

QSE³ IGERT

The Quantitative Spatial Ecology, Evolution, and Environment (QSE³) IGERT is an NSF-funded program at the University of Florida that started in Fall 2008. QSE³ involves students and faculty from 10 programs and departments (Biology, Mathematics, Statistics, Wildlife Ecology & Conservation, Geography, Fisheries & Aquatic Sciences, Forest Resources & Conservation, Agricultural & Biological Engineering, Infectious Diseases & Pathology [Veterinary Medicine], Computer & Information Science & Engineering) at UF and outside clients from state, federal and international agencies. The program focuses on the **critically important and conceptually unifying theme of spatial dynamics, covering topics such as evolution and spread of emerging pathogens; the causes and consequences of shifting species distributions; and conservation of species in patchy habitats**. To tackle these critical issues, graduate students must acquire an arsenal of tools from the disparate fields of mathematics, biology, geography, and statistics. We seek to train scientists who embrace a new philosophy about quantitative tools, who can speak to colleagues from different disciplines, and who



April 24th and 25th, 2014

McKnight Brain Institute, LG110A/B

5th Annual QSE³ IGERT Symposium



Thursday April 24th, 2014

8:30-9:00 Coffee and pastries

9:00-9:15 **Dr. Craig Osenberg**
Department of Biology, University of Florida

Introduction and Welcome

9:15-10:15 **Dr. Wayne Getz**
Department of Environmental Science, Policy, and Management, University of California Berkeley

A Computational Population Modeling Platform for Linking the Inner and Outer Worlds of Organisms

10:15-10:30 Coffee break

10:30-11:30 **Dr. David Vasseur**
Department of Ecology and Evolutionary Biology, Yale University

Ecological and evolutionary contributions to spatial synchronization.

11:30-12:30 Lunch

12:30- 12:50 **Dr. Cameron Browne**
Department of Mathematics, Vanderbilt University

A Nosocomial Epidemic Model with Room Contamination

12:55-1:15 **Dr. Mollie Brooks**
Institute of Evolutionary Biology and Environmental Studies, University of Zurich

TBA

1:20-1:40 **Dr. Miguel Acevedo**
Department of Biological Sciences, Louisiana State University

The virulence trade-off hypothesis: a meta-analysis

1:45- 2:05 **Hayriye Gulbudak and Vincent Cannataro**
Department of Mathematics and Department of Biology, University of Florida

A Nested Immuno-Epidemiological Vector-Host Model with Applications to the Arbovirus Diseases

2:05-2:20 Break

2:20-5:00 **Workshop V**

6:30- **Dinner at Dr. Craig Osenberg's House**
1901 NW 20th Way – just north of 16th Ave between 13th and 34th St

Friday April 25th, 2014

8:30-9:00	Coffee and Pastries
9:00-10:00	Dr. Matthew Potts <i>Department of Environmental Science, Policy, and Management. University of California Berkeley</i> Communicating Environmental Risk: Are Ex-Ante Predictions of Benefits and Costs Being Accurately Estimated?
10:00-11:00	Dr. Benjamin Bolker <i>Department of Mathematics and Statistics McMaster University</i> TBA
11:00-11:15	Coffee Break
11:15-11:35	Dr. Jessica Langebrake <i>Department of Biology. University of Florida</i> Life After the PhD: Non-Academic Careers
11:40-12:00	Dr. Andrew Hein <i>Department of Ecology and Evolutionary Biology. Princeton University</i> Spatial ecology and ecosystem dynamics: the long and short of it
12:00-1:00	Lunch

1:00-1:20	Dr. Kenneth Lopiano <i>Department of Statistical Science Duke University and SAMSI</i> The IGERT Effect Part II: An Interdisciplinary Approach to Entrepreneurism
1:25-1:45	Dr. Trevor Caughlin <i>Department of Biology. University of Florida</i> Spatial models to scale up tropical forest dynamics and promote reforestation
1:45-2:00	Break
2:00-2:30	Wrap Up

Abstracts

Dr. Wayne Getz

*Department of Environmental Science, Policy, and Management
University of California Berkeley*

A Computational Population Modeling Platform for Linking the Inner and Outer Worlds of Organisms

Computationally complex systems models are needed to advance research and implement policy in theoretical and applied population biology. Difference and differential equations used to build lumped dynamic models (LDMs) may have the advantage of clarity, but are limited in their inability to include fine scale spatial information and individual-specific physical, physiological, immunological, neural and behavioral states. Current formulations of agent-based models (ABMs) are too idiosyncratic and freewheeling to provide a general coherent framework for dynamically linking the inner and outer worlds of organisms. Here I propose principles for a general, modular, hierarchically scalable, framework for building computational population models (CPMs) designed to treat the inner world of individual agents as complex dynamical systems that pass information to their outer world and to take information from this spatially detailed outer world to drive the dynamic inner world of these agents, simulate their ecology and the evolutionary pathways of their progeny, using genetic algorithms. I also discuss development of a new software platform, called **NOVA**, for building CPMs, as well as the need for a cultural shift in the way population biologists communicate and share models and their modular components to develop **Computational Population Biology** as a field in its own right. Finally, I will discuss the formulation of the genetic algorithms using NOVA.

Dr. David Vasseur

*Department of Ecology and Evolutionary Biology
Yale University*

Ecological and evolutionary contributions to spatial synchronization.

Many biological populations are confined to live in local patches of suitable habitat within a larger inhabitable landscape. Work aimed at understanding how these metapopulations function has revealed that many properties, such as extinction risk, are linked to the extent to which local patches exhibit spatially synchronized dynamics. In this talk I will discuss the various mechanisms that generate and break down spatial synchronization and highlight how interactions between ecological and evolutionary processes yield new insight into the impact of spatial synchronization.

Abstracts

Dr. Cameron Browne

*Department of Mathematics
Vanderbilt University*

A Nosocomial Epidemic Model with Room Contamination

Nosocomial infections, i.e. hospital-acquired infections, are a major public health concern, especially in light of the spread of antibiotic-resistant bacteria. Healthcare workers act as "vectors" in direct transmission of bacteria between patients. However, there is increasing awareness that environmental contamination plays an important role in nosocomial infections. In this talk, I present a model of epidemic bacterial infections in hospitals which incorporates the infection of patients and contamination of healthcare workers due to environmental causes. The model is analyzed and interpreted to provide insight for controlling these nosocomial epidemics. Furthermore, the problem of antibiotic resistance, along with potential intervention strategies, are discussed.

Dr. Miguel Acevedo

*Department of Biological Sciences
Louisiana State University*

The virulence trade-off hypothesis: a meta-analysis

Understanding the drivers of pathogen evolution is a central issue in evolutionary biology with important consequences for both our general understanding of evolution and applied disease management.

In the last 20 years evolutionary biologists have been interested in explaining the close relationship between pathogen fitness and host exploitation. The trade-off hypothesis explains this relationship making three general predictions. First, it predicts that an increase in within host parasite results in increased virulence because the parasite reproduces at the expense of host resources. Second, this increase in replication results in an increase in parasite transmission until the point where the host is not able to efficiently transmit the pathogen due to increased virulence. Third, increasing parasite virulence and transmission will relate similarly where transmission is maximized at intermediate levels of virulence. There is contradicting empirical evidence supporting these predictions. Therefore, we conducted a meta-analysis of published empirical studies aimed at testing the trade-off hypothesis. We found support for the linear relationship between replication and virulence, and the trade-off between replication and transmission predicted by the trade-off hypothesis. However, we found no support for the trade-off between virulence and transmission, mostly owing to the lack of empirical data aimed at testing this prediction.

Abstracts

Hayriye Gulbudak and Vincent Cannataro

*Department of Mathematics and Department of Biology
University of Florida*

A Nested Immuno-Epidemiological Vector-Host Model with Applications to the Arbovirus Diseases

The within-host dynamics of a pathogen and the immune system play a large role in disease transmission between hosts. The amount of pathogen within an infected host governs the transmissibility of that pathogen to susceptible hosts. After infection of a host, the pathogen population grows inside the host, triggering an immune response of pathogen-specific antibodies, which can clear the infection. Pathogen and antibody dynamics are often monitored in laboratory experiments and modeling their interaction may inform our understanding of disease spread.

We derive an immunological model to capture the within-host dynamics for arbovirus disease and link this model to a vector-host infection-age structured epidemiological model. We compute the immune-response-dependent epidemiological reproduction number, R_0 , and interpret it biologically. We derive the equilibria of the system and show their local stability and uniqueness in endemic equilibrium case. Numerically, we show how within-host parameter affect R_0 and the equilibrium prevalence of the disease in the host population.

Dr. Matthew Potts

*Department of Environmental Science, Policy, and Management
University of California Berkeley*

Communicating Environmental Risk: Are Ex-Ante Predictions of Benefits and Costs Being Accurately Estimated?

In a rapidly changing world, environmental scientists are rightly concerned about the negative and likely irreversible impact humans are having on the planet. However are the stories of change being told accurate and realistic? In this talk, I will explore this issue through the lens of the production of biofuel feedstocks. Specifically, I will present evidence that the potential greenhouse gas impacts and biodiversity impacts of biofuels are being overestimated. In doing so, I hope to spark a discussion on how best to assess future environmental risks when the science is uncertain or unknown.

Abstracts

Dr. Jessica Langebrake

*Department of Biology
University of Florida*

Life After the PhD: Non-Academic Careers

I will give a brief overview of what I have learned during my search for a non-academic career, with an aim to provide useful resources and tips to those considering a non-academic career and to encourage discussion among those who have never considered it.

Dr. Andrew Hein

*Department of Ecology and Evolutionary Biology
Princeton University*

Spatial ecology and ecosystem dynamics: the long and short of it

The effect of spatial processes on ecological systems has always been a major theme of the QSE3 IGERT program. I'll explain why I think we need to study spatial processes if we want to understand how ecosystems work. I'll discuss a few examples from recent projects. First, I will describe how dispersal of freshwater invertebrates, amphibians, and phytoplankton drive the short-term dynamics of spatially structured wetlands in Florida. Then, I'll show how oceanic dispersal of marine fish larvae can influence the long-term structure of coral reef communities from across the Pacific ocean.

Abstracts

Dr. Kenneth Lopiano

*Department of Statistical Science
Duke University and SAMSI*

The IGERT Effect Part II: An Interdisciplinary Approach to Entrepreneurism

As a postdoctoral fellow at the Statistical and Applied Mathematical Sciences Institute (SAMSI), my research has focused on data-driven decisions in healthcare. The healthcare industry is poised for disruption and the innovative use of data will be at the center of this disruptive movement. The effective disruption requires *research*, *development* and *implementation* of new ideas. In order to pursue all three of the requisite areas, I founded the health analytics company Roundtable Analytics. Roundtable Analytics is founded on the principle that the biggest challenges facing healthcare today will be solved in a collaborative environment using advanced analytical tools coupled with the knowledge of subject-matter experts. In this talk, I will discuss how my participation in the QSE3 IGERT will shape the development of the company. In addition, I will discuss how federally funded Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) grants will be used for early stage research and development.

Dr. Trevor Caughlin

Department of Biology, University of Florida

Spatial models to scale up tropical forest dynamics and promote reforestation

Tropical reforestation can benefit carbon sequestration, human livelihood and biodiversity. Due to these benefits and more, policymakers increasingly recognize the need for landscape-scale restoration projects and have set ambitious goals to reforest millions of hectares of degraded land. However, most empirical research on the ecological processes underlying reforestation is conducted at a small spatial extent. Applying this ecological knowledge to heterogeneous landscapes represents a major challenge because we lack an understanding of how spatial variation can alter the dynamics of tropical forest succession. We demonstrate how mathematical models may provide a solution. First, we derive an analytically-tractable model for the transient dynamics of canopy closure in reforesting sites and analyze how variation in landscape-scale seed arrival affects the rate of patch-scale reforestation. We then extend this model to a multipatch case and show that conditions resulting in rapid canopy closure at the patch scale may actually slow the rate of landscape-scale reforestation. Our results suggest that scaling up reforestation from patch to landscape scales is likely to require an understanding of spatial processes, including patch configuration and connectivity.

McKnight Brain Institute

LG110A/B

The building is located south (and slightly east) from Bartram and Carr . It is located next to the pediatric area of Shands Hospital. Driving or walking south on Newell you will see the building on your left.

