation on interdisciplinary research to undergraduates at the College of Humanities and Social Sciences at North Carolina State University.

**Title:** International Academies Meeting Talk  
**Media Outlet/Organization:** International Academies  
**Activity Date:** 10/11/2017  
**Description:** IGERT Co-PI Dr. Fred Gould gave a talk at the International Academies meeting on biosecurity in Hanover, Germany.

**Title:** Math & Science Night: Washington GT Elementary  
**Media Outlet/Organization:** Washington GT Elementary School  
**Activity Date:** 01/25/2018  
**Description:** IGERT trainee Johanna Elsensohn volunteered at the Math and Science Night at Washington GT Elementary School in Raleigh, NC.

**Title:** NASEM Sackler Colloquium - Gene Drives: From Species Eradication to Species Preservation  
**Media Outlet/Organization:** National Academies of Sciences, Engineering & Medicine  
**Activity Date:** 11/17/2017  
**Description:** IGERT Co-PI Dr. Fred Gould gave a presentation on gene drives at the NASEM Meeting on Communicating Science III Sackler Colloquia. <https://research.ncsu.edu/ges/2017/12/video-fred-gould-gene-drives-nasem-sackler-scicomm/>

**Title:** NCSU High School Student Shadow Day  
**Media Outlet/Organization:** North Carolina State University  
**Activity Date:** 07/19/2017  
**Description:** IGERT trainee Jennifer Baltzegar (Cohort 3) volunteered for NC State University's High School Student Shadow Day and shared her graduate school experience with high school seniors from around the state.

**Title:** New Frontiers: The Story Collider  
**Media Outlet/Organization:** The Story Collider  
**Activity Date:** 06/26/2017  
**Description:** IGERT trainee Caroline Leitschuh (Cohort 2) participated in The Story Collider's show about New Frontiers at Motorco Music Hall in Durham, NC. This show is a place for scientists to share their true, personal science stories to the general public.

**Title:** Packapalooza  
**Media Outlet/Organization:** North Carolina State University  
**Activity Date:** 08/19/2017  
**Description:** IGERT trainee Johanna Elsensohn volunteered at Packapalooza, an all-day block party and street festival capping off Wolfpack Welcome Week at the start of the academic year at NCSU, featuring 326 vendor booths & 60 sponsoring organizations.

**Title:** Public Forum on GE Crops  
**Media Outlet/Organization:** University of Idaho and University of Washington  
**Activity Date:** 09/18/2017  
**Description:** IGERT Co-PI Dr. Fred Gould participated in a public form on GE crops with representatives from both of these universities.

**Title:** Science Cafe: CRISPR and the Ethics of Editing Genes  
**Media Outlet/Organization:** North Carolina Museum of Natural Sciences  
**Activity Date:** 09/28/2017  
**Description:** In an event co-coordinated by trainee Caroline Leitschuh, IGERT faculty mentors Drs. Jason Delborne and John Godwin spoke to the public about CRISPR and other advanced gene-editing tools regarding the elimination of invasive pest species.

**Title:** Science Seminar: Genetically Engineered Mosquitoes  
**Media Outlet/Organization:** Durham Technical Community College  
**Activity Date:** 10/18/2017  
**Description:** IGERT trainee Sophia Webster (Cohort 1) was invited to give a talk describing the use of genetically engineered mosquitoes to prevent the transmission of diseases such as Zika at Durham Technical Community College.

**Title:** SciLine Briefing: Gene Drives  
**Media Outlet/Organization:** SciLine  
**Activity Date:** 04/25/2018  
**Description:** IGERT faculty mentor Dr. Jennifer Kuzma participated in SciLine's first Media Briefing on Gene Drives; <https://www.sciline.org/media-briefings-blog/gene-drives>

**Title:** Talking about Gene Drive: Communications Workshop  
**Media Outlet/Organization:** Foundation for the National Institutes of Health  
**Activity Date:** 11/04/2017  
**Description:** IGERT faculty mentor Dr. Jason Delborne participated in this workshop at which attendants discussed how gene drive technology is being described in the media and ways to work together to enhance related communication and clarify public perception.

**Title:** University of Arizona Seminar: Genetic Pest Management  
**Media Outlet/Organization:** University of Arizona  
**Activity Date:** 03/16/2018  
**Description:** IGERT Co-PI Dr. Fred Gould participated in the University of Arizona's Seminar on Genetic Pest Management.

**Title:** University of Arizona Seminar: GE crops

**Media Outlet/Organization:** University of Arizona

**Activity Date:** 03/15/2018

**Description:** IGERT Co-PI Dr. Fred Gould participated in the University of Arizona's Seminar on Genetic Engineering crops.

## Publications, Presentations, and Patents

### Journal Articles in Refereed Publications

#### 5a. Journal Articles in Refereed Publications

Adelman, Z., Akbari, O., Bauer, J., Bier, E., Bloss, C., Carter, S. R., Callender, C., Denis, A.C., Cowhey, P., Dass, B., Delborne, J., Devereaux, M., Ellsworth, P., Friedman, R.M., Gantz, V., Gibson, C., Hay, B.A., Hoddle, M., James, A.A., James, S., Jorgenson, L., Kalichman, M., Marshall, J., McGinnis, W., Newman, J., Pearson, A., Quemada, H., Rudenko, L., Shelton, A., Vinetz, J.M., Weisman, J., Wong, B., & Wozniak, C. (2017). Rules of the road for insect gene drive research and testing. *Nature Biotechnology*, 35 (8), 716-718. <https://doi.org/10.1038/nbt.3926>

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Wang, J. P., Matthews, M., Shi, R., Yang, C., Tunlaya-Anukit, S., Chen, H-C., Li, Q., Liu, J., Lin, C-Y., Naik, P., Sun, Y-H., Loziuk, P. L., Yeh, T-F., Kim, H., Gjersing, E., Shollenberger, T., Shuford, C. M., Song, J., Miller, Z., Edmonds, W., Huang, Y-Y., Lin, Y-C., Li, W., Chen, H., Peszlen, I., Williams, C. M., Ducoste, J. J., Ralph, J., H Chang, H-M., Muddiman, D. C., Davis, M., Isik, F., Smith, C., Sederoff, R. R., & Chiang, V. L. (2018). Improving wood properties for wood utilization through multi-omics integration in lignin biosynthesis. *Nature Communications*, 9, 1-16. DOI: 10.1038/s41467-018-03863-z

Weissman, J. L., Holmes, R., Barrangou, R., Moineau, S., Fagan, W. F., Levin, B. R., & Johnson, P. L. F. (2018). Immune Loss as a Driver of Coexistence During Host-Phage Coevolution. *International Society for Microbial Ecology Journal*, 12, 585-597. DOI: 10.1038/ismej.2017.194

Yap, T. Nguyen, N. \*Serr, M. Shepack, A., & Vredenburg, V. T. (2017). Batrachochytrium salamandrivorans and the Risk of a Second Amphibian Pandemic. *EcoHealth*, 14 (4), 851-864. <https://doi-org.prox.lib.ncsu.edu/10.1007/s10393-017-1278-1>

Zhou, S., Luoma, S. E., St. Armour, G. E., Thakkar, E., Mackay, T. F. C., & Anholt, R. R. H. (2017). A Drosophila model for toxicogenomics: Genetic variation in susceptibility to heavy metal exposure. *Public Library of Science (PLOS) Genetics*, 13 (7), e1006907. <https://doi.org/10.1371/journal.pgen.1006907>

Zhu, J., Dhammi, A., van Kretschmar, J. B., Vargo, E. L., Apperson, C. S., & Roe, R. M. (2017). Novel use of aliphatic n-methyl ketones as a fumigant and alternative to methyl bromide for insect control. *Pest Management Science*, 74 (3). <https://doi-org.prox.lib.ncsu.edu/10.1002/ps.4749>

## Journal Articles in Non-Refereed Publications

### 5b. Journal Articles in Non-Refereed Publication

\*Elsensohn, J. E. (2018). Two model organisms are better than one: toward a better understanding of plant/insect interactions. *The Signal*, 19 (5), 2. <http://keck.sciences.ncsu.edu/wp-content/uploads/2018/01/The-Signal-19.5.pdf>

\*Elsensohn, J.E., & K. Sears. (2017). Synthetic plant-associated microorganisms. *Genetic Engineering and Society Center Issue Brief #2017.1*. <https://research.ncsu.edu/ges/2017/07/synthetic-microorganisms-for-agricultural-use-2017-01/>

Gould, F., Amasino, R. M., Brossard, D., Buell, C. R., Dixon, R. A., Falck-Zepeda, J. B., Gallo, M. A., Giller, K. E., Glenna, L. L., Griffin, T., Hamaker, B. R., Kareiva, P. M., Magraw, D., Mallory-Smith, C., Pixley, K. V., Ransom, E.P., Rodemeyer, M., Stelly, D.M., Stewart, C. N., & Whitaker, R. J. (2017). National Academies Report on Genetically Engineered Crops Guarded Against Bias. *The Chronicle of Higher Education*. <https://www.chronicle.com/blogs/letters/national-academies-report-on-genetically-engineered-crops-guarded-against-bias/>

Keitt, B., Scheuer, J., & Delborne, J. (2017). Communicating Conservation: Aiming for Consensus on the Use of New Conservation Technologies. *Switzer Foundation Grant Programs*. <https://www.switzernetwork.org/network-innovation-proposal/communicating-conservation-aiming-consensus-use-new-conservation>

## Books

### 5c. Books

Delborne, J.A., Kuzma, J., Gould, F., Frow, E., \*Leitschuh, C., & \*Sudweeks, J. (Eds.). (2018). *Roadmap to Gene Drives: Research and Governance Needs in Social, Political, and Ecological Contexts* [special issue of 14 peer-reviewed articles] - *The Journal of Responsible Innovation*, 5 (sup1). London: Routledge/Taylor & Francis Group. Print ISSN: 2329-9460, Online ISSN: 2329-9037, <https://www.tandfonline.com/toc/tjri20/5/sup1?nav=toCList>

## Book Chapters

### 5d. Book Chapters

Jameson, J. K., Berry-James, R. M., Daley, D. M., & Cogburn, J. C. (2017). Effectiveness of Mediation in the State Agency Grievance Process. In A. Georgakopoulos (Ed.), *The Handbook of Mediation: Theory, Research and Practice* (pp. 164-169). New York: Routledge/Taylor & Francis. ISBN 987-1-138-12421-9

Jones, M. G., & Ennes, M. (2018). High-stakes Testing. In A. Hynds (Ed.), *Oxford Bibliographies in Education* (pp. 1-12). New York: Oxford University Press. DOI: 10.1093/OBO/9780199756810-0200

## Conference Publications

### 5g. Conference Publications

Delborne, J., Farooque, M., & Shapiro, J. (2017). *Genetically Engineered Algae Public Engagement Strategies: A Stakeholder Workshop Report* (Workshop Report). Tempe, AZ: ECAS: Expert and Citizen Assessment of Science and Technology. <https://ecastnetwork.org/research/genetically-engineered-algae-public-engagement-strategies/>

Foley, R. W., Asare, P., Delborne, J., Lach, J., & Misra, V. (2017). *Prototype to Patient Treatment: Dialogue on Safety, Regulation, Privacy,*

Tateosian, L., Guenter, R., Yang, Y. P., & Ristaino, J. (2017). Tracking 19th Century Late Blight from Archival Documents using Text Analytics and Geoparsing. In *Free and Open Source Software for Geospatial (FOSS4G) Conference Proceedings*, 17 (1), 17. <https://doi.org/10.7275/R5J964K5>

## Conference Presentations

### 5h. Conference Presentations

\*Backus, G. A., & Delborne, J. A. (2017, August). Gene Drives over the Horizon: A Model, for Anticipatory Governance. Paper presented at the Annual Meeting of the Society for Social Studies of Science, Boston, MA.

\*Baltzegar, J. (2017, August). Evolution of Insecticide Resistance in Iquitos, Peru. Oral Presentation given at the Annual Genetic Program Retreat, Raleigh, NC.

\*Baltzegar, J. & Gould, F. (2017, November). Temporal and Spatial Patterns of Knockdown Resistance in *Aedes aegypti* from Iquitos, Peru. Poster Presentation at the Entomological Society of America Conference, Denver, CO.

\*Barnes, J. C. (2017, August). The co-production of resurrection science and policy. Paper presented at the Society for the Social Studies of Science (4S) Annual Meeting, Boston, MA.

\*Barnes, J. C. (2017, October). Anticipating the biogeography of blight-resistant American chestnut. Poster presented at the 34th Annual Meeting of the American Chestnut Foundation, Portland, ME.

\*Barnhill-Dilling, S.K. (2017, August). Emerging Technologies & Conservation. Panel presenter at Society for the Social Studies of Science annual meeting, Boston, MA.

\*Barnhill-Dilling, S. K (2017, August). Growing Governance: Genetically Modified American Chestnut & Indigenous-led Participatory Process. Paper presented at the Society for the Social Studies of Science annual meeting, Boston, MA.

\*Barnhill-Dilling, S. K. (2017, November). Scientists Branching Out? Scientists' Perception of Public & Reciprocal Engagement Potential. Paper presented at the Society of American Foresters, Albuquerque, New Mexico.

Berry-James, R. M. (2017, October). Evaluating the Complexity of Food Systems for Vulnerable Citizens: Sustainable Policy Practices on track Policy, Planning and Program Evaluation. Panelist presenter at the 2017 SECOPA Conference: Defending Public Administration in a Time of Uncertainty, Hollywood, FL.

Berry-James, R. M. (2017, October). Responsible Innovation in Food Biotechnology: Exploring Cultural Attitudes and Public Trust. Paper presented at the 2017 NASPAA Annual Conference, Washington, DC.

Berry-James, R. M. (2017, October). The Skills and Resources Needed to be Effective MPA and PhD Directors. Panelist presenter at the 2017 NASPAA Annual Conference, Washington, DC.

Binder, A. R. (2017, December). The salience of environmental hazards: Making sense of citizen concerns and their implications for risk communication. Paper presented at the annual meeting of the Society for Risk Analysis, Arlington, VA.

Cayton, E., & Jones, M. G. (2017, June). Social Cognitive Career Factors and Students' Interest in Electronics and Engineering. Oral presentation at the American Society Engineering Education Annual Meeting, Columbus, OH.

Cayton, E., Jones, M. G., Chesnutt, K., Ennes, M., & Huff, P. (2017, August). Students' interest in engineering careers. Oral presentation at the meeting of the European Science Education Research Association, Dublin, Ireland.

Chesnutt, K., Jones, M. G., Cayton, E., Ennes, M., Hite, R., Huff, P., & Pereya Perez, M. (2017, August). Scientific measurement tools: understanding access and implications for learning about size and scale. Oral presentation at the meeting of the European Science Education Research Association, Dublin, Ireland.

Dayrizadeh, A., Carpenter, P. P., Walsh, S., Jones, M.G., Cayton, E., & Huff, P. (2017, June). Wide Band Gap Academy - Education and Workforce Development for the 21st Century Power Electronics and Power Systems Industries. Paper presented at 2017 ASEE Annual Conference & Exposition, Columbus, Ohio.

Delborne, J. A. (2017, December). A Decade of Synthetic Biology. Panelist presenter at The End of Synthetic Biology? What Futures? Meeting, University of Edinburgh, UK.

Delborne, J. A. (2017, October). Public engagement: Rationales, methods, and intended outcomes. Oral presentation at the International Workshop Assessing the Security Implications of Genome Editing Technology, Hanover, Germany.

Delborne, J. A. (2017, October). Emerging Technologies and Public Engagement. Oral presentation at the US-China Agricultural Biotechnology Safety Administration Collaboration Workshop: Communication, Engagement, and Biotechnology, Raleigh, NC.

Delborne, J. A. (2017, September). Strategies of engagement in synthetic biology. Oral presentation at the meeting for Engineering Resilience, Heron Island, Australia.

Delborne, J. A. (2017, November). Emerging Technologies, New Governance Arrangements, and the Time-Honored Challenges: Searching for Novelty in Anticipatory Governance. Panelist presenter at the meeting for Advancing Science for Policy through Interdisciplinary Research in Regulation, Berkeley, CA.

Delborne, J. A. (2017, August). Envisioning Responsible Innovation in Biotechnology for Conservation: Engagement, GM Chestnut Trees, and Gene Drive Mice. Paper presented at the Annual Meeting of the Society for Social Studies of Science, Boston, MA.

- \*Elsensohn, J. E., & Burrack, H. J. (2018, January). New directions in SWD research from the Southeast. Oral presentation at the Southeast Regional Fruit and Vegetable Conference, Savannah, GA.
- \*Elsensohn, J. E., \*Jones, M. S., Brown, Z. S., Mitchell, P., & Delborne, J. A. (2018, February). Assessing attitudes on gene drives: What consumers want to know. Oral presentation at the Specialty Crops Research Initiative on *Drosophila suzukii* annual meeting, Portland, OR.
- \*Elsensohn, J. E., \*Jones, M. S., Brown, Z. S., Mitchell, P., & Delborne, J. A. (2018, March). Assessing attitudes on gene drives: What consumers want to know. Oral presentation given at the meeting of the Southeastern Branch of Entomological Society of America, Orlando, FL.
- Ennes, M., Jones, M. G., Cayton, E., Chesnutt, K., & Huff, P. (2017, August). Education in informal science centers: Educators' perceived levels of self-efficacy. Oral presentation at the meeting of the European Science Education Research Association, Dublin, Ireland.
- Gould, F. (2017, June). Environmental effects of GM crops: Findings of a National Academies of Sciences, Engineering and Medicine (US-NASEM) report. Keynote address given at the 14th International Symposium on the Biosafety of Genetically Modified Organisms, Guadalajara, Mexico.
- Gould, F. (2017, June). Realities of Gene Drive. Oral presentation given at the JASON meeting on Gene Drive and Biosecurity, San Diego, CA.
- Gould, F. (2017, November). Prospects for the use of transgenic maize in the management of fall armyworm in Africa. Oral presentation at the Entomological Society of America Conference, Denver, CO.
- Grubbs, N., \*Gutzmann, N., \*Klobasa, W., Chu, F., Slayton, L. & Lorenzen, M.D. (2017, November). Can Cas9-mediated Gene Editing Uncover the Function of the Elusive Medea Element? Poster session presentation at the Entomological Society of America Conference, Denver, CO.
- Hedgespeth, M. L., McEachran, A. D., Rashash, D., Shea, D., Strynar, M., Delborne, J. A., & Nichols, E.G. (2017, November). Municipal Wastewater Application to Forests: Using Participatory Science to Understand Human Exposure and Risks to Chemical Contaminants of Concern. Poster session presented at the SETAC North America 38th Annual Meeting, Minneapolis, MN.
- Hite, R., Jones, M. G., Childers, G., Ennes, M., Chesnutt, K., Pereyra Perez, M., & Cayton, E., (2017, August). Cognitive development and adolescents' perceptions of presence in 3D, haptic, virtual reality. Oral presentation at the meeting of the European Science Education Research Association, Dublin, Ireland.
- Jones, M. G. (2017, October). Visualizing without vision: Teaching science to students with visual impairment. Oral presentation at the Visualization and Students With Special Needs Conference, Norrkoping, Sweden.
- Jones, M. G. & Baird, E. (2017, June). Promoting STEM interests and careers through families and museums exploring. Oral presentation at the Stellar Itest PI and evaluator Summit: Building the Foundational Skills of the Future Science and Engineering Workforce, Washington, DC.
- Jones, M. G., Cayton, E., Chesnutt, K., Ennes, M., Ward, R., & Huff, P. (2017, October). Enhancing motivation, confidence, and career goals: Creating tomorrow's scientists. Oral presentation at the NC Science Teachers Association Conference, Greensboro, NC.
- Jones, M. G., Childers, G., Chesnutt, K., Corin, E., Andre, T., & Cayton, E. (2017, August). Choosing a science career: Free choice science learning, self-efficacy, identity, and motivation. Oral presentation at the meeting of the European Science Education Research Association, Dublin, Ireland.
- Lorenzen, M.D. (2018, January). Genetic Engineering of Edible Insects for the Greater Good. Paper presented at the International Plant & Animal Genome Conference, San Diego, CA.
- Lorenzen, M.D. (2017, November). Genome editing in beetles: Lessons learned from the red flour beetle. Oral presentation at the Entomological Society of America Conference Workshop, Denver, CO.
- Ristaino, J. (2017, September). Major emerging plant diseases and their impact on food security. Paper presented at the Triangle Global Health Conference, Raleigh, NC.
- \*Serr, M., & Godwin, J. (2017, November). Updates on Assessing reproductive competitiveness between wild and lab strains of mice. Oral presentation at the Genetic Biocontrol of Invasive Rodents 3rd Conference, Washington, DC.
- \*Serr, M., & Godwin, J. (2017, July). Towards a genetic approach to invasive rodent eradications. Assessing reproductive competitiveness between wild and laboratory mice. Oral presentation given at the Island Invasives Conference, Dundee, Scotland, UK.
- Tracy, J., Jones, M. G., Ennes, M., Cayton, E., Chesnutt, K., Huff, P., & Ward, R. (2017, October). Bioinspired Materials. Oral presentation at NC Science Teachers Association Conference, Greensboro, NC.

## Partnerships/Collaborations

### Academic Partner 1

#### Active Status

No

#### Partner Name

University of Adelaide

#### Type of partner

Ph.D.-granting institution

Foreign-based institution

#### Funding arrangement for this partner



Partner provides funding to the IGERT project for research, curriculum, or other project activities, but not directly for trainees.

Other :A joint grant from both universities that awarded \$10,000 to research teams at each institution

**Activities for this partner/institution**

**Facilities:** IGERT trainees or faculty use a partner organization's facilities for project activities.

**Collaborative Research/Teaching:** Partner organization's personnel work with IGERT project staff on collaborative research/teaching.

**Personnel Exchange:** IGERT Trainees, faculty and/or partner organization personnel use each other's facilities or work at each other's sites on an ad hoc or as-needed basis.

**Activities for this partner/institution**

**Academic Partner 2**

**Active Status**

Yes

**Partner Name**

North Carolina A&T University

**Type of partner**

Ph.D.-granting institution

Minority-serving institution

**Funding arrangement for this partner**

Other :Potentially funded by separate NSF NRT gran

**Activities for this partner/institution**

**Collaborative Research/Teaching:** Partner organization's personnel work with IGERT project staff on collaborative research/teaching.

**Personnel Exchange:** IGERT Trainees, faculty and/or partner organization personnel use each other's facilities or work at each other's sites on an ad hoc or as-needed basis.

**Activities for this partner/institution**

Our newly submitted NSF NRT proposal, FEW: Agricultural Biotechnology in Our Evolving Food, Energy & Water Systems (AgBioFEWS), is a cornerstone of our collaboration with NC A&T. AgBioFEWS CoPIs are creating cooperative education projects with two HBCUs in North Carolina. One of them, North Carolina A&T University in Greensboro, recently received an NRT grant titled "Improving Strategies for Hunger Relief and Food Security through Computational Data Science." The focus of that program, like ours, is Eastern North Carolina. Most of the NC A&T students will be getting Masters degrees and they are required to do internships. We are arranging for them to do internships at NC State with AgBioFEWS faculty members. These students will be pre-adapted to enter our AgBioFEWS PhD program.

**Academic Partner 3**

**Active Status**

Yes

**Partner Name**

Fayetteville State University

**Type of partner**

Ph.D.-granting institution

Minority-serving institution

**Funding arrangement for this partner**

Other :Potentially funded by separate NSF NRT gran

**Activities for this partner/institution**

**Collaborative Research/Teaching:** Partner organization's personnel work with IGERT project staff on collaborative research/teaching.

**Personnel Exchange:** IGERT Trainees, faculty and/or partner organization personnel use each other's facilities or work at each other's sites on an ad hoc or as-needed basis.

**Activities for this partner/institution**

Our newly submitted NSF NRT proposal, FEW: Agricultural Biotechnology in Our Evolving Food, Energy & Water Systems (AgBioFEWS), is a cornerstone of our collaboration with Fayetteville State University. The University of North Carolina at Fayetteville is a HBCU with a large contingent of military or post-military students. Dr. Lieceng Zhu recently received an NSF-HCUP-NIA project titled "Mechanisms of Heat-Induced Loss of Host Plant Resistance to Insects." We are making arrangements for some of her students to come to NC State this summer and the following summer to work in molecular biology labs and to have discussions with some of the AgBioFEWS proposal faculty in the natural and social sciences. We expect this to set up a pipeline into the AgBioFEWS and other NC State graduate programs.

**Academic Partner 4**

**Active Status**

Yes

**Partner Name**

University of Wisconsin-Madison

**Type of partner**

Ph.D.-granting institution

**Funding arrangement for this partner**

Other :A joint grant from both universities that awarded \$100,000 for a joint (interdisciplinary) study

**Activities for this partner/institution**

**Collaborative Research/Teaching:** Partner organization's personnel work with IGERT project staff on collaborative research/teaching.

**Activities for this partner/institution**

Trainee Mike Jones and faculty mentor Zack Brown along with collaborators at the University of Wisconsin-Madison, were awarded a joint grant for \$100,000 for a joint (interdisciplinary) study, conceived in preparation for and during the GES-sponsored 'Roadmap to Gene Drives' conference at NCSU in February 2016. They have an AAEA presentation & associated conference paper that has resulted from this study - Jones, M. and Brown, Z. 2018. Willingness-to-pay Effects of Gene Drive Insect Use for Agricultural Pest Management in Diverse U.S. Market Applications. Selected paper prepared for presentation at the 2018 American Agricultural Economics Association (AAEA) Conference, Washington, D.C., USA, 5-7 August.

**Academic Partner 5**

**Active Status**

Yes

**Partner Name**

Center for Native Peoples and the Environment, SUNY-ESF

**Type of partner**

Ph.D.-granting institution

Minority-serving institution

**Funding arrangement for this partner**

Other :A collaborative award from NSF to support research by students and faculty

**Activities for this partner/institution**

**Collaborative Research/Teaching:** Partner organization's personnel work with IGERT project staff on collaborative research/teaching.

**Personnel Exchange:** IGERT Trainees, faculty and/or partner organization personnel use each other's facilities or work at each other's sites on an ad hoc or as-needed basis.

**Activities for this partner/institution**

IGERT faculty mentor Jason Delborne organized a stakeholder workshop held on NC State campus in April 2018, including participation by funded partners from CNPE. Neil Patterson (Co-PI and member of the Haudenasaunee Environmental Task Force) and Percy Abrams (linguist from Syracuse University) co-presented on indigenous perspectives on American chestnut restoration through biotechnology, as well as their linguistic analysis of indigenous concepts for biotechnology, GMO, and chestnut restoration. Trainees Jessica Barnes and Katie Barnhill-Dilling also participated.

**Government Partner 1**

**Active Status**

Yes

**Partner Name**

U.S. Naval Medical Research Unit - 6 Peru (NAMRU-6)

**Type of government agency**

U.S. Federal **laboratory or research facility**

**Funding arrangement for this partner**

Other :A separate NIH funded project on Dengue provides a CRADA contract to partner for the purposes of providing services or support of IGERT research related to the NIH project

**Activities for this partner/institution**

**Facilities:** IGERT trainees or faculty use a partner organization's facilities for project activities.

**Collaborative Research/Teaching:** Partner organization's personnel work with IGERT project staff on collaborative research/teaching.

**Personnel Exchange:** IGERT Trainees, faculty and/or partner organization personnel use each other's facilities or work at each other's sites on an ad hoc or as-needed basis.

**Activities for this partner/institution**

We have a joint research project in Iquitos Peru on Dengue epidemiology and potential for use of transgenic mosquitoes. This team was recently awarded a new NIH grant to continue their work on *Aedes aegypti* mosquitoes. Based in large part on trainee Jennifer Baltzegar's (Cohort 3) dissertation work, this grant, with total funding of \$1.6 million, will be vital for continued project development. Their grant was in the top 6 percentile of proposals received. Jen's cornerstone study explores the evolution of two single nucleotide polymorphisms (SNPs), F1534C and V1016I, across an 18-year period in Iquitos, Peru, which includes all years of pyrethroid use in the city. Her results present an intriguing dynamic between resistant haplotypes that improves understanding of insecticide resistance evolution. The new grant will allow for more in-depth exploration into pyrethroid resistance evolution and hypotheses about the efficacy of new gene drive strategies for mosquito suppression.

**Government Partner 2**

**Active Status**

No

**Partner Name**

Centro Regional de Investigación en Salud Pública, INSP, Mex

**Type of government agency**

Foreign institution or foreign government/agency : Mexico

**Funding arrangement for this partner**

No funding/direct financial interaction is involved in this partnership.

**Activities for this partner/institution**

**Facilities:** IGERT trainees or faculty use a partner organization's facilities for project activities.

**Collaborative Research/Teaching:** Partner organization's personnel work with IGERT project staff on collaborative research/teaching.

**Personnel Exchange:** IGERT Trainees, faculty and/or partner organization personnel use each other's facilities or work at each other's sites on an ad hoc or as-needed basis.

**Activities for this partner/institution**

**Government Partner 3**

**Active Status**

Yes

**Partner Name**

CSIRO Commonwealth Scientific and Industrial Research Organization Australia

**Type of government agency**

Foreign institution or foreign government/agency : Australia

**Funding arrangement for this partner**

Other :In development

**Activities for this partner/institution**

**Facilities:** IGERT trainees or faculty use a partner organization's facilities for project activities.

**Collaborative Research/Teaching:** Partner organization's personnel work with IGERT project staff on collaborative research/teaching.

**Personnel Exchange:** IGERT Trainees, faculty and/or partner organization personnel use each other's facilities or work at each other's sites on an ad hoc or as-needed basis.

**Activities for this partner/institution**

This collaboration is focus on the mouse island eradication project. CSIRO personnel are involved at different levels but mostly in terms of risk analysis and regulatory pathway assessment. Keith Hayes with CSIRO is undertaking a formal quantitative risk assessment for gene drive mice that arose in part out of collaborations the IGERT program contributed to, specifically the preliminary data gathered by Dr. John Godwin and trainees Megan Serr and Caroline Leitschuh (both Cohort 2). Keith and team at the Commonwealth Scientific and Industrial Research Organization in Australia are focused on the use of a genetically-modified, sex-biasing gene drive mouse to reduce invasive mouse populations on islands where they threaten diversity. This will include input from experts at the molecular/cellular, population/community, and ecosystem levels with input from experts in these fields including participating faculty from the IGERT program.

**Other Partner 1**

**Active Status**

Yes

**Partner Name**

CIMMYT - International Maize and Wheat Improvement Center

**Funding arrangement for this partner**

No funding/direct financial interaction is involved in this partnership.

**Activities for this partner/institution**

**Facilities:** IGERT trainees or faculty use a partner organization's facilities for project activities.

**Collaborative Research/Teaching:** Partner organization's personnel work with IGERT project staff on collaborative research/teaching.

**Personnel Exchange:** IGERT Trainees, faculty and/or partner organization personnel use each other's facilities or work at each other's sites on an ad hoc or as-needed basis.

**Activities for this partner/institution**

Two of our fellows from Cohort 3, Jennifer Baltzegar & Mike Jones, were assisted by CIMMYT during their field work in Mexico in 2016. They spent 3 weeks in Mexico gathering economic and biological data from local farms in pre-selected field sites. Martha Willcox (CIMMYT) assisted them with site selection locales and provided logistical support in country. They have completed most of the analyses of the data gathered during that trip (see International Opportunities - Research/Educational Achievements). Moving forward, they will combine the economic context of maize production, storage, and trade movement with data on population genetics to make statements about how human-mediated processes may impact the genetic diversity of maize weevils. This information will be compiled in a joint publication with CIMMYT with planned submission to The Journal of Stored Products Research.

**Other Partner 2**

**Active Status**

Yes

**Partner Name**

UN FAO Food and Agriculture Organization

**Funding arrangement for this partner**

No funding/direct financial interaction is involved in this partnership.

**Activities for this partner/institution**

**Collaborative Research/Teaching:** Partner organization's personnel work with IGERT project staff on collaborative research/teaching.

**Personnel Exchange:** IGERT Trainees, faculty and/or partner organization personnel use each other's facilities or work at each other's sites on an ad hoc or as-needed basis.

**Internships:** IGERT Trainees or faculty work in a partner's facilities specifically as interns.

**Activities for this partner/institution**

Co-PI Dr. Fred Gould presented "Prospects for the use of transgenic maize in the management of fall armyworm in Africa" at the Entomology 2017 Annual Meeting in Denver, CO, in November, on the prospects of using GMO technology to help alleviate the issue of crop pests in Africa. The Fall Armyworm which is a major pest of corn in the western hemisphere has become an invasive pest in Africa in the past few years. Some groups are calling for use of Bt corn as a solution. This "Late-Breaking Symposium: Fall Armyworm in Africa: Status, Management Challenges, and Potential for Further Spread" was organized by Allan Hruska, the UN-FAO Program Officer in Panama, and is just the latest collaboration between the two in a relationship that spans nearly 30 years.

**Other Partner 3**

**Active Status**

Yes

**Partner Name**

OECD France

**Funding arrangement for this partner**

Partner provides funding to the IGERT project for research, curriculum, or other project activities, but not directly for trainees.

**Activities for this partner/institution**

**Collaborative Research/Teaching:** Partner organization's personnel work with IGERT project staff on collaborative research/teaching.

**Activities for this partner/institution**

In October of 2016, the GES Center hosted scholars from all over the world for a workshop entitled "Environmental Release of Engineered Pests: Building an International Governance Framework". Co-hosted with OECD, this workshop brought individuals from countries from 5 different continents together to discuss the problems facing regulation of emerging technologies. The 2-day invite-only workshop focused on practical solutions to address the international dimension of GPM regulation. With many countries evaluating gene drives for solving some of their most vexing agricultural and public health challenges, the time was ripe to discuss common governance principles for regulatory authorities to consider, with an eye towards harmonizing eventual regulatory structures. There are now 8 Conference Proceedings papers are being published by individuals whose collaborations were formed at that workshop.

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