04 - 05 June 2018 | Raleigh, North Carolina

SYMPOSIUM

FORGING INTEGRATED EXPERTISE IN GRADUATE EDUCATION

Diverse Experiences, Workforce Needs, and the Way Forward

GES CENTER
NC STATE UNIVERSITY

Genetic Engineering and Society Center

Integrating scientific knowledge and public values in shaping the futures of biotechnology

NSF

NC STATE
College of Agriculture and Life Sciences

Symposium website: All Symposium information available online at
> go.ncsu.edu/ges-capstone

Resources: Symposium documents and resources available to download at
> go.ncsu.edu/ges-symp

Live Streaming: Portions of the Symposium will be live streamed at
> go.ncsu.edu/ges-livestream

Follow us on Twitter at
> @GESCenterNCSU

Email us at gesocietycenter@ncsu.edu

Wi-Fi: Guests to NC State may connect to
> NCSU Guest (no password)

Statement on Productive, Inclusive and Ethical Communication

Genetic Engineering and Society Center, Adopted June 28, 2013

Genetic engineering encompasses technologies, practices, and policies that can affect all of society and must be informed by substantial, rigorous, open, and inclusive civic deliberation. The Genetic Engineering and Society (GES) Center at North Carolina State University has adopted the following guidelines to promote productive, inclusive, and ethical communication.

1. **Our discussions will be inclusive**, seeking out and listening respectfully to a broad range of voices and perspectives. We will listen carefully and openly before evaluating the statements of others.
2. We recognize that participants' views may be grounded in substantially **different cultural frameworks and belief systems**. Engagement across these differences is essential to the success of our dialog.
3. **We honor differences of opinion without reducing those to mere opinion**. We recognize that opinions have a variety of foundations: accurate facts, rigorous reasoning, personal experience, and cultural and personal values. We expect a combination of tolerance and open-minded skepticism on the part of all participants.
4. Participants in our discussions will not only have varied opinions; they will also have **varied degrees of familiarity with the underlying science and technology**, and with its **social, cultural, and political contexts and implications**. We expect participants to be as fully informed as possible, but we will not dismiss or exclude participation based on degree of familiarity with the topic.
5. Participants are expected to share their knowledge with the rest of the community, limiting the use of discipline-specific jargon and maximizing efforts to **illustrate complex material clearly, concisely, and rigorously**.
6. **We value ongoing dialog** in which participants make time and effort to examine and research others' ideas before returning to the conversation.
7. We expect appropriate **disclosure and transparent representation** of group and self-interests.
8. Differences and conflicts often emerge in such deliberations and can help illuminate the issues and interests at stake. We will **engage with issues in the most collaborative manner possible**, seeking to use disagreements productively rather than to avoid disagreement.
9. Our members and guests can expect to be challenged on the basis of facts and reasoned arguments, but not in ways that are personal or disrespectful. **Emotional expression and creative and performative expression are welcome** when consistent with our other guidelines.
10. Should arguments be made, or positions be taken, that violate basic principles of equity, justice, inclusion, and mutual respect, these will be challenged. We will **avoid disparagement or exclusion of individuals based on personal or group characteristics**.

Source Materials

Farrell, T. (1993). *Norms of rhetorical culture*. New Haven: Yale University Press.
Folger, JP, Poole, MS, & Stutman, RK (2012). *Working through conflict: Strategies for relationships, groups, and organizations* (7th ed.). Boston: Pearson.
Habermas, J. (1971). *Knowledge and human interests* (Trans. J. Shapiro). Boston: Beacon.
Habermas, J. (1984). *The theory of communicative action, Vol. 1: Reason and the rationalization of society* (Trans. T. McCarthy). Boston: Beacon.
International Environmental Communication Association (IECA) (2013). Code of ethics. Available at: http://theieca.org/about/code-ethics
National Communication Association (1999). Credo for ethical communication, Available at: http://www.natcom.org/uploadedFiles/About_NCA/Leadership_and_Governance/Public_Policy_Platform/PDF-PolicyPlatform-NCA_Credo_for_Ethical_Communication.pdf
Pearce, W. B., & Littlejohn, S. (1997). *Moral conflict: When social worlds collide*. Thousand Oaks, CA: Sage

GES CENTER

Forging Integrated Expertise in Graduate Education Symposium

04 - 05 June 2018 | Talley Student Union, NC State University

TABLE OF CONTENTS

Genetic Engineering and Society Center

Integrating scientific knowledge and public values in shaping the futures of biotechnology

James B. Hunt, Jr. Library

1070 Partners Way, 5th floor
NC State University, Campus Box 7565
Raleigh, NC 27695-7565

GO.NCSU.EDU/GES
GESOCIETYCENTER@NCSU.EDU
(919) 515-2596
@GESCenterNCSU

Co-Directors

Dr. Fred Gould
University Distinguished Professor,
Entomology and Plant Pathology
fred_gould@ncsu.edu

Dr. Jennifer Kuzma
Goodnight-NC GSK Foundation Distinguished Professor,
School of Public and International Affairs
jkuzma@ncsu.edu

Back to Table of Contents >

WELCOME

June 4, 2018

Welcome to North Carolina State University. We want to thank you for making the effort to be here for what we hope will be a productive and insightful two days.

We live in an interconnected world, with complex problems, emerging technologies, and limited resources. As noted in the National Science Foundation's *10 Big Ideas for Future NSF Investments:*

> *"The grand challenges of today — protecting human health; understanding the food, energy, water nexus; exploring the universe at all scales — will not be solved by one discipline alone. They require convergence: the merging of ideas, approaches and technologies from widely diverse fields of knowledge to stimulate innovation and discovery."*

This workshop was originally conceived as a Capstone Symposium for the NC State NSF-IGERT "Genetic Engineering and Society: The Case of Transgenic Pests" that had equal contributions from the natural and social sciences. It would be a place to celebrate accomplishments and share valuable lessons learned.

As time went by though, this idea grew into something more. An integrated, transdisciplinary approach to graduate student training was more than simply a feature of the program, it was its core. Our students became "T-shaped" — equally adept at thinking about and solving problems around policy and governance as they are with biomathematics and synthetic biology. At the same time, programs were being developed in other places around issues like plant science, engineering, and artificial intelligence. What insights and experiences could they share with institutions and organizations? We hope to gain valuable insight on this and other questions during our time together.

We would like to thank the NC State College of Agriculture and Life Sciences (CALS) for providing the majority of the funding for this Symposium. Additional funding has been provided by the National Science Foundation (award #1068676) and the Genetic Engineering and Society Center. We are truly grateful for this support.

We look forward to a very worthwhile time together!

Dr. Zachary Brown *Dr. Fred Gould*

Organizing Committee

This symposium was organized by the Genetic Engineering and Society (GES) Center at North Carolina State University.

Co-Chairs

Zachary Brown, GES Center Executive Committee member and Assistant Professor, Ag and Resource Economics, College of Agriculture and Life Sciences

Fred Gould, GES Center Co-director and University Distinguished Professor, Entomology and Plant Pathology, College of Agriculture and Life Sciences

Committee

Patti Mulligan,
GES Center Communication Director

Sharon Stauffer,
GES Center Program Associate

Karina T. Smith,
IGERT Program Coordinator

Funding support provided by

NC STATE College of Agriculture and Life Sciences

GES CENTER

NSF National Science Foundation

Back to Table of Contents >

AGENDA | AT A GLANCE

***All presentation times include Q&A**

DAY 1 | MONDAY, 04 JUNE

8:00 AM **Breakfast and Check In** | Talley 4280

8:30 AM **NC State Welcome** LIVE STREAM
Zachary Brown, GES Center
Provost Warwick Arden
Dean Richard Linton, CALS

8:50 AM **KEYNOTE |** ***STEM Graduate Education: Advancing Knowledge & Transforming the Future*** LIVE STREAM
Laura Regassa, National Science Foundation

9:45 AM **NASEM Report |** ***Branches from the Same Tree: Integrative Learning in Higher Education*** LIVE STREAM
Pamela L. Jennings, NC State (Incoming July 2018)

10:20 AM **Coffee Break**

• • •

Experiences from the NC State IGERT PhD program

10:45 AM ***"Genetic Engineering and Society: The Case of Transgenic Pests" 2011-2017*** LIVE STREAM
Fred Gould, GES Center

11:05 AM **Presentations from IGERT Fellows**
2012 Cohort - Mosquitoes and Human Health:
Amanda Walsh and Tim Antonelli
2013 Cohort - Invasive Rodents and Biodiversity Conservation: Megan Serr and Elizabeth Pitts
2014 Cohort - Agricultural Pests:
Jennifer Baltzegar and Jayce Sudweeks

12:30 PM **Lunch** (Buffet) | Talley 4280

1:00 PM **Poster Session** | Talley 3285

• • •

Diverse Experiences in Integrated Education LIVE STREAM
Talley 4280

1:45 PM ***Toward Transferable and Sustainable Models for Interdisciplinary Training in Environmental Sustainability***
Jeff Kelly, University of Oklahoma

2:05 PM ***Graduate Education Informed by Social Network Analysis***
Sez Atamturktur, Clemson University

2:40 PM **Coffee Break**

3:10 PM ***Transdisciplinary, Parallel Play, or Something in Between?*** LIVE STREAM
Rebecca Jordan, Rutgers University

3:30 PM ***Fostering the Future from FFAR***
LaKisha Odom, Foundation for Food and Agriculture Research

4:15 PM **Adjourn**

4:30 PM **Poster Session** | Talley 3285

5:00 PM **Happy Hour!** | 1887 Bistro, Talley
Drinks and heavy hors d'oeuvres

DAY 2 | TUESDAY, 05 JUNE

8:00 AM **Breakfast and Check In** | Talley 4280

8:30 AM **Welcome** | Zachary Brown LIVE STREAM

8:45 AM **KEYNOTE |** ***The Future of Innovation: Workforce Needs and the Way Forward for Graduate Education***
Terri Lomax, Innovation Ecosystems LIVE STREAM

9:40 AM ***Meeting the Challenges of Integrative Doctoral Program Initiatives*** LIVE STREAM
Brian Verrelli, VCU Integrative Life Sciences

10:15 AM **Coffee Break**

• • •

10:30 AM **PANEL:** ***Interdisciplinary Graduate Training and the Workforce***
Introductions: Chancellor Randy Woodson, NC State
Moderator: Zachary Brown, GES Center
Panelists: Congressman David Price, NC 4th District
Stephen Briggs, NC Plant Sciences Initiative
Corey Scott, Cargill
Maggie Monast, Environmental Defense Fund
Sheryl Kunickis, USDA Office of Pest Mgmt Policy

Where Do We Go from Here?

11:45 AM **The Task at Hand**
Zachary Brown and Fred Gould, GES Center

12:00 PM **Lunch with Breakout Groups**
Talley 3210, 3220, 3221, 3223, 3285, or 4280

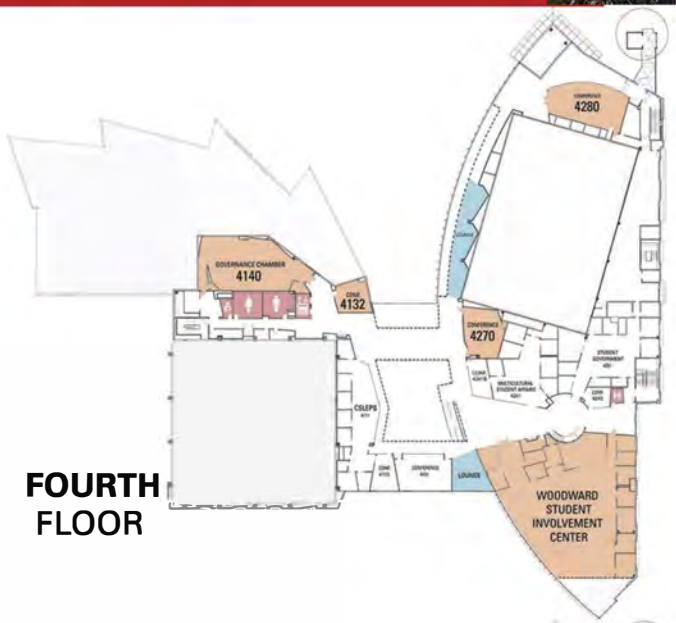
1:20 PM **Reconvene and Report Out** | Talley 4280

2:05 PM ***Summary and Perspectives***
Jennifer Kuzma, GES Center

2:15 PM **Adjourn**

Find your way around TALLEY STUDENT UNION

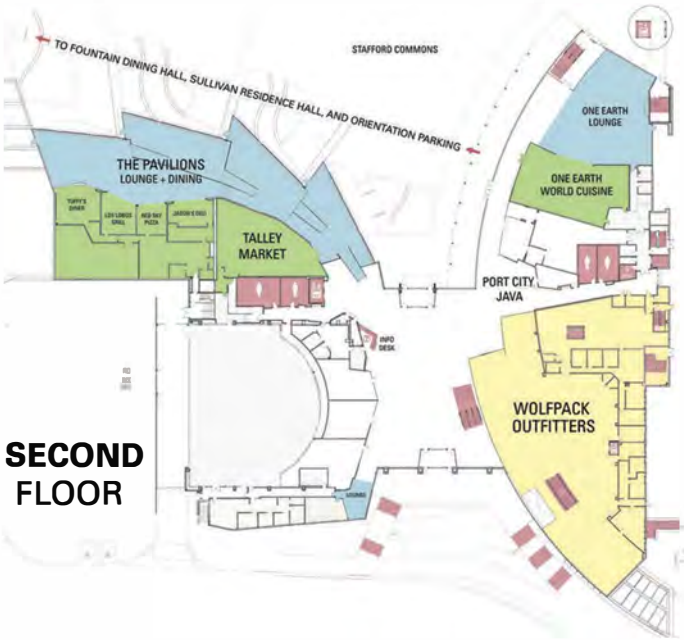
Back to Table of Contents >



FOURTH FLOOR

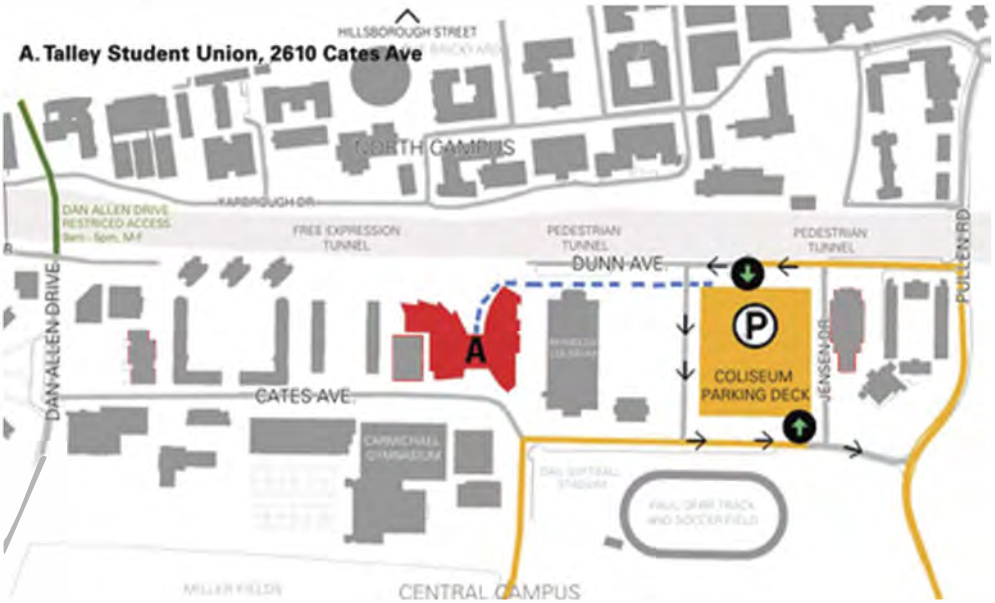
MAIN ROOM: 4280
Poster Sessions: 3285
Breakout Sessions:
- 3210, 3220, 3221, 3223, OR 4280
Overflow Room: 3210
Happy Hour: - 1887 Bistro, 3rd Floor

THIRD FLOOR



SECOND FLOOR

Campus Map



Back to Table of Contents >

KEYNOTE SPEAKERS

Laura Regassa

Program Director, Division of Graduate Education, National Science Foundation

Dr. Laura Regassa is a Professor of Biology at Georgia Southern University. She is currently on assignment at the National Science Foundation as a Program Director in the Division of Graduate Education. At the NSF, she is a program officer for the NSF Research Traineeship (NRT) Program.

Dr. Regassa served as the director of a graduate student training and professional development program at Georgia Southern, the Molecular Biology Initiative. She has a PhD in bacteriology from the University of Wisconsin-Madison, with past and present content-area research interests in bacterial pathogenesis, biodiversity and systematics. Prior to her assignment at the NSF, Dr. Regassa served as Editor-in-Chief for an international educational journal and held numerous leadership roles for national, regional and international professional organizations.

Terri L. Lomax

CEO, Innovation Ecosystems; Adjunct Professor, Plant, and Microbial Biology, NC State

Terri L. Lomax, PhD, is the CEO of Innovation Ecosystems and an Adjunct Professor of Plant and Microbial Biology at NC State University. She has over three decades of experience developing and leading innovative programs in academia, government, and nonprofit organizations and facilitating partnerships between those organizations and industry to form thriving innovation ecosystems. Until recently, as Executive Vice President at RTI International, a nearly billion dollar non-profit research institute, she led their innovation, laboratory science, and engineering programs.

As the Vice Chancellor for Research, Innovation, and Economic Development at NC State University, Terri led the research enterprise, technology transfer, and university-industry partnerships. Under her leadership, NC State experienced record levels of external research funding and commercialization agreements; implemented a national best practice model for partnering with industry; and became the only university in the nation to house two National Science Foundation Engineering Research Centers. As Dean of The Graduate School at NC State, Terri led the development and implementation of a strategic plan for graduate education that increased career-oriented skills training and professional development options, grew the number of professional degrees, and provided interdisciplinary and international opportunities that enhanced its ability to recruit and retain the best and brightest graduate students.

Prior to NC State, Terri led all of NASA's research and technology development for human space exploration and served as a senior policy advisor to the NASA administrator. As a professor at Oregon State University for 20 years, Terri ran a successful research program in cellular and molecular biology, developed new graduate programs, and designed and directed public outreach programs.

Terri currently chairs the Board of Directors of Innovate Raleigh, and also serves on the Raleigh Performing Arts and Convention Center Commission, is a board member for the NC Biotechnology Center, and on the Executive Committee of Power America.

INVITED SPEAKERS

Sez Atamturktur

Provost's Distinguished Professor, Assistant Vice President for Research Development, Clemson University

Dr. Sez Atamturktur serves as the Assistant Vice President for Research Development and Provost's Distinguished Professor at Clemson University. Dr. Atamturktur is a professor of environmental engineering and earth sciences, professor of mechanical engineering, professor of industrial engineering, and professor of civil engineering. She is the director of the National Science Foundation-funded National Research Traineeship project at Clemson, with funding for over 30 doctoral students and a goal of initiating a new degree program on scientific computing and data analytics.

Dr. Atamturktur's research, focused on uncertainty quantification in scientific computing, has been documented in over 100 peer-reviewed journals. Her research has received funding from several federal agencies including the National Science Foundation, the U.S. Department of Energy, the Department of the Interior, Department of Transportation, the Department of Education, and the Los Alamos National Laboratory, as well as industry organizations and partners, such as the National Masonry Concrete Association and Nucor. She serves as the director of the National Science Foundation-funded Tigers ADVANCE project, which focuses on improving the status of women and minority faculty at Clemson. In addition, Dr. Atamturktur is also the director of a Department of Education-funded Graduate Assistantship in Areas of National Need project that provides funding for 10 doctoral students.

Dr. Atamturktur is one of the four co-directors of Clemson's Center of Excellence in Next Generation Computing and Creativity. Prior to joining Clemson University, Dr. Atamturktur served as an LTV technical staff member at Los Alamos National Laboratory.

Stephen Briggs

Launch Director, NC Plant Sciences Initiative, NC State University

Steve Briggs joined NC State's College of Agriculture and Life Sciences in August 2017 as the NC Plant Sciences Initiative (NC PSI) Launch Director. As Launch Director, Briggs has oversight of the 184,000 square foot PSI Building, is assembling the inaugural research project teams, and developing partnerships that will establish NC as a world leader in plant sciences.

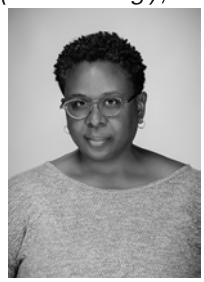
Prior to joining NC State, he was the Senior Vice President of Agronomy and Corporate Marketing for South Dakota Wheat Growers (SDWG), the largest farmer owned cooperative in the United States.

Steve's career began as an Extension Entomologist at the University of Illinois in Champaign-Urbana. From there he joined American Cyanamid Company (AmCy) in Des Moines, Iowa, where he rose to the position of Vice President and General Manager of Specialty Products, concentrating in non-crop businesses such as pest control, turf, and forestry. He has also held senior executive positions at BASF, Cheminova, and TyraTech.

Steve has served as chairman of two boards – Responsible Industry for a Sound Environment (RISE) and Consolidated Sourcing Solutions (CSS) – and as an ex-officio member of the Strategic Outlook Committee for CropLife America. He also has served on the boards of numerous agricultural organizations, and is currently a member of the Security Seed and Chemical Board in Clarksville, TN.

Pamela L. Jennings

Head, Department of Art + Design (incoming), NC State University



Pamela L. Jennings, PhD, is the incoming Professor and Head of the Department of Art + Design in the College of Design at NC State. She is the Principal Researcher of CONSTRUKTS, Inc., an NSF-funded consumer electronics research company developing mixed-reality and wireless technologies for learning. Pamela served as a committee member on the National Academies of Sciences, Engineering, and Medicine 2018 consensus report, *The Integration of the Humanities and Arts with Sciences, Engineering, and Medicine in Higher Education: Branches from the Same Tree*.

Pamela held the first joint professorship appointment between the School of Art and the Human Computer Interaction Institute at Carnegie Mellon University. She later served as an NSF Program Officer in the Computer, Information Science & Engineering Information and Intelligent Systems division (CISE IIS) where she led the CreativeIT program and co-led the Human Centered Computing program. Pamela led several special initiatives at higher education institutions aimed to support faculty, students, and emerging professionals involved in integrative research and practice. She was the Inaugural Director of the Shapiro Center for Research and Collaboration at the School of the Art Institute of Chicago (SAIC). The Shapiro Center provided faculty mentoring, funding, and institutional policy development support for research and civic engagement activities. As the Director of the University of NC system Center for Design Innovation (CDI) and Professor of Innovation and Entrepreneurship, Pamela led the transition of the center into its dedicated facility in Winston-Salem, NC. (*Continued on next page*)

As director of the Advanced Research Technology (ART) Lab at the Banff New Media Institute (BNMI) in Banff, Canada and visiting faculty in the Department of Computer Science at the University of Calgary, Pamela transformed the ART Lab into a place for scholarship and creativity with an international post-graduate cohort who worked at the intersecting borders of their disciplines in software development, electronics, computational design, rapid prototyping, virtual reality, games, and animation.

Pamela L. Jennings received her PhD in Human Centered Systems Design at the University of Plymouth (UK); MBA at the University of Michigan Ross School of Business; MFA in Computer Art at the School of Visual Arts; MA in Studio Art in the International Center of Photography/New York University Program; and BA in Psychology at Oberlin College.

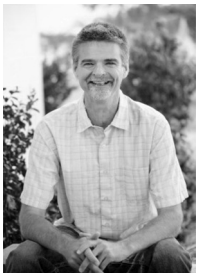
Rebecca Jordan

Professor, Environmental Education and Citizen Science and Director of Program in Science Learning, Rutgers University

Dr. Rebecca Jordan is currently a Professor of Environmental Education and Citizen Science and the Director of Program in Science Learning at Rutgers University in New Brunswick, New Jersey. She currently studies how people reason with data in formal and informal learning contexts. Dr. Jordan received her Bachelor's degree in biological sciences from the University of Connecticut and her Master's and Doctorate degrees in organismic and evolutionary biology from the University of Massachusetts – Amherst. Dr. Jordan also completed post-doctoral work at Princeton University and the University of NC, Chapel Hill on the topic of ecology and evolutionary biology.

Jeffrey Kelly

Director, Corix Plains Institute and Professor of Biology, University of Oklahoma



Dr. Jeff Kelly is a Professor of Biology at the University of Oklahoma, and Director of the Oklahoma Biological Survey. His research interests center on the ecology and conservation of migrant birds. He is fascinated by the way these animals' life histories depend on environments at continental and hemispheric scales. The unique combination of their relatively small size (10 to 20g) and long distance movements also make these migrants fantastic sensors of the environment and potentially very valuable real-time indicators of our impact on the environment at large spatial scales. Dr. Kelly's current research is summarized on his website AnimalMigration.org.

Sheryl Kunickis

Director, US Department of Agriculture, Office of Pest Management Policy

Dr. Sheryl Kunickis is the Director of the USDA Office of Pest Management Policy (OPMP). She has served in this position since May 2010. She represents USDA's interests in FIFRA-related matters and is the USDA representative on the Pesticide Program Dialogue Committee (PPDC), an EPA Federal Advisory Committee. In 2013, she was Acting Director in the Office of the Chief Scientist, and from 2008 to 2010, Director of the NRCS Remote Sensing Laboratories (RSLs). Prior to assuming leadership for the RSLs, she served at the White House Council on Environmental Quality (CEQ) as Deputy Assistant Director for Agriculture, Lands, and Wildlife.

From 2002-2007, she served as the National Agricultural Research Coordinator and was responsible for managing the Partnership Management Team (PMT), now known as the National Institute of Food and Agriculture (NIFA), and the Natural Resources Conservation Service (NRCS), where she was responsible for the national priority research needs. She was a core member of the Agricultural Drainage Management Systems Task Force, which is focused on improving the quality of drainage waters in the Midwest. In 2003-2004, she was selected as a Department of Commerce Science and Technology Fellow. Dr. Kunickis received her PhD in Soil Science from NC State University; her M.S. and B.S. in Agronomy were earned at Brigham Young University.

Dr. Kunickis received her PhD in Soil Science from NC State University; her M.S. and B.S. in Agronomy were earned at Brigham Young University.

Maggie Monast

Senior Manager, Agricultural Sustainability, Environmental Defense Fund

Maggie Monast is the Senior Manager for the Agricultural Sustainability program at the Environmental Defense Fund. She works with farmers, food companies, agricultural organizations and others to create an agricultural system that drives climate stability, clean water, and food security. Her team quantifies the farm financial impacts of conservation practice adoption, collaborates with major corporations to develop sustainability initiatives, and develops innovative financial incentives to advance sustainable agriculture. Maggie received her undergraduate degree in political science and economics from Tufts University and a Masters in Environmental Management from Duke University's Nicholas School.

Back to Table of Contents >

LaKisha Odom

Scientific Program Director, Foundation for Food and Agriculture Research

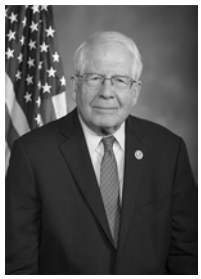
Dr. LaKisha Odom joined FFAR in September 2016 as a Scientific Program Director to pursue her commitment to promoting the use of innovative science and interdisciplinary thinking to tackle today's complex challenges in food and agriculture. She is also extremely committed to cultivating increased diversity in a new generation of food and agriculture scientists.

Dr. Odom developed her passions for the inter-sectional space of research and policy while working at the U.S. EPA in the Office of Research and Development and the Office of Solid Waste and Emergency Response's Brownfield's Redevelopment Program. In her academic career at Tuskegee University, she continued to seek out opportunities to work in interdisciplinary and collaborative science, as a Create-IGERT fellow and as a researcher at Teagasc Research facility in Carlow, Ireland. She then had the opportunity to combine her passion for interdisciplinary innovative research and policy when selected to serve as an Early Career Intern for the Public Policy Board of the American Phytopathologicial Society. In 2013, Dr. Odom became an AAAS Science and Technology Policy Fellow at the USDA Biotechnology Regulatory Service, where she managed a diverse portfolio which included working with the OECD Working Group for the Harmonization of Regulatory Oversight in Biotechnology.

Dr. Odom received her BS in Environmental Science from Tuskegee University, her MA in Environmental Resource Policy from The George Washington University and her PhD in Integrative Biosciences from Tuskegee University.

David Price

Congressman, US House of Representatives



Congressman David Price represents North Carolina's Fourth District - a rapidly growing, research-and-education-focused district that includes parts of Orange, Durham, and Wake counties. David Price was first elected to Congress in 1987, representing NC's Fourth District. He received his undergraduate degree at UNC-Chapel Hill and went on to Yale University to earn a Bachelor of Divinity and PhD in Political Science. Before serving in Congress, Price was a professor of Political Science and Public Policy at Duke University. Among his many honors, Price was named a "Champion of Science" by the Science Coalition, was awarded the Charles Dick Medal of Merit by the NC National Guard, and is a recipient of the American Political Science Association's Hubert H. Humphrey Public Service Award.

Corey Scott

Principal Nutrition Scientist, Cargill

Dr. Corey E. Scott is a Principal Nutrition Scientist with Cargill in Minneapolis, Minnesota. Corey has previously worked for General Mills in Golden Valley, Minnesota, focusing on vegetable intake, phytochemicals, and human health. Prior to this, Corey worked as Global Nutrition Manager for Lipid Nutrition B.V., in The Netherlands, focusing on clinical research on novel lipids for infant nutrition, weight management, and diabetes.

Dr. Scott holds a PhD in Food Science and Nutrition from The Ohio State University, an MS in Chemistry from NC A&T State University, and a BA in Chemistry from The University of North Carolina at Chapel Hill.

Brian Verrelli

Associate Professor and Director, Center for Life Sciences Education, Virginia Commonwealth University

Dr. Brian Verrelli is Director of the Center for Life Sciences Education, which houses the Integrative Life Sciences Doctoral Program and Master's degrees in Environmental Studies and Bioinformatics, at Virginia Commonwealth University. His research program focuses on using molecular population and evolutionary genetic approaches to address problems in human health and disease, biodiversity, and conservation.

IGERT FELLOWS

Tim Antonelli

Assistant Professor of Mathematics,
Worcester State University

Dr. Tim Antonelli is an Assistant Professor of Mathematics at Worcester State University where his work focuses on statistics and probability. Tim graduated from NCState University in 2015 with a PhD in Biomathematics and was a member of 2012 IGERT Cohort which focused on Mosquitoes and Human Health. While at NCSU, under the advisement of Drs. Alun Lloyd and Fred Gould, he developed mathematical models for novel control strategies of the dengue vector *Aedes aegypti*, such as releasing mosquitoes infected with Wolbachia, a bacterium that can spread through a population of *Ae. aegypti* and has been shown to block transmission of dengue virus. The international experience and focus on interdisciplinarity provided by participation in the IGERT program broadened his horizons, and he soon found himself immersed in a foreign culture during the first cohort's time in Peru, learning Spanish, and eventually returning to pursue research experiments and guest lecture on math models at a Peruvian university.

IGERT classes and discussions at NC State provided unique experiences in examining the non-mathematical aspects of predictive models, such as public communication and the ethics of genetic engineering. This unique background has allowed him to connect with students of diverse backgrounds and better communicate the variety of real-world applications that mathematics has to offer.

Tim Antonelli grew up in Wilmington, NC. Thinking to combine his interests in math and biology, he chose to study biomedical engineering at Duke University. After receiving his bachelor's degree, he worked as an engineer for several years, but ultimately felt distant from his original passions. Thus, he decided to attend the biomathematics doctoral program at NC State and while there to participate in the GES IGERT program.

Jennifer Baltzegar

PhD Candidate, Genetics, NC State University

Jennifer Baltzegar is a PhD Candidate in Genetics. She is a member of the 2014 IGERT Cohort which focused on Agricultural Pests. Her current work focuses on the population genetics of the insect pest species *Aedes aegypti* (Yellow Fever Mosquito) and *Sitophilus zeamais* (Maize Weevil). The 2014 cohort traveled to Mexico during the summer of 2014 to learn about the social and biological implications of genetic engineering in the country, particularly as that relates to the cultural importance of maize. Jen returned with fellow cohort member Mike Jones in the summer of 2016 to Oaxaca and Chiapas, Mexico, to conduct field work aimed at better understanding maize weevil (MW) impact on farming families and communities. She has worked with her cohort to write a paper geared toward an interdisciplinary audience titled *Anticipating Complexity in the Deployment of Gene Drive Insects in Agriculture*. She and her fellow cohort members also contributed to a correspondence in *EMBO Reports* titled *"CRISPR-based Gene Drive in Agriculture Will Face Technical and Governance Challenges*." Both publications highlight the complex landscape that must be considered if and when gene drives are deployed for control of agricultural pests.

Jennifer Baltzegar was born in Georgia, where she grew up with a strong appreciation for biology and the natural world. She completed her Bachelor of Science in Marine Biology at the College of Charleston. She then worked as a technician for the South Carolina Department of Natural Resources at the Marine Resource Research Institute before returning to the College of Charleston to earn a Master of Science in Marine Biology. Following completion of her master's degree she accepted a job as a Research Analyst at Duke University. Ultimately ennui set in and she entered the Graduate Program in Genetics at NC State University to embark on a new challenge.

Elizabeth Pitts

Assistant Professor of English,
University of Pittsburgh

Dr. Elizabeth Pitts is an Assistant Professor of English at the University of Pittsburgh. Her research blends rhetorical theory, organizational studies, and science studies to examine how technologies influence the nature of professional work and professional identity. Her current book project offers insights into a movement to make the coding of DNA as pervasive as the coding of software. By drawing parallels between the composition of genetically engineered organisms and the composition of persuasive speech and writing, the book facilitates humanistic inquiry into the material practices undertaken in biotechnology laboratories.

Elizabeth graduated from NC State University in 2016 with a PhD in Communication, Rhetoric and Digital Media and was a member of the 2013 IGERT Cohort which focused on Invasive Rodents and Biodiversity Conservation. Elizabeth's interdisciplinary IGERT collaborations have enabled her to develop a thorough understanding of genetic technologies, focusing on case studies including the release of genetically engineered mosquitoes to control the Zika virus, malaria, and dengue fever, and the potential application of genetic engineering for conservation purposes. Elizabeth also formerly served as a postdoctoral researcher with NC State's Genetic Engineering and Society Center, contributing to scholarly conversations in organizational and environmental communication by exploring how negotiations of meaning influence the organizing of genetic engineering governance systems. She has co-authored research with geneticists, ecologists, and policy scholars, among others. Her work is informed by her decade of experience as a professional writer and speechwriter at the White House, the US Department of Education, and the Pew Charitable Trusts.

Megan Serr

PhD Candidate, Biological Science,
NC State University

Megan Serr is a PhD Candidate in Biological Sciences. She is a member of the 2013 IGERT Cohort which focused on Invasive Rodents and Biodiversity Conservation. Her research is focused on characterizing genetic and behavioral differences between *Mus musculus* strains in collaboration with the Genetic Biocontrol of Invasive Rodents program (GBIRd) which aims to suppress invasive mouse populations on islands, by heavily biasing offspring sex ratios. Effective implementation of this approach will depend on engineered hybrid mice being competitive and able to mate successfully. Megan's behavioral and genetic tests use wild house mice derived from an invasive population on the Farallon islands (MmF), a laboratory strain C57BL/6/129 (tw2), and hybrid wild-lab offspring.

In 2013, the 2013 Cohort traveled around the Farallon islands, which is also where Megan and Dr. Lisa McGraw returned to collect live wild mice for their behavioral research. Along with her fellow cohort members, Megan created a website that describes thoughts and ideas surrounding the potential for a genetic technique that would create a male-biased population, hence causing the invasive rodents in a particular area to die off. Megan also had the opportunity to develop and co-teach an undergraduate course with fellow cohort member, Elizabeth Pitts. The course, Ethics of Biotechnical Communication, spent several weeks exploring genetic pest management strategies and included several members of the Genetic Engineering and Society Center as guest speakers.

Megan Serr grew up in Southern California where she developed a love for nature and conservation, particularly towards amphibians. She earned her Bachelor of Science in biology, as well as her teaching licensure from California State University, San Bernardino. After graduation she began teaching biology and environmental science at the high school level. Then, while continuing to teach high school, she earned her Master of Science in biology from the University of Nebraska. With her masters she then expanded into teaching at the university level as well as working at NC State as a laboratory-teaching technician. With a strong desire to perform both research and teaching, Megan entered the IGERT program at NC State.

Jayce Sudweeks

PhD Candidate, Public Administration,
NC State University

Jayce Sudweeks is a PhD Candidate in Public Administration. He is a member of the 2014 IGERT Cohort which focused on Agricultural Pests. His current research investigates the public policy process and how the narratives created by various groups supporting or opposing biotechnology influence policy decisions. In 2014, Jayce participated in the International Genetically Engineered Machine Competition (iGEM) where his team won the Best Policy & Practices Project award. He has participated in several workshops hosted by the GES Center including: Graduate Professional Development Workshop: Intersections of Genetics and Society, USDA Stakeholder Workshop on Coexistence, and the Roadmap to Gene Drives: A Deliberative Workshop to Develop Frameworks for Research and Governance. Jayce was an assistant editor for the special edition of the *Journal of Responsible Innovation* that published peer-reviewed articles from the Roadmap to Gene Drives workshop.

Jayce's experiences in the IGERT program have helped identify for him the complex and conflicting milieu in which important biotechnology policy decisions are made and how difficult this can be. His current and future research will attempt to understand how this complexity is generated and how differing coalitions can come to agreement on important technologies that will better the life of mankind.

Jayce Sudweeks was raised in Twin Falls, Idaho. He spent two years in Costa Rica and Panama on a Spanish speaking mission. Jayce graduated from Brigham Young University with a Bachelor of Science and Master of Science in Molecular Biology. His research focused on mapping the genes that caused the mouse form of Multiple Sclerosis. During this time, he was an author on nine peer-reviewed publications, including a first author publication in the *Proceedings of the National Academy of Science*. After graduation, Jayce spent seventeen years in private industry in a variety of jobs focused on business process engineering, program and project management, and computer systems analysis. Most recently, Jayce worked as an IT production support manager for a global supply chain company. The potential that science and technology had to improve lives and relieve suffering never strayed far from Jayce's mind, and when the opportunity presented itself he enrolled in the Public Administration PhD program at NC State University. His goal was to understand how bureaucracy, policy and politics influence the deployment and regulation of biotechnology.

Amanda Walsh

Senior Economist, RTI International

Dr. Amanda (Clayton) Walsh is a Senior Economist in the Innovation Economics group at RTI International. In her role, she analyzes the benefits and costs of public policy initiatives relating to innovation, technology and infrastructure improvements, and education and workforce training. Amanda graduated from NC State University in 2016 with a PhD in Economics and was a member of the 2012 IGERT Cohort which focused on Mosquitoes and Human Health. Her graduate research focused on using insights from applied microeconomics to study the impacts and control of mosquito-borne disease. Her GES collaborations studying the potential use of genetically modified mosquitoes to combat dengue fever culminated in the co-authorship of the introductory chapter of the text, *Genetic Control of Malaria and Dengue*, edited by Zach Adelman.

Amanda Walsh grew up in the suburbs of Chicago, IL. She received her bachelor's degree in Economics from Illinois Wesleyan University in 2010, graduating Summa Cum Laude and with research honors. She entered the Economics PhD program at NCState that fall, with the intention of studying development economics. Her passion for carrying out policy-relevant economic research through cross-cultural and interdisciplinary collaboration lead her to take master's level coursework in cultural anthropology, and eventually to join the IGERT-funded GES program.

SYMPOSIUM TALKS

Back to Table of Contents >

KEYNOTE | DAY 1

MONDAY, 04 JUNE | 8:50 AM LIVE STREAM

Dr. Laura Regassa
National Science Foundation

STEM Graduate Education: Advancing Knowledge & Transforming the Future

Graduate education will continue to evolve as we consider how best to prepare students for a dynamically shifting workforce that is often responding to sweeping technological changes. Convergent research and training that supports scientists coming together across disciplines to develop creative and innovative solutions is a critical part of this culture change. This talk will reflect on recent recommendations for graduate education, National Science Foundation priorities, and the role that the NSF Research Traineeship Program is playing in our understanding of innovative training models and best practices.

INVITED SPEAKER

MONDAY, 04 JUNE | 9:45 AM LIVE STREAM

Dr. Pamela L. Jennings
NC State University

Branches from the Same Tree: Integrative Learning in Higher Education

Integrative discovery across disciplines in the Arts, Humanities, and STEMM requires reflection about how forms of inquiry converge to create paths for new knowledge. The National Academies of Sciences, Engineering, and Medicine (NASEM) consensus report, *The Integration of the Humanities and Arts with Sciences, Engineering, and Medicine in Higher Education: Branches from the Same Tree,* supports the premise that a holistic approach to learning is requisite for the preparation of tomorrow's leaders. Integrative learning prepares students to become our future workforce of global citizens who are equipped to invoke a more comprehensive and inclusive cultural perspective to problem solving and solution finding. This presentation will provide an overview of the recommendations from the NASEM report in context of initiatives that have been funded by the National Science Foundation to support integrative learning and research across the fine, applied, and performing arts, and STEMM.

EXPERIENCES FROM THE NC STATE IGERT PHD PROGRAM

MONDAY, 04 JUNE | 10:45 AM – 12:30 PM LIVE STREAM

Dr. Fred Gould
GES Center,
NC State University

"IGERT - Genetic Engineering and Society: The case of transgenic pests," 2011-2017

Student speakers to discuss cohort goals and outcomes, as well as personal experiences, challenges, and interdisciplinarity:

Genetically Modified Mosquitoes (GMM) Dengue Control in a Social and Cultural Context

Dr. Amanda Walsh | Senior Economist, RTI International

Dengue is one of the many human diseases transmitted by the *Aedes aegypti* mosquito. The first student cohort investigated the potential of GM control techniques for both mosquito population suppression and population replacement in efforts to combat these diseases. In their introductory book chapter, "Transgenic pests and human health: A short overview of social, cultural, and scientific considerations," featured in Genetic Control of Malaria and Dengue, the cohort explored these issues and concluded that, while improving dengue treatment should be prioritized in the short-term, research on GMM control techniques should continue due to its wide ranging implications for other mosquito-borne diseases such as malaria, chagas, west-nile, etc. They also highlighted the need to maintain an open dialogue with all interested publics throughout all processes, specifically the research, policy, regulation, and implementation phases.

IGERT Program Speakers, cont.

A Look Back at the IGERT's Role in Shaping My Career as a Math Professor

Dr. Tim Antonelli | Assistant Professor of Mathematics, Worcester State University

Having completed my third year as an assistant professor of statistics and probability at a liberal arts university, I share my personal perspective — as well as insights from my employer — on the various ways that the IGERT has shaped my career. The interdisciplinary graduate training continues to influence my interactions with students and faculty, creating opportunities that allow me to adopt new roles at a university that values interdisciplinary learning. I reflect on my experiences and the lessons learned to make suggestions for how future interdisciplinary graduate training programs might also hope to succeed.

Exploring the biological, ecological, and social implications of genetic techniques for invasive rodent eradications on islands

Megan Serr | PhD Candidate, Biology, NC State University

The second IGERT cohort examined the potential use of a genetic tool to remove invasive house mice from islands, where non-native species pose an increased threat to biodiversity. To consider the application of gene engineering for conservation purposes, the cohort incorporated the perspective of multiple fields from the humanities, social sciences, and natural sciences with the goal of communicating our collective knowledge with publics. Rather than seeking consensus, the cohort shared our varying viewpoints via a website as well as a publication in the *Journal of Responsible Innovation*. As a team and individually, cohort members have also presented at several conferences and performed community outreach to increase input and engagement with respect to this emerging technology.

Integrating the Humanities and the Sciences: What it Looks Like in Practice

Dr. Elizabeth Pitts | Assistant Professor of English, University of Pittsburgh

As support for interdisciplinary education grows, conversations in academia and beyond are beginning to shift from the question of whether to integrate multiple fields of study, to the question of how to facilitate successful integration. As a recent report from the National Academies of Sciences, Engineering, and Medicine noted, incorporating the humanities and arts into graduate training in the sciences, engineering, and mathematics can foster improved communication, teamwork, critical thinking, and the ability to translate knowledge to real-life applications, among other skills. However, successful commingling of the humanities and the sciences remains rare. This presentation draws on North Carolina State University's IGERT program to offer examples of what this type of collaboration can look like, how successful integration can be achieved, and what benefits it can produce for students, researchers, employers, and broader publics.

Genetic Pest Management for Agricultural Insects

Jennifer Baltzegar | PhD Candidate, Genetics, NC State University

Using Mexico as a model, the third IGERT cohort focused on the complexities surrounding the use of genetic engineering (GE) that may exist in agricultural pests. Mexico accepts the use of GE crops (e.g. soy and cotton), but does not allow GE maize to be planted because of its cultural importance to the region. By acknowledging the complicated relationships which exist between genetic engineering and society across many levels, the cohort produced two publications that highlight important concepts to address when considering the development and deployment of gene drive insects for agriculture.

Navigating Worldviews, Crossing Boundaries, and Finding a Safe Place: How the IGERT Fellowship Influenced My Graduate Experience

Jayce Sudweeks | PhD Candidate, Public Administration, NC State University

From my perspective the most important aspect of learning is discovering and examining the mental models that influence how I interpret the world and then being able to modify them based on experience, theory and research, and personal interaction. This presentation discusses how the interdisciplinary nature of the IGERT program at NC State University challenged my understanding of how science, culture and society interact when addressing social issues and how these ideas influenced my dissertation research.

Back to Table of Contents >

MONDAY, 04 JUNE | 1:45 PM LIVE STREAM

Dr. Jeffrey Kelly
University of Oklahoma

Toward transferable and sustainable models for interdisciplinary training in environmental sustainability

There is a long-standing need for convergence among institutions and individuals interested in solving urgent environmental problems that impact human well-being and ecosystem health. Nonetheless, models for creating this convergence have been slow to materialize. Initiatives often falter when they try to grapple with the complexity of wicked problems at scales that would drive societal change. A consistent concern in these initiatives is a shortage of diverse results-oriented leaders with the interdisciplinary training needed to assemble and guide teams to make progress when confronted with complexity. We are attempting to create an effective training program to produce these leaders. I will describe the development and implementation of our interdisciplinary model for training students in Aeroecology and our efforts to use this platform to understand the constraints on broadening participation in graduate training programs. We also are working with the University of Delaware and the University of Nebraska to test the transferability of these ideas among institutions. I will reflect on ways that our program is succeeding and failing to provide students with the tools they need to tackle the most pressing problems at this interface.

MONDAY, 04 JUNE | 2:05 PM LIVE STREAM

Dr. Sez Atamturktur
Clemson University

Graduate Education Informed by Social Network Analysis

Overview of a transformative approach to graduate education program on Resilient Infrastructure & Environmental Systems (RIES) at Clemson University funded by the NSF National Research Traineeship (NRT) program. Clemson's NRT responds to the urgent need for professionals capable of crossing disciplinary boundaries to (1) assess technological and societal risks, (2) communicate those risks to decision makers, and (3) devise strategies that improve community resilience. Our focus - identifying and mitigating the vulnerabilities of complex, critical, and interdependent infrastructure systems - is important both nationally and globally, as the growing scale and interconnectedness of critical infrastructure systems rapidly escalates societal vulnerabilities.

There are two interrelated education theories underlying the activities in our NRT RIES project: one which describes development of individual skills and another which focuses on skills for working effectively in teams (taken together, we propose to prepare competent individuals within learning communities). The first education theory focuses on preparing competent, well-prepared individuals. Such agents are capable of making good choices about their learning, specifically the efforts devoted to developing technical competency. Individual learning programs are particularly influenced by social networking -our second education theory. When teams tackle the social and technical interdependencies of difficult, real-world problems (such as infrastructure vulnerabilities), they generate collective creativity, learning, adaptability, and productivity that is beyond the capacity of the individual. Within social networks, interdependent agents grow their individual and collective influence and competence (i.e., "agency within complexity"). That is, individuals learn best when they are embedded in interactive, interdependent networks of individuals called complex systems.

In this presentation, Dr. Sez Atamturktur will overview the implementation of Clemson's NRT RIES program, including securing institutional commitment, developing faculty working-groups, implementing trainee recruitment strategies, engaging trainees in project implementation, establishing the advisory committee, ensuring sustainability of the project, and using social network analysis to guide the execution of the project to achieve its goals.

Back to Table of Contents >

MONDAY, 04 JUNE | 3:10 PM LIVE STREAM

Dr. Rebecca Jordan
Rutgers University

Transdisciplinary, Parallel Play, or Something in Between?

In the United States, about 23 million people live within 6 meters of sea level. In many parts of the country, sea-level rise has already led to a 2-5-fold increase in the rate of 'nuisance' flooding. On top of rising seas, intensifying hurricanes and more frequent extremes of heat, humidity and precipitation pose additional risks to coastal societies, economies and ecosystems. Many factors, ranging from topography and biodiversity to land-use patterns and social networks, affect the vulnerability and resilience of people, ecosystems, and the built environment along the coast. Thus, building coastal resilience requires integrating expertise from many fields, ranging from urban planning to climate science and oceanography, from engineering to sociology and economics. The Coastal Climate Risk & Resilience (C2R2) initiative prepares graduate students to meet this challenge through its trainee and certificate programs. I will discuss major successes, challenges, and future plans for this program based on reflections from the past two years.

MONDAY, 04 JUNE | 3:30 PM LIVE STREAM

Dr. LaKisha Odom
Foundation for Food and Agriculture Research

Fostering the Future with FFAR

As the world's population is estimated to reach 9.7 billion by 2050 and exceed 11 billion by 2100, a period of unprecedented challenges is emerging, exacerbated by the decrease in available resources presenting a number of "wicked problems" in Agriculture and Environmental fields. These challenges will demand bold innovative solutions that will require concerted efforts from diverse fields, including many science-focused disciplines, engineering, and social science. The Foundation for Food and Agriculture Research, as a core component of its mission, seeks transformative discoveries from the best and brightest scientists to identify and investigate the researchable questions whose answers have the potential to enhance the economic and environmental resilience of our food supply as part of the Foundation's Fostering the Future initiative, a suite of programs designed to build a strong, collaborative food and agriculture workforce. I will reflect on both the importance of interdisciplinarily trained professionals and the ways in which they will be an asset to the workforce in a number of disciplines, as well as examples of how FFAR is supporting students and early-career researchers, as FFAR strives to inspire the next generation of scientists to pursue careers that help put nutritious food on every table, now and in the future.

Keynote | Day 2

Back to Table of Contents >

Tuesday, 05 June | 8:45 AM

Dr. Terri Lomax
Innovation Ecosystems

The Future of Innovation: Workforce Needs and the Way Forward for Graduate Education

Addressing the convergent issues and grand challenges that face society today requires creating a new generation of innovators, whether that be for generating new technologies, unique approaches to social problems, or innovating next generation graduate training. Rapidly changing workforce needs (e.g. the necessity of skills to cope with big data, or the ability to be "bi- or multi-lingual" across the social, physical, and natural sciences) has been met with many innovations in graduate education, including Professional Science Masters, graduate minors and certificates, interdisciplinary programs, and training in professional development, innovation and entrepreneurship. I will discuss both these innovations and the challenges that remain, especially with respect to developing flexibility, diversity, and integration in doctoral programs.

Invited Speaker

Tuesday, 05 June | 9:40 AM

Dr. Brian Verrelli
Virginia Commonwealth University

Meeting the Challenges of Integrative Doctoral Program Initiatives

Solving problems today in the life sciences requires approaches that draw on multiple disciplines. Students trained with this interdisciplinary vision need to combine expertise in technological skills, big data analytics and management, and written and oral communication to generate a workforce that seamlessly moves between academics, policy, and non-scientific communities. The success of any approach that builds across disciplines requires acknowledgment that these training initiatives cannot be met by single academic units. The Integrative Life Sciences (ILS) doctoral program at Virginia Commonwealth University is designed with a philosophy that draws on resources University-wide to meet these challenges.

Panel: Interdisciplinary Graduate Training and the Workforce

Tuesday, 05 June | 10:30 – 11:45 AM

Introductions:

Chancellor Randy Woodson
NC State University

Moderator:

Dr. Zachary Brown
GES Center, NC State University

Workforce Development Policies and Priorities in the Context of Graduate Education
Government | Congressman David Price, 4th District, North Carolina

Training Next Generation Plant Science Students for 21st Century Jobs
University Development | Stephen Briggs, NC Plant Sciences Initiative

Cultivating STARS - Interdisciplinary Program Needs to Prepare Students for the Dynamic Demands of Life Sciences Industries
Industry | Dr. Corey Scott, Cargill

Opportunities in the Nonprofit Sector
Nonprofit | Maggie Monast, Environmental Defense Fund

Building and Integrating Diverse Scientific Expertise for Regulatory Policy in the Federal Government
Regulatory | Dr. Sheryl Kunickis, USDA Office of Pest Management Policy

POSTER SESSIONS

Monday, 04 June | 1:00 PM and 4:30 PM | Talley 3285

1. Katie Barnhill-Dilling

Katie Barnhill-Dilling (skbarnhi@ncsu.edu)
Forestry & Environmental Resources, North Carolina State University, Raleigh, NC

The Genetically Modified American Chestnut as Potential for Reciprocal Restoration in Indigenous Communities

The era of chestnut loss paralleled significant cultural loss for Haudenosaunee communities of Central and Upstate New York. The Haudenosaunee communities, which neighbor the research institutions, field trials, and proposed release sites of genetically modified American chestnut trees, have no living memory (and little cultural memory) of the American chestnut as part of their landscape. This paper explores how the use of a transgenic chestnut for restoration — however controversial it may be — may create opportunity for *reciprocal restoration,* which attends to the land and to the cultures that are sustained by that land, and where repair of ecosystem services contributes to cultural revitalization (Kimmerer, 2011). Drawing on in-depth interviews of community members and participant observation of tribal leaders and American chestnut foundation meetings, this chapter finds that the potential for interconnected cultural and species (or ecological) restoration is situated in complicated terrain. While there are clear dimensions of reciprocal restoration present, efforts to restore the chestnut are still rooted in a mechanistic worldview of humans as managers or manipulators of the natural environment. For the chestnut project to approach reciprocal restoration, that managerial approach is what needs repairing, healing, and changing.

2. Sophia H. Webster-Tostenson

Sophia H. Webster-Tostenson (shwebste@ncsu.edu) and Maxwell J. Scott
Entomology & Plant Pathology, North Carolina State University, Raleigh, NC

Genetically Engineering a Killer-Rescue Gene Drive System in the Zika Mosquito Aedes aegypti

Mosquitoes transmit numerous diseases with great morbidity and mortality that affect hundreds of millions of people each year. The mosquito *Aedes aegypti* is a vector for zika, dengue, chikungunya, and yellow fever. The symptoms of these viruses can range from minor flu-like to severe hemorrhaging, circulatory shock and sometimes death. The zika epidemic has led to thousands of babies born with microcephaly and other severe birth defects. Genetically engineering mosquitoes to carry anti-pathogen or lethal genes is an innovative form of vector control that can work in combination with current tools such as insecticides and larval habitat removal.

Genetic technologies designed for population replacement are a promising approach to mosquito vector control. The end goal of population replacement is to drive anti-pathogen genes though a population so that the original disease transmitting population is replaced with a population that has decreased vector competency and is incapable of spreading the virus. Since mosquito population densities are so high, researchers are favoring population replacement approaches over population suppression or eradication.

We are creating a gene drive system, that when coupled with an anti-viral gene, can be used to reduce disease incidence through mosquito population replacement. This gene drive system, Killer-Rescue, includes two engineered constructs that are present on independently segregating loci. Mosquitoes that inherit the killer gene die unless they also inherit the rescue gene, which in the future, will be coupled to an anti-viral gene. Thus, the only mosquitoes that survive each generation are those that inherit the rescue and linked anti-viral genes. We have established an initial killer-rescue gene drive system in *Aedes aegypti* as well as *Drosophila melanogaster* and are beginning laboratory cage experiments to test the efficacy of the system to drive the desired genes through a population.

Back to Table of Contents >

3. Jennifer Baltzegar

Jennifer Baltzegar (jfbaltze@ncsu.edu)
Genetics, North Carolina State University, Raleigh, NC

Evolution of Insecticide Resistance in Aedes aegypti from Iquitos, Peru

The mosquito, *Aedes aegypti*, transmits yellow fever, chikungunya, zika, and dengue fever, which affect large numbers of people annually. One of the most prevalent methods to control the spread of arboviral diseases is by using insecticides. Pyrethroids, a common class of insecticides, has been implicated in the development of knockdown resistance (kdr) in multiple arthropod species. With frequent and recurrent applications of pyrethroids to control *Ae. aegypti* populations, increased levels of kdr are expected to occur. This is a major concern for the continued efficacy of this control method. Many genetic loci associated with kdr resistance have been identified; however, two single nucleotide polymorphisms (SNPs), F1534C and V1016I, located in the voltage-gated sodium channel have been shown to be important in Central and South America. This study explores the evolution of these two SNPs across an 18-year period in Iquitos, Peru, which includes all years of pyrethroid use in the city. The results present an intriguing dynamic between resistant haplotypes that improves understanding of insecticide resistance evolution. Through further analysis, significant heterogeneity in fine-scale patterns of insecticide resistance was found, leading to a better understanding of *Ae. aegypti* population structure. Together these data provide crucial information to develop mosquito control programs for delaying widespread insecticide resistance and for improving the empirical evidence used to model emerging mosquito control techniques.

4. Jayce Sudweeks

Jennifer Baltzegar, Johanna Elsensohn, Nicole Gutzmann, Jessica Cavin Barnes, Michael Jones, Sheron King and **Jayce Sudweeks** (jdsudwee@ncsu.edu)
2014 IGERT Student Cohort, North Carolina State University, Raleigh, NC

Gene Drive Insects in Agriculture

Genetic pest management (GPM) is the use of genetically engineered pest species to either suppress population size or replace the genotype of individuals in a population. Recent advances in molecular engineering techniques, such as CRISPR/Cas9 gene drives, have promised to escalate the use of GPM for plant and human disease vectors, as well as other agriculturally important pests. In addition to technical and biological considerations, successful implementation of GPM tools should include a thorough analysis of social and economic factors. Here, we present a comprehensive conceptual framework for technology developers and governing actors to aid decisions on the appropriateness of specific GPM strategies and highlight key components of responsible implementation. This interdisciplinary framework includes biological, social, and economic issues essential to addressing uncertainties of the technology and may serve as a valuable resource for governing body actors who seek to regulate these emerging technologies in a responsible and transparent manner.

5. Jessica Cavin Barnes

Jessica Cavin Barnes (jcavinbarnes@ncsu.edu)
Forestry & Environmental Resources, North Carolina State University, Raleigh, NC

Anticipating the Biogeography of Blight-Resistant American Chestnut

Given the scale and speed of contemporary environmental changes, intensive conservation interventions are increasingly being proposed that would assist the evolution of adaptive traits in threatened species. The ambition of these projects is tempered by a number of concerns, including the potential maladaptation of manipulated organisms for contemporary and future climatic conditions in their historical ranges. Following the guidelines of the International Union for the Conservation of Nature, we use a species distribution model (SDM) to consider the potential impact of climate change on the distribution and quantity of suitable habitat for American chestnut (*Castanea dentata* (Marsh.) Borkh.), a functionally extinct forest species that has been the focus of various restoration efforts for over 100 years. Today, efforts to release blight-resistant American chestnut trees developed through backcross breeding and genetic engineering are positioned to be one of the first range-wide experiments in assisted evolution. Consistent with other SDMs for North American trees, our model shows contraction of suitable habitat for American chestnut within the species' historical range and the expansion of suitable habitat in regions to the north of it by 2080. These broad changes have significant implications for restoration practice; in particular, they highlight the importance of germplasm conservation, local adaptation, and addressing knowledge gaps about the interspecific interactions of American chestnut. More generally, this model demonstrates that the goals of assisted evolution projects, which often aim to maintain species in their native ranges, may need to adjust to account for the uncertainty and novelty of future environmental conditions.

Back to Table of Contents >

6. Diego Vargas Blanco

Diego Vargas Blanco (davargasblanco@wpi.edu)
Biology & Biotechnology, Worcester Polytechnic Institute, Worcester, MA

Regulation of mRNA Stability in Mycobacteria as an Adaptive Response to Stress Conditions

Mycobacterium tuberculosis (MTB) is the causative agent of tuberculosis, a significant cause of human mortality. MTB is a successful pathogen due in part to its ability to survive stress conditions, such as hypoxia or nutrient deprivation, by entering non-growing states. In these low-metabolic states, MTB can tolerate antibiotics and develop genetically encoded antibiotic resistance, making its metabolic adaptation to stress crucial for survival.

Numerous bacteria, including MTB, have been shown to reduce their rates of mRNA degradation under growth limitation and stress. While the existence of this response appears to be conserved across different species, the mechanisms underlying mRNA stabilization in bacteria remain unknown. To identify the mechanisms that govern mRNA stabilization in mycobacteria, we used the non-pathogenic model Mycobacterium smegmatis. Using the transcriptional inhibitor rifampicin and quantitative PCR we determined RNA abundance at different time points following inhibition of transcription, and we used this information to estimate mRNA half-lives for cells cultured in log phase, hypoxia and carbon starvation. We found that mRNA half-lives were longer in hypoxia and carbon starvation compared to log phase. Interestingly, hypoxia-adapted cultures that were re-exposed to oxygen for two minutes displayed increased transcription of some genes accompanied by dramatic shortening of their mRNA half-lives. Western blotting showed that levels of RNase E, a major endonuclease, were similar in log phase, hypoxia and re-aeration conditions, indicating that RNA turnover is not regulated by RNase E expression levels. Furthermore, preliminary tests using the translational inhibitor chloramphenicol in re-aerated hypoxia cultures suggested that the increased mRNA turnover occurs in absence of new protein synthesis. This led us to hypothesize that metabolic changes during growth cessation impact the activity of degradation proteins, increasing mRNA stability. However, other mechanisms may be involved in mRNA stabilization. For example, we found that in M. smegmatis total RNA levels remain similar in non-growing states, while mRNA levels are significantly reduced. Thus, mRNA stability could result from ribosomes masking RNase cleavage sites. Together, our data are consistent with a model in which mRNA stability is controlled at the level of RNase activity and/or accessibility of transcripts to the RNA degradation machinery.

7. Nicole Gutzmann

Nicole Gutzmann (negutzma@ncsu.edu) and Marcé Lorenzen
Entomology & Plant Pathology, North Carolina State University, Raleigh, NC

Optimized CRISPR/Cas9 Tools in the Stored Grain Pest and Coleopteran Model Tribolium castaneum

With a focus on genetic pest management of agricultural and stored grain pests, we sought to optimize the use of CRISPR/Cas9 as a gene editing system in red flour beetle (*Tribolium castaneum*). While transient expression of Cas9 and guides from plasmids was sufficient for knockout projects, subsequent use of the system for knock-in projects have failed. In order to eliminate the potential problems of short expression time and low expression levels, we sought to create transgenic lines of Tribolium that express Cas9 endogenously. Here I discuss our work using piggyBac transposase-mediated transformation to establish multiple lines of Cas9-expressing *Tribolium castaneum*. We used the ubiquitous promoters *polyubiquitin (TcPub)* and *alpha-Tubulin (TcαTub)* to drive expression of Cas9. Using the piggyBac transposase-mediated transformation system, we had multiple insertion events and established unique lines for each.

8. Elizabeth Pitts

Dr. Elizabeth Pitts (eap90@pitt.edu)
English, University of Pittsburgh, Pittsburgh, PA

Organizing Synthetic Biology: Structuring the Social and the Technical at iGEM

Drawing on scholarship in Organizational Communication, this study analyzes communication in the context of the International Genetically Engineered Machine (iGEM) competition - an annual event that will unite undergraduate, graduate, and amateur researchers from 245 universities in 32 countries in 2014 - to generate insights into the governance of synthetic biology.

9. Mike Jones

Mike Jones (msjones2@ncsu.edu)
Agricultural and Resource Economics, North Carolina State University, Raleigh, NC

U.S. Public Attitudes and Uncertainties About Agricultural Gene Drive Insects

Gene drive systems could genetically alter or eliminate certain agricultural pests that spread disease and cause economic damage. Acknowledging significant benefits and risks, the National Academies of Sciences, Engineering and Medicine recommended in 2016 that gene drive research continue in concert with upstream public engagement, societal appraisal, and ecological risk assessment. We analyze the first statistically representative survey of U.S. attitudes on agricultural gene drive insects. While most adults support some type of gene drive application, over 70% want to know more about the risks, and support depends heavily on scientists' ability to control drive spread. The public places a high priority on investigating potential health and ecological impacts of gene drive insects before release decisions, outweighing concerns of cost-effectiveness or technical feasibility. Further, consumers of organically certified food are apprehensive about certification in the presence of modified insect material, though greater knowledge of organic regulations decreases opposition. Results provide a vehicle to incorporate targeted public feedback in research, regulatory deliberations, and further engagement with affected publics.

10. Michael R. Vella

Michael R. Vella (mrvella@ncsu.edu)
Biomathematics, North Carolina State University, Raleigh, NC

Evaluating Strategies for Reversing CRISPR-Cas9 Gene Drives

A gene drive biases inheritance of a gene so that it increases in frequency within a population even when the gene confers no fitness benefit. There has been renewed interest in environmental releases of engineered gene drives due to recent proof of principle experiments with the CRISPR-Cas9 system as a drive mechanism. Release of modified organisms, however, is controversial, especially when the drive mechanism could theoretically alter all individuals of a species. Thus, it is desirable to have countermeasures to reverse a drive if a problem arises. We develop a discrete time model for population genetics of a drive and proposed genetic countermeasures to evaluate the ability to stop and eliminate the drive. We find that the choice among countermeasures by researchers and regulators will depend on goals of using the countermeasure and parameters of target populations.

11. Pat Roberts

Pat Roberts (jprober2@ncsu.edu)
Public Administration, North Carolina State University, Raleigh, NC

Stakeholder Attitudes Towards Responsible Innovation and Implications for Research Policy

Contemporary debates within biotechnology over the last several decades, particularly concerning applications in food, agriculture, and the environment have been both contentious and polarizing. These debates have led to a rise in the number of social scientists working to incorporate nonscientific voices and views into the objectives of research and innovation and decision-making processes. The framework of Responsible Research and Innovation (RRI) has received considerable attention among social scientists for its use as a guiding ideal to realign current processes with outcomes achieved through participative mechanisms. The framework posits an inclusive and temporal decision-making process which relies on the reflexive capacity and responsiveness of institutions and organizations, and subsequently researchers and innovators, to responsibly manage emerging technologies.

Evoking the "ideal type," the RRI construct for embedding responsibility into research and innovation requires goal alignment and mutual accountability between multiple sectors (or groups) operating within the biotechnology space, including: the academy, industry, government, and NGOs. Responsibility between sectors, however, is directed by different and often conflicting goals. Utilizing a mixed methods approach involving structured focus groups and surveys, this paper analyzes the attitudes of each sector towards the conception of responsibility put forth by RRI, allowing for between sector comparison. These comparisons reveal tensions and barriers that must be navigated if RRI is to have an appreciable influence on both US policy design for biotechnology and on restructuring of priorities for researchers and innovators.

12. Caroline Leitschuh

Caroline Leitschuh (cleitsc@ncsu.edu)
Biological Sciences, North Carolina State University, Raleigh, NC

The Effects of Rearing Environment on the Stress Response of Wild-Derived and Laboratory Mice

Though wild house mice have been spread worldwide by humans and adapt well to human environments, they are not as successful in competing with endemic rodent species. Islands offer a unique opportunity for house mice to colonize new territory without competition, often at the expense of native species: 80% of island vertebrate extinctions have been caused by either invasive rats or mice. Current efforts to eradicate invasive mice on islands rely on the use of toxicants, which have a high failure rate for mice. Our research group is developing a genetic modification approach to create heavily male-biased populations by releasing a modified mouse that could only produce male offspring. This approach could potentially be used to manage invasive mice. For these approaches to work, modified mice would need to be effective competitors with established wild mice. My research contributes to this project by comparing anxiety-related and exploratory behavior of wild-derived mouse and the laboratory strain being modified to see if a laboratory mouse has the potential to be as successful as a wild mouse in surviving in a new environment. I also raised each of these strains of mice under both standard and more naturalistic conditions to as a way to help determine if a mouse raised in standard lab conditions could survive under wild conditions.

My research also has translational relevance to human studies of mental health, for which rodent models are often used. Comparing laboratory and wild-derived mice in the same conditions can shed light on how the domestication of wild house mice may have led to differences or even losses of behaviors in laboratory mice. While I am not exploring the mental health research from a biomedical perspective, I am using a communication studies perspective to look at how perceptions of mental health in the United States over the last few decades have changed, and if these perceptions are linked to current events for the time period.

Back to Table of Contents >

13. Jennifer Baltzegar, Mike Jones

Jennifer Baltzegar (jfbaltze@ncsu.edu) and **Mike Jones** (msjones2@ncsu.edu)
IGERT 3rd Year Funding Project, North Carolina State University, Raleigh, NC

Development of Genetic and Economic Models for Maize Weevil in México

Genetic pest management (GPM) techniques have been developed to control insect pests such as Diamondback moth and Yellow-Fever mosquito. With recent genetic engineering (GE) advances, more agricultural pest species may be targeted for GPM approaches. The maize weevil (MW), *Sitophilus zeamais*, is a worldwide pest of stored- grain, including in México. Control methods have focused on insecticides, hermetic storage techniques, and breeding resistant varieties. GE maize containing Bacillus thuringiensis (Bt) toxins is not effective against MW. However, GE technologies implemented in other species, such as insect pests, may offer promise and are currently permissible. Nevertheless, before investing in GE technologies to manage MW populations, we must first assess biological feasibility and potential farm-level economic impacts of this approach.

MW reduces quantity (and quality) for consumption and sale, increases protection expenses and forces early stock liquidation. Small producers growing dozens of varieties predominate, with median production of 958kg. Six months post-harvest, the average farmer still has 46% of production in storage, and 75% who store maize use protectants like phosphine 'pastillas', hermetic silos, or malathion powder. Small farmers store longer and likely face (proportionally) greater MW impacts than large farmers, whose credit constraints mitigate MW risk. Few genetic tools exist for MW, but will be required to develop novel GPM technologies. We measured genome size using flow cytometry and developed a genetic linkage map using 1123 single nucleotide polymorphism markers. The linkage map, totaling 1421.6 centiMorgans, resolves to 11 linkage groups which represent 10 autosomes and the X chromosome. We then measured genetic differentiation (Fst) between populations in four sites in Chiapas and Oaxaca, split between high and low altitude locations. Results indicate a very high level of gene flow between sampled locations. These results will be important for implementing both traditional and genetic control methods for this ubiquitous insect pest.

14. Dr. Amanda Sorensen

Dr. Amanda Sorensen (asorensen8@unl.edu)
School of Natural Resources, University of Nebraska–Lincoln, Lincoln, NE

Student Cognitive Processes and Argumentation During Consensus Modeling of a Socio-Ecological System

To achieve meaningful learning, students must be active, intentional, constructive, cooperative through engagement in authentic tasks. Modeling is an essential skill and practice to promote meaningful learning in science. To further align modeling experiences to promote meaningful learning, consensus modeling gives students an opportunity to further work cooperatively and constructively. Here, we explore the cognitive processes and information use (argumentation) of student groups during a consensus modeling exercise in the context of a course-based undergraduate research experience on an endangered canid species in Nebraska. Further, we explore how the interplay between cognitive processes and argumentation within groups relates to model accuracy. Preliminary results suggest that groups who engage in more deep argumentation and identified more limitations of their models while modeling generated more accurate models. By understanding the dynamics of consensus modeling, we can develop scaffolds to support student learning during this process.

15. Brandon Hollingsworth

Brandon Hollingsworth (bhollin@ncsu.edu), Fred Gould, Zach Brown, Alun Lloyd, and Michael Reiskind
Biomathematics, North Carolina State University, Raleigh, NC

A Mathematician in the Field: Using Field Experiments to Inform Mathematical Models of Vector Control

Commercial mosquito control for residential properties is a growing multimillion dollar business, but how effective is it for controlling mosquitoes? Customer retention and the growth of the industry provide at the very least anecdotal evidence for its effectiveness, but very little scientific work has been done on the subject and many questions remain. However, no single discipline can answer all these questions. Questions about how treatments directly affect the local mosquito population are best answered using field studies, while questions about where and when to use the treatments require mathematical modeling. In this project, we look at combining field work, mathematical simulations, and economic theory to determine how effective these small-scale mosquito control techniques are and how to optimally implement them to control mosquito nuisance and mosquito-borne disease.

IGERT COHORT PROJECTS

Back to Table of Contents >

Each of our IGERT Student Cohorts is required to complete at Cohort Project with the goal of fostering a deeper, interdisciplinary understanding of their focal system. By working together with faculty guidance, each cohort gains not only a better grasp of their topic, but also becomes a more cohesive collaborative team. Their accomplishments are below.

2012 Student Cohort – Mosquitoes & Human Health

The 2012 Cohort's co-authored a white paper that was selected for publication as the opening chapter in Genetic Control of Malaria and Dengue. The book's summary is below.

Timothy Antonelli, Amanda Clayton, Molly Hartzog, Sophia Webster & Gabriel Zilnik. (2016). Transgenic Pests and Human Health: A Short Overview of Social, Cultural, and Scientific Considerations. In: Adelman, Z.N. (ed.), Genetic Control of Malaria and Dengue, (1-30). Boston: Academic Press. ISBN 9780128002469

Book Summary:

"Genetic Control of Malaria and Dengue focuses on the knowledge, technology, regulation and ethics of using genetically modified mosquitoes to interrupt the transmission of important vector-borne diseases including Malaria. It contains coverage of the current state of knowledge of vector-borne diseases and how they are currently controlled; vaccine, drug and insecticide development; various strategies for altering the genome of mosquitoes in beneficial ways; and the regulatory, ethical and social environment concerning these strategies.

For more than five decades, the prospect of using genetically-modified mosquitoes to control vector-borne disease transmission has been a purely hypothetical scenario. We simply did not have the technology or basic knowledge to be able to do it. With the explosion of field trials and potential interventions in development, Genetic Control of Malaria and Dengue provides a comprehensive overview of research in genetics, microbiology, virology, and ecology involved in the development and implementation of genetic modification programs for virus and disease control. This book is meant to provide a practical guide to researchers, regulators and the general public about how this technology actually works, how it can be improved, and what is still unknown." - Zach N. Adelman

2013 Student Cohort – Invasive Rodents & Biodiversity Conservation

The 2013 Student Cohort developed a reference website and co-authored a paper on the potential impacts of genetic engineering on the issues facing invasive rodent impacts on island biodiversity.

Cohort Website: https://research.ncsu.edu/ges/igert/student-research/island-mice-conserving-island-biodiversity/

Website Description:

Our goal in constructing this website is to explore the intersection of invasive species, biodiversity, island conservation, and genetic engineering. In particular we examine the potential uses of genetically modified organisms (GMOs) as a tool for the field of conservation. We explore key questions through the perspectives of multiple fields from the humanities, social, and natural sciences with the aim of providing clear answers for decision makers and the general public.

Our group is open to the potential benefits that genetic engineering methods may offer to the field of conservation biology. However, we are aware not only of the use and impacts transgenic mice may have on wild house mouse populations, but also the impacts they could have on entire ecosystems as well as human society. Together we explore the ecological, social, and ethical implications of releasing transgenic rodents as a form of pest management, and assess the appropriateness of such methods. Our home programs are Biomathematics, Communication, Rhetoric, & Digital Media, Fisheries Wildlife & Conservation Biology, and Zoology. Academically and professionally, we bring a variety of perspectives to the intersection of biotechnology and conservation biology. We do not share a unified view and cannot account for every possible perspective. Some of us hope to see this technology develop and be implemented while others are more cautious about the ethical problems genetic techniques may pose for human society. We have come together to investigate, learn, and discuss these complex issues. This website is a result of our collaborations.

Caroline M. Leitschuh, Dona Kanavy, Gregory A. Backus, Rene X. Valdez, Megan Serr, Elizabeth A. Pitts, David Threadgill & John Godwin. (2017). Developing gene drive technologies to eradicate invasive rodents from islands, *Journal of Responsible Innovation*, 5:sup1, (S121-S138). DOI: 10.1080/23299460.2017.1365232

Article Abstract:

Island ecosystems are highly threatened by invasive rats and mice. Currently, the only effective technology for eradicating rodents from islands is toxicants. Though effective, they are expensive and have high failure rates. They are not species-specific and are potentially dangerous to humans. Gene drive technology is one alternative to toxicants for rodent eradication. Gene drive methods of rodent eradication offer an alternative to killing that has the potential to be more species-specific, more humane, and more biologically safe for use around humans. Technologies in development aim to apply either natural meiotic drive or clustered regularly interspersed short palindromic repeats to influence offspring development so that all offspring are phenotypically male, eventually creating a population that is not reproductively viable. Implementing this technology would involve releasing laboratory-developed engineered mice into wild populations. Some areas for further research include assessing the ecological effects of releasing engineered mice, the potential risks for the accidental or deliberate release of genetically modified organisms into mainland mouse populations, and the social, ethical, and regulatory acceptability of the technology.

2014 Student Cohort – Agricultural Pests

The 2014 Cohort co-authored two papers, a cohort focus-specific, peer-reviewed paper and a response paper to: Virginie Courtier-Orgogozo, Baptiste Morizot & Christophe Boëte. (2017). Using CRISPR-based gene drive for agriculture pest control, *EMBO reports*, 18, 9, (1481-1481). Both abstracts are below.

Jennifer Baltzegar, Jessica Cavin Barnes, Johanna E. Elsensohn, Nicole Gutzmann, Michael S. Jones, Sheron King & Jayce Sudweeks. Anticipating complexity in the deployment of gene drive insects in agriculture, *Journal of Responsible Innovation*, (1-17), published online: 7 December 2017

Article Abstract:

Insects cause substantial losses to agricultural crops each year and require intensive management approaches. Genetic pest management has emerged as a viable, non-chemical alternative for managing insect pests. The development of engineered gene drives for agricultural use is promising, though unproven, and has the potential to impact farmers as well as broader socio-ecological systems in several ways. Drawing on lessons from the deployment of other pest control technologies, this paper considers how insects containing gene drives could intersect with some of the complexities that characterize agricultural systems. Gene drives are being developed in a landscape of pest management shaped by past and current approaches, experiences, regulations, public opinion, and pest invasions. Because gene drive insects may spread well beyond their release area, stakeholder groups at different spatial scales need to be engaged in decisions about their deployment. This new paradigm both complicates and offers great promise for future pest management efforts.

Nicole Gutzmann, Johanna E. Elsensohn, Jessica Cavin Barnes, Jennifer Baltzegar, Michael S. Jones & Jayce Sudweeks, CRISPR-based gene drive in agriculture will face technical and governance challenges, *EMBO Reports*, 18, 9, (1479-1480), published online: 7 August 2017

Article Abstract:

Courtier-Orgogozo, et al. recently called for public debate about the use of CRISPR-based gene drive (GD) in agricultural pest management. We agree that this use of GD deserves specific attention, given that it would pose unique challenges to economic, social, ecological, and regulatory systems. However, many details in the report are oversimplified or imprecise; GD will likely face greater technical and governance challenges than suggested by the authors.

More information about the IGERT Student Cohorts can be found at:
https://research.ncsu.edu/ges/igert/student-research/

SYMPOSIUM DIRECTORY

Back to Table of Contents >

01 | Derek Aday
Professor and Head of Applied Ecology, NC State University
Raleigh, NC | Biological Sciences
ddaday@ncsu.edu | @ddadayNCSU

02 | Tim Antonelli
Assistant Professor, Worcester State University; IGERT Alumnus
Worcester, MA | Mathematics
tantonelli@worcester.edu

03 | Warwick Arden
Provost, NC State University
Raleigh, NC | Education, Policy & Governance
@NCStateProvost

04 | Sez Atamturktur
Provost's Distinguished Professor, Assistant Vice President for Research Development, Clemson University
Clemson, SC | Engineering | sez@clemson.edu

05 | Jennifer Baltzegar
PhD Candidate, IGERT Fellow, NC State University
Raleigh, NC | Biological Sciences
jen_baltzegar@ncsu.edu | @jenbaltzegar

06 | Katie Barnhill-Dilling
Postdoctoral Research Associate, IGERT Fellow, NC State University
Durham, NC | Policy & Governance
skbarnhi@ncsu.edu | @barnhilldilling

07 | Rodolphe Barrangou
Todd R. Klaenhammer Distinguished Professor, The CRISPR Lab, NC State University
Raleigh, NC | Agriculture/Food
rbarran@ncsu.edu | @CRISPRlab

08 | John Beghin
Professor and Head, Ag and Resource Economics, NC State University
Raleigh, NC | Agriculture/Food
jcbeghin@ncsu.edu

09 | Cecilia Bianchi-Hall
Biology Professor, Lenoir Community College
Kinston, NC | Agriculture/Food, Biological Sciences, Humanities | cbianchihall@lenoircc.edu

10 | Thomas Birkland
Associate Dean for Research and Engagement, NC State University
Raleigh, NC | Humanities, Policy & Governance, Research | tabirkla@ncsu.edu

11 | Larry Blanton
Professor & Director of Graduate Programs, NC State University
Raleigh, NC | Biological Sciences
rlblanto@ncsu.edu

12 | Geoffrey Bock
Project Manager, NC Plant Sciences Initiative, NC State University
Raleigh, NC | Agriculture/Food, Biological Sciences
grbock@ncsu.edu

13 | Rebecca Boston
Assistant Director, NC Agricultural Research Service, NC State University
Raleigh, NC | Agriculture/Food
boston@ncsu.edu

14 | Joe L. Bridger
Retired / IBM, Alumnus, NC State University
Raleigh, NC | Information Sciences/A.I.
jbridger49@gmail.com

15 | Stephen Briggs
Launch Director, NC Plant Sciences Initiative, NC State University
Raleigh, NC | Agriculture/Food | spbriggs@ncsu.edu

16 | Zachary Brown
Assistant Professor, Ag and Resource Economics, Genetic Engineering and Society Center, NC State University
Raleigh, NC | Agriculture/Food, Climate/Environment, Policy & Governance
zack_brown@ncsu.edu | @TheKazath

17 | Martha Burford Reiskind
Assistant Professor, Applied Ecology, NC State University
Raleigh, NC | Biological Sciences, Climate/Environment
mbreiski@ncsu.edu | @FishGirlBurford

18 | Elaine Cohen Hubal
Director, Computational Exposure Division, USEPA/Office of Research and Development
RTP, NC | Climate/Environment, Health/Medicine, Policy & Governance | hubal.elaine@epa.gov

19 | Jason Cramer
Director, Accelerate to Industry (A2i) Program, NC State University
Raleigh, NC | Biological Sciences
jmcramer@ncsu.edu | @jmcramer_ncsu

20 | Bethany Cutts
Assistant Professor, Human Dimensions of the Environment, Center for Geospatial Analytics, NC State University
Raleigh, NC | Policy & Governance, Human Geography | bbcutts@ncsu.edu | @BethanyCutts

21 | Jason Delborne
Associate Professor, Science, Policy, and Society, Genetic Engineering and Society Center, NC State University
Raleigh, NC | Policy & Governance
jadelbor@ncsu.edu | @JasonDelborne

22 | Laura Demarse
Assistant Dean of Professional Development, The Graduate School, NC State University
Raleigh, NC | Graduate Education | @ncsugradschool

23 | Elizabeth Dickey
Professor and Director of NRT on Science and Engineering of Atomic Strucuture, NC State University
Raleigh, NC | Engineering | ecdickey@ncsu.edu

24 | John Dole
Associate Dean, College of Agriculture and Life Sciences, NC State University
Raleigh, NC | Agriculture/Food | jmdole@ncsu.edu

25 | Rebecca Dunning
Research Asst Professor, Horticultural Science, Center for Environmental Farming Systems, NC State University
Cary, NC | Agriculture/Food, Policy & Governance
rddunnin@ncsu.edu

26 | Johanna Elsensohn
PhD Candidate, IGERT Fellow, NC State University
Raleigh, NC | Agriculture/Food
j_elsensohn@ncsu.edu

27 | John Godwin
Professor, Biological Sciences, NC State University
Raleigh, NC | Biological Sciences
john_godwin@ncsu.edu

28 | Fred Gould
University Distinguished Professor and Co-director, Genetic Engineering and Society Center, NC State University
Raleigh, NC | Agriculture/Food, Biological Sciences
fred_gould@ncsu.edu | @GESCenterNCSU

29 | Tom Gower
Department Head and Professor, Forestry and Environmental Resources, NC State University
Raleigh, NC | Climate/Environment; Policy & Governance | stgower@ncsu.edu | @NCState_FER

30 | Nicole Gutzmann
PhD Candidate, IGERT Fellow, NC State University
Raleigh, NC | Agriculture/Food
negutzma@ncsu.edu

31 | Nora Haenn
Associate Professor, Anthropology and International Studies, NC State University
Pittsboro, NC | Social Sciences
nora_haenn@ncsu.edu

32 | Joseph Herkert
Associate Professor Emeritus of STS; Visiting Scholar, Genetic Engineering and Society Center, NC State University
Cary, NC | Engineering, Policy & Governance, Ethics
jherkert@ncsu.edu

33 | Brandon Hollingsworth
Graduate Student, Biosciences, NC State University
Raleigh, NC | Biological Sciences
bhollin@ncsu.edu

34 | Pamela L. Jennings
Head, Department of Art + Design (incoming), NC State University
Winston-Salem, NC | Art + Design
pljenn@gmail.com | @DesignConflux

35 | Michael Jones
PhD Candidate, IGERT Fellow, NC State University
Durham, NC | Agriculture/Food
msjones2@ncsu.edu

36 | Rebecca Jordan
Professor, Environmental Education and Citizen Science and Director of Program in Science Learning, Rutgers University
New Brunswick, NJ | Agriculture/Food, Biological Sciences, Climate/Environment, Policy & Governance
rebecca.jordan@rutgers.edu

37 | Sophie Kartharіou
Professor, Food Science and Microbiology, NC State University
Raleigh, NC | Agriculture/Food, Biological Sciences, Climate/Environment, Health/Medicine | skathar@ncsu.edu

38 | Glenda T. Kelly
Associate Director and Research Scientist, Duke University
Durham, NC | Engineering | glenda.kelly@duke.edu

39 | Jeffrey Kelly
Director, Corix Plains Institute and Professor of Biology, University of Oklahoma
Norman, OK | Biological Sciences
jkelly@ou.edu | @Jeffrey_F_Kelly

40 | George Kennedy
William Neal Reynolds Distinguished Professor, Entomology & Plant Pathology, NC State University
Raleigh, NC | Agriculture/Food | kennedy@ncsu.edu

41 | William Kimler
Faculty Mentor, Thomas Jefferson Scholars, NC State University
Raleigh, NC | Biological Sciences, Humanities
kimler@ncsu.edu

42 | Todd Kuiken
Senior Research Scholar, Genetic Engineering and Society Center, NC State University
Raleigh, NC | Climate/Environment, Policy & Governance | tkuiken@ncsu.edu | @drtoddoliver

43 | Sheryl Kunickis
Director, US Department of Agriculture, Office of Pest Management Policy
Washington, DC | Agriculture/Food; Policy & Governance | sheryl.kunickis@osec.usda.gov

44 | Jennifer Kuzma
Goodnight-NC GSK Foundation Distinguished Professor and Co-director, Genetic Engineering and Society Center, NC State University
Raleigh, NC | Agriculture/Food, Biological Sciences, Policy & Governance
jkuzma@ncsu.edu | @GESCenterNCSU

45 | Duane Larick
Senior Vice Provost for Academic Strategy and Resource Management and Chief of Staff, NC State University
Raleigh, NC | Policy & Governance
duane_larick@ncsu.edu

46 | Aranzazu Lascurain
Assistant University Director, SE Climate Adaptation Science Center, NC State University
Raleigh, NC | Biological Sciences, Climate/Environment, Policy & Governance
alascur@ncsu.edu | @se_csc

47 | Caroline Leitschuh
PhD Candidate, IGERT Fellow, NC State University
Raleigh, NC | Biological Sciences, Science Communication | cleitsc@ncsu.edu | @caro_leit

48 | Richard Linton
Dean, College of Agriculture and Life Sciences, NC State University
Raleigh, NC | Agriculture/Food; Policy & Governance
@NCStateCALS

49 | Alun Lloyd
Director, Biomathematics Graduate Program, NC State University
Raleigh, NC | Biological Sciences
alun_lloyd@ncsu.edu

50 | Terri L. Lomax
CEO, Innovation Ecosystems
Durham, NC | Agriculture/Food, Biological Sciences, Policy & Governance, Innovation
lomaxt@me.com | @tlomax

51 | Marce Lorenzen
Associate Professor, Entomology & Plant Pathology, NC State University
Raleigh, NC | Agriculture/Food, Biological Sciences
dr.marce@ncsu.edu

52 | Katie Martin
Assistant Professor, Forestry and Environmental Resources, Center for Geospatial Analytics, NC University
Raleigh, NC | Climate/Environment
katie_martin@ncsu.edu

53 | Carolyn Mattingly
Associate Professor, Interim Head of Biological Sciences, NC State University
Raleigh, NC | Biological Sciences
cjmattin@ncsu.edu | @NCStateBioSci

54 | Susan McCord
Executive Director,
Institute of Forest Bioscience
Cary, NC | Climate/Environment
susan.mccord@forestbiotech.org | @forestbiotech

55 | Chris McGahan
Dean, College of Sciences, NC State University
Raleigh, NC | Biological Sciences, Health/Medicine
chris_mcgahan@ncsu.edu | @NCStateSciences

56 | Ross Meentemeyer
Professor and Director, Center for Geospatial Analytics, NC State University
Raleigh, NC | Information Sciences/A.I.
rkmeente@ncsu.edu | @NCSUgeospatial

57 | Maggie Monast
Senior Manager, Agricultural Sustainability, Environmental Defense Fund
Raleigh, NC | Agriculture/Food
mmonast@edf.org | @EnvDefenseFund

58 | Patti Mulligan
Communications Director, Genetic Engineering and Society Center, NC State University
Raleigh, NC | Science Communication
phmullig@ncsu.edu | @chachina

59 | Raj Narayan
Associate Director, Kenan Institute for Engineering, Technology & Science
Raleigh, NC | Multidisciplinary - Research, STEM Education, Technology Entrepreneurship, Public Policy, Engagement and Outreach
rnaraya@ncsu.edu | @KenanETS

60 | LaKisha Odom
Scientific Program Director, Foundation for Food and Agriculture Research
Washington, DC | Agriculture/Food
lodom@foundationfar.org | @FoundationFAR

61 | Jorge Piedrahita
Director, Comparative Medicine Institute, NC State University
Raleigh, NC | Biological Sciences, Health/Medicine
japiedra@ncsu.edu | @NCStateCMI

62 | Elizabeth Pitts
Assistant Professor of English, University of Pittsburgh; IGERT Alumnus
Pittsburgh, PA | Humanities
eap90@pitt.edu | @elizabethapitts

63 | David Price
Congressman, US House of Representatives
Chapel Hill, NC | Policy & Governance
@RepDavidEPrice

64 | Laura Regassa
Program Director, Division of Graduate Education, National Science Foundation
Alexandria, VA | Biological Sciences, Education
lregassa@nsf.gov | @nsf

65 | Pat Roberts
PhD Candidate, IGERT Fellow, NC State University
Raleigh, NC | Policy & Governance

66 | Marcela Rojas-Pierce
Associate Professor, Plant and Microbial Biology, NC State University
Raleigh, NC | Agriculture/Food, Biological Sciences
mrojasp@ncsu.edu

67 | Jeff Rosichan
Director, Crops of the Future Collaborative, Foundation for Food and Agriculture Research
Washington, DC | Agriculture/Food
jrosichan@foundationfar.org | @FoundationFAR

68 | Henry Schaffer
Professor Emeritus Genetics & Biomathematics; Coordinator of Special IT Projects & Faculty Collaboration, NC State University
Raleigh, NC | Biological Sciences | hes@ncsu.edu

69 | Corey Scott
Principal Nutrition Scientist, Cargill
Plymouth, MN | Agriculture/Food
ces904@hotmail.com

70 | Heike Sederoff
Professor, Systems and Synthetic Biology Cluster and Chair, Plant Metabolic Engineering, NC State University
Raleigh, NC | Agriculture/Food
hwsedero@ncsu.edu

71 | Ron Sederoff
Distinguished University Professor Emeritus, NC State University
Raleigh, NC | Biological Sciences
ron_sederoff@ncsu.edu

72 | Megan Serr
PhD Candidate, IGERT Fellow, NC State University
Raleigh, NC | Biological Sciences
meserr@ncsu.edu | @SerrMegan

73 | Prerna Shelke
Research Assistant, Amravati University, India
Morrisville, NC | Agriculture/Food
prernashelke101@gmail.com

74 | Erin Sills
Professor, Forestry and Environmental Resources, NC State University
Raleigh, NC | Climate/Environment; Policy & Governance | sills@ncsu.edu

75 | Rob Smart
William Neal Reynolds Distinguished Professor, Biological Sciences, NC State University
Raleigh, NC | Biological Sciences
rcsmart@ncsu.edu

76 | Karina T. Smith
IGERT Program Coordinator, NC State University
Raleigh, NC | Biological Sciences, Engineering, Health/Medicine | kltodd@ncsu.edu

77 | Amanda Sorensen
Postdoctoral Assoc., University of Nebraska Lincoln
New Brunswick, NJ | Biological Sciences, Climate/Environment | asorensen8@unl.edu

78 | Sharon Stauffer
Program Associate, Genetic Engineering and Society Center, NC State University
Raleigh, NC | Agriculture/Food, Biological Sciences, Policy & Governance | sastauff@ncsu.edu

79 | Jayce Sudweeks
PhD Candidate, IGERT Fellow, NC State University
Raleigh, NC | Policy & Governance
jayce.sudweeks@gmail.com

80 | Deborah Thompson
Director of Research Partnerships, NC State University
Raleigh, NC | Agriculture/Food
dmt@ncsu.edu | @biotechnetwork

81 | Destiny Tyson
Lab Assistant, NC State University
Durham, NC | Agriculture/Food, Biological Sciences
dntyson@ncsu.edu

82 | Diego Vargas Blanco
Graduate Student, Worcester Polytechnic Institute
Worcester, MA | Biological Sciences, Engineering
davargasblanco@wpi.edu | @DaVargasB

83 | Michael Vella
PhD Candidate, IGERT Fellow, NC State University
Raleigh, NC | Biological Sciences, Mathematics/Statistics
mrvella@ncsu.edu | @MrVella

84 | Brian Verrelli
Associate Professor and Director, Center for Life Sciences Education, Virginia Commonwealth University
Richmond, VA | Biological Sciences
bverrelli@vcu.edu

85 | Amanda Walsh
Senior Economist, RTI International; IGERT Alumnus
Research Triangle Park, NC | Policy & Governance
awalsh@rti.org | @RTI_Intl

86 | Mary Watzin
Dean, College of Natural Resources, NC State University
Raleigh, NC | Climate/Environment
mary_watzin@ncsu.edu | @NCStateCNR

87 | Sophia Webster-Tostenson
PhD Candidate, IGERT Fellow, NC State University
Cary, NC | Biological Sciences
shwebste@ncsu.edu

88 | Randy Woodson
Chancellor, NC State University
Raleigh, NC | Education, Policy & Governance
@NCState

89 | Ashleigh Wright
Coordinator, Science and Engineering of Atomic Structure NRT, NC State University
Raleigh, NC | Engineering
ashleigh.wright@ncsu.edu

90 | Rebecca Zuvich
Assistant Dean, College of Agriculture and Life Sciences, NC State University
Raleigh, NC | Policy & Governance
rbzuvich@ncsu.edu

ACTION PLAN NOTES

Back to Table of Contents >

Day 1 | Diverse Experiences in Integrated Graduate Education

Opening Remarks / **Zachary Brown, Warwick Arden, Richard Linton**, NC State
Notes/Action Items:

Keynote: STEM Graduate Education: Advancing Knowledge & Transforming the Future / **Laura Regassa**, NSF
Notes/Action Items:

Branches from the Same Tree: Integrative Learning in Higher Education / **Pamela L. Jennings**, NC State
Notes/Action Items:

Experiences from the NC State IGERT PhD program / **Fred Gould and Graduate Students**, NC State
Notes/Action Items:

Toward transferable and sustainable models for interdisciplinary training in environmental sustainability / **Jeff Kelly**, University of Oklahoma | **Notes/Action Items:**

Graduate Education Informed by Social Network Analysis / **Sez Atamturktur**, Clemson University
Notes/Action Items:

Transdisciplinary, Parallel Play, or Something in Between? / Rebecca Jordan, Rutgers University
Notes/Action Items:

Fostering the Future with FFAR / **LaKisha Odom**, Foundation for Food and Agriculture Research
Notes/Action Items:

Poster Sessions / Internal and External **Graduate Students**
Notes/Action Items:

Day 2 | Workforce Needs and the Way Forward

Opening Remarks / **Zachary Brown**, NC State
Notes/Action Items:

Keynote: The Future of Innovation: Workforce Needs and the Way Forward for Graduate Education /
Terri Lomax, Innovation Ecosystems | **Notes/Action Items:**

Meeting the Challenges of Integrative Doctoral Program Initiatives / **Brian Verrelli**, VCU Integrative Life Sciences
Notes/Action Items:

Panel Discussion: Workforce Needs / Congressman **David Price**; **Stephen Briggs**, Plant Sciences Initiative; **Corey Scott**, Cargill; **Maggie Monast**, Environmental Defense Fund; **Sheryl Kunickis**, USDA OPMP
Notes/Action Items:

Overview and Perspective / **Jennifer Kuzma**, GES Center, NC State
Notes/Action Items:

Where Do We Go from Here? / Breakout Groups

Notes/Action Items: _____

Special thanks to the NC State University College of Agriculture and Life Sciences for their support of this symposium, and of the work of the Genetic Engineering and Society Center.

NC STATE
College of Agriculture and Life Sciences

The National Academies of
SCIENCES
ENGINEERING
MEDICINE

Learn more about the GES Center

Visit go.ncsu.edu/ges to

- Subscribe to the eNewsletter
- Download publications
- Read about affiliated faculty research projects
- Listen to podcasts, and
- Watch past colloquia, event, and archive videos

Genetic Engineering and Society Center

Integrating scientific knowledge and public values in shaping the futures of biotechnology

GES CENTER

GO.NCSU.EDU/GES