

# mbi *fall* newsletter

AUTUMN 2013 / VOLUME 9 / ISSUE 1

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follow us on:



*MBI receives major funding from the National Science Foundation Division of Mathematical Sciences and is supported by The Ohio State University.*



## Ecosystem Dynamics and Management

A changing world raises great challenges since we need to take steps that either reduce the rate of global change or that manage resources in the face of global change. Both steps require making predictions, which requires theory. But the systems involved are truly complex, so the theory must use mathematics. Despite the long history of mathematical approaches in ecology and other environmental sciences, understanding the resilience of environmental systems in the face of global change presents substantial mathematical challenges that require novel approaches.

The mathematical issues include understanding very complex dynamical systems on appropriate time scales, with complex or stochastic forcing terms. If explicit control measures are to be designed, then issues in both control and optimal control come to the forefront. Since these are real-world problems, complex statistical issues also are present as well as computational issues. In particular, the computation and solution of partial differential equation systems (or other high dimensional systems) on irregular domains with forcing presents difficult challenges. The workshop topics will highlight both the biological and mathematical issues involved. We envision three related workshops. One workshop on fundamental mathematical issues related to the study of complex systems and two workshops focused more on two broad ranging biological issues in sustainability: rapid evolution and sustainable management of living natural resources.

## Apply for Postdoctoral Fellowship or Early Career Award

MBI postdoctoral fellows engage in a three-year integrated program of tutorials, working seminars or journal clubs, and workshops, and in interactions with their mathematical and bioscience mentors. These activities are geared toward providing the tools to pursue an independent research program with an emphasis on collaborative research in the mathematical biosciences. MBI facilitated activities are tailored to the needs of each postdoctoral fellow.

Early Career Awards enable recipients to be in residence at the Mathematical Biosciences Institute for stays of at least three months during an emphasis program. Details of the 2014-2015 programs can be found at [http://mbi.osu.edu/annual\\_programs.html](http://mbi.osu.edu/annual_programs.html).

Early Career Awards are aimed at non-tenured scientists who have continuing employment and who hold a doctorate in any of the mathematical, statistical and computational sciences, or in any of the biological, medical, and related sciences.

An Early Career Award will be for a maximum of \$7,000 per month of residency and for a maximum of nine months during the academic year. The award may be used for salary and benefits, teaching buyouts, and/or local expenses (restrictions apply).

Applications for an MBI Postdoctoral Fellowship and Early Career Award should be submitted online at:

<http://www.mathjobs.org/jobs/mbi>

Applications for an Early Career Award completed before December 2, 2013 will receive full consideration. Applications for a postdoctoral fellowship completed before December 9, 2013 will receive full consideration. The applicant should state the period that he or she would like to be in residence.

For additional information visit <http://www.mbi.osu.edu/postdoctoral/postdoctoral.html>.

## Propose an Emphasis Year Program

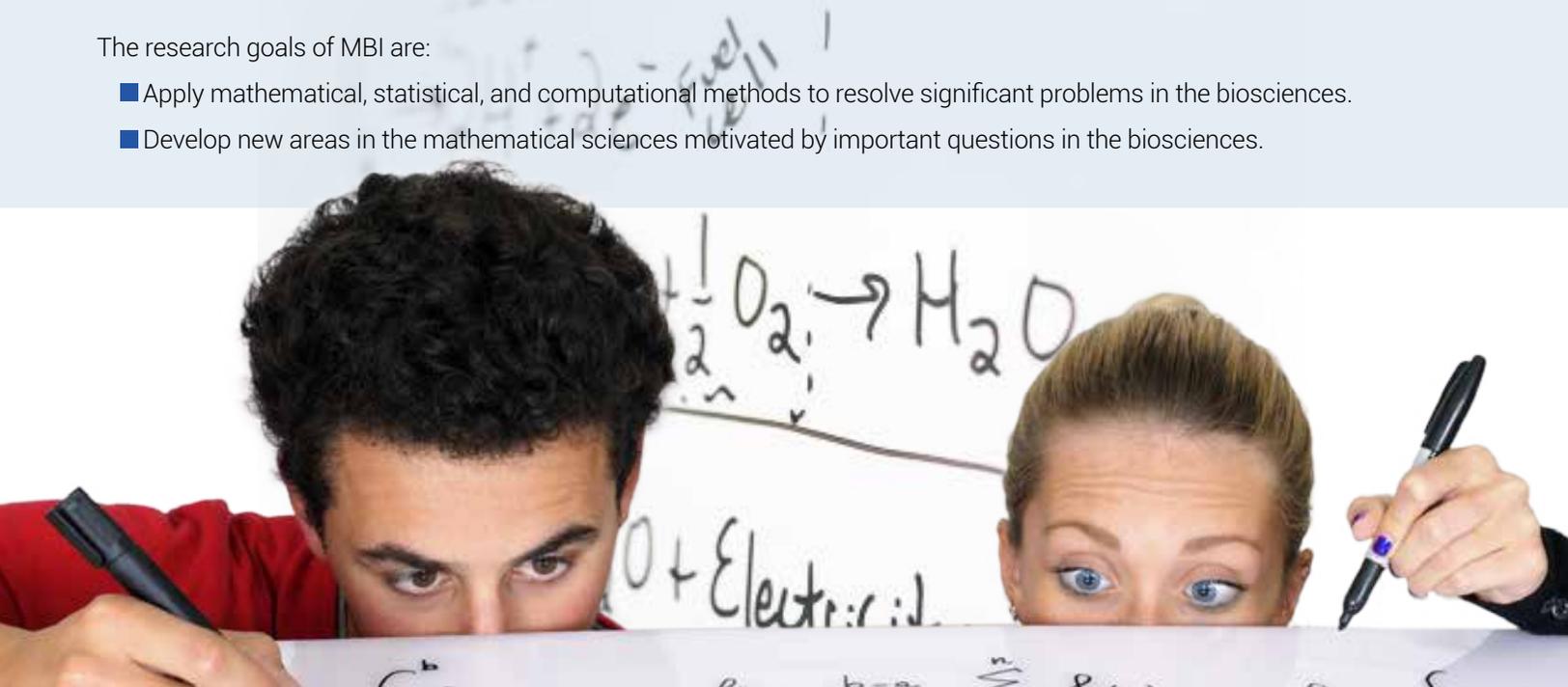
MBI seeks researchers to propose semester or year long emphasis programs at MBI for Fall 2015 and beyond. Emphasis programs consist of either three or six weeklong workshops and related activities. For details see:

[http://www.mbi.osu.edu/organize\\_ey.html](http://www.mbi.osu.edu/organize_ey.html)

Before submitting a proposal, please discuss ideas with MBI Director Martin Golubitsky ([mg@mbi.osu.edu](mailto:mg@mbi.osu.edu)).

The research goals of MBI are:

- Apply mathematical, statistical, and computational methods to resolve significant problems in the biosciences.
- Develop new areas in the mathematical sciences motivated by important questions in the biosciences.





## Current Topic Workshop Applications

CTWs bring mathematical and bio-scientists together to discuss ways in which the math sciences are used to solve significant problems in the life sciences or ways in which the biosciences are opening new areas of research for math scientists. CTWs can also revisit areas from previous emphasis year programs.

MBI workshops are easy to organize. The organizers schedule the talks. MBI makes all other arrangements including contacting speakers and participants.

Typical MBI CTWs are:

- 3-5 days in length
- Have between 15 and 20 speakers
- Have no parallel sessions
- Have a poster session, and
- Leave time for discussion.

MBI can also support up to 20-25 additional participants (faculty, post-docs, and graduate students) chosen by the organizers. A small number of researchers are supported by MBI from among those who apply to attend the workshop and a small number of local researchers attend the workshops. So, typically, there are between 50 and 70 participants at a given CTW. However, some workshops are smaller and more focused and some are larger.

### How to submit an application for an MBI Program

Applications for CTW may be submitted either by contacting the MBI Director (Marty Golubitsky, [mg@mbi.osu.edu](mailto:mg@mbi.osu.edu)) or by using the form at <http://www.mbi.osu.edu/forms/applyctw.html>

CTW usually take place within one year from time of acceptance. Applicants need not spend too much effort on making the initial application. MBI will require more details if the basic idea is accepted. Questions that should be addressed include:

- Why is your topic timely?
- Is your proposed program relevant to the MBI mission?
- Who are the meeting co-organizers (usually two to four)?
- A list of 10-15 possible speakers (who need not have been contacted).



Decisions on which CTW to support are made by the MBI Scientific Advisory Committee and the Committee of MBI Directors.

## Undergraduate Research Program

The program consists of three parts:

- 1 **Two-week Introduction:** Tutorials, computer labs, and short-term team efforts designed to introduce students to a variety of topics in mathematical biology.
- 2 **REU Program:** An 8 week individualized research experience as part of a research team at one of the participating host institutions.
- 3 **Capstone Conference:** A student centered conference featuring talks and posters by students doing research in mathematical biology, keynotes by prominent mathematical biologists, a graduate studies recruitment fair, and other special features including a conference dinner and social event.

[www.mbi.osu.edu/eduprograms/undergrad2014.html](http://www.mbi.osu.edu/eduprograms/undergrad2014.html)

**Deadline for applications for next year's program is January 31, 2014.**



## Focus on MBI Postdocs



### Spotlight on Jon Lo

Wing Cheong (Jon) Lo earned his PhD in Mathematics at University of California, Irvine in 2011. His thesis focused on growth and pattern controls by growth factors, where he developed a model for multi-stage stem cell lineages. He also systematically studied the conditions of existence, uniqueness and stability of steady states of the system with an application to the olfactory epithelium. His analysis showed how negative feedback enhances the stability and robustness of the system and showed that the feedback on cell cycle from the growth factor is important for forming temporary "stem cell niche" - a term that generally refers to the microenvironment where the stem cells reside and sustain their renewing functions, during the development of the tissue. These findings are consistent with the experimental results observed by collaborators.

After joining MBI in 2011, Jon extended his interests to the realm of cancer research. He is working with Avner Friedman (Math, OSU) to construct models of colon cancer associated with inflammatory bowel diseases. In collaboration with Edward Martin (Surgery, OSU) and Charles Hitchcock (Pathology, OSU), they have published a mathematical model demonstrating that increased levels of cells with TP53 mutations result in abnormal

growth and proliferation of the epithelium. Since inflammatory bowel disease is one of the critical factors in colon cancer, Avner and Jon are also working with Razvan Arsenescu (Internal Medicine, OSU) on developing a model of inflammatory bowel disease that demonstrates how abnormal levels of T cells can arise from abnormal regulation of Th1 and Th2 cells by Treg cells.

More recently, Jon began working with Avner, Edward and Charles on a new project of tumor margin detection using fluorodeoxyglucose (FDG). One of the critical problems in the treatment of cancer is the recurrence of the disease sometime after surgery. In their work, they consider an approach based on FDG injection into the tumor, which provides a view of the cancer by PET imaging. Their model has a potential to make quantitative predictions with regard to the tumor margin.

In another project, Jon is working with collaborators Ching-Shan Chou, Monisha Narayan (Department of Mathematics, OSU), Mid Eum Lee and Hay-Oak Park (Department of Molecular Genetics, OSU) on modeling budding yeast polarization, having published a paper which investigates how polarization of diploid daughter cell is directed by spatial cues and GTP hydrolysis of Cdc42 in budding yeast.

With Qing Nie, his PhD advisor at UCI, Jon is continuing his work on robust and efficient numerical methods for pattern formation. They have developed a new approach that combines the advantages of temporal schemes in robustness and Newton's method in fast convergence in solving steady states of reaction-diffusion equations. Application of this new approach to two reaction-diffusion equations in one, two, and three spatial dimensions, along with direct comparisons to several other existing methods, demonstrates that AIE is a more desirable method for searching inhomogeneous spatial patterns of reaction-diffusion equations in a large parameter space.

Jon has had wonderful time at MBI. He has enjoyed the opportunities to interact with other postdocs, staff, visitors, and participants of MBI programs, and with various MBI workshop programs themselves. Additionally, Jon had an opportunity to enrich his teaching experience through teaching an undergraduate course Calculus for Biological science in Autumn 2012. He really appreciated that MBI, especially Tony Nance, gave him full support on teaching. The exceptional environment at MBI has provided excellent resource to plan and conduct research programs on his own feet in the mathematical biosciences and to accomplish his education goal through learning from and collaborating with many remarkable people. The fabulous experience at MBI has brought a successful step in his career.

## Focus on MBI Postdocs



### Spotlight on Franziska Hinkelmann

Franziska Hinkelmann graduated from Virginia Tech with a PhD in Mathematics in 2011. Her research was discrete models in systems biology. In collaboration with her advisor, Dr. Reinhard Laubenbacher, she developed analysis methods for discrete models and developed several software tools that aid the construction and analysis of discrete models.

Since her arrival at the MBI, Franziska has focused her research on cancer systems biology. In a project in collaboration with Dr. Beverly Delidow from the Department of Biochemistry and Molecular Biology at Marshall University School of Medicine, she investigates the Wnt signaling pathway in early stage and aggressive human melanoma cells. With the aid of a discrete model that she developed, her biological collaborator is experimentally testing the newly found hypotheses.

In collaboration with her mathematical mentor, Dr. Michael Stilman from the department of mathematics at Cornell University, Franziska is working on primary decomposition algorithms, which are a useful mathematical tool also in model analysis. Furthermore, she has developed a webtool for Macaulay2, a computer algebra software NSF funded since

1992. She envisions that a website like this will be of great use to educators and students, because it gives easy access to computer algebra without the initial hurdle of installation and registration. The website shows interactive tutorials, that allow for an accessible introduction to computer algebra.

Franziska is collaborating on PlantSimLab ([www.plantsimlab.org](http://www.plantsimlab.org)), a project is funded by the Biological Informatics Program at the NSF. PlantSimLab is a software package, currently in the form of an early prototype, that provides a very intuitive user interface, coupled with a natural language processing capability. The package allows the user to input biological knowledge about regulatory processes, which the software translates into a dynamic mathematical network model, which can be interrogated and modified in intuitive ways, such as by performing gene knockouts and seeing the resulting network evolve over time. Such work can be done with simple, natural commands. This is a continuation of her PhD work, as it encompasses both the development of mathematical algorithms as well as translating them to something accessible and useful to experimentalists. Systems biology provides a valuable approach to many problems in molecular plant biology, in particular host-pathogen interactions, since many plant processes are driven by large molecular networks whose dynamics is best understood at the system level. Mathematical models and their computational implementation can serve as a virtual laboratory for the experimentalist that provides a way to integrate and represent knowledge about the system to be studied as well as a way to quickly and cheaply carry out virtual experiments, thereby informing the design of experiments in the laboratory. Unfortunately, the construction and use of mathematical models typically requires fairly sophisticated understanding of mathematical modeling, and available software presents often a very steep learning curve to the experimentalist.

Franziska has served as mentor for several Research Experiences for Undergraduates (REU) students. The work of one of her REU teams resulted in a publication in BMC Bioinformatics, several of her students won prizes and recognitions for posters and presentations they gave on the REU research. She is proud to have impacted the lives of several young scientists, many of them decided to apply for graduate school, and one of her REU students was recently awarded an National Science Foundation's Graduate Research Fellowship. This summer, she mentored a group of undergraduates during the MBI REU 2 week workshop, where she aims to spark their interest in algebraic biology.

Franziska recently left MBI to take on a exciting job at TNG Technology Consulting GmbH in Germany, where she will get to work at the interface of technology and research.

## Workshop 1:

# Sustainability and Complex Systems (September 16–20, 2013)

**Organizers:** Chris Cosner, Volker Grimm, Alan Hastings and Otso Ovaskainen

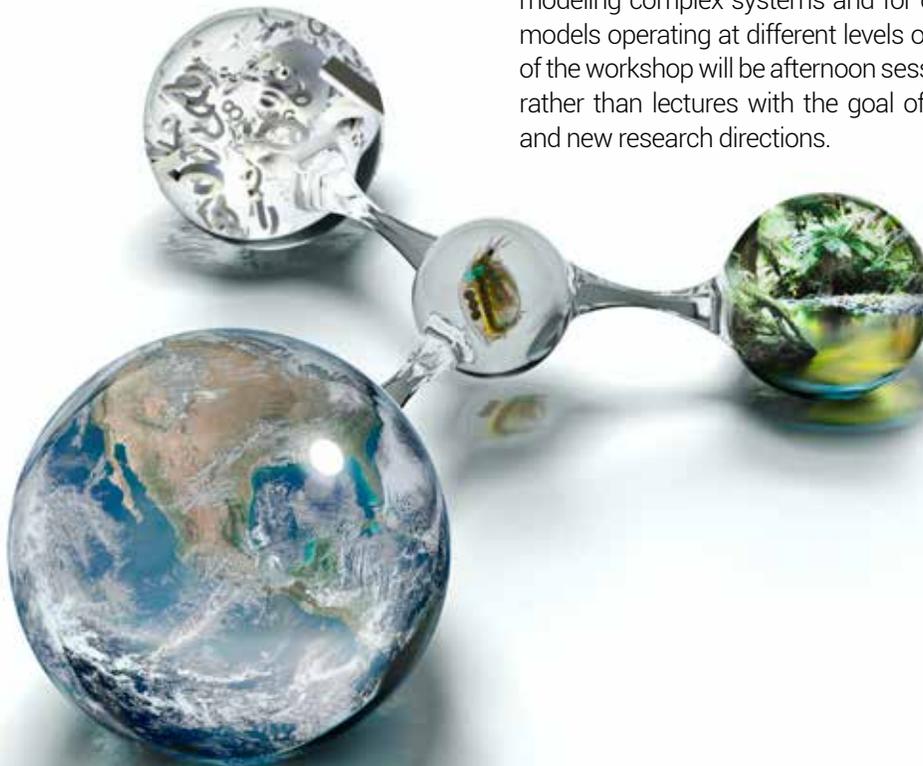
Creating usable models for the sustainability of ecosystems has many mathematical challenges. Ecosystems are complex because they involve multiple interactions among organisms and between organisms and the physical environment, at multiple spatial and temporal scales, and with multiple feedback loops making connections between and across scales. The issue of scaling and deriving models at one scale from another is well known to lead to substantial mathematical issues, as in going from descriptions of stochastic spatial movement at the population scale from the individual scale and as in getting diffusion limits. Here, for example, recent work has focussed on alternatives to the diffusion limit. The mathematical challenges in the analysis of full ecosystems are truly great.

Many modeling approaches have been used in studying ecosystems, ranging from simple dynamical systems to highly detailed computational models. Relatively simple models are essential to gain insight into fundamental features of complex systems and the mechanisms behind them, whereas highly detailed models are essential for making predictions about the specific effects that changes may have on ecosystem functioning. The complex ones include agent-based models and models that place biological models into realistic and detailed models for physical processes such as ocean dynamics. There is a need to develop

new mathematical tools for making connections among different processes at different scales and thus provide a robust framework for assessing the sustainability of ecosystem processes.

Understanding models at multiple scales also requires case studies of particular systems. Plankton dynamics provide a good case study. At one extreme, low dimensional Nutrient-Phytoplankton-Zooplankton (NPZ) models give insight into the balance between light penetration and nutrient upwelling that underlie patterns of plankton blooms. At the other extreme, computational models of a myriad competing plankton species, rapidly evolving in the face of changing ocean temperature and salinity, are numerically incorporated into global climate models. As a second example, forests and savanna are complex systems where organisms interact with physical processes, specifically fire and hydrology, and they have been studied from the viewpoint of individual-based modeling but also with simple models.

This workshop aims to engage computational and mathematical modelers, empiricists, and mathematicians in a dialogue about how to best address the problems raised by the pressing need to understand complex ecological interactions at many scales. Its ultimate goal is to initiate transformative research that will provide new approaches and techniques, and perhaps new paradigms, for modeling complex systems and for connecting different types of models operating at different levels of detail. An important feature of the workshop will be afternoon sessions devoted to case studies rather than lectures with the goal of starting new collaborations and new research directions.



## Workshop 2:

# Rapid Evolution and Sustainability

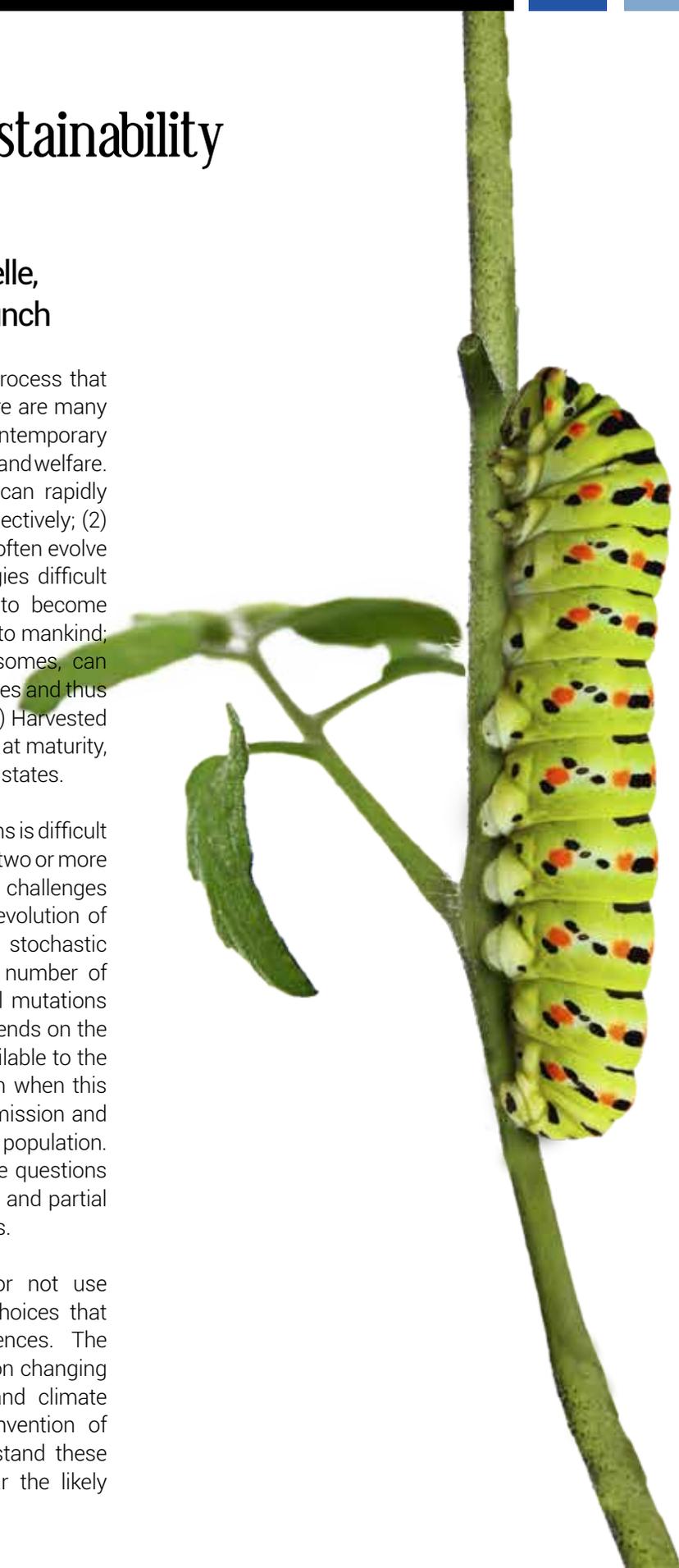
(October 7–11, 2013)

**Organizers:** Jim Cushing, Katia Koelle,  
Patrick De Leenheer and Stephan Munch

Although evolution is often thought of as a slow process that proceeds on the time scale of millennia, in fact there are many very rapid evolutionary processes, often called contemporary evolution, that have profound effects on human health and welfare. For example: (1) In agriculture, plants and pests can rapidly evolve resistance to herbicides and pesticides, respectively; (2) The influenza virus, and other viruses and bacteria, often evolve within an individual host making treatment strategies difficult and/or temporary; (3) The evolution of bacteria to become resistant to most antibiotics poses a serious threat to mankind; (4) Some parasites, for example African trypanosomes, can change the proteins that they express on their surfaces and thus can become invisible to the immune system; and (5) Harvested populations may show rapid evolution in size or age at maturity, which affects both yield and recovery from depleted states.

Understanding the dynamic behavior of such problems is difficult because one is typically studying the co-evolution of two or more interacting complex systems. The mathematical challenges are daunting. On the local level (for example, the evolution of influenza within a host) mutations are driven by stochastic processes. However, one is not interested in the number of mutations per se, but in the number of successful mutations that can establish themselves in the host. This depends on the immune status of the host, including resources available to the mutant and the history of previous infections. Even when this is understood one must face the problem of transmission and spatial spread of the mutant strain in the whole population. Thus, not only is the biology very difficult, but these questions naturally involve stochastic processes and ordinary and partial differential equations on several different time scales.

Giving or not giving drugs, choosing to use or not use pesticides, or choosing when to use them, are choices that have political, ethical and economic consequences. The consequences themselves depend in many cases on changing human cultural behavior, changing technology, and climate change. Mathematical modeling, including the invention of new mathematical structures, can help us understand these rapidly co-evolving systems and thus make clear the likely consequences of various policy choices.



## Current Topic Workshop: Mathematics Guiding Bioartificial Heart Valve Design (October 28 – October 31, 2013)

**Organizers:** Suncica Canic, Boyce Griffith, Aresh Kheradvar, and Stephen Little

This Current Topics Workshop will address the development of mathematical and computational modeling techniques that can be used to facilitate the development and optimal design of cardiac valve prostheses and other cardiovascular devices. Workshop topics will include the design of tissue scaffolds and cardiovascular stents used in bioartificial heart valve design

and replacement, and also fluid-structure interaction between blood and cardiovascular tissue. The speakers will include mathematicians, biomedical engineers, and medical specialists. Poster presentations by students and post-doctoral researchers will also be included.

## Workshop 3: Sustainable Management of Living Natural Resources (November 4–8, 2013)

**Organizers:** Paul Armsworth, Alan Hastings and Andrew Liebhold

Natural resources, such as forests, fish, land, and biodiversity, while renewable, are being pushed to the brink and beyond by sectorial mismanagement and the resulting cumulative impacts on the macroscopic environmental and ecosystem conditions. For many, the solution is to take a more holistic or ecosystem-based approach to management (EBM).

While this approach seems intuitive, there are many unanswered questions as to the information and modeling requirements for implementing EBM and the potential impacts both at a micro and macroscopic level that it would have on the sustainability of natural resources and the communities that rely on them. It is clear that EBM requires a synthesis of our understanding of ecology and economics, which are both complex systems in their own right. Each has its own highly developed mathematical models and modeling approaches.

Methods from optimal control have been applied in the context of fisheries and forestry, as exemplified by the classic text by Colin Clark, *Mathematical Bioeconomics*. These approaches have proved extremely useful, but for the most part have focused on single species questions. Extending these ideas to questions that are larger in scope in terms of more species and including spatial heterogeneity is a real mathematical challenge. Optimal



control theory provides one potential framework for evaluating EBM, but the complexities of spatially distributed, age structured, and/or stochastic population models will push the frontier of analytical and numerical analysis. Answering the many questions surrounding the implementation and effects of EBM also requires developing mathematical tools and methods for understanding complex coupled natural-human systems, that is, the interaction between ecosystem dynamics and human community dynamics.

Mathematical models for EBM need to take into account both the dynamics of coupled ecological and economic systems and the game theoretic issues arising from the differing interests and values of different stakeholders. Some mathematical approaches to those issues have been developed in both ecology and economics. On the ecological side there are ideas such as the theory of adaptive dynamics. On the economic side there is the theory of differential games, where the single control parameter that can be used for optimization in traditional control theory is replaced by a collection of controls, and where different controls are in the hands of different stakeholders who may want to optimize different things.

# MBI New Postdocs

MBI welcomes 9 new postdocs this year. To find out more about them visit [www.mbi.osu.edu/postdoctoral/current\\_postdocs.html](http://www.mbi.osu.edu/postdoctoral/current_postdocs.html)



## Márcio Albasini Mourão

Molecular & Integrative Physiology, Michigan

Márcio has studied the reverse engineering of the mechanisms and the dynamical behavior of complex biochemical pathways.



## Leila Kheibarshekan

Pharmacology, Montreal; Applied Mathematics

Leila has studied quality assessment and improvement of limited sampling strategies for accurate estimation of therapeutic related indices that is part of a larger research program on drug related modeling problems.



## Andrew Critch

Mathematics, UC Berkeley

Andrew works on algebraic statistics; the application of algebraic geometry to machine learning and statistical modeling; causal inference; hidden Markov models; graphical models; singular learning theory; and parameter identifiability.



## Jae Kyoung Kim

Mathematics, University of Michigan

Jae's research has focused on developing theories and models to understand biological rhythms. Basic questions are: Is there an easier way to find hidden or unknown biochemical interactions? How do complex biochemical networks generate rhythms and control period? He has worked closely with several experimental groups in biology to develop new protocols to test model predictions.



## Kimberly Fessel

Mathematics, RPI

Kimberly's research focuses on developing a comprehensive nonlinear wave model for the governing physics of the transduction mechanism in the inner ear. This work requires a detailed analysis of the fluid-solid interaction dynamics of the cochlea, as well as the utilization of various perturbation methods and numerical techniques.



## Marc Sturrock

Applied Mathematics, Dundee

Marc has studied a variety of areas including: spatio-temporal modeling, gene regulatory networks, negative feedback loops, intracellular signaling pathways, systems biology, and cancer modeling.



## Wenrui Hao

Applied and Computational Math, Notre Dame

Wenrui applies numerical algebraic geometry methods and numerical partial differential equation methods to mathematical problems arising in biology, such as tumor growth, blood coagulation, and deriving efficient numerical methods for large scale computing. The mathematical tools that he uses include PDEs, numerical algebraic geometry, bifurcation analysis, and computational methods.



## Joy Zhou

Applied Mathematics, University of Washington

Joy's research has focused on mathematical models for geographic range shifts of plants and animals under climate change. Math tools include deterministic and stochastic dynamical systems, integral operators, and PDEs.



## Karly Jacobsen

Mathematics, University of Florida

Karly works in mathematical biology, specifically in population models (ODE and PDE) to study the population dynamics for citrus greening disease and on oncolytic virotherapy.

For more information about the program and how to apply for a MBI Postdoctoral Fellowship visit [www.mbi.osu.edu/postdoctoral/postdoctoral.html](http://www.mbi.osu.edu/postdoctoral/postdoctoral.html)

## Fall Semester Visitors



**Komi Afassinou**

**Mathematics, University of KwaZulu-Natal**

Mr Komi Afassinou is currently a PhD candidate in mathematical biology at University of KwaZulu-Natal (UKZN), South Africa. He graduated at UKZN for Master degree (cum laude) in 2013. His postgraduate diploma (PGD) was awarded at African Institute for Mathematical Sciences (AIMS) in 2011.



**Eddy Kimba**

**Mathematics, University of KwaZulu-Nata**

My research interests are dynamical systems, techniques of variables aggregation (Centre Manifold Theory & Tichonov Theorem) and Singularly Perturbed Theorem.



**Lee Altenberg**

**Research Scientist, Ronin Institute**

My research focuses on the dynamics of evolutionary processes. I am particularly interested in higher order phenomena, such as the evolution of evolvability, the evolution of the genotype-phenotype map, including modularity, and the evolution of genetic systems. My work also addresses theoretical problems in evolutionary computation.



**Vlastimil Krivan**

**Mathematics, Academy of Sciences of the Czech republic**

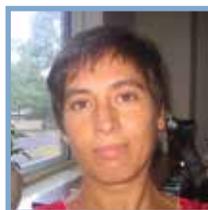
My core personal research focuses on applications of mathematics to biology and ecology. In particular, I'm interested in links between animal behavior, population dynamics and evolutionary processes that preserve biodiversity on Earth. I study these links by creating mathematical models that allow me to discover new laws of biodiversity



**Reinhard Burger**

**Mathematics, University of Vienna**

My research area is mathematical population genetics. Population genetics is concerned with the study of the genetic composition of populations. This composition may be changed by segregation, selection, mutation, recombination, mating structure, migration, and other genetic, ecological, and evolutionary factors.



**Maria Leite**

**Mathematics, RPI**

My research emphasizes dynamics with and without symmetry, bifurcations and applications of coupled dynamical systems. Concerning applications, I am particular interested in addressing biological motivated questions.



**Steve Cantrell**

**Mathematics, RPI**

Steve's research interests includes: Mathematical Ecology, Nonlinear Analysis and Partial Differential Equations



**Jinhua Luo**

**Information Technology, Shanghai Ocean University**

My research interests include: The behavior of dynamical systems especially on non-autonomous periodic systems also, population dynamics in ecosystems specifically in algal bloom research and the control of dynamical systems.



**Obiora Collins**

**Mathematics, University of Nigeria, Nsukka**

Obiora Collins is an Assistant Lecturer in the Department of Mathematics, University of Nigeria, Nsukka. He obtained BSc Mathematics (First Class Honours) and MSc Applied Mathematics both from the University of Nigeria. He is currently pursuing a PhD research programme in Mathematics



**Richard Rebarber**

**Mathematics, University of Nebraska**

Richard is a Professor of Mathematics at the University of Nebraska – Lincoln. He spent his first 20+ years at Nebraska working on Control Theory, and has recently been working with biologists on population dynamics and other topics in Mathematical Ecology. In his free time he writes, performs and records music.



**Chris Cosner**

**Mathematics, University of Miami**

Dr. G. Chris Cosner is a professor in the Department of Mathematics and faculty advisory committee member and collaborator in the Abess Center. Dr. Cosner received a B.A. in Mathematics from the University of California, San Diego, and an M.A. and Ph.D. in Mathematics from the University of California, Berkeley.



**Hao Wang**

**Mathematical & Statistical Science, University of Alberta**

Dr. Wang has strong interests in interdisciplinary research of mathematical biology. His research group is working on areas as diverse as modeling stoichiometry-based ecological interactions, microbiology, infectious diseases, habitat destruction and biodiversity, risk assessment of oil sands pollution. Mathematical models include ODE, DDE, PDE, SDE, IDE.



**Leah Johnson**

**Integrative Biology, University of South Florida**

My research interests are in statistical and mathematical biology, ecology, and epidemiology. In particular, I am interested in how individual behavior and local interactions between individuals in a population influence population level patterns, and statistical methodologies for inference of mechanistic models of biological systems.



**Jin Wang**

**Mathematics & Statistics, Old Dominion University**

I am an applied and computational mathematician, and most of my research projects are interdisciplinary. My current work is concerned with fluid dynamics, mathematical biology, and marine engineering. I combine numerical simulation and mathematical analysis to gain deeper insight into the physical and biological problems in my research.

# Frontiers in

# IMAGING

## mathematics and the life sciences



This one semester program will bring together researchers from mathematics, imaging technology and the life sciences to explore new ways to bridge these diverse disciplines, and to facilitate the use of mathematics in key problems in imaging, and its applications.

**January 13-17, 2014**

Workshop 1: Visualizing and Modeling Cellular and Sub-Cellular Phenomena

**February 10-14, 2014**

Workshop 2: Morphogenesis, Regeneration, and the Analysis of Shape

**March 17-21, 2014**

Workshop 3: Integrating Modalities and Scales in Life Science Imaging

**April 7-11, 2014**

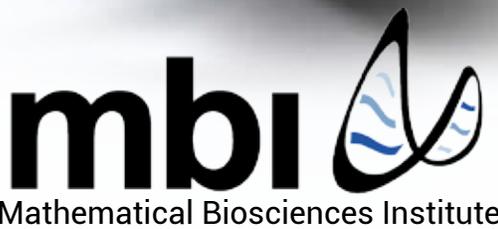
CTW: From Within Host Dynamics to the Epidemiology of Infectious Disease

**April 21-25, 2014**

Workshop 4: Analysis and Visualization of Large Collections of Imaging Data

**May 5-9, 2014**

CTW: Molecular to Systems Physiology



## Welcome New MBI Directors

MBI welcomes two new members to its Directorate. **Grzegorz (Greg) Rempala** joins MBI as a Deputy Director with a split appointment in the OSU College of Public Health. Formerly of Georgia Regents University, Greg's research interests include Complex Stochastic Systems Theory, Molecular Biosystems Modeling, and Mathematical and Statistical Methods in Genomics. **Laura Kubatko** is an MBI Associate Director who has appointments in the Department of Statistics and the Department of Evolution, Ecology, and Organismal Biology. Laura's research

interests are in statistical genetics, including the estimation of phylogenetic trees from nucleotide sequence data, linkage and QTL analysis, and the analysis of microarray data. Laura succeeds Dennis Pearl who has retired from the university. Best wishes to Dennis, and welcome aboard Greg and Laura.



**Grzegorz Rempala – Deputy Director**

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**Laura S. Kubatko – Associate Director**

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## The mission of the MBI is:

- to foster innovation in the application of mathematical, statistical, and computational methods in the resolution of significant problems in the biosciences;
- to foster the development of new areas in the mathematical sciences motivated by important questions in the biosciences;
- to engage mathematical and biological scientists in these pursuits; and
- to expand the community of scholars in mathematical biosciences through education, training, and support of students and researchers.

## Propose an Event

MBI encourages members from the mathematical sciences and the biosciences community to propose ideas for MBI programs. MBI programs fall into three categories:

- Semester or yearlong emphasis programs.
- Current Topic Workshops (typically stand alone meetings of up to one week).
- High level education programs.

Please contact Tony Nance ([tony@mbi.osu.edu](mailto:tony@mbi.osu.edu)) to submit your idea.

**mbi**   
*newsletter* *fall*

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