

**Annual Report - 2013**

**Award ID:** 1068676

**Institution:** North Carolina State University

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

**Principal Investigator(s)**

**Name:** Fred Gould

**Project Years Active:** 2011-2012, 2012-2013

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

**Name:** Andrew R. Binder

**Project Years Active:** 2012-2013

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

**Name:** Matthew M. Booker

**Project Years Active:** 2012-2013

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

**Name:** John R. Godwin

**Project Years Active:** 2012-2013

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

**Name:** Nick Haddad

**Project Years Active:** 2011-2012, 2012-2013

**Role in Project:** Co-PI

**Name:** Nora Haenn

**Project Years Active:** 2011-2012, 2012-2013

**Role in Project:** Co-PI

**Name:** William Kinsella

**Project Years Active:** 2011-2012, 2012-2013

**Role in Project:** Co-PI

**Name:** Alun Lloyd

**Project Years Active:** 2011-2012, 2012-2013

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

**Name:** Marce D. Lorenzen

**Project Years Active:** 2012-2013

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

**Name:** Melinda S. Morrill

**Project Years Active:** 2012-2013

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

**Name:** Max J. Scott

**Project Years Active:** 2012-2013

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

**Name:** Walter N. Thurman

**Project Years Active:** 2012-2013

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

## Trainees

**Name:** Timothy D. Antonelli

**Total number of months funded:** 11

**Project Years Active:**

2012-2013 Project Year - Trainee supported for 11 months

**Name:** Amanda C. Clayton

**Total number of months funded:** 11

**Project Years Active:**

2012-2013 Project Year - Trainee supported for 11 months

**Name:** William A. Klobasa

**Total number of months funded:** 11

**Project Years Active:**

2012-2013 Project Year - Trainee supported for 11 months

**Name:** Molly S. Storment

**Total number of months funded:** 11

**Project Years Active:**

2012-2013 Project Year - Trainee supported for 11 months

**Name:** Sophia H. Webster

**Total number of months funded:** 11

**Project Years Active:**

2012-2013 Project Year - Trainee supported for 11 months

**Name:** Gabriel L. Zilnik

**Total number of months funded:** 11

**Project Years Active:**

2012-2013 Project Year - Trainee supported for 11 months

## Associates

**Name:** Sarah A. Cash

**Project Years Active:** 2012-2013

**Name:** Rebecca M. Edman

**Project Years Active:** 2012-2013

**Name:** Ashley R. Kelly

**Project Years Active:** 2012-2013

**Name:** Meagan Kittle Autry

**Project Years Active:** 2012-2013

**Name:** Arina Loghin

**Project Years Active:** 2012-2013

**Name:** Kate Maddalena

**Project Years Active:** 2012-2013

**Name:** Michael A. Robert

**Project Years Active:** 2012-2013

**Name:** Stacy Roberts

**Project Years Active:** 2012-2013

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

### **Interdisciplinary Research Achievements**

**First Achievement:** Community Involvement: A group of students, including IGERT fellows Gabriel Zilnik and William Klobasa, lead by IGERT-associated faculty member, Dr. Mike Cobb, conducted two separate but related surveys of people in the Florida Keys to get a clear assessment of their views related to transgenic mosquitoes at the special request of the Florida Keys mosquito control group, including Dr. Mike Doyle. Gabe and Will also collected additional qualitative data about how the controversy has impacted the local community, and spoke with local media and key stakeholders. In both studies, a majority supported using GE technologies to control mosquitoes. More importantly, only a small percentage of respondents in either survey are opposed; the same percentage, or more, was neutral rather than opposed. Both reports were made available online on the NCSU IGERT website on February 14, 2013:

<http://geneticengsoc.ncsu.edu/ncsu-study-a-majority-of-key-west-residents-support-release-of-gm-mosquitoes>

**Second Achievement:** National Discourse: Three of our IGERT faculty, Drs. Mike Cobb, Andrew Binder and Fred Gould, developed the first nationally representative survey in the U.S. to gauge public opinion on the use of genetic manipulations to drive down mosquito populations and related diseases. Conducted by Dr. Cobb, the survey of 1,211 people was conducted in July 2012. The objective was to learn what the public thinks about GM mosquitoes, since they are already being released in other parts of the world, and are under consideration for use in the U.S. The poll found that giving people accurate information about how this process works increases their support for the concept, but support is also contingent on the label used to describe these mosquitoes. The survey findings are an excellent example of how public attitudes toward novel scientific innovations are far from fixed. The survey results are available online:

<http://geneticengsoc.ncsu.edu/wp-content/uploads/MosquitoSurvey.August5.pdf>

**Third Achievement:** New Technology: Dr. Max Scott, a GPM course instructor, is currently developing transgenic screwworm fly strains to combat its spread. The New World screwworm (NWS) fly, *Cochliomyia hominivorax*, is a devastating pest of warm-blooded animals. The Sterile Insect Technique (SIT) was used to eradicate the NWS from U.S.A., Mexico and Central America. Sterilized male and female NWS are released continually in a "buffer zone" in Southern Panama to prevent re-introduction from South America. His new transgenic NWS strains carry tetracycline-repressible female lethal genetic systems. This will enable male-only releases, which will significantly improve the efficiency of genetic suppression. Several transgenic lines have been made. The most promising line to date shows 98-100% female lethality when raised on diet that lacks tetracycline. The transgenic flies will carry a stable fluorescent protein marker, which will allow strain determination of sampled flies within the NWS-free zone.

### **Education Achievements**

**First Achievement:** In our first GES course over Summer 2012 students engaged with local researchers, university students and faculty, policy makers, NGOs, and citizens in Lima and Iquitos, Peru, on topics associated with the genetic engineering of pests. This began with their participation in a two-day conference in Lima that brought together shareholders from 4 colleges at NCSU and 4 different countries (US, Peru, Panama, Brazil). The course aimed to provide students with an experiential introduction to the topic's various complexities. At the same time, the course established intellectual and social foundations for students' participation in the Genetic Engineering and Society program throughout their doctoral studies. Students also engaged in team-building activities that probed the nature of inter-disciplinary collaboration. Students also participated in reading and discussion on ethical decision-making and began to create their own ethical framework in respect to the genetic engineering of pests.

**Second Achievement:** Our successful development and implementation of two more of our academic courses required for the achievement of the GES minor was accomplished during this reporting period. The first course, Principles of Genetic Pest Management, was taught during the Fall 2012 semester and served to give our students a basis in the hard science behind Genetic Pest Management. This course was team taught by three professors across multiple disciplines (Entomology, Genetics, Ecology) and required student-lead discussions and material presentations. The second course, New Technologies in Social and Cultural Contexts, was taught during the Spring 2013 semester and served to give the students a structural framework with which to approach the humanities and social science side of our IGERT. This course was team taught by three IGERT faculty across multiple disciplines (Communication, Anthropology & History) and required student-lead and student-mediated group discussion.

**Third Achievement:** Our Colloquium continued meeting once every other week for the full duration of the 2012-2013 academic year. Our colloquia involved faculty, staff, students and postdocs from 4 different colleges at NCSU encompassing numerous disciplinary distinctions. We brought in multiple outside speakers to discuss topics from synthetic biology and the production of biofuels to policy regulation and developmental economics. Exposure to the wide world of genetic modification has allowed us to elevate our conversation from genetic pest management as a focus to apply our discussion to a variety of fields. Our colloquia have also given our GES fellows an opportunity to present multiple times as a group in a generalized academic setting. They have also given them a platform by which to receive a wide variety of input on their cohort project at various stages as their White Paper has progressed.

### **Trainee Achievements**

**First Achievement:** William Klobasa: defended his masters thesis in Entomology in November 2012. His thesis and seminar title was "Annotation and Functional Analysis of a Unique Family of Bacteria-Like Genes in the Red Flour Beetle, *Tribolium castaneum*". He reported the presence of a class of genes in *Tribolium castaneum* which exhibit sequence similarity to bacterial genes of the PD-(D/E)XK nuclease superfamily. He detected members of this gene family for the first time in higher eukaryotes and explored the possibility of horizontal gene transfer to explain the obscure history of inheritance. Phylogenetic analysis indicates that these genes have undergone expansion within *Tribolium*, encompassing > 7 subfamilies which are scattered throughout the genome (> 8 different linkage groups). All insects receiving a dsRNA treatment specific for all 7 subfamilies died, indicating that one subfamily of these genes has acquired an essential function in a eukaryote. He hypothesizes gene fusion may be responsible.

**Second Achievement:** Molly Stormont: is presenting her current research project "Mutant Mosquitoes and Benevolent Scientists: A rhetorical approach to framing controversial science in digital media" at the 2013 Conference on Communication and the Environment in Uppsala, Sweden this summer. Her project integrates a rhetorical approach into framing theory with a comparative analysis of media frames and audience frames on a controversial topic in new science. The case study focuses on the British company Oxitec, which has patented a genetically modified mosquito-control technique: Release of Insect with Dominant Lethal (RIDL) or "sterile" male mosquitoes. She analyzed Oxitec's use of Twitter to communicate with interested publics by identifying the frame of each tweet in terms of agent and action identified in the text. She then compare these results to the frames identified in a U.S. public opinion survey. Her research sheds light on the differences in conceptualization evidenced by these two groups.

**Third Achievement:** Tim Antonelli: developed a biologically accurate model for mosquito larval growth using Iquitos, Peru, as a case study. Dengue infects 50 to 100 million people each year and is currently the world's fastest growing tropical disease. There is no treatment or

vaccine available, so control efforts focus on the virus's primary mosquito vector, *Aedes aegypti*. Skeeter Buster is a detailed mathematical model developed to predict the response of an *Ae. aegypti* population in Iquitos to various control strategies. However, the model consistently overestimates both the proportion of containers with larvae present and the abundance of larvae found in the field, due to an incomplete understanding of food availability and its impact on larval growth. Tim conducted an experiment in Iquitos which allowed him to obtain maximum-likelihood estimates of parameters governing food accumulation and larval growth which he then applied to the Skeeter Buster equations, resulting in a more accurate model.

### **International Opportunities: Achievements**

**Research/Educational Achievement 1:** Tim Antonelli returned to Peru over Winter Break 2012 to continue research begun during the GES Summer course. Over the break, Tim conducted an experiment to assess how growth of *Aedes aegypti* larvae in household containers depends on the age of water. Buckets were set out to accumulate debris for varying lengths of time and Tim evaluated how larvae placed in each grew and developed over time for better understanding of what factors contribute most to larval growth to inform models of population dynamics. He then presented his work at the 8th Annual NC State University Graduate Student Research Symposium. Antonelli, T\*, Lloyd, A.L., Gould, F. (2013, March). Developing a Biologically Accurate Model for Mosquito Larval Growth in Iquitos, Peru. 8th Annual NC State University Graduate Student Research Symposium, Raleigh, NC.

**Research/Educational Achievement 2:** Amanda Clayton also travelled to Iquitos, Peru, over Winter Break 2012, to work with the US Naval Medical Research Unit (NAMRU-6). She was incorporated into their procedures in order to obtain access to their data sets which have been collected over the past fourteen years. These data sets are invaluable to her economics dissertation research on household participation in controlling the Dengue vector in order to prevent transmission of the disease. Traveling to Iquitos not only provided her with key access to the data but also allowed her to get first hand knowledge about the quality and applicability of the data by speaking with NAMRU-6 researchers that have been working with the data for over a decade.

### **Outreach Activities**

**Title:** "When Mutant Mosquitoes Attack" Article

**Media Outlet/Organization:** New York Times Magazine

**Activity Date:** 02/24/2013

**Description:** IGERT faculty, Drs. Nora Haenn, John Godwin, Fred Gould, Bill Kinsella, interviewed by Maggie Koerth-Baker for NYT Magazine about the science, risks and ethics involved in genetically modifying organisms such as mosquitoes; appeared in print 2/26/13.

**Title:** Daily Planet NRC Lightning Talk

**Media Outlet/Organization:** North Carolina Museum of Natural Sciences' Natural Resource Center (NRC)

**Activity Date:** 06/25/2012

**Description:** At regular intervals during the day, scientists present to NRC visitors using the cutting edge technology and media of the Daily Planet auditorium. Dr. Fred Gould gave a presentation describing the research and merits of the NCSU IGERT program.

**Title:** Pints of Science - Bees

**Media Outlet/Organization:** North Carolina Museum of Natural Sciences

**Activity Date:** 12/18/2012

**Description:** Spearheaded by GES fellow Gabriel Zilnik and supported by GES Co-PI Dr. Andrew Binder, this is a joint effort between NC State University and the N.C. Museum of Natural Sciences. It is held the last Tuesday of every month at a local bar, Tir Na Nog.

**Title:** Pints of Science - Darwin

**Media Outlet/Organization:** North Carolina Museum of Natural Sciences

**Activity Date:** 02/26/2013

**Description:** Spearheaded by GES fellow Gabriel Zilnik and supported by GES Co-PI Dr. Andrew Binder, this is a joint effort between NC State University and the N.C. Museum of Natural Sciences. It is held the last Tuesday of every month at a local bar, Tir Na Nog.

**Title:** Pints of Science - Fear

**Media Outlet/Organization:** North Carolina Museum of Natural Sciences

**Activity Date:** 10/03/2012

**Description:** Spearheaded by GES fellow Gabriel Zilnik and supported by GES Co-PI Dr. Andrew Binder, this is a joint effort between NC State University and the N.C. Museum of Natural Sciences. It is held the last Tuesday of every month at a local bar, Tir Na Nog.

**Title:** Pints of Science - Fungi

**Media Outlet/Organization:** North Carolina Museum of Natural Sciences

**Activity Date:** 09/25/2012

**Description:** Spearheaded by GES fellow Gabriel Zilnik and supported by GES Co-PI Dr. Andrew Binder, this is a joint effort between NC State University and the N.C. Museum of Natural Sciences. It is held the last Tuesday of every month at a local bar, Tir Na Nog.

**Title:** Pints of Science - Genetics

**Media Outlet/Organization:** North Carolina Museum of Natural Sciences

**Activity Date:** 03/26/2013

**Description:** Spearheaded by GES fellow Gabriel Zilnik and supported by GES Co-PI Dr. Andrew Binder, this is a joint effort between NC State University and the N.C. Museum of Natural Sciences. It is held the last Tuesday of every month at a local bar, Tir Na Nog.

**Title:** Pints of Science - Sex & Chocolate

**Media Outlet/Organization:** North Carolina Museum of Natural Sciences

**Activity Date:** 01/22/2013

**Description:** Spearheaded by GES fellow Gabriel Zilnik and supported by GES Co-PI Dr. Andrew Binder, this is a joint effort between NC State University and the N.C. Museum of Natural Sciences. It is held the last Tuesday of every month at a local bar, Tir Na Nog.

**Title:** Pints of Science - Thanksgiving

**Media Outlet/Organization:** North Carolina Museum of Natural Sciences

**Activity Date:** 11/27/2012

**Description:** Spearheaded by GES fellow Gabriel Zilnik and supported by GES Co-PI Dr. Andrew Binder, this is a joint effort between NC State University and the N.C. Museum of Natural Sciences. It is held the last Tuesday of every month at a local bar, Tir Na Nog.

## **Publications, Presentations, and Patents**

## Journal Articles in Refereed Publications

### 5a. Journal Articles in Refereed Publications

Bergen, E.L., Rowell, J.T., Gould, F., & Servedio, M.R. (2012). Stochasticity in Sexual Selection Enables Divergence: Implications for Moth Pheromone Evolution. *Evolutionary Biology*. 39, 271-281.

Broehan, G., Kröger, T., Lorenzen, M.D. & Merzendorfer, H. (2013) Functional analysis of the ATP-binding cassette (ABC) transporter gene family of *Tribolium castaneum*. *BioMed Central Genomics*. 14(6), <http://www.biomedcentral.com/1471-2164/14/6>

Cobb, M. (2012). U.S. Public Wary of GM Mosquitoes. *Science*. 337, 782-783.

Connallon, T., Singh, N.D., & Clark, A.G. (2012). Impact of genetic architecture on the relative rates of X versus autosomal adaptive substitution. *Molecular Biology and Evolution*. 29, 1933-1942.

Facchinelli, L., Valerio, L., Ramsey, J.M., Gould, F., Walsh, R.K., Bond, G., Robert, M.A., Lloyd, A.L., James, A.A., Alphey, L., & Scott, T.W. (2013). Field Cage Studies and Progressive Evaluation of Genetically-Engineered Mosquitoes. *Public Library of Science Neglected Tropical Diseases*. 7(1), e2001. doi:10.1371/journal.pntd.0002001.

Gatton, M.L., Chitnis, N., Churcher, T., Donnelly, M.J., Ghani, A.C., Godfray, H.C.J., Gould, F., Hastings, I., Marshall, J., Ranson, H., Rowland, M., Shaman, J., Lindsay, S.W. (2013). The Importance of Mosquito Behavioural Adaptations to Malaria Control in Africa. *Evolution*. 67(4), 1218-1230.

Grubbs, N., Leach, M., Su, X., Petrisko, T., Rosario, J.B., et al. (2013). New Components of *Drosophila* Leg Development Identified through Genome Wide Association Studies. *Public Library of Science ONE*. 8(4), e60261. doi:10.1371/journal.pone.0060261

Legros, M., Xu, C., Okamoto, K., Scott, T.W., Morrison, A.C., Lloyd, A.L., & Gould, F. (2012). Assessing the Feasibility of Controlling *Aedes aegypti* with Transgenic Methods: A Model-Based Evaluation. *Public Library of Science ONE*. 7(12), e52235. doi:10.1371/journal.pone.0052235.

Li, F., Vensko II, S.P., Belikoff, E.J. & Scott, M.J. (2013). Conservation and sex-specific splicing of the transformer gene in the calliphorids *Cochliomyia hominivorax*, *Cochliomyia macellaria* and *Lucilia sericata*. *Public Library of Science ONE*. 8(2), e56303. doi:10.1371/journal.pone.0056303.

Loh, Y.H., Bezault, E., Muenzel, F.M., Roberts, R.B., Swofford, R., Barluenga, M., Kidd, C.E., Howe, A.E., Di Palma, F., Lindblad-Toh, K., Hey, J., Seehausen, O., Salzburger, W., Kocher, T.D., Streelman, J.T. (2013). Origins of shared genetic variation in African cichlids. *Molecular Biology and Evolution*. 30, 906-17.

Oppenheim, S.J., Gould, F., & Hopper, K.R.. (2012). The genetic architecture of a complex ecological trait: host plant use in the specialist moth, *Heliothis subflexa*. *Evolution*. 66, 3336-3351.

Oppert, B., Dowd, S.E., Bouffard, P., Li, L., Conesa, A., Lorenzen, M.D., Toutges, M., Marshall, J., Huestis, D.L., Fabrick, J., Oppert, C., & Jurat-Fuentes, J.L. (2012). Transcriptome profiling of the intoxication response of *Tenebrio molitor* larvae to *Bacillus thuringiensis* Cry3Aa protoxin. *Public Library of Science ONE*. 7(4), e34624. doi:10.1371/journal.pone.0034624.

OQuin, C.T., Drilea, A.C., Roberts, R.B., Kocher, T.D. (2012). A small number of genes underlie male pigmentation traits in Lake Malawi cichlid fishes. *Journal of Experimental Zoology B: Molecular and Developmental Evolution*. 318, 199-208.

Reiner, R.C., Perkins, T.A., Barker, C.M., Niu, T., Chaves, L.F., Ellis, A.M., George, D.B., Le Menach, A., Pulliam, J.R.C., Bisanzio, D., Buckee, C., Chiyaka, C., Cummings, D.A.T., Garcia, A.J., Gatton, M.L., Gething, P.W., Hartley, D.M., Johnston, G., Klein, E.Y., Michael, E., Lindsay, S.W., Lloyd, A.L., Piggot, D.M., Reisen, W.K., Ruktanonchai, N., Singh, B.K., Tatem, A.J., Kitron, U., Hay, S.I., Scott, T.W., & Smith, D.L. (2013). A systematic review of mathematical models of mosquito-borne pathogen transmission: 1970-2010. *Journal of the Royal Society Interface*. 10(81), e.20120921. doi:10.1098/rsif.2012.0921.

Robert, M.A., Legros, M., Facchinelli, L., Valerio, L., Ramsey, J. M., Scott, T.W., Gould, F. & Lloyd, A.L. (2012). Mathematical Models as Aids for Design and Development of Experiments: The Case of Transgenic Mosquitoes. *Journal of Medical Entomology*. 49(6), 1177-1188.

Semeao, A.A., Campbell, J.F., Beeman, R.W., Lorenzen, M.D., Whitworth, R.J., & Sloderbeck, P.E. (2012). Genetic Structure of *Tribolium castaneum* (Coleoptera: Tenebrionidae) Populations in Mills. *Environmental Entomology*. 41: 188199.

Singh, N.D., Jensen, J.D., Clark, A.G. & Aquadro, C.F. (2013). Inferences of demography and selection in an African population of *D. melanogaster*. *Genetics*, 193, 215-228.

Singh, N.D., Stone, E.A., Aquadro, C.F., & Clark, A.G. (2013). Fine-scale heterogeneity in crossover rate in the garnet-scalloped region of the *D. melanogaster* X chromosome. *Genetics*. <http://www.genetics.org/content/early/2013/02/04/genetics.112.146746.long>

Tabashnik, B.E., & Gould, F. (2012). Delaying Corn Rootworm Resistance to Bt Corn. *Journal of economic entomology*. 105(3), 767-776.

Thresher, R.E., Hayes, K., Bax, N.J., Teem, J., Benfey, T.J., & Gould, F. (2013). Genetic control of invasive fish: technological options and its role in Integrated Pest Management. *Biological Invasions*. <http://link.springer.com/article/10.1007%2Fs10530-013-0477-0#page-1>

Walsh, R.K., Bradley, C., Apperson, C.S., & Gould, F. (2012). An Experimental Field Study of Delayed Density Dependence in Natural Populations of *Aedes albopictus*. *Public Library of Science ONE*. 7(4), e35959. doi:10.1371/journal.pone.0035959.

## **Books**

### 5c. Books

Booker, Matthew, M. (2013). *Down By The Bay: San Francisco's History between the Tides*. Berkeley and Los Angeles: University of California Press. ISBN 978-0-520-27320-7 (cloth, paper), ISBN 978-0-520-95148-8 (ebook).

## **Conference Presentations**

### 5h. Conference Presentations

Antonelli, T., Lloyd, A.L., & Gould, F. (2013, March). Developing a Biologically Accurate Model for Mosquito Larval Growth in Iquitos, Peru. Symposium speaker at the 8th Annual NC State University Graduate Student Research Symposium, Raleigh, NC.

Cash, S., Lorenzen, M., & Gould, F. (2013, February). Medea: a mechanism for suppression of arthropod-vectored diseases. Symposium Speaker at the Genetics Graduate Student Symposium, Raleigh, NC.



Fu-Chyun, C. & Lorenzen, M.D. (2012, June). Development of RNAi-based Dominant Markers for use in Genetic Pest Management. Poster session presented at the 6th Annual Arthropod Genomics Symposium, Kansas City, MO.

Gould, F. (2012, July). Potential for genetic pest management through transgenic crops and transgenic pests. Symposium speaker at El Simposio de Los Recientes Innovaciones Tecnologicas en el Control Vectorial del Dengue at La Universidad Nacional de San Marcos, Lima, Peru.

Hunter, C. M. & Singh, N.D. (2013, April). Do males matter? Exploring male-mediated effects on female meiotic recombination. Poster session presented at the annual Drosophila Research Conference, Washington, DC.

Lloyd, A. (2012, September). Quantifying Mosquito Movement Using Mark Release Recapture Data. Symposium speaker at RAPIDD Mark Release Recapture Meeting, Half Moon Bay, CA.

Lorenzen, M.D. (2012, November). Lessons from transgenic beetles. Symposium Speaker at Transgenic Engineering of Invertebrate Species Symposia, Entomological Society of America meeting, Knoxville, TN.

Lorenzen, M.D. (2012, October). Bioengineering the common silkworm to produce biomimetic spider silk. Seminar speaker for Science Seminar Series at Durham Technical Community College, Durham, NC.

Lorenzen, M.D., Prince, E.G., Wong, S., Chu, F., Brown, S.J., Demuth, J.P., & Beeman, R.W. (2013, February). Identification of Y-chromosome sequences from the red flour beetle, *Tribolium castaneum*. Poster session presented at the 14th Annual Advances in Genome Biology and Technology meeting, Marco Island, Florida.

Scott, M.J. (2012, August). Development of "male-only" strains of the New World screwworm fly, *Cochliomyia hominivorax*. Paper presented at the XXIV International Congress of Entomology, Daegu, South Korea.

Scott, M.J. (2012, November). Characterization of blowfly gene promoters in transgenic *Lucilia cuprina*. Paper presented at the annual meeting of the Entomological Society of America, Knoxville, TN.

Scott, M.J. (2012, November). Development of "male-only" strains of the New World screwworm fly, *Cochliomyia hominivorax*. Paper presented at the annual meeting of the Entomological Society of America, Knoxville, TN.

Singh, N.D. (2012, July). Recombination: Molecular mechanisms and evolutionary consequences. Symposium speaker at the American Genetics Association Symposium, Durham, NC.

## Partnerships/Collaborations

### Government Partner 1

#### Active Status

Yes

#### Partner Name

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

#### Type of government agency

U.S. Federal laboratory or research facility

### **Funding arrangement for this partner**

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

### **Activities for this partner/institution**

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

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

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

### **Activities for this partner/institution**

Involvement with the NAMRU-6 research center in Iquitos, Peru, was critical to the success of the 2012 GES Summer Course. NAMRU staff provided on-the-ground support to all our faculty and students over the of three weeks that our team was in Peru. Our collaboration with them has resulted in a mutually beneficial relationship and granted our students unique opportunities including those described in 3e. International Opportunities.

Printed: Dec 11, 2013

---