2016 Annual Report

National Institute for Mathematical and Biological Synthesis

Reporting Period September 2015 – August 2016
Submitted to the National Science Foundation May 2016

This work was conducted at the National Institute for Mathematical and Biological Synthesis, sponsored by the National Science Foundation, the U.S. Department of Homeland Security, and the U.S. Department of Agriculture through NSF Award #EF-0832858, with additional support from The University of Tennessee, Knoxville.

Preview of Award 1300426
Annual Project Report

Cover

Federal Agency and Organization Element to Which Report is Submitted:
4900
Federal Grant or Other Identifying Number Assigned by Agency:
1300426
Project Title:
NIMBioS: National Institute for Mathematical and Biological Synthesis
PD/PI Name:

- Colleen Jonsson, Principal Investigator
- Louis J Gross, Co-Principal Investigator

Recipient Organization:
University of Tennessee Knoxville
Project/Grant Period:
09/01/2013 - 08/31/2018
Reporting Period:
09/01/2015 - 08/31/2016
Submitting Official (if other than PD\PI):

- Colleen Jonsson
- Principal Investigator

Submission Date:
05/26/2016
Signature of Submitting Official (signature shall be submitted in accordance with agency specific instructions)
Colleen Jonsson

Back to the top

Accomplishments

* What are the major goals of the project?

A major goal of mathematical models and analysis in biology is to provide insight into the complexities arising from the non-linearity and hierarchical nature of biological systems. The primary goals of NIMBioS are to foster the maturation of cross-disciplinary approaches in mathematical biology and to assist in the development of a cadre of researchers who are capable of conceiving and engaging in creative and collaborative connections across disciplines to address fundamental and applied biological questions. NIMBioS is structured to efficiently use NSF funding: 1) to address key biological questions by facilitating the assembly and productive collaboration of interdisciplinary teams; and 2) to foster development of the critical and essential human capacity to deal with the complexities of the multi-scale systems that characterize modern biology.

Our efforts have included a variety of strategies to achieve the above goals, based upon the successes of our leadership team in developing new interdisciplinary collaborations nationally and internationally and upon the successful efforts at other NSF-supported Synthesis Centers. A major goal has been to encourage the development of small Working Groups, which focus on emphasis areas at several levels of biological organization that will benefit from interdisciplinary efforts. Working Groups arise from community requests for NIMBioS support and are vetted by our external Advisory Board. A second component to meet our goals is through encouraging community requests for Investigative Workshops. These assemble larger groups of researchers to assess somewhat broader problems, with dual goals of fostering language-building across disciplines and defining specific issues to be addressed by future Working Groups.

Human capacity building goals are fostered through: direct mentoring of new researchers (including undergraduate and graduate students and post-doctoral fellows); outreach efforts in collaboration with diverse professional organizations to educate biologists about mathematical and computational approaches useful in biological applications; connections to institutions serving under-represented groups; a summer research experience program targeted at undergraduates and high school teachers; and varying levels of tutorials designed to enlighten biologists about key quantitative methods, with particular emphasis on the application of high performance computing methods to analyze biological problems that involve large datasets, spatial information, and dynamics. A further objective is to assist mathematicians in identifying new mathematical challenges arising from current biological research.

The questions addressed by NIMBioS span all of biology, impacting both basic and applied science. Hence, the impacts are wide-ranging from those arising due to the application of specific models to particular challenges, such as controlling zoonotic disease spread, to fundamental questions about human origins, biosphere functioning, and the emergence of biological patterns at diverse scales. An objective is for NIMBioS to provide the effective infrastructure so that it becomes a primary location for the careful analysis of numerous questions of direct public policy concern, a particular emphasis of which has included issues arising from infectious diseases of zoonotic origin. To carry out research and address the challenging nature of modern biology, NIMBioS fosters the continuing development of

individuals trained at this interface of biology and mathematics as well as the development of entire programs that are equipped to educate the array of mathematically competent, biologically knowledgeable and computationally adept researchers needed to address the vast array of challenging questions in this century of biology. Fostering high quality interdisciplinary programs, including a diverse representation of individuals involved in life science and mathematical research, is a major emphasis of NIMBioS.

* What was accomplished under these goals (you must provide information for at least one of the 4 categories below)?

Major Activities:

Over the reporting period from September 1, 2015 through August 31, 2016, NIMBioS hosted (or will host this summer) 32 meetings of 22 different Working Groups, 3 Investigative Workshops, and 2 Tutorials. There are projected to be over 800 participants in NIMBioS-hosted activities during this period with 14 Postdoctoral Fellows in residence, and 43 Short-term Visitors.

The Working Groups that met during this period were: Leptospirosis Modeling (September 2015, May 2016), Teaching Quantitative Biology (October 2015, March 2016), Vector Movement and Disease (October 2015, March/April 2016), Evolutionary Approaches to Sustainability (October 2015, March/April 2016), Climate Proxies (November 2015, April 2016), Modeling Molecules-to-Organisms (November 2015, April 2016), Modeling Organisms-to-Ecosystems (November 2015, April 2016), Spatial Cell Simulation (December 2015, March 2016), Ecological Network Dynamics (December 2015), Cooperation and Cognition (December 2015, May 2016), Multiscale Vectored Plant Viruses (December 2015, June 2016), Climate Change and Vector-borne Disease (December 2015), Modeling Antimicrobial Resistance (AMR) Intervention (March 2016), Dispersal Biogeography (March 2016), Computational Landscape Genomics (March 2016), Models of Produce Contamination (April 2016), Remote Sensing Biodiversity (April 2016), Prediction and Control of Cardiac Alternans (May 2016), Habitat for Migratory Species (May 2016), Dynamic Energy Budget Models for Trees (May 2016), Caulobacter Cell-Cycle Model (summer 2016), and Human Risk Perception and Climate Change (July 2016).

The Investigative Workshops were: Morphological Plant Models (September 2015), Evolution and Warfare (September 2015), and Algebraic Mathematical Biology (July 2016).

The Tutorials were: Game Theoretical Modeling of Evolution in Structured Populations (April 2016) and Evolutionary Quantitative Genetics (August 2016).

Ongoing this period were efforts in collaboration with the NSF-funded Extreme Science and Engineering Discovery Environment (XSEDE) program and the National Institute for Computational Sciences (NICS) to encourage broader use of computational methods in a variety of biological areas.

Demographics data available for participants in events from September 1, 2015 through April 30, 2016 and are presented in detail in the NIMBioS Evaluation Report (see section Y8-2 of the attached addendum to this Annual Report) and summarized below. There were 624 participants through April 30, 2016 from 23 countries and 44 U.S. states as well as the District of Columbia representing 218 different institutions. International participants amounted to 16% of all participants. Most participants were college or university faculty (52%), but post-doctoral researchers (13%), undergraduates (12%), and graduate students (6%) accounted for a significant fraction of participants. Across all events female representation was 45%, and minority representation was near 14%. Representation of various minority categories was slightly above levels of minority representation for doctoral recipients in the biological sciences and the mathematical sciences.

Short-term Visitors from September 1, 2016 through April 30, 2016 were from 34 different institutions and collaborated with NIMBioS post-doctoral and sabbatical fellows, faculty from four University of Tennessee departments, and 22 external researchers.

Specific Objectives:

A goal of NIMBioS is to encourage research activities at the interface of mathematics and biology by encouraging requests from the broad community for activities to be held at NIMBioS. These activities are evaluated by the external Advisory Board. The Board met once physically and twice virtually during this reporting period, evaluating 26 requests for Working Groups and Investigative Workshops of which eight were approved. The Board also evaluated 62 requests for postdoctoral fellowships of which ten were supported and six accepted offers. The Board recommended support for two of five Sabbatical Fellow requests. All of these major activities facilitate development of interdisciplinary collaborations in mathematical biology.

A specific objective of NIMBioS is to foster the development of a cadre of scholars who are able to effectively carry out research at the interface of mathematics and biology. NIMBioS supported activities using several different methods in order to meet this objective for individuals at diverse levels of experience.

NIMBioS supported an array of outreach activities for the general public, K-12 students and teachers that illustrated, including in a hands-on manner, the connections between math and biology. The Biology in a Box program, Girls in Science, SHADES (Sharing Adventures in Engineering and Science), and Adventures in STEM Camp (Science, Technology, Engineering, and Mathematics) are all examples of efforts to reach out to K-12 students and pique their interest in math and the sciences. Combined, the NIMBioS' teacher collaboration and math/biology curriculum programs, Junior Science and Humanities Symposium, and the Summer Research Experience (SRE)for undergraduates help participants gain the skills and make the connections between mathematics and biology that are a core component of the NIMBioS mission.

NIMBioS hosted a Summer Research Experience for undergraduates program, which included undergraduates in math and biology fields from 15 different institutions. The students engaged in team research projects in one of five different topics including using statistical filters to follow fast organelle movements in plant cells, dynamic modeling of human emotion, modeling the spread of mice and hantavirus in pressured landscapes, decoding allostery by mathematical analysis of molecular dynamics simulations, and developing computer games for teaching biology. The goal of these programs is to further enhance the students' abilities to independently and as part of a team develop quantitative approaches to answering biological questions. An indicator of the success of the NIMBioS SRE program is the progression of many former participants into doctoral programs in STEM fields.

In fall 2015, NIMBioS hosted its sixth annual undergraduate research conference at the interface of math and biology, which included more than 50 undergraduate research talks and posters and was attended by more than 100 students and faculty from academic institutions across North America.

Graduate students have been regular participants in many NIMBioS research activities, particularly workshops, tutorials, and short-term visits. NIMBioS co-organized, jointly with the Mathematical Biosciences Institute and the Centre for Applied Mathematics in Bioscience and Medicine, a Summer Graduate Research Workshop on Mathematical modeling of infectious disease spread. NIMBioS supported seven UT graduate students to carry out research in collaboration with NIMBioS post-docs and researchers and to provide assistance with specific programs. Four of these worked on research projects, two on evaluation projects, and one on database development. The Visiting Graduate Fellow program supported one Fellow from outside the University of Tennessee for a longer visit to collaborate with NIMBioS post-docs and University of Tennessee faculty.

Post-doctoral Fellows at NIMBioS are independent researchers who develop their own proposed research activity and receive mentoring from both a mathematical sciences and a biological sciences faculty member. Of the 14 Postdoctoral Fellows in residence for at least part of this reporting period, five had completed a Ph.D. in mathematical or computational sciences and nine had backgrounds in areas of biology. An objective of NIMBioS is to enhance career opportunities for current and former Post-doctoral Fellows, and career development seminars and workshops are held regularly. Of eight Post-doctoral Fellows who moved on or will move on from NIMBioS during this reporting period, three have accepted faculty positions, three accepted new post-doctoral positions, and two accepted positions at research institutions.

Significant Results:

NIMBioS relies upon participants to self-report products that were derived from their participation in NIMBioS activities. There were a total of 311 products reported from the time of preparation of the September 2014 - August 2015 annual report (April 2015) and April 30, 2016, including 177 journal articles, 6 book chapters, 4 dissertations and theses, 6 software/netware/data and research materials, 97 presentations/posters, 10 grant requests, 4 educational aids or curricula, and 6 meetings, workshops or symposiums.

Details on publications in journals, books, and conference proceedings are included in the Products section; details on featured articles, websites, and media coverage are included as Additional Products in Section Y8-5 of the Addendum to this annual report.

Since inception NIMBioS-supported activities have resulted in publications in a broad range of topics as designated by ISI Web of Science categories. Ecology has been the most common subject category, followed by Evolutionary Biology, Mathematical & Computational Biology, Biology, Multidisciplinary Sciences, and Genetics & Heredity. Figure 1 illustrates the diversity of scientific topics covered by working groups and workshops hosted by NIMBioS between September 1, 2015 and April 30, 2016 (more information on interpretation of this figure is available in the NIMBioS Evaluation Report, Section Y8-2 of the addendum to this annual report - see Figure 2 and associated text in Section Y8-2).

A number of the publications resulting from NIMBioS activities this reporting period appeared in top national and international journals with high impact factors, including Nature, Systematic Biology, Nature Communications, Proceedings of the National Academy of Sciences, Nucleic Acids Research, Philosophical Transactions of the Royal Society B, Molecular Ecology, Proceedings of the Royal Society B, PLoS Computational Biology, Evolution, Journal of Animal Ecology, The American Naturalist, Journal of the Royal Society Interface, PLoS ONE, Animal Behaviour, and BMC Bioinformatics. Table 1 provides details on NIMBioS-derived publications in certain high-impact journals.

Key outcomes or Other achievements:

Metrics of success for NIMBioS include establishing new connections between researchers from diverse backgrounds leading to new interdisciplinary science. Illustrations of the outcomes NIMBioS has in this regard appear in Figure 2. Figure 2 shows the fields of expertise of participants in NIMBioS Working Groups during the current reporting period and the connections fostered between individuals with different backgrounds by participation in the Working Groups. The nodes on the graphic correspond to the participant's major field of expertise, with the node size being a non-linearly scaled metric for the number of participants in that field. While the majority of participants identify themselves as being in fields of biological sciences and mathematical sciences, there are a number of participants from the social sciences, marine sciences, agricultural sciences, health sciences, and others. As the width of the connecting line segments in this graphic illustrates, these NIMBioS Working Groups have generated a large number of connections between individuals from diverse fields.

A major emphasis at NIMBioS has been ongoing efforts to evaluate activities in light of NIMBioS objectives as outlined in the Strategic Plan. The NIMBioS evaluation program follows the CIPP systems approach (Context, Inputs, Process, Products), which takes into account not only the outcomes of the Center, but also how the outcomes are achieved. The Process Evaluation seeks to evaluate congruence between goals and activities,

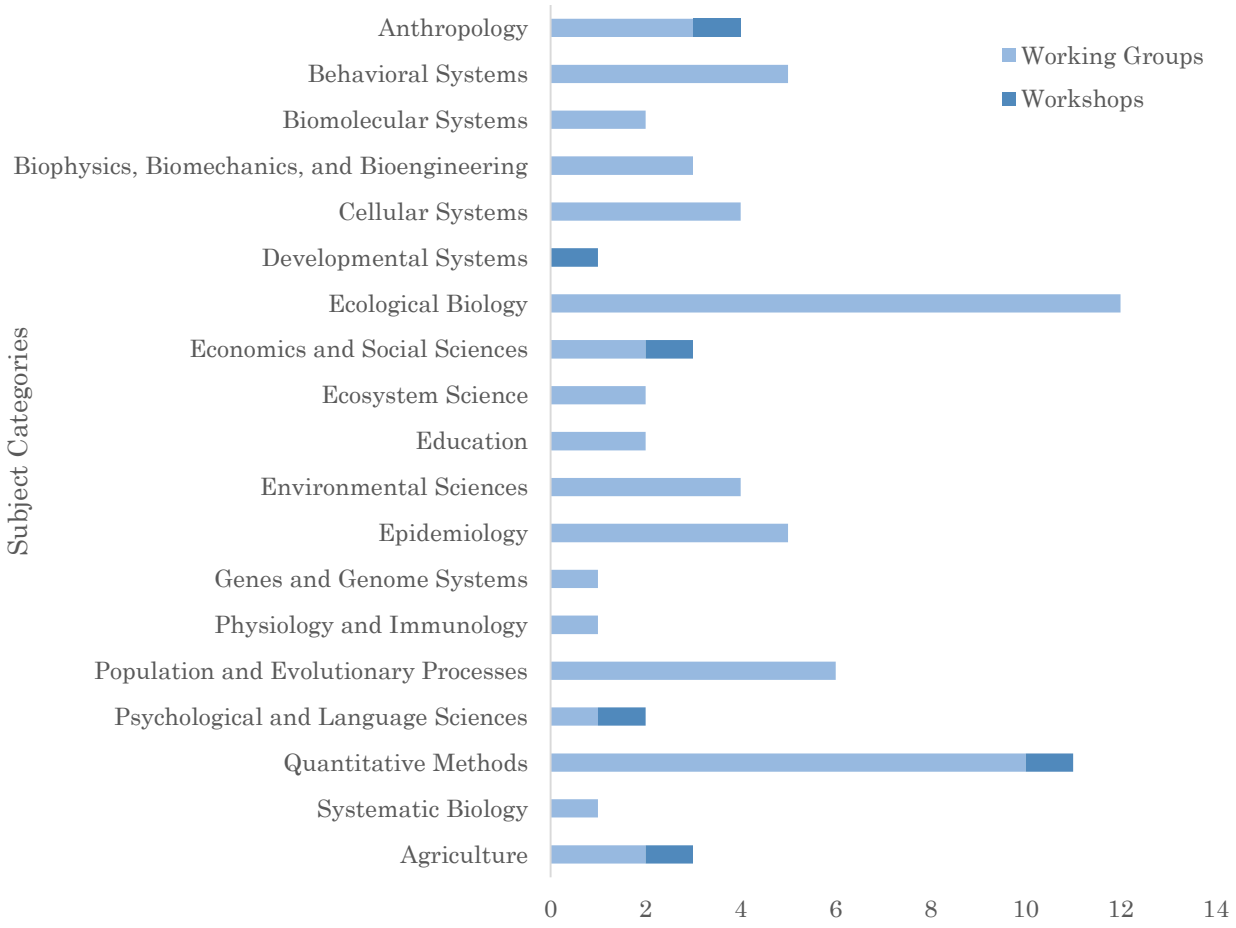


Figure 1. Diversity of scientific topics represented in NIMBioS Working Group Meetings and Investigative Workshops during the period from September 1, 2015 – April 30, 2016.

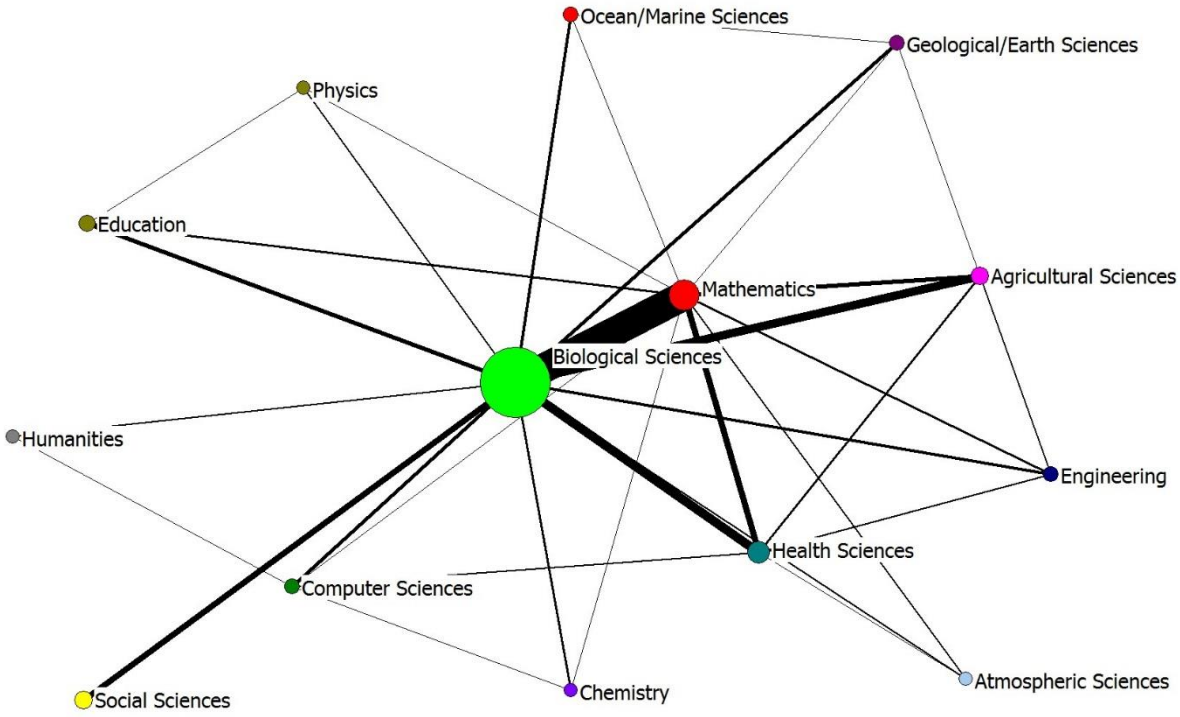


Figure 2. Cross-disciplinary connections fostered among Working Group members through meetings hosted at NIMBioS from September 1, 2015 through April 30, 2016. Node radius is representative of the log-scaled number of participants in each field of study. Line size is representative of the number of times researchers from each field were brought together to collaborate and problem-solve at NIMBioS.

Table 1. Number of NIMBioS articles published in a selection of high-impact journals during the current reporting period (through April 2016) and since NIMBioS' inception, sorted by journal 5-Year Impact Factor

Journal Title	5-Year Impact Factor *	# of NIMBioS Publications in Year 8 **	# of NIMBioS Publications Since Inception ***
Nature	41.30	-	5
Cell	35.53	-	1
Science	35.26	2	7
Trends in Ecology and Evolution	19.82	2	7
Ecology Letters	16.78	2	10
Systematic Biology	14.79	2	7
PLoS Biology	11.9	1	3
Nature Communications	11.9	-	2
Proceedings of the National Academy of Sciences	10.56	1	16
Current Biology	10.13	-	1
PLoS Genetics	8.56	-	2
Nucleic Acids Research	8.87	-	3
Phil Trans of the Royal Soc B-Biological Sciences	7.89	2	6
Molecular Ecology	6.33	3	10
Ecology	6.16	-	6
Proc of the Royal Soc B-Biological Sciences	5.65	1	10
PLoS Computational Biology	5.28	2	8
Evolution	5.25	2	17
Journal of Animal Ecology	5.32	1	4
The American Naturalist	4.96	2	13
Journal of the Royal Society Interface	4.65	-	5
PLoS One	3.7	9	35
Animal Behaviour	3.42	2	9
BMC Bioinformatics	3.45	-	2

* The journal impact factor is a measure of the frequency with which the "average article" in a journal has been cited in a particular year. The impact factor is an indicator of a journal's relative importance, especially as compared to other journals in the same field. Impact factor calculation: cites in year n to articles published in year (n-1 + n-2)/number of articles published in year(n- 1 + n-2).

** Number of publications in Year 8 includes all publications reported since compilation of the previous Annual Report (April 2015) through April 2016.

*** September 2008 – April 2016

monitoring and judging activities at NIMBioS, mainly through periodic evaluative feedback surveys from participants and organizers. The Products Evaluation seeks to monitor, document, and assess the quality and significance of the outcomes of NIMBioS activities. It provides guidance for continuing, modifying, or terminating specific efforts. Previous evaluation case studies found that affiliation with a NIMBioS Working Group has a significant positive effect on participant collaboration activities (i.e. number of co-authors, number of international co-authors, number of cross institutional co-authors), and a moderate effect on publication activities (i.e. publishing in new fields). Qualitative analysis of interdisciplinarity showed a shift in publication Web of Science subject categories toward mathematical fields. A current evaluation case study examines the growth and productivity of NIMBioS working group teams using social network analysis, bibliometric measures, and psychometric surveys regarding views and experiences with interdisciplinary research. Preliminary results suggest:

- Network density (collaboration) among working group participants increases with each subsequent meeting
- Collaboration patterns change drastically among group members from before they are brought together and after. The more time that passes between meetings, the more the collaboration patterns change (i.e. who is collaborating academically with whom).
- Participants tend to collaborate more with those (1) of their own gender, (2) who physically attend meetings together, (3) knew each other prior to the formation of the group, (4) had collaborated before the group started
- participants collaborate more outside of their own gender, professional status, field of study, and country the more we bring them together.

A multi-level model analysis of the network characteristics and individual productivity found that females were more productive when they were in groups with female leaders (an increase in co-authorship rate of 33% for each additional female leader), and that the same connection did not hold true for minorities in minority-led groups.

One issue common across all Synthesis Centers is the need for a viable comparison group for Outcome Evaluations. NIMBioS is currently working on an evaluation case study that will use a matched comparison group of journal articles based on several criteria to compare with NIMBioS-affiliated products on several bibliometric indicators, including influence (citation analysis, H-indices), interdisciplinarity (subjects covered), collaboration (levels of co-authorship), and diversity (gender, discipline area, geographic location, of coauthors).

* What opportunities for training and professional development has the project provided?

NIMBioS carries out extensive training and professional development activities. We provide some highlights here, but see the detailed listing of activities during this reporting period in Section Y8-4 of the Annual Report Addendum.

Graduate Students

During AY15-16, NIMBioS funded five UTK graduate student research fellowships using recovered F&A funds. These students (three male, two female, one of which is an underrepresented minority) are pursuing degrees in Mathematics, Ecology and Evolutionary Biology, or Electrical Engineering and Computer Science. Four of the students were granted research awards based on an internal annual competitive application process. These students performed research in the areas of development and application of biogeography models for inference of ancestral geographic range of taxa and dispersal barriers, optimal control for spatial-temporal management in epidemiological and natural resources models and development of metapopulation models to estimate the impact of invasive species in Great Smoky Mountains National Park. Collectively, these students gave 5 presentations at national conferences and have 2 published manuscripts, 1 under review and 2 in revision. All of these students participated in NIMBioS-related K-12 outreach activities. Two of the NIMBioS Fellows (Benjamin Levy and Buddhi Pantha) successfully defended their PhDs in Mathematics in Spring 2016. Both have secured tenure-track positions in Mathematics Departments (at Fitchburg State University and Abraham Baldwin Agricultural College, respectively). The EECS student was supported to assist in development and implementation of an administrative database for NIMBioS. Two additional graduate students worked on projects related to NIMBioS Evaluation Services. The visiting graduate student fellowship program, which was implemented in AY13-14, was terminated and funds earmarked for this program were redirected to activities aimed at NIMBioS sustainment post the NSF award period.

Our tutorials provide training on specific research tools. The Evolutionary Quantitative Genetics tutorial in August 2016 reviewed the basics of theory in the field of evolutionary quantitative genetics and its connections to evolution observed at various time scales. About 25 participants learned to use R, an open-source statistical programming language, and to build and test evolutionary models. The Game Theoretical Modeling of Evolution in Structured Populations tutorial was held in April 2016. Thirty participants were introduced to the discrete graph theory methods and models of structured populations as well as classical continuous models based on differential equations. They worked in small groups to experience how to use the methodology to describe, simulate, and analyze the relevant biological systems.

Our collaboration on the US-Canadian Institutes Epidemiology Summer School Mathematical Modeling of Infectious Disease Spread in June 2016 will help train 55 graduate students in modeling and simulation techniques in epidemiology. Students will work on projects in groups with research mentors and attend a panel discussion about career opportunities.

Post-doctoral Fellows

As of the time of writing, there are eight Post-doctoral Fellows in residence, and thirty two Fellows have completed their fellowships. During this reporting period (Sept 2015-Aug 2016) as many as 14 Post-doctoral Fellows have been in residence, and eight Fellows will have finished and moved on to faculty positions or new post-doctoral or research appointments. Each Post-doctoral Fellow is assigned two mentors, one with more mathematical/computational expertise and one with more biological expertise. These mentors are not directing the research efforts of

the post-docs, but they are expected to discuss research with the post-doc, suggest possible new projects, and provide career and training suggestions as well. Mentors are expected to meet routinely with each post-doc. The meetings may be part of any regular lab group meetings the mentor organizes. Based on reports from post-docs, they value individual mentoring meetings, and many are attending lab meetings supervised by their mentors or others.

NIMBioS provides a Postdoctoral Professional Development Seminar series for the Fellows. It meets monthly during the academic year and gives the Fellows additional opportunities to explore and discuss shared professional development issues with faculty and staff from around the University. Often the ratio of Fellow to faculty in these discussions will be between 2:1 and 3:1 enabling a rich discussion environment in which the Fellows can explore questions and ideas they have. Topics for the series are typically suggested by the post-doctoral Fellows themselves. The most frequently requested topics concern aspects of the job application and interview process, which was the subject of three seminars during this reporting period. Examples of recent successful job applications by mentors and previous NIMBioS post-docs (cover letters, research and teaching statements, etc.) have been posted on a dedicated web site only available to post-docs. Other topics of high interest identified by the Fellows included, for example, being a peer reviewer, writing effective grant proposals and designing effective presentations. Teams of Fellows and their mentors are involved in the design of some of these professional development sessions. Independently, the Fellows coordinate a weekly workshop environment in which they explore research ideas and challenges together and with the NIMBioS Graduate Research Assistants and other members of the NIMBioS community. New post-docs participate in a training session on how to communicate their science to the media and to non-scientific audiences; topics included using social media, talking to a reporter, on-camera interviewing, and poster and slide presentation tips. Post-docs are informed of other opportunities (e.g., workshops, short-courses, web sites and other information relevant to professional development) that are occurring on campus and elsewhere. All Post-doctoral Fellows are asked to complete online profiles that require them to succinctly describe their work. Post-doctoral Fellows are provided with a travel allowance to promote their development as scientists and for career development. Presentations by post-docs are included with Other Products in the Products section of this report.

Annual reviews of post-docs are conducted with a focus on professional and scientific development. Submission of manuscripts is an expected goal for all post-docs and other goals include presentations at national/international meetings, mentoring of undergraduates/graduate students, teaching if that is an individual career goal, and to have visited at least one of the NIMBioS minority-serving institution partners. Three of the NIMBioS Post-doctoral Fellows will serve as mentors for undergraduates during the 2016 Summer Research Experiences for Undergraduates and Teachers program.

Undergraduates

Our Summer Research Experiences for Undergraduates program provided training in research process, mathematical modeling, R and MATLAB programming, and poster and oral presentations. In this program, our professional development activities included sessions on career opportunities, graduate school applications, cross-cultural mentoring, and learning to work in teams (including the use of self-assessments). Our Undergraduate Research Conference at the Interface of Biology and Mathematics (November 2015) exposed about 100 undergraduates and mentors to a variety of research topics; advice on graduate school and other career opportunities were presented in a panel discussion and in a graduate school fair (with representatives from several graduate programs).

* How have the results been disseminated to communities of interest?

The award-winning website of the National Institute for Mathematical and Biological Synthesis (URL: http://www.nimbios.org) is the primary vehicle for communicating the scientific endeavors of NIMBioS, for both internal and external audiences. The NIMBioS website was initiated when the Institute was established in October 2008 with 40 html pages. As of April 2016, the website contained 1390 pages and 1501 pdf documents. Its performance is monitored regularly. Table 2 and Figure 3 illustrate trends in the number of site visits over the current reporting period and over the full range of NIMBioS operations. The purpose of the website is to provide information about research at the interface of mathematics and biology and attract potential scientists/researchers to participate in the work of NIMBioS while also providing scientific information to a generalized audience. The audience for nimbios.org is multifaceted with a wide range of needs and interests, primarily consisting of scientists from academic institutions, state and federal government agencies and non-governmental organizations. Viewers searching online for information about science-related topics visit NIMBioS pages where they can view videos on science topics, read feature stories about science and scientists, interact using social media tools including sharing posts or leaving comments on the NIMBioS blog. The website provides up-to-date and accurate information about the wide range of topics addressed by NIMBioS groups and researchers, while familiarizing viewers with the NIMBioS mission and activities. It also provides a comprehensive listing of research results via NIMBioS "products," including publications, presentations, proposals, scientific meetings generated by NIMBioS activities, educational products, and data and software. The site is updated with new content on a daily basis and we are also modernizing the website to conform to current viewing standards.

Another key channel for disseminating information to NIMBioS communities of interest is the bi-monthly newsletter called "NIMBioS News." The newsletter includes a science story, an education and outreach-related feature, links to videos from the library of NIMBioS-produced videos, and a listing of future educational and research opportunities. As of April 2016, there are more than 6,000 subscribers, and the newsletter typically has an average click-through rate well above industry standards of about 30 percent.

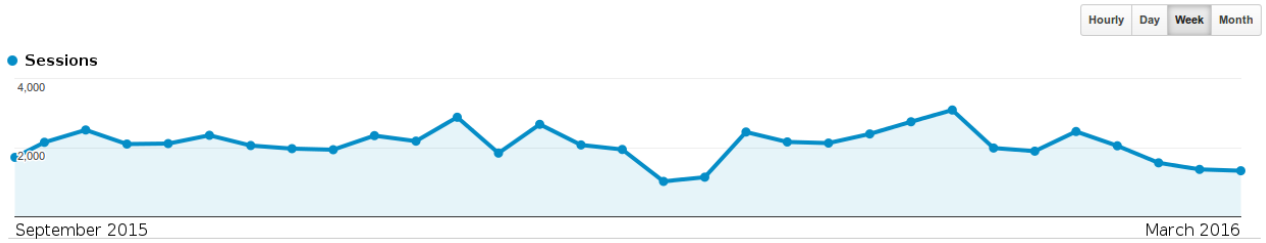
NIMBioS regularly distributes e-blasts of announcements about upcoming research and educational and outreach opportunities as well as calls for support. The e-blast reaches individual email addresses and also goes to a variety of interdisciplinary listservs and websites for placement. NIMBioS also distributes a weekly, "NEXT@NIMBioS," email to a more internal

Table 2. Number of *nimbios.org* website visits and unique visitors for NIMBioS reporting years (site use data from Google Analytics).

Reporting year	Unique visitors	Visits
Sep 1, 2008 - Aug 31, 2009	9259	19951
Sep 1, 2009 - Aug 31, 2010	21278	41700
Sep 1, 2010 - Aug 31, 2011	33449	65208
Sep 1, 2011 - Aug 31, 2012	45084	88398
Sep 1, 2012 - Aug 31, 2013	74123	116473
Sep 1, 2013 - Aug 31, 2014	73906	116331
Sep 1, 2014 - Aug 31, 2015	78604	125992
Sep 1, 2015 - Mar 31, 2016*	42313	64703

*Partial year

(a)



(b)

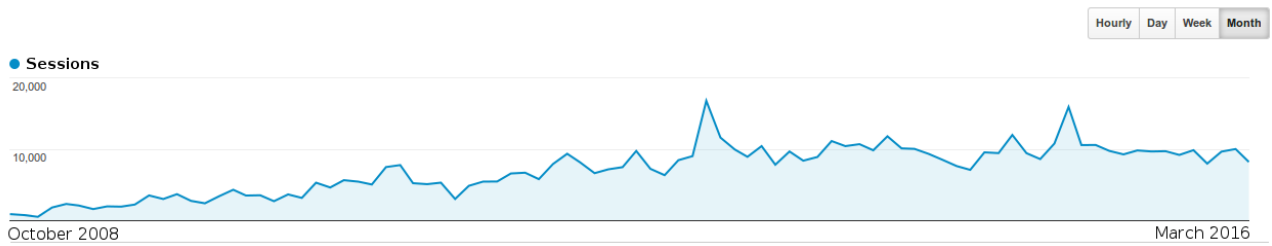


Figure 3. Number of *nimbios.org* website visits for (a) the 2016 reporting year (weekly, September 1, 2015 through March 31, 2016) and (b) monthly for the period October 1, 2008 through March 31, 2016. The peaks in Figure 3 (a) show the impact of significant products on the number of website visits in the reporting period. Figure 3(b) documents the overall increasing trend in visits since the inception of NIMBioS (site use data from Google Analytics).

audience with a listing of the next week's events and visiting scientists.

To reach a wider audience for the purposes of enhancing public understanding and increasing interest in learning about science, NIMBioS publicizes its extensive library of more than 250 NIMBioS-produced videos featuring groundbreaking research, interviews with top scientists, seminars, workshops, tutorials and other educational topics. The videos are hosted on the NIMBioS YouTube channel and also featured on the NIMBioS website.

NIMBioS also provides live streaming of many of its events, including workshops, tutorials and seminars. Live streaming is accessed through the NIMBioS website via a log-in page, and a live chat window is also provided.

NIMBioS maintains a subscription account with EurekAlert!, an online, global news service which reaches thousands of journalists. NIMBioS press releases are disseminated via EurekAlert! as well as via its private list of media contacts. The press releases are written for a non-specialized audience interested in science topics. NIMBioS also collaborates with the media office at the University of Tennessee, Knoxville, as well as the press offices of visiting scientists' institutions, in order to increase dissemination of research results via press releases.Press releases derived from NIMBioS activities have led to news coverage in local, regional, national and international press including Science, Nature, The New York Times, the Los Angeles Times, National Public Radio, and other national media.

Other ways NIMBioS reaches wider audiences are through its social media sites, including Facebook, Twitter, LinkedIn, Flickr, Storify, and the NIMBioS WordPress Blog, Each account is set to receive and respond to comments by individuals using these websites.

In addition, NIMBioS gives workshop and tutorial organizers the option to have NIMBioS create and maintain a WordPress site for each workshop and tutorial. The site facilitates group communication and information sharing for the workshop/tutorial, and is accessiblefor informational purposes to individuals not participating in the workshop.

Finally, aside from NIMBioS' multimedia channels and communication activities, NIMBioS undertakes numerous outreach activities via the NIMBioS Education and Outreach office. These include presentations and exhibits about our activities at professional meetings, such as the Joint Mathematics Meeting, the Society for the Advancement of Chicanos and Native Americans in Science, and the National Science Teachers Association. It also includes outreach to the general public, such as the presentation of a special NIMBioS math and biology award at the regional science fair and coordinating activities for the Sharing Adventures in Science and Engineering (SHADES) event. For a complete listing of all of our outreach activities during the reporting period, please see the Addendum to this report.

* What do you plan to do during the next reporting period to accomplish the goals?

In accordance with its Strategic Plan, NIMBioS will continue to utilize the following specific methods to meet its general goals: Focused research projects (Working Groups) to build

collaboration among diverse communities; Building collaborations through more open-ended general problems, addressed through multiple approaches (Investigative Workshops); Skill and methods-based programs (Tutorials) that foster a broader understanding of potential applications of modern math and computational science in biology; Increasing and diversifying the workforce in cross-disciplinary research through Postdoctoral Fellowships; Visiting researcher programs including Sabbatical, and Short-term opportunities for visitors to collaborate with post-docs and students, and participate in other activities; and an expansive set of education-linked-to-research endeavors from elementary through post-doctoral level that provide diverse opportunities at the math/biology interface.

A key component of the Strategic Plan has been a formal evaluation process, following the Evaluation Plan approved by our Advisory Board, which provides a mechanism to assess the variety of activities NIMBioS supports in terms of how effectively they contribute to meeting the NIMBioS mission. The success of the programs is evident from past participant evaluations and from Site Reviews. We have continued to re-envision our evaluation program in part because participant responses have been so highly positive that we gain little additional information by continuing to evaluate each individual activity. Over this next period we will thus continue to transition our evaluation effort toward the science of evaluating collaborative interdisciplinary activities and the effectiveness of centers such as NIMBioS and expand our evaluation program. An emphasis over this period will be the development of appropriate comparison groups to which to compare the impacts of NIMBioS programs. This includes building comparison datasets of journal publications to which to compare those arising from NIMBioS activities in a variety of bibliographic metrics and group collaboration methods to assess the effectiveness of interdisciplinary education and collaboration efforts as part of the science of team science. We are also working to expand these team-based concepts in graduate education as we discuss STEM sustainment within UT. A component that will assist this effort is the planned completion of the NIMBioS Administrative DataBase system, which will more effectively allow us to coordinate all aspects of the demographic information and evaluation responses we obtain from participants.

NIMBioS continues efforts in a variety of areas to continue building for long-term sustainability. Long-term sustainability planning is currently focused on increasing the critical mass of faculty working at the interface of math and biology as well as providing support for those activities. In addition to moving forward on the hire of one new Assistant Professor in collaboration with the Department of Microbiology in the next academic year described earlier, three of the new NIMBioS faculty hires will bring new research dimensions and perspectives to UT and to NIMBioS next year. The addition of these new faculty will bring an incredible diversity of modeling approaches and critical mass to UTK and NIMBioS. In addition, these hires will help to deepen or broaden the appreciation of scientific research on the UT campus of those not involved directly in NIMBioS. Indeed it is anticipated that these hires will have a broad impact in terms of attracting those not currently engaged in our programs. For example, one new hire is in a brand new area and a department that has not engaged with NIMBioS since its

inception. A second hire will lead the development of a hands-on computational laboratory for spatial biology for research for NIMBioS participants, tutorials, outreach and local interdisciplinary research. With the goal of sustainability, NIMBioS is engaged in three growth areas; creation of an evaluation center for STEM, fund raising and proposal writing. Dr. Pamela Bishop was promoted to Associate Director of STEM Evaluation and is building a collaborative evaluation program that is rapidly expanding. Catherine Crawley and Jane Comiskey have led efforts to generate a web site for fund raising to ensure programmatic continuity after the away for workshops, undergraduate summer research and postdoctoral training. Finally the leadership team and affiliate faculty are moving forward to sustain NIMBioS through new multidisciplinary grants in research and education.

Back to the top

Products

Books

Book Chapters

- Akcay E (2015). Evolutionary models of mutualisms. *Mutualism, Oxford University Press* . Status = PUBLISHED; Acknowledgement of Federal Support = Yes
- Gray MJ, Brunner JL, Earl JE, Ariel E. (2015). Design and analyses of ranavirus studies with a focus on assessing risk.. *Ranaviruses: Lethal Pathogens of Ectothermic Vertebrates.* . Status = PUBLISHED; Acknowledgement of Federal Support = Yes
- Mesterton-Gibbons M, Sherratt TN (2013). Signalling Victory to Ensure Dominance: A Continuous Model. *Advances in Dynamic Games Part I.* 12. Cardaliaguet P and Cressman R. 25. Status = PUBLISHED; Acknowledgement of Federal Support = Yes ; Peer Reviewed = Yes ; ISBN: 10.1007/978-0-8176-8355-9_2.
- Palagi E (2015). Humans, Other Animals, and the Biology of Morality. *Beastly Morality.* Crane JK. Columbia University Press. . Status = PUBLISHED; Acknowledgement of Federal Support = Yes ; Peer Reviewed = Yes
- Pellis SM, Burghardt GM (2015). Play and exploration. *APA handbook of comparative psychology: Concepts, History, and Methods* 1. Call J. American Psychological Association. . Status = PUBLISHED; Acknowledgement of Federal Support = Yes ; Peer Reviewed = Yes
- Smuts B (2014). Social behavior among companion dogs with an emphasis on play. *The Social Dog.* J Kaminsky, S Marshall-Pescini. Elsevier Inc.. 105. Status = PUBLISHED; Acknowledgement of Federal Support = Yes ; Peer Reviewed = Yes
- Swedlund AC, Sattenspiel L, Warren A, Meindl RS, and Gumerman GJ III (2016). Explorations in paleodemography: an overview of the Artificial Long House Valley agent-based modeling project, with new observations on demographic estimation. *New Directions in Biocultural Anthropology* Zuckerman MK, Martin D. Wiley-Blackwell. . Status = AWAITING_PUBLICATION; Acknowledgement of Federal Support = Yes ; Peer Reviewed = Yes
- Tsiligaridis J (2015). MSA and Clustering with Dot Matrices, Entropy and Genetic Algorithms. *In Big Data: Algorithms, Analytics, and Applications* CRC Press, Taylor &

Francis Group. . Status = PUBLISHED; Acknowledgement of Federal Support = Yes ; Peer Reviewed = Yes

Inventions

Journals or Juried Conference Papers

- Abbott KC, Karst J, Biederman LA, Borrett SR, Hastings A, Walsh V, Bever JD (2015). Spatial heterogeneity in soil microbes alters outcomes of plant competition. *PLoS One*. 10 (5), e0125788. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1371/journal.pone.0125788
- Agusto FB, Gumel AB, Parham PE (2015). Qualitative Assessment of the Role of Temperature Variations on Malaria Transmission Dynamics. *Journal of Biological Systems*. 23 (4), 597. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1142/S0218339015500308
- An G, Bevers M, Christley S, Federico P, Fitzpatrick B, Gurarie D, Hinkelmann F, Kanarek A, Laubenbacher R, Lenhart S, Neilan RM, Oremland M, Salinas R, Tridane A, Turner M, Xiong J, Yong J (2015). A systems of agent-based models in biology. *Bulletin of Mathematical Biology*. . Status = SUBMITTED; Acknowledgment of Federal Support = Yes
- Anderson TL, Hocking DJ, Conner CA, Earl JE, Harper EB, Osbourn MS, Peterman WE, Rittenhouse TAG, Semlitsch RD (2015). Abundance and phenology patterns of two pond-breeding salamanders determine species interactions in natural populations. *Oecologia*. 177 (3), 761. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1007/s00442-014-3151-z
- Ankrah et al (2014). Phage infection of an environmentally relevant marine bacterium alters host metabolism and lysate composition. *The ISME Journal*. 8 1089. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1038/ismej.2013.216
- Arriaga J, Sanchez H, Vallejo EE, Hedley R, Taylor CE (2016). Identification of Cassin′s Vireo (Vireo cassinii) individuals from their acoustic sequences using an ensemble of learners. *Neurocomputing*. 175 (Part B), 966. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.neucom.2015.05.129
- Asih TSN, Lenhart S, Wise S, Aryati L, Adi-Kusumo F, Hardianti MS, Forde J (2016). The Dynamics of HPV Infection and Cervical Cancer Cells. *Bulletin of Mathematical Biology*. 78 (1), 4. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1007/s11538-015-0124-2
- Auerbach J, Kanarek AR, Burghardt GM (2015). To play or not to play? That's a resource abundance question. *Adaptive Behavior*. 23 (6), 354. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1177/1059712315611188
- Ayers C, Armsworth P, Brosi B (2015). Determinism as a statistical metric for ecologically important recurrent behaviors with trapline foraging as a case study. *Behavioral Ecology and Sociobiology*. 69 (8), 1395. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1007/s00265-015-1948-3

- Baez J, Harte J, Harper M (2016). Special Issue: Information and Entropy in Biological Systems. *Entropy*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; ISSN: 1099-4300
- Baez JC, Pollard BS (2016). Relative Entropy in Biological Systems. *Entropy*. 18 (2), 46. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.3390/e18020046
- Bauer JT, Mack KLM, Bever JD (2015). Plant-soil feedbacks as drivers of succession: Evidence from remnant and restored tallgrass prairies. *Ecosphere*. 6 (9), . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1890/ES14-00480.1
- Beaulieu JM, O'Meara BC (2015). Extinction can be estimated from moderately-sized phylogenies. *Evolution*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes
- Beaulieu JM, O'Meara BC, Crane P, Donoghue MJ (2015). Heterogeneous Rates of Molecular Evolution and Diversification Could Explain the Triassic Age Estimate for Angiosperms. *Systematic Biology*. 64 (5), 869. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1093/sysbio/syv027
- Bechette A, Stojsavljevic T, Tessmer M, Berges JA, Pinter GA, Young EB (2013). Mathematical modeling of bacteria-virus interactions in Lake Michigan incorporating phosphorus content. *Journal of Great Lakes Research*. 39 (4), 646. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.jglr.2013.09.003
- Beckage B, Bucini G, Platt WJ, Higgins S, Gross LJ, Fowler NL, Slocum MG (). A general savanna model: Mechanisms influencing grass-tree relationships vary along moisture gradients. *Ecosphere*. . Status = SUBMITTED; Acknowledgment of Federal Support = Yes
- Bell HC, Bell GD, Schank JA, Pellis SM (2015). Evolving the tactics of play fighting: insights from simulating the “keep away game” in rats. *Adaptive Behavior*. 23 371. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1177/1059712315607606
- Benazzo A, Ghirotto S, Vilaca ST, Hoban S (2015). Using ABC and microsatellite data to detect multiple introductions of invasive species from a single source. *Heredity*. (2015), 1. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1038/hdy.2015.38
- Berner D, Thibert-Plante X (2015). How mechanisms of habitat preference evolve and promote divergence with gene flow. *Journal of Evolutionary Biology*. 28 (9), 1641. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1111/jeb.12683
- Bewick S, Chisholm R, Akcay E, Godsoe W (). Effects of niche overlap on patterns of biodiversity in a stochastic community model. *Ecology Letters*. . Status = SUBMITTED; Acknowledgment of Federal Support = Yes
- Blankenship T, Tisdale C, Yang Y (). Statistical tracking of fast movements of organelles. *Involve, A Journal of Mathematics*. . Status = SUBMITTED; Acknowledgment of Federal Support = Yes

- Bode M, Sanchirico JN, Armsworth PR (2016). Returns from matching management resolution to ecological variation in a coral reef fishery. *Proceedings of the Royal Society B: Biological Sciences*. 283 (1826). Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1098/rspb.2015.28
- Boettiger C, Bode M, Sanchirico JN, LaRiviere J, Hastings A, Armsworth PR (2015). Optimal management of a stochastically varying population when policy adjustment is costly. *Ecological Applications*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1890/15-0236.1
- Botta F, Eriksen C, Fontaine MC, Guillot G (2015). Enhanced computational methods for quantifying the effect of geographic and environmental isolation on genetic differentiation. *Methods in Ecology and Evolution*. 6 (11), 1270. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1111/2041-210X.12424
- Bowden TS, Ferguson JM, Ward RV, Taper ML, Willey DW (2015). Breeding Season Home Range and Habitat Use of Mexican Spotted Owls (Strix occidentalis lucida) Below the South Rim of Grand Canyon National Park. *The Wilson Journal of Ornithology*. 127 (4), 678. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1676/15-004.1
- Buchan A, LeCleir GR, Gulvik CA, Gonzalez JM (2014). Master recyclers: features and functions of bacteria associated with phytoplankton blooms. *Nature Reviews Microbiology*. 12 686. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1038/nrmicro3326
- Burghardt L, Metcalf J, Donohue K (2015). A cline in seed dormancy helps conserve the environment experienced during reproduction across the range of A. thaliana. *American Journal of Botany*. 103 (1), 47. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.3732/ajb.1500286
- Carvalho BM, Rangel EF, Ready PD, Vale MM (2015). Ecological Niche Modelling Predicts Southward Expansion of Lutzomyia (Nyssomyia) flaviscutellata (Diptera: Psychodidae:Phlebotominae),Vector of Leishmania (Leishmania) amazonensis in South America, under Climate Change. *PLoS ONE*. 10 (11), e0143282. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1371/ journal.pone.0143282
- Chen S, Ilany A, White BJ, Sanderson MW, Lanzas C (2015). Spatial-Temporal Dynamics of High-Resolution Animal Networks: What Can We Learn from Domestic Animals?. *PLOS One*. 10 (6), . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1371/journal.pone.0129253
- Chitwood DH, Bucksch A (eds.) (2016). Plant morphological modeling: Unleashing geometric and topologic potential within the plant sciences. *Frontiers Research Topic*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes
- Ciocanel V, Stepien TL, Edwards A, Layton AT (2015). Modeling autoregulation of the afferent arteriole of the rat kidney. *AWM proceedings for NIMBioS WS for Women in Mathematical Biology*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

- Cordoni G, Palagi E (2015). Aggression and hierarchical steepness inhibit social play in adult wolves. *Behaviour*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1163/1568539X-00003326
- Cornetti L, A Benazzo, S Hoban, C Vernesi, G Bertorelle (2016). Genetic variation pattern in alpine yellow-bellied toad populations- potential for complete recovery. *Conservation Genetics*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1007/s10592-016-0818-5
- Cornetti L, Ficetola GF, Hoban S, Vernesi C (2015). Genetic and ecological data reveal species boundaries between viviparous and oviparous lizard lineages. *Heredity*. 115 (6), 517. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1038/hdy.2015.54
- Dantzler A, Hujoel M, Parkman V, Wild A, Lenhart S, Levy B, Wilkes R (2016). Canine distemper outbreak modeled in an animal shelter. *Letters in Biomathematics*. 3 (1), 13. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1080/23737867.2016.1148644
- Day SW, Higham TE, Holzman R, Van Wassenbergh S (2015). Morphology, Kinematics, and Dynamics: The Mechanics of Suction Feeding in Fishes. *Integrative and Comparative Biology*. 55 (1), 21. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1093/icb/icv032
- DeAngelis DL (2013). Intraspecific trait variation and its effects on food chains. *Mathematical Biosciences*. 244 (2), 91. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.mbs.2013.04.008
- Dembo M, Matzke NJ, Mooers AO, Collard M (2015). Bayesian analysis of a morphological supermatrix sheds light on controversial fossil hominin relationships. *Proceedings of the Royal Society B*. 282 (1812), 133. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1098/rspb.2015.0943
- Deng Q, Hui D, Wang J, Yu CL, Li C, Reddy KC, Dennis S (2016). Assessing the impacts of tillage and fertilization management on nitrous oxide emissions in a cornfield using the DNDC model. *Journal of Geographical Research: Biogeosciences*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1002/2015JG003239
- Donahue MJ, Karnauskas M, Toews C, Paris CB (2015). Location Isn't Everything: Timing of Spawning Aggregations Optimizes Larval Replenishment. *PLOS ONE*. 10 (6), e0130694. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1371/journal.pone.0130694
- Donohue K, Burghardt LT, Runcie D, Bradford KJ, Schmitt J (2015). Applying developmental threshold models to evolutionary ecology. *Trends in Ecology & Evolution*. 30 (2), 66. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.tree.2014.11.008
- Dorazio RM, Connor EF, Askins RA (2015). Estimating the effects of habitat and biological interactions in an avian community. *PLoS ONE*. 10 (8), e0135987. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1371/journal.pone.0135987

- Durand S, Schank JC (2015). The evolution of social play by learning to cooperate. *Adaptive Behavior*. 23 340. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1177/1059712315608243
- Earl JE, Whiteman HH (2015). Are Commonly Used Fitness Predictors Accurate? A Meta-analysis of Amphibian Size and Age at Metamorphosis. *Copeia*. 103 (2), 297. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1643/CH-14-128
- Edelaar P, et al (2015). Shared genetic diversity across the global invasive range of the monk parakeet suggests a common restricted geographic origin and the possibility of convergent selection. *Molecular Ecology*. 24 (9), 2164. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1111/mec.13157
- Eisenberg S, Rutten V, Koets AP (2015). Dam Mycobacterium avium subspecies paratuberculosis (MAP) infection status does not predetermine calves for future shedding when raised in a contaminated environment: a cohort study. *Special Issue of Veterinary Research*. 46 70. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1186/s13567-015-0191-2
- Elser JJ, Loladze I, Peace AL, Kuang Y (2012). Lotka re-loaded: Modeling trophic interactions under stoichiometric constraints. *Ecological Modelling*. 245 3. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.ecolmodel.2012.02.006
- Erickson RA, Eager EA, Stanton JC, Beston JA, Diffendorfer JE, Thogmartin WE (2015). Assessing local population vulnerability with branching process models: an application to wind energy development. *Ecosphere*. 6 (12), . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1890/ES15-00103.1
- Farrior CE, Bohlman SA, Hubbell S, Pacala SW (2016). Dominance of the suppressed: Power-law size structure in tropical forests. *Science*. 351 (6269), 155. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1126/science.aad0592
- Farrior CE, Rodriguez-Iturbe I, Dybzinski R, Levin SA, Pacala SW (2015). Decreased water limitation under elevated CO2 amplifies potential for forest carbon sinks. *PNAS*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1073/pnas.1506262112
- Federico P, Oremland M, Gurarie D, Fitzpatrick B, Lenhart S, Kanarek A (). Approximation and optimal control of a Rabbits-Grass ABM with a ODE/PDE system. *Not reported*. . Status = SUBMITTED; Acknowledgment of Federal Support = Yes
- Ferguson J, Ponciano JM (2015). Evidence and implications of higher order scaling in the environmental variation of animal population growth. *Proceedings of the National Academy of Sciences*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes
- Ferguson JM, Carvalho F, Murillo-Garcia O, Taper ML, Ponciano JM (2015). An updated perspective on the role of environmental autocorrelation in animal populations. *Theoretical Ecology*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1007/s12080-015-0276-6

- Fernandez R, Schubert M, Vargas-Velazquez AM, Brownlow A, Vikingsson GA, Siebert U, Jensen LF, Oien N, Wall D, Rogan E, Mikkelsen B, Dabin W, Alfarhan AH, Alquraishi SA, Al-Rasheid KAS, Guillot G, Orlando L (2016). A genomewide catalogue of single nucleotide polymorphisms in white-beaked and Atlantic white-sided dolphins. *Molecular Ecology Resources*. 16 (1), 266. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1111/1755-0998.12427
- Fitzpatrick B, Federico P (). An empirical system identification approach to control of agent-based models. *Not reported*. . Status = SUBMITTED; Acknowledgment of Federal Support = Yes
- Forbes VE, Galic N (2016). Next generation ecological risk assessment: predicting risk from molecular initiation to ecosystem service delivery. *Environmental International*. 91 215. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.envint.2016.03.002
- Franca ASC, Lobao-Soares B, Muratori L, Nascimento G, Winne J, Pereira CM, Jeronimo SMB, Ribeiro S (2015). D2 dopamine receptor regulation of learning, sleep and plasticity. *European Neuropsychopharmacology*. 25 (4), 493. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.euroneuro.2015.01.011
- Franz M, Altmann J, Alberts SC (2015). Knockouts of high-ranking males have limited impact on baboon social networks. *Current Zoology*. 61 107. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1093/czoolo/61.1.107
- Ganusov V, Klinkenberg D, Bakker D, Koets A (2015). Evaluating contribution of the cellular and humoral immune responses to the control of shedding of Mycobacterium avium spp. paratuberculosis in cattle. *Special Issue of Veterinary Research*. 46 62. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1186/s13567-015-0204-1
- Gao J, Hu J, Liu F, Cao Y (2015). Multiscale entropy analysis of biological signals: a fundamental bi-scaling law. *Frontiers in Computational Neuroscience*. 9 64. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.3389/fncom.2015.00064
- Gaoue OG (2015). Transient dynamics reveal the importance of early life survival to the response of a tropical plant to harvest. *Journal of Applied Ecology*. 53 (1), 112. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1111/1365-2664.12553
- Gaoue OG, Jiang J, Ding W, Agusto FB, Lenhart S (2015). Optimal harvesting strategies for timber and non-timber forest products in tropical ecosystems. *Theoretical Ecology*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes
- Gaoue OG, Ngonghala CN, Jiang J, Maud L (2015). Towards a mechanistic understanding of the synergistic effects of harvesting timber and non-timber forest products. *Methods in Ecology and Evolution*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1111/2041-210X.12493
- Gardner A (2010). Sex-biased dispersal of adults mediates the evolution of altruism among juveniles. *Journal of Theoretical Biology*. 262 (2), 339. Status = PUBLISHED;

Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.jtbi.2009.09.028

- Gavin et al (2014). Climate refugia: joint inference from fossil records, species distribution models and phylogeography. *New Phytologist*. 204 (1), 37. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1111/nph.12929
- Gavrilets S (2015). Collective action problem in heterogeneous groups. *Philosophical Transactions of the Royal Society B-Biological Sciences*. 370 (1683), . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1098/rstb.2015.0016
- Ghosh-Dastidar U (2015). Modeling the effect of vaccines on cholera transmission. *Journal of Biological Systems*. 23 (2), 323. Status = ACCEPTED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1142/S0218339015500175
- Gilchrist MA, Chen WC, Shah P, Landerer CL, Zaretzki R (2015). Estimating Gene Expression and Codon-Specific Translational Efficiencies, Mutation Biases, and Selection Coefficients from Genomic Data Alone. *Genome Biology and Evolution*. 7 (6), 1559. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1093/gbe/evv087
- Gilman RT, Kozak G (2015). Learning to speciate: the biased learning of mate preferences promotes adaptive radiation. *Evolution*. 69 (11), 3004. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes
- Gonzalez-Forero M (2015). Stable eusociality via maternal manipulation when resistance is costless. *Journal of Evolutionary Biology*. 28 (12), 2208. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1111/jeb.12744
- Gotteland C, McFerris B, Gilot-Fromont E, Zhao X, Lelu M (2014). Agricultural landscape and spatial distribution of Toxoplasma gondii in rural environment: an agent-based model. *International Journal of Health Geographics*. 13 45. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1186/1476-072X-13-45
- Grohn Y, Koets A (eds.) (2015). Modeling Johne's disease: From the inside out. *Special Issue of Veterinary Research*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes
- Grunloh N, Mangel M (2015). State-dependent behavioral theory and the evolution of play. *Adaptive Behavior*. 23 362. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1177/1059712315588613
- Guo Z, Adomas AB, Jackson ED, Qin H, Townsend JP (2011). SIR2 and other genes are abundantly expressed in long-lived natural segregants for replicative aging of the budding yeast Saccharomyces cerevisiae. *FEMS Yeast Res*. 11 (4), 345. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1111/j.1567-1364.2011.00723.x
- Gustison ML, Semple S, Ferrer-i-Cancho R, Bergman TJ (2016). Gelada vocal sequences follow Menzerath's linguistic law. *Proceedings of the National Academy of Sciences*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1073/pnas.1522072113

- Hamelin FM, Allen LJ, Prendeville HR, Hajimorad MR, Jeger MJ (2016). The evolution of plant virus transmission pathways. *Journal of Theoretical Biology*. 396 75. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.jtbi.2016.02.017
- Hamerlinck G, Lemoine NP, Hood GR, Abbott KC, Forbes AA (2016). Meek mothers with powerful daughters: effects of novel host environments and small trait differences on parasitoid competition. *Oikos*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1111/oik.02701
- Hill DE, Dubey JP, Baroch JA, Swafford SR, Fournet VF, Hawkins-Cooper D, Pyburn DG, Schmit BS, Gamble HR, Pedersen K, Ferreira LR, Verma SK, Ying Y, Kwok OCH, Feidas H, Theodoropoulos G (2014). Surveillance of feral swine for Trichinella spp. and Toxoplasma gondii in the USA and host-related factors associated with infection. *Veterinary Parasitology*. 205 (3-4), 653. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.vetpar.2014.07.026
- Hoban S, Strand A (2015). Ex situ seed collections will benefit from considering spatial sampling design and species' reproductive biology. *Biological Conservation*. 187 182. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.biocon.2015.04.023
- Hobson EA, DeDeo S (2015). Social feedback and the emergence of rank in animal society. *PLOS Computational Biology*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1371/journal.pcbi.1004411
- Hobson EA, John DJ, Mcintosh TL, Avery ML, Wright TF (2015). The effect of social context and social scale on the perception of relationships in monk parakeets. *Current Zoology, 61: 55–69*. 61 55. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes
- Holzman R, China V, Yaniv S, Zilka M (2015). Hydrodynamic Constraints of Suction Feeding in Low Reynolds Numbers, and the Critical Period of Larval Fishes. *Integrative and Comparative Biology*. 55 (1), 48. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1093/icb/icv030
- Houle D, Meyer K (2015). Estimating sampling error of evolutionary statistics based on genetic covariance matrices using maximum likelihood. *Journal of Evolutionary Biology*. 28 (8), 1542. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1111/jeb.12674
- Huang Y, Lechowicz MJ, Zhou D, Price CA (2016). Evaluating general allometric models: interspecific and intraspecific data tell different stories due to interspecific variation in stem tissue density and leaf size. *Oecologia*. 180 (3), 671. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1007/s00442-015-3497-x
- Iacona G, Price FD, Armsworth PR (2016). Predicting the presence and cover of management relevant invasive plant species on protected areas. *Journal of Environmental Management*. 166 537. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.jenvman.2015.10.052
- Ilany A, Booms AS, Holekamp KE (2015). Structural constraints on long-term social network dynamics in a wild mammal. *Ecology Letters*. 18 687. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1111/ele.12447

- Ilany A, Booms AS, Holekamp KE (2015). Topological effects of network structure on long-term social network dynamics in a wild mammal. *Ecology Letters*. 18 (7), 687. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1111/ele.12447
- Ingersoll et al (2015). A plan for the North American Bat Monitoring Program (NABat). *Gen. Tech. Rep. SRS-XXX. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes
- Jhwueng DC, Maroulas V (2016). Adaptive trait evolution in random environment. *Journal of Applied Statistics*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1080/02664763.2016.1140729
- Jiang J, DeAngelis DL, Teh SY, Krauss KW, Wang H, Li H, Smith TJ, Koh HL (2015). Defining the next generation modeling of coastal ecotone dynamics in response to global change. *Ecological Modelling*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.ecolmodel.2015.04.013
- Jiang Y, Qin H, Yang L (2015). Using network clustering to predict copy number variations associated with health disparities. *PeerJ*. 3 e677. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.7717/peerj.677
- Kawano SM, Blob RW (2015). Mixed chains of safety factors in the limb bones of salamanders: implications for differential limb function in the evolution of terrestrial locomotion. *Integrative and Comparative Biology*. 55 . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes
- Kawano SM, Economy DR, Kennedy MS, Dean D, Blob RW (2016). Comparative limb bone loading in the humerus and femur of the tiger salamander, Ambystoma tigrinum: testing the "mixed-chain" hypothesis for skeletal safety factors. *Journal of Experimental Biology*. 219 341. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1242/jeb.125799
- Kelly MR, Tien JH, Eisenberg MC, Lenhart S (2016). The impact of spatial arrangements on epidemic disease dynamics and intervention strategies. *Journal of Biological Dynamics*. 10 (1), 222. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1080/17513758.2016.1156172
- Kelly MR, Xing YL, Lenhart S (2016). Optimal fish harvesting for a population modeled by a nonlinear parabolic partial differential equation. *Natural Resource Modeling*. 29 (1), 36. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1111/nrm.12073
- Kershenbaum A, Garland EC (2015). Quantifying similarity in animal vocal sequences: which metric performs best?. *Methods in Ecology and Evolution*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1111/2041-210X.12433
- Kershenbaum A, Root-Gutteridge H, Habib B, Koler-Matznick J, Mitchell B, Palacios V, Waller S (2016). Disentangling canid howls across multiple species and subspecies: Structure in a complex communication channel. *Behavioural Processes*. 124 149. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.beproc.2016.01.006

- Kingsolver JG, Heckman N, Zhang J, Carter PA, Knies JL, Stinchcombe J (2015). Genetic Variation, Simplicity, and Evolutionary Constraints for Function-Valued Traits. *The American Naturalist*. 166 E166. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1086/681083
- Klinkenberg D, Koets A (2015). The long subclinical phase of Mycobacterium avium ssp. paratuberculosis infections explained without adaptive immunity. *Special Issue of Veterinary Research*. 46 63. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1186/s13567-015-0202-3
- Koets A, Eda S, Sreevatsan S (2015). The within host dynamics of Mycobacterium avium ssp. paratuberculosis infection in cattle: where time and place matter. *Special Issue of Veterinary Research*. 46 61. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1186/s13567-015-0185-0
- Koets AP, Grohn YT (2015). Within- and between-host mathematical modeling of Mycobacterium avium subspecies paratuberculosis (MAP) infections as a tool to study the dynamics of host-pathogen interactions in bovine paratuberculosis. *Special Issue of Veterinary Research*. 46 60. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1186/s13567-015-0205-0
- Krishna NA, Pennington HM, Coppola CD, Eisenberg MC, Schugart RC (2015). Connecting local and global sensitivities in a mathematical model for wound healing. *Bulletin of Mathematical Biology*. 77 (12), 2294. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1007/s11538-015-0123-3
- Krivan V, Lewis M, Bentz BJ, Liebhold A, Lenhart SM, Bewick S (2015). A Dynamical Model for Bark Beetle Outbreaks. *Journal of Theoretical Biology*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes
- Krueger-Hadfield S, Hoban S (2016). The importance of effective sampling for exploring the population dynamics of haplo-diploid organisms. *Journal of Phycology*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1111/jpy.12366
- Kubatko L, Shah P, Herbei R, Gilchrist MA (2016). A codon model of nucleotide substitution with selection on synonymous codon usage. *Molecular Phylogenetics and Evolution*. 94 290. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.ympev.2015.08.026
- Landscape Genomic WG (). A perspective on the pitfalls of experimental design in landscape genomic studies. *Not reported*. . Status = OTHER; Acknowledgment of Federal Support = Yes
- Lanzas C, Chen S (2015). Complex System Modeling for Veterinary Epidemiology. *Preventive Veterinary Medicine*. 118 (2-3), 207. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes
- Layton AT, Edwards A (2015). Introduction to mathematical modeling of blood flow control in the kidney. *AWM proceedings for NIMBioS WS for Women in Mathematical Biology*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes
- Leander R, Lenhart S, Protopopescu V (2015). Controlling synchrony in a network of Kuramoto oscillators with time-varying coupling. *Physica D-Nonlinear Phenomena*. 301

36. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.physd.2015.03.003

- Leander R, Lenhart S, Protopopescu V (2015). Optimal control of continuous systems with impulse controls. *Optimal Control Applications & Methods*. 36 (4), 535. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1002/oca.2128
- LeGrand EK, Day J (2016). Self-harm to Preferentially Harm the Pathogens Within: Non-specific Stressors in Innate Immunity. *Proceedings of the Royal Society B*. 283 20160266. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1098/rspb.2016.0266
- Leinster T, Meckes MW (2016). Maximizing Diversity in Biology and Beyond. *Entropy*. 18 (3), 88. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.3390/e18030088
- Levi T, Keesing K, Oggenfuss K, Ostfeld RS (2015). Accelerated phenology of blacklegged ticks under climate warming. *Philosophical Transactions of the Royal Society B: Biological Sciences*. 370 (1665), . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1098/rstb.2013.0556
- Leviyang S, Ganusov V (2015). Broad CTL Response in Early HIV Infection Drives Multiple Concurrent CTL Escapes. *PLoS Computational Biology*. 11 (10), e1004492. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1371/journal.pcbi.1004492
- Levy B, Collins C, Lenhart S, Madden M, Corn J, Salinas RA, Stiver W (2015). A metapopulation model for feral hogs in Great Smoky Mountains National Park. *Natural Resource Modeling*. 29 (1), 71. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1111/nrm.12080
- Levy B, Collins C, Lenhart S, Madden M, Corn J, Salinas RA, Stiver W (2015). Modeling feral hogs in Great Smoky Mountains National Park. *Natural Resource Modeling*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes
- Li Y, Gaillard JR, McLaughlin T, Sorensen TIA, Periwal V (2015). Macro fat and micro fat: Insulin sensitivity and gender dependent response of adipose tissue to isocaloric diet change. *Adipocyte*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes
- Louzoun Y, Mitchell R, Behar H, Schukken Y (2015). Two state model for a constant disease hazard in paratuberculosis (and other bovine diseases). *Special Issue of Veterinary Research*. 46 67. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1186/s13567-015-0189-9
- Magombedze G, Eda S, Stabel J (2016). Predicting the Role of IL-10 in the Regulation of the Adaptive Immune Responses in Mycobacterium avium Subsp. paratuberculosis Infections Using Mathematical Models. *PLOS One*. 10 (11), e0141539. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1371/journal.pone.0141539
- Magombedze G, Seda S, Marteen E, Koets A (2016). Can immune response mechanisms explain the fecal shedding patterns of cattle infected with Mycobacaterium avium subspecies paratuberculosis?. *Not reported*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes

- Maikai BV, Umoh JU, Maikai VA (2015). Insight into malaria transmission and control in endemic areas. *International Society for Disease Surveillance*. 7 (1), e198. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.5210/ojphi.v7i1.5954
- Mallela A, Lenhart S, Vaidya NK (2016). HIV-TB Co-infection Treatment: Modeling and Optimal Control Theory Perspectives. *Journal of Computational and Applied Mathematics*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes
- Manlove et al (2016). One Health or Three? Publication silos among the One Health disciplines. *PLoS Biology*. . Status = ACCEPTED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes
- Maroulas V, Nebenfuehr A (2015). Tracking rapid intracellular movements: A Bayesian random set approach. *Annals of Applied Statistics*. 9 (2), 926. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1214/15-AOAS819
- Martcheva M, Lenhart S, Eda S, Klinkenberg D, Momotani E, Stabel J (2015). An immuno-epidemiological model for Johne's Disease in cattle. *Veterinary Research Journal*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes
- Martcheva M, Lenhart S, Eda S, Klinkenberg D, Momotani E, Stabel J (2015). An immuno-epidemiological model for Johne's disease in cattle. *Special Issue of Veterinary Research*. 46. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1186/s13567-015-0190-3
- Martinez MV, Lenhart S, White KAJ (2015). Optimal control of integrodifference equations in a pest-pathogen system. *Discrete and Continuous Dynamical Systems - Series B*. 20 (6), 1759. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.3934/dcdsb.2015.20.1759
- Matzke N (2016). The evolution of antievolution policies after Kitzmiller v. Dover. *Science*. 351 (6268), 10. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1126/science.aad4057
- Matzke NJ (2013). Probabilistic historical biogeography: new models for founder-event speciation, imperfect detection, and fossils allow improved accuracy and model-testing. *Frontiers of Biogeography*. 5 (4), 242. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI:
- Matzke NJ, Shih PM, Kerfeld CA (2014). Bayesian Analysis of Congruence of Core Genes in Prochlorococcus and Synechococcus and Implications on Horizontal Gene Transfer. *PLoS One*. 9 (1), e85103. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1371/journal.pone.0085103
- McInroe B, Gong C, Kawano S, Astley H, Blob RW, Choset H, Goldman DI (2016). Robotic and mathematical modeling reveals principles of appendage coordination in terrestrial locomotion. *Integrative and Comparative Biology*. 56 E145. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes
- Mcinroe BM, Astley HC, Kawano SM, Blob RW, Goldman DL (2015). Biological and robotic modeling of the evolution of legged locomotion on land. *Integrative and*

Comparative Biology. 55 (E123), . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

- Meik JM, Streicher JW, Lawing AM, Flores-Villela O, Fujita MK (2015). Limitations of Climatic Data for Inferring Species Boundaries: Insights from Speckled Rattlesnakes. *PLOS One*. 10 (6), e0131435. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1371/journal.pone.0131435
- Mesterton-Gibbons M, Dai Y, Goubault M (2016). Modeling the evolution of winner and loser effects: A survey and prospectus. *Mathematical Biosciences*. 274 33. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.mbs.2016.02.002
- Meyer EL, Matzke NJ, Williams SJ (2015). Remote sensing of intertidal habitats predicts West Indian topsnail population expansion but reveals scale-dependent bias. *Journal of Coastal Conservation*. 19 (2), 107. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1007/s11852-014-0371-7
- Mickens R (2016). Mathematical and numerical comparisons of five single-population growth models. *Journal of Biological Dynamics*. 10 (1), 95. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1080/17513758.2015.1112041
- Milt AW, Gagnolet T, Armsworth PR (2016). Synergies and Tradeoffs Among Environmental Impacts Under Conservation Planning of Shale Gas Surface Infrastructure. *Environmental Management*. 57 (1), 21. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1007/s00267-015-0592-z
- Mitchell R, Schukken Y, Koets A, Weber M, Bakker D, Stabel J, Whitlock R, Louzoun Y (2015). Differences in intermittent and continuous fecal shedding patterns between natural and experimental Mycobacterium avium subspecies paratuberculosis infections in cattle. *Special Issue of Veterinary Research*. 46 66. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1186/s13567-015-0188-x
- Munther D, Luo Y, Wu J, Magpantay FM, and Srinivasan P (2015). A mathematical model for pathogen cross-contamination dynamics during produce wash. *Food Microbiol*. 51 101. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes
- Munther D, Sun, X, Xiao Y, Tang S, Shimozako HJ, Wu J, Smith BA, Fazil A (2016). Modeling cross-contamination during poultry processing: Dynamics in the chiller tank. *Food Control*. 59 271. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.foodcont.2015.05.007
- Ngonghala C, Mohammed-Awel J, Zhao R, Prosper O (2016). Interplay between insecticide-treated bed-nets and mosquito demography: implications for malaria control. *Journal of Theoretical Biology*. 397 (2016), 179. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.jtbi.2016.03.003
- Noon K, Welsh CJE, Ingersoll T (2013). Analysis of changes in wintering bird numbers using the Knoxville Christmas Bird Count as a case study. *The Migrant*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes

- O'Meara BC, Graham KL, Pellis SM, Burghardt GM (2015). Evolutionary models for the retention of adult-adult play in primates: The roles of diet and other factors associated with resource acquisition. *Adaptive Behaviour*. 23 381. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1177/1059712315611733
- O'Regan SM, Vinson JE, Park A (2015). Interspecific contact and competition may affect the strength and direction of disease-diversity relationships for directly transmitted microparasites. *American Naturalist*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1086/682721
- Oremland M, DeAngelis C, Susmann H, Twohy E, Laubenbacher R (). A framework for solving optimization problems for agent-based models. *Not reported.*. . Status = OTHER; Acknowledgment of Federal Support = Yes
- O'Regan SM, Lillie JW, Drake JM (2015). Leading indicators of mosquito-borne disease elimination. *Theoretical Ecology*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1007/s12080-015-0285-5
- Palagi E, Cordoni G, Demuru E, Bekoff M (2016). Fair play and its connection with social tolerance, reciprocity and the ethology of peace. *Behaviour*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1163/1568539X-00003336
- Palagi E, Nicotra V, Cordoni G (2016). Rapid mimicry and emotional contagion in domestic dogs. *Royal Society Open Science*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1098/rsos.150505
- Palagi E, Spada G (2014). Relaxed open mouth as a playful signal in wild ring-tailed lemurs. *American Journal of Primatology*. 76 (11), 1074. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes
- Pauley LR, Earl JE, Semlitsch RD (2015). Ecological effects and human use of commercial mosquito insecticides in aquatic communities. *Journal of Herpetology*. 49 (1), 28. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1670/13-036
- Peace A (2015). Effects of light, nutrients, and food chain length on trophic efficiencies in simple stoichiometric aquatic food chain models. *Ecological Modelling, 312: 125-135*. 312 125. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.ecolmodel.2015.05.019
- Pellis SM, Burghardt GM, Palagi E, Mangel M (2015). Modeling play: Distinguishing between origins and current functions. *Adaptive Behaviour*. 23 331. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1177/1059712315596053
- Pinter-Wollman N (2015). Editorial: An introduction to the special column on animal social networks. *Current Zoology*. 61 (1), 42. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes
- Pinter-Wollman N (2015). Persistent variation in spatial behavior affects the structure and function of interaction networks. *Current Zoology*. 61 (1), 98. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes
- Pope et al (2015). Whole genome comparison of a large collection of mycobacteriophages reveals a continuum of phage genetic diversity. *eLife*. 4 e06416.

Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.7554/eLife.06416

- Prokop ZM, Drobniak SM (2016). Genetic variation in male attractiveness: It's time to see the forest for the trees. *Evolution*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1111/evo.12898
- Qin H, Driks A (2013). Contrasting evolutionary patterns of spore coat proteins in two Bacillus species groups are linked to a difference in cellular structure. *BMC Evolutionary Biology*. 13 261. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1186/1471-2148-13-261
- Qin H, Shapiro A, Yang L (editors) (2012). Emerging infectious disease: A computational multi-agent model. *IEEE 2012 ASE International Conference on Biomedical Computing*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes
- Read Q, Hoban S, Schweitzer J, Eppinga M, and Bailey J (2016). Accounting for the nested nature of genetic variation across levels of organization improves our understanding of biodiversity and community ecology. *Oikos*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1111/oik.02760
- Ribeiro TL, Ribeiro S, Copelli M (2016). Repertoires of Spike Avalanches Are Modulated by Behavior and Novelty. *Frontiers in Neural Circuits*. 10 . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.3389/fncir.2016.00016
- Robins J, Bogen S, Francis A, Westhoek A, Kanarek A, Lenhart S, Eda S (2015). Agent-based model for Johne's disease dynamics in a dairy herd. *Special Issue of Veterinary Research*. 46. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1186/s13567-015-0195-y
- Rodhouse TJ, PC Ormsbee, KM Irvine, LA Vierling, JM Szewczak, KT Vierling (2015). Establishing a conservation baseline with dynamic distribution models for bats facing imminent decline. *Diversity and Distributions*. 21 1401. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1111/ddi.12372
- Ross C, Hooper P, Borgerhoff Mulder M (2015). Data on the frequency of non-reproductive adults in a cross-cultural sample of small-scale human societies. *bioRxiv*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1101/032318
- Rua MA, Wilson EC, Steele S, Munters AR, Hoeksema JD, Frank AC (2016). Associations between Ectomycorrhizal Fungi and Bacterial Needle Endophytes in Pinus radiata: Implications for Biotic Selection of Microbial Communities. *Frontiers in Microbiology*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.3389/fmicb.2016.00399
- Saldana A, Calzada JE, Pineda V, Perea M, Rigg C, Gonzalez K, Santamaria AM, Gottdenker NL, Chaves LF (2015). Risk factors associated with Trypanosoma cruzi exposure in domestic dogs from a rural community in Panama. *Memórias do Instituto Oswaldo Cruz, Rio de Janeiro*. 110 (7), 936. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1590/0074-02760150284

- Schank JC (2015). The evolution and function of play. *Adaptive Behavior*. 23 329. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1177/1059712315611964
- Schneider MC, Najera P, Pereira MM, Machado G, dos Anjos CB, Rodrigues RO, Cavagni GM, Munoz-Zanzi C, Corbellini LG, Leone M, Buss DF, Aldighieri S, Espinal MA (2015). Leptospirosis in Rio Grande do Sul, Brazil: An Ecosystem Approach in the Animal-Human Interface. *PLOS Neglected Tropical Diseases*. 9 (11), e0004095. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1371/journal.pntd.0004095
- Schukken YH, Whitlock RH, Wolfgang D, Gorhn Y, Beaver A, VanKessel J, Zurakowski M, Mitchell R (2015). Longitudinal data collection of Mycobacterium avium subspecies Paratuberculosis infections in dairy herds: the value of precise field data. *Special Issue of Veterinary Research*. 46 65. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1186/s13567-015-0187-y
- Sgouralis I, Layton AT (2015). Modeling blood flow and oxygenation in a diabetic rat kidney. *AWM proceedings for NIMBioS WS for Women in Mathematical Biology*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes
- Shizuka D, Farine DR (2016). Measuring the robustness of network community structure using assortativity. *Animal Behaviour*. 112 237. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.anbehav.2015.12.007
- Slater N, Mitchell RM, Whitlock RH, Fyock T, Pradhan AK, Knupfer E, Schukken YH, Louzoun Y (2016). Impact of the shedding level on transmission of persistent infections in Mycobacterium avium subspecies paratuberculosis (MAP). *Veterinary Research*. 47 (1), 38. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes
- Smith JE, Estrada JR, Richards HR, Dawes SE, Mitsos K, Holekamp KE (2015). Collective movements, leadership and consensus costs at reunions in spotted hyaenas. *Animal Behaviour*. 105 187. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.anbehav.2015.04.023
- Smith JE, Gavrilets S, Borgerhoff Mulder M, Hooper PL, El Moudon C, Nettle D, Hauert C, Hill K, Perry S, Pusey AE, van Vugt M, Alden Smith E (2015). Leadership in Mammalian Societies: Emergence, Distribution, Power, and Payoff. *Trends in Ecology & Evolution*. 31 (1), 54. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.tree.2015.09.013
- Smuts B, Bauer E, Ward C (2015). Rollovers during play: Complementary perspectives. *Behavioural Processes*. 116 50. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.beproc.2015.04.006
- Spencer M, Bruno JF, Cooper JK (2015). Stochastic dynamics of a warmer Great Barrier Reef. *Ecology*. 96 (7), 1802. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes
- Spinka M, Paleckova M, Rehakova M (2015). Metacommunication in social play: The meaning of aggression-like elements is modified by place faces in hanuman langurs (Semnopithecus entellus). *Behaviour*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

- Taylor CM, Laughlin AJ, Hall RJ (2016). The response of migratory populations to phenological change: a Migratory Flow Network modeling approach. *Journal of Animal Ecology*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes
- Teboh-Ewungkem M, Prosper O, Gurski K, Manore C, Peace A, Feng Z (2015). Intermittent preventive treatment (IPT) and the spread of drug resistant malaria. *The IMA Volumes in Mathematics and Its Applications*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes
- Teboh-Ewungkem MI, Mohammed-Awel J, Baliraine FN, Duke-Sylvester S (2014). The effect of intermittent preventive treatment on anti-malarial drug resistance spread in areas with population movement. *Malaria Journal*,. 13 428. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes
- Teufel AI, Masel J, and Liberles DA (2015). What fraction of duplicates observed in recently sequenced genomes is segregating and destined to fail to fix?. *Genome Biology and Evolution*. 7 (8), 2258. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1093/gbe/evv139
- Van Dam M, Matzke NJ (2016). Evaluating the Influence of Connectivity and Distance on Biogeographic Patterns in the Southwestern Deserts of North America. *Journal of Biogeography*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1111/jbi.12727
- Van Wassenbergh S, Day SW, Hernandez LP, Higham TE, Skorczewski T (2015). Suction power output and the inertial cost of rotating the neurocranium to generate suction in fish. *Journal of Theoretical Biology*. 372 (2015), 159. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.jtbi.2015.03.001
- Vernesi C, Hoban S, Pecchioli E, Crestanello B, Bertorelle G, Rosà R, Hauffe H (2016). Ecology, environment and evolutionary history influence genetic structure in five mammal species from Italian Alps. *Biological Journal of the Linnean Society*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1111/bij.12651
- Wainwright PC, McGee MD, Longo SJ, Hernandez JP (2015). Origins, Innovations, and Diversification of Suction Feeding in Vertebrates. *Integrative and Comparative Biology*. 55 (1), 134. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes
- Wang YP, Jiang J, Chen-Charpentier B, Agusto FB, Hastings A, Hoffman F, Rasmussen M, Smith MJ, Todd-Brown K, Wang Y, Xu X, Luo YQ (2016). Responses of two nonlinear microbial models to warming and increased carbon input. *Biogesciences*. 13 (4), 887. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.5194/bg-13-887-2016
- Weitz et al (2015). A multitrophic model to quantify the effects of marine viruses on microbial food webs and ecosystem processes. *The ISME Journal*. 9 (6), 1352. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1038/ismej.2014.220
- Whitehead H, James R (2015). Generalized affiliation indices extract affiliations from social network data. *Methods in Ecology and Evolution*. 6 (7), 836. Status =

PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1111/2041-210X.12383

- Wigington CH, Sonderegger D, Brussaard CPD, Buchan A, Finke JF, Fuhrman JA, Lennon JT, Middelboe M, Suttle CA, Stock C, Wilson WH, Wommack KE, Wilhelm SW, Weitz JS (2016). Re-examination of the relationship between marine virus and microbial cell abundances. *Nature Microbiology*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1038/nmicrobiol.2015.24
- Wommack KE, Nasko DJ, Chopyk J, Sakowski EG (2015). Counts and sequences, observations that continue to change our understanding of viruses in nature. *Journal of Microbiology*. 53 (3), 181. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1007/s12275-015-5068-6
- Yamamichi M, Meunier CL, Peace A, Prater C, Rua MA (2015). Rapid evolution of a consumer stoichiometric trait destabilizes consumer-producer dynamics. *Oikos*. 124 (7), 960. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1111/oik.02388
- Zefferman M, Mathew S (2015). An evolutionary theory of large-scale human warfare: Group-structured cultural selection. *Evolutionary Anthropology*. 24 (2), 50. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1002/evan.21439
- Zefferman MR (2016). Mothers teach daughters because daughters teach granddaughters: evolution of sex-biased transmission. *Behavioral Ecology*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1093/beheco/arw022
- Zenni RD, Hoban SM (2015). Loci under selection during multiple range expansions of an invasive plant are mostly population specific, but patterns are associated with climate. *Molecular Ecology*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1111/mec.13234
- Zhu S, Degnan JH, Eldon B (2015). Hybrid-Lambda: simulation of multiple merger and Kingman gene genealogies in species networks and species trees. *Systematic Biology*. 6 292. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes
- Zia A, Hammond Wagner C (2015). Mainstreaming Early Warning Systems in Development and Planning Processes: Multilevel Implementation of Sendai Framework in Indus and Sahel. *International Journal of Disaster Risk Science*. 6 (2), 189. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1007/s13753-015-0048-3
- Robins J, Bogen S, Francis A, Westhoek A, Kanarek A, Lenhart S, Eda S (2015). Agent-based model for Johne's disease dynamics in a dairy herd. *Veterinary Research Journal*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Licenses

Other Conference Presentations / Papers

Other Products

- *Educational aids or Curricula.*

  Ehrlich H. 2014. Research Project: Mapping the vector suitable habitat of dengue in Australia. Course Work, Tufts University.

- *Educational aids or Curricula.*

  Tsiligaridis J. 2012. New Course: Bioinformatics - Tools, Programming, and Algorithms.

- *Educational aids or Curricula.*

  Tsiligaridis J. 2013. New Course: Bioinformatics - Tools and Programming.

- *Educational aids or Curricula.*

  Waller S, Kershenbaum A. 2015. Student Internships recording wolves in Yellowstone National Park. PHL 492: Wolf Study, offered in Spring of 2015, Fall of 2015, Spring of 2016, and continuing. Typical enrollment: 3 students.

- *Data and Research Materials (e.g. Cell lines, DNA probes, Animal models).*

  Egizi A, Fefferman NH, Fonseca DM. 2015. Data: Evidence that implicit assumptions of ‘no evolution’ of disease vectors in changing environments can be violated on a rapid timescale. Dryad Digital Repository.

- *Data and Research Materials (e.g. Cell lines, DNA probes, Animal models).*

  Farrior CE, Rodriguez-Iturbe I, Dybzinski R, Levin SA, Pacala SW. 2015. Data: Decreased water limitation under elevated CO2 amplifies potential for forest carbon sinks.

- *Data and Research Materials (e.g. Cell lines, DNA probes, Animal models).*

  Hamerlinck G, Lemoine NP, Hood GR, Abbott KC, Forbes AA. 2016. Data from: Meek mothers with powerful daughters: effects of novel host environments and small trait differences on parasitoid competition. Dryad Digital Repository. 10.5061/dryad.c509n

- *Data and Research Materials (e.g. Cell lines, DNA probes, Animal models).*

  Kawano SM, Economy DR, Kennedy MS, Dean D, Blob RW. 2016. Data: Comparative limb bone loading in the humerus and femur of the tiger salamander, Ambystoma tigrinum: testing the "mixed-chain" hypothesis for skeletal safety factors. Dryad Digital Repository. 10.5061/dryad.7f1j1.2.

- *Data and Research Materials (e.g. Cell lines, DNA probes, Animal models).*

  Kingsolver JG, Heckman N, Zhang J, Carter PA, Knies JL, Stinchcombe JR, Meyer K. 2015. Data from: Genetic variation, simplicity and evolutionary constraints for function-valued traits. Dryad Digital Repository.

- *Data and Research Materials (e.g. Cell lines, DNA probes, Animal models).*

  Utsey K, Estes S, Kalobwe E, Zhao X, Finotti H. 2015. Wolfram Demonstration: Synthetic Fetal Electrocardiogram.

- *Award.*

  Bechette A, Stojsavljevic T, Tessmer M. 2014. The Journal of Great Lakes Research and Elsevier Student Award: Any student submitting a top-ranked paper and who is first author at the time of acceptance of the paper is eligible.

- *Grant/Proposal.*

  Cooke J, Lewis M. 2013-2017. The NSERC TRIA Network: Turning risk into action for the Mountain Pine Beetle epidemic. 2013-2017. Natural Sciences and Engineering Research Council of Canada Strategic Network Grants Program and Partners. $2,977,148.

- *Grant/Proposal.*

  Qin H. 2014-2016. XSEDE Start up allocation: 50,000 CPU Hours at the Blacklight Computing Cluster, 100,000 CPU Hours at the Open Science Grid.

- *Grant/Proposal.*

  Qin H. 2015-2016. Conference: A strategic planning workshop to explore quantitative biology as a vehicle for broad participation. NSF, $41k. Awarded.

- *Grant/Proposal.*

  Qin H. 2015-2020. Co-PI, NSF, MCB, Problem-based learning modules for systems biology (PI, Eberhard Voit, Georgia Tech), $500K. Award #1517588, $500K ($58.9K to Spelman College), Aug 1, 2015- July 31, 2018, awarded.

- *Grant/Proposal.*

  Qin H. 2015. XSEDE Educational allocation: 40,000 CPU Hours at the Gordon Computing Cluster.

- *Grant/Proposal.*

Sattenspiel L, Warren AL. 2015. Doctoral Dissertation Research: Simulating prehistoric population dynamics and adaptive behavioral responses to the environment in Long House Valley and Black Mesa, Arizona. $12,450. Accepted.

- *Grant/Proposal.*

  Schugart RC. 2016-2017. Developing and analyzing mathematical models in wound healing to engage undergraduate students in mathematical research. Council for Undergraduate Research in Mathematics, RDE-019. $25000. Applied.

- *Grant/Proposal.*

  Schugart RC. 2016-2017. Using Individual Data to Predict a Wound-Healing Outcome. Kentucky Science and Engineering Program - The Research and Development Program, RDE-019. $30000. Applied.

- *Grant/Proposal.*

  Sturner K, Lenhart S, Bishop P. 2015. 2016 Blackwell-Tapia Conference and Awards Ceremony. Alfred P. Sloan Foundation. $26,364. Accepted.

- *Grant/Proposal.*

  Voit E, Qin H. 2015-2018. Problem-based learning modules for systems biology. NSF, MCB. $500k. Accepted.

- *Meeting/Workshop.*

  Bertherat E, Geffner L, Caldas E, Mendigana Paez F, Velasquez R, Gonzalez Arrebato J. 2015 November 10-12. Session 3 – Surveillance.

- *Meeting/Workshop.*

  Hartskeerl R, Cedeno H, Rajeev S, Pereira M. International Workshop of the Oswaldo Cruz Institute/FIOCRUZ for Leptospirosis Research Based on Country Needs & 5th Global Leptospirosis Environmental Action Network (GLEAN) Meeting, Rio de Janeiro, Brazil. Session 5: Current tools and emerging technologies for leptospirosis diagnosis.

- *Meeting/Workshop.*

  Hoban S. 2015 August 4. Conservation genetics in action. Round Table Discussion, International Congress for Conservation Biology, Montpelier, France.

- *Meeting/Workshop.*

Jancloes M, Schneider C, Bertherat E, Costa F, Molina B, Allan K. 2015 November 10-12. Session 1: Setting the scene – Leptospirosis as an emerging and neglected disease.

- *Meeting/Workshop.*

  Munoz-Zanzi C, Salazar Y, Munoz-Zanzi C, Schneider C, Convertino M. 2015 November 10-12. Session 4: Prediction.

- *Meeting/Workshop.*

  Schneider C, Jancloes M, Benschop J, Previtali A. International Workshop of the Oswaldo Cruz Institute/FIOCRUZ for Leptospirosis Research Based on Country Needs & 5th Global Leptospirosis Environmental Action Network (GLEAN) Meeting, Rio de Janeiro, Brazil. Panel Discussion: The "One Health" approach.

- *Poster.*

  Boribong B, Cruz M, Hong F, Earl J, Hoban S. 2015. A meta-analysis of coastal populations' genetic diversity of species throughout their range. Joint Mathematics Meeting, San Antonio, TX.

- *Poster.*

  Levy B. 2015 June. Modeling Feral Hogs in Great Smoky Mountains National Park. Mathematics of Planet Earth Workshop on Management of Natural Resource, Howard University, Washington DC.

- *Poster.*

  Levy B. 2015 September. Modeling Feral Hogs in Great Smoky Mountains National Park. Mathematics of Planet Earth Workshop on Education for the Planet Earth of Tomorrow, National Institute for Mathematical & Biological Synthesis, Knoxville, TN.

- *Presentation.*

  Rohly M. 2015 November. Exploring host-pathogen interactions with agent-based models in NetLogo. NIMBioS Undergraduate Research Conference at the Interface of Mathematics and Biology, Knoxville, TN.

- *Presentation.*

  2015 November. Modeling Canine Distemper Virus in an Animal Shelter. Southern Africa Mathematical Sciences Association Annual Conference, Windhoek, Namibia.

- *Presentation.*

Barocas A. 2015 June. Latrine visits and fission-fusion dynamics in coastal Alaska river otters. Animal Behavior Society, Anchorage, AK.

- *Presentation.*

  Carter PA. 2015 June. Evolution of Biological Shape: A Function-Valued Approach. Seminar, Institute of Biological & Environmental Sciences, Aberdeen University, Scotland.

- *Presentation.*

  Carter PA. 2015 June. Evolution of Biological Shape: A Function-Valued Approach. Seminar, Statistical Laboratory, Cambridge University, England.

- *Presentation.*

  Carter PA. 2015 May. Evolution of Biological Shape: A Function-Valued Approach. Seminar, Dept. of Biology and Biochemistry, University of Bath, England.

- *Presentation.*

  Carter PA. 2015 May. Evolution of Biological Shape: A Function-Valued Approach. Seminar, Paris Descartes Univeristy & Institut National du Sport et de l'éducation Physique, France.

- *Presentation.*

  Cho E. 2015 August. Application of Algebraic Topology to Data Analysis. US Korea Conference 2015 on Science and Technology, Atlanta.

- *Presentation.*

  Cressie N. 2011 August. Spatio-temporal statistics. CSIRO Workshop on Statistics for Spatio-Temporal Data, CSIRO, Canberra, Australia.

- *Presentation.*

  Ehrlich H, Koch M, Mor S, Naumova EN. 2015 March. Mapping the potential transmission of dengue in Australia. Proceedings of the 3rd OneHealth Congress, The Netherlands.

- *Presentation.*

  Forbes VE, Galic N. 2016 March 23. Predicting human impacts on ecological systems and the need for mechanistic models. Department of Ecology, Evolution and Behavior, University of Minnesota.

- *Presentation.*

  Gotteland C, Forin-Wiart MA, Poulle ML, Charbonnel N, Gilot-Fromont E, Villena I. 2012. Spatial distribution of soil and animal contamination by Toxoplasma gondii in a rural area. European Multicolloquium of Parasitology, Kluj, Romania.

- *Presentation.*

  Gotteland C, Poulle ML, Charbonnel N, Villena I, Gilot-Fromont E. 2012. Spatial distribution of Toxoplasma gondii in animal populations and soil. 13th International Symposium on Veterinary Epidemiology and Economics, Maastricht, the Netherlands.

- *Presentation.*

  Hoban S. 2015. Invited Lecturer US Fish and Wildlife Service Advanced Conservation Genetics Training Webinar.

- *Presentation.*

  Hoffman FM, Smith M, Todd-Brown K, Luo Y, Wang Y. 2015 August 14. Explaining the sources of variation in CMIP5 models by fitting reduced complexity models to their simulation outputs. Ecological Society of America (ESA) 2015 Annual Meeting, Baltimore, MD.

- *Presentation.*

  Jerde C, Daszak P, Finnoff D, Smith K, Chadderton WL, Lodge D. 2010 June. Uncertainty in net present value emerging from punctuate rare event damages: Emerging infectious diseases and biological invasions. Organized Session at the 4th World Congress of Environmental and Resource Economics, Montreal, CA.

- *Presentation.*

  Kawano SM, Blob RW. 2014. Biomechanical comparisons of modern analogs for understanding the functional evolution of terrestrial locomotion in early stem tetrapods. Society for Vertebrate Paleontology Meeting. Berlin, Germany.

- *Presentation.*

  Kawano SM, Blob RW. 2015. Hack the past: resurrecting the dead in silico. Ecological Society of America Centennial Meeting, Invited Ignite Session - "Hacking ecology: the infiltration of coding in ecology for data integration, analysis, and visualization", Baltimore, MD.

- *Presentation.*

Kawano SM, Blob RW. 2015. Mixed chains of safety factors in the limb bones of salamanders: implications for differential limb function in th evolution of terrestrial locomotion. Society for Integrative and Comparative Biology Meeting. Division of Comparative Biomechanics Best Student Talk Finalist. West Palm Beach, FL.

- *Presentation.*

  Kawano SM. 2014 September. Applying biological models to understand how vertebrate animals moved onto land. University of Texas, El Paso. Bioinformatics Program.

- *Presentation.*

  Kawano SM. 2015 July. One small step for stem tetrapods, one giant leap for tetrapod evolution. University of Wisconsin, Parkside. Department of Biological Sciences.

- *Presentation.*

  Kawano SM. 2016 January. A synthesis of quantitative methods to estimate patterns of phenotypic selection. Society for Integrative and Comparative Biology, Oregon Convention Center.

- *Presentation.*

  Koets AP. 2015 June. Keynote lecture: Pathogenomics and MAP biology in Parma, Italy. 12th International Colloquium on Paratuberculosis (ICP).

- *Presentation.*

  Koets AP. 2015 September. Invited lecture: Vaccination and memory. 5th European Veterinary Immunology Workgroup, Vienna, Austria.

- *Presentation.*

  Ledder G. 2015 January. A carbon economy model for tree growth. Joint Mathematics Meetings, San Antonio.

- *Presentation.*

  Ledder G. 2015 July. Allocation of resources in two-component systems. SMB annual meeting, Atlanta, GA.

- *Presentation.*

  Levy B. 2014 July. Modeling Feral Hogs in Great Smoky Mountains National Park. Society for Industrial & Applied Mathematics Annual Meeting Special Session for Student Research, Chicago, IL.

- *Presentation.*

  Levy B. 2014 November. Modeling Feral Hogs in Great Smoky Mountains National Park. Mathematics Seminar at Maryville College, Maryville, TN.

- *Presentation.*

  Levy B. 2014 November. Modeling Feral Hogs in Great Smoky Mountains National Park. Southern Africa Mathematical Sciences Association Annual Conference, Victoria Falls, Zimbabwe.

- *Presentation.*

  Levy B. 2014 October. Modeling Feral Hogs in Great Smoky Mountains National Park. International Symposium on Biomathematics & Ecology: Education & Research, Harvey Mudd College, Claremont, CA.

- *Presentation.*

  Levy B. 2015 June. Modeling Feral Hogs in Great Smoky Mountains National Park to Assess the Importance of a Control Program. Society for Mathematical Biology Annual Conference Session on Discrete Population Models with Management Features, Atlanta, GA.

- *Presentation.*

  Levy B. 2016 January. Modeling Feral Hogs in Great Smoky Mountains National Park to Evaluate Control Efforts and Analyze the Population's Niche. Joint Mathematics Meetings AMS Special Session on Mathematics in Natural Resource Modeling, Seattle, WA.

- *Presentation.*

  Long K, Bieri JA, Dissanayake C, Erickson R, Thogmartin WE. 2015 January. A continuous energy-based model for the migration of species in a network. Joint Mathematics Meeting, Seattle, WA.

- *Presentation.*

  Mallela A, Lenhart S, Vaidya N. 2015 May 19. Optimal Treatment Strategies for HIV-TB Co-Infected Individuals. Topics in Feedback/Control/Optimization II, 2015 SIAM Conference on Applications of Dynamical Systems, Snowbird, UT.

- *Presentation.*

McInroe B, Astley H, Kawano SM, Blob RW, Goldman DI. 2015. Biological and robotic modeling of the evolution of legged locomotion on land. Society for Integrative and Comparative Biology Meeting. West Palm Beach, FL.

- *Presentation.*

  McInroe B, Astley H, Kawano SM, Blob RW, Goldman DI. 2015. Animal and robot experiments to discover principles behind the evolution of a minimal locomotor apparatus for robust legged locomotion. American Physical Society Meeting, San Antonio, TX.

- *Presentation.*

  Minter A. 2015 April. Understanding the mechanisms of a zoonotic reservoir: Leptospira infection in Rattus norvegicus in urban slums in Brazil. British Society for Parasitology, Liverpool, UK.

- *Presentation.*

  Minter A. 2015 December. Understanding the mechanisms of a zoonotic reservoir: Leptospira infection in Rattus norvegicus in urban slums in Brazil.

- *Presentation.*

  Minter A. 2015 May. Understanding the mechanisms of a zoonotic reservoir: Leptospira infection in Rattus norvegicus in urban slums in Brazil. Ecology & Evolution of Infectious Diseases, Athens, Georgia.

- *Presentation.*

  Muller E. 2015 April. Dynamic Energy Budget Theory as integrative hub for evaluating organismal performance in multivariate environments. Keynote lecture, International Symposium on Dynamic Energy Budget Theory, Marseille, France.

- *Presentation.*

  Muller E. 2016 January. Metabolic theory as integrative hub for evaluating the performance of organisms and symbiotic assemblages in multivariate environments. Departmental seminar, Universite Francois Rabelais de Tours, France.

- *Presentation.*

  Myers L. 2011 August. How individual variation in contact behavior influences the spread of disease. ESA Symposium, The Ecological Consequences of Intraspecific Variation.

- *Presentation.*

  Nisbet R, Ledder G, Russo S, Bartlett M, Farrior C, Couvreur V, Muller E, Peace A, Poorter L, Sack L, Sterck F, Way DA, Zimmer E. 2015. DEB modeling of tree performance to predict functional trait drivers, species distributions, and responses to global change. Dynamic Energy Budget Symposium, Marseille, France.

- *Presentation.*

  Nisbet R. 2015 April. DEB Modeling of Tree Performance. International Symposium on Dynamic Energy Budget Theory, Marseille, France.

- *Presentation.*

  Palagi E. 2016. The strategic functions of play: modality and communication. Darwin Day Celebration, University of Alabama, Birmingham.

- *Presentation.*

  Panchanathan K. 2016 February. The evolution of sustainability fishing through cultural multi-level selection. Department of Anthropology, U.C. Davis.

- *Presentation.*

  Parkman V. 2015 November. Canine distemper outbreak modeled in an animal shelter. NIMBioS Undergraduate Research Conference at the Interface of Mathematics and Biology, Knoxville, TN.

- *Presentation.*

  Peace A. 2015 July. Ecotoxicological stoichiometric model of Methylmercury bioaccumulation in Daphnia. Fishheads Seminar, Oak Ridge National Laboratory.

- *Presentation.*

  Peace A. 2015 June. Somatic growth dilution: Toxin predator-prey model under stoichiometric constraints. Micro and Macro Systems in Life Sciences Conference, Stefan Banach International Mathematical Center Bedlewo, Poland.

- *Presentation.*

  Peace A. 2015 June. Modeling the effects of co-occurring nutrient and contaminant stressors in aquatic systems. Conference on Biological Stoichiometry, Trent University Peterborough, Ontario, Canada.

- *Presentation.*

Pigoli D, Aston JAD, Carter PA. 2015 December. Curve registration in function-valued quantitative genetics. The 8th International Conference of The European Research Consortium for Informatics and Mathematics Working Group on Computational and Methodological Statistics, London, England.

- *Presentation.*

  R Miller Neilan. 2015 June. Optimal control of the Sugarscape ABM via a PDE model. Society of Math Biology Annual Meeting, Georgia State University.

- *Presentation.*

  R Miller Neilan. 2015 October. Optimal control of the Sugarscape ABM via a PDE model.

- *Presentation.*

  Rogers A, Medlyn B, Dukes J, Bonan G, von Caemmerer S, Dietze M, Kattge J, Leakey A, Mercado L, Niinemets Ü, Prentice I, Serbin S, Sitch S, Way DA, Zaehle S. 2015. Improving the representation of photosynthesis in Earth system models. American Geophysical Union, San Francisco, CA.

- *Presentation.*

  Rohly M. 2016 February. Modeling host-pathogen interactions using agent-based models. Columbus State University.

- *Presentation.*

  Rua MA. 2015 October. Educational talk at Ecology and Evolution seminar, mentored and judged at the annual meeting. SACNAS, National Harbor, MD.

- *Presentation.*

  Rua MA. 2016. Exploring the relative importance of biotic and abiotic sources of for pine-fungal interaction. University of Michigan, Early Career Scientists Symposium, Ann Arbor, MI.

- *Presentation.*

  Russo SE. 2014 December. A mechanistic dynamic energy budget model to predict tropical tree species distributions. Invited oral presentation: International semi-open workshop on carbon cycling in the tropical and subtropical forests, Ryukyu University, Japan.

- *Presentation.*

Russo SE. 2014 July. A mechanistic dynamic energy budget model to predict tropical tree species distributions. Annual meeting of the Association for Tropical Biology and Conservation, Cairns, Australia.

- *Presentation.*

  Russo SE. 2014 November. A mechanistic dynamic energy budget model to predict tropical tree species distributions. Invited oral presentation: 4th Taiwan-Japan Ecology Workshop, National Dong Hwa University, Taiwan.

- *Presentation.*

  Sample C. 2016 January. A fundamental modeling framework for spatio-temporal population dynamics. Special session on Mathematics in Natural Resource Modeling, Joint Mathematics Meetings, Seattle, WA.

- *Presentation.*

  Sattenspiel L, Warren A, Swedlund AC, Gumerman GJ III. 2014 March. The reincarnation of Artificial Anasazi: How the grandfather of agent-based models in archaeology is morphing into the Artificial Long House Valley project. Santa Fe Institute.

- *Presentation.*

  Sattenspiel L, Warren AL, Swedlund AC, Gumerman GJ. 2015 February. Modeling environmental and demographic effects on population size in the Southwest US. American Association for the Advancement of Science, San Jose, CA.

- *Presentation.*

  Schugart RC. 2015 November. Can Mathematics Heal All Wounds?. Seminar Talk, National Institute for Mathematical and Biological Synthesis, The University of Tennessee, Knoxville.

- *Presentation.*

  Schugart RC. 2015 November. Connecting local and global sensitivities for a mathematical model in wound healing. Contributed Talk, 35th Annual Mathematics Symposium, Western Kentucky University.

- *Presentation.*

  Schugart RC. 2015 November. Using Optimal Control Theory to Analyze the Treatment of a Bacterial Infection in a Wound Using Oxygen Therapy. Contributed Talk, 35th Annual Mathematics Symposium, Western Kentucky University.

- *Presentation.*

  Schugart RC. 2015 October. Connecting local and global sensitivities for a mathematical model in wound healing. Casual Seminar Talk, National Institute for Mathematical and Biological Synthesis, The University of Tennessee, Knoxville.

- *Presentation.*

  Schugart RC. 2015 October. Connecting local and global sensitivities for a mathematical model in wound healing. Contributed Talk, The 35th Southeastern Atlantic Conference on Differential Equations, The University of North Carolina, Greensboro.

- *Presentation.*

  Schugart RC. 2015 September. Can Mathematics Heal All Wounds?. Graduate Student Seminar Talk, Department of Mathematics, Western Kentucky University.

- *Presentation.*

  Sgouralis I, Schwartz F, Nebenfuhr, Maroulas V. 2015 May. A novel algorithm for automatic reconstruction of subcellular motion. 45th Annual John H. Barrett Memorial Lectures, University of Tennessee.

- *Presentation.*

  Sgouralis I. 2016 March. Mathematical modeling in renal physiology. Colloquium, Department of Mathematics and Statistics, Wright State University.

- *Presentation.*

  Sgouralis I. 2016. Mathematical modeling of kidney's blood flow. Seminar, Department of Mathematics and Computer Science, Fisk University.

- *Presentation.*

  Shimozako HJ. 2014 August. Pathogen cross contamination in chilling tanks: modelling and analysis. Fourth Annual CDM Incubation Day, York University's Centre for Disease Modeling.

- *Presentation.*

  Shimozako HJ. 2014 May. Pathogen cross contamination in chilling tanks: modelling and analysis. Biomath Days, University of Ottawa's Department of Mathematics.

- *Presentation.*

Spinka M. 2014 September 29. The role of play in shaping of behavioural phenotypes. Paper presented at the Zif and DFG Workshop, New perspectives in behavioural development: adaptive shaping of behaviour over a lifetime? September 29-October 2, 2014, Bielefeld, Germany.

- *Presentation.*

  Spinka M. 2015 September 9. Animal play behavior: Its role in cognition, evolution and welfare. Paper presented at the Jornada Uruguayas de Comportamiento Animal, September 7-9, 2015, Montevideo, Uruguay.

- *Presentation.*

  Sturner K, Lenhart S, Jenkins K, Reichart S. 2016. Biology by Numbers: Math and Life Science Are Better Together!. National Science Teachers Association.

- *Presentation.*

  Sturner K, Lucci K, Jenkins K. 2015 November. Integrating Math Across the Biology Curriculum: Opportunities for Quantitative Skills in Biology. National Association of Biology Teachers Professional Development Conference, Providence, RI.

- *Presentation.*

  Sturner K. 2014 September 26-27. Measuring Biodiversity with Probability. Tennessee Environmental Education Association Conference, Great Smoky Mountains Institute at Tremont, TN.

- *Presentation.*

  Tsiligaridis J. 2012 November 7-10. Consensus Discovery Membership Evaluation and Comparison of Profile HMM. Annual Biomedical Research Conference for Minority Students, San Jose, CA.

- *Presentation.*

  Tsiligaridis J. 2013 November 13-16. Approximation methods for Multiple Sequence Alignment based on Minimum Spanning Trees. Annual Biomedical Research Conference for Minority Students, ABRCMS 2013, Nashville, Tennessee.

- *Presentation.*

  Tsiligaridis J. 2014 July 21-24. Discovering Association Rules and Classification for Biological Data using Data Mining Methods. BioComp 2014, Las Vegas,Nevada.

- *Presentation.*

Tsiligaridis J. 2014 October 16-18. Consistency based MSA with Genetic Algorithms and Tabu search. SACNAS 2014, Los Angeles, USA.

- *Presentation.*

  Utsey K. 2014 January. Mathematical Modeling of Fetal Electrocardiograms. Joint Mathematics Meeting, Baltimore, MD.

- *Presentation.*

  Vasseur D, Amarasekare P, Levine J, Rudolf V. 2011 August. Intro – Phenotypic variance in a classic Lotka-Volterra competitive system. ESA Symposium, The Ecological Consequences of Intraspecific Variation.

- *Presentation.*

  Waller S. 2015 March. Cats talk back: Feral & socialized. Living with Animals Conference, Eastern Kentucky University.

- *Presentation.*

  Warren AL, Bhat U, Sattenspiel L, Swedlund AC, Gumerman GJ III. 2015 March. Exploring the effects of constant versus age-specific fertility rates on prehistoric population estimates. Annual Meeting of the American Association of Physical Anthropologists. St. Louis, MO.

- *Presentation.*

  Warren AL, Sattenspiel L, Swedlund AC, Meindl RS, Gumerman GJ III. 2014 March. Challenges in realistically modeling prehistoric demography: The Long House Valley project. Annual Meeting of the Society for Applied Anthropology (SASci section), Albuquerque, NM.

- *Presentation.*

  Wei J. 2015 November. Discriminating between alternative mechanisms of in vitro mycobacterial granuloma formation in Johne's disease. NIMBioS Undergraduate Research Conference at the Interface of Mathematics and Biology, Knoxville, TN.

- *Presentation.*

  Wiederholt R. 2015 January. Estimating the contributions of discrete habitats in population dynamics of migratory species. Joint Mathematical Meetings, San Antonio, TX.

- *Presentation.*

Wikle N, Yan R. 2015 November. Projecting terrestrial species invasion spread using commodity flow pathways. NIMBioS Undergraduate Research Conference at the Interface of Mathematics and Biology, Knoxville, TN.

- *Presentation.*

  Yazdi S, Wurm A. 2013 November. Using Bioinformatics to Determine which Proteolytic Enzymes cut GPI-Anchored Proteins into Peptides of Ideal Length for Mass Spectrometry Analysis. Undergraduate Research Conference at the Interface of Biology and Mathematics.

- *Presentation.*

  Zia A, Fefferman N, Howe P, Metcalk S, Franck T, Lacasse K, Hoffman F, Winter J, Schlosser A, Beckage B, Gross L. 2015 July 10-12. Modeling the Effects of Heterogeneous Climate Change Risk Perceptions on Energy Consumption and Green House Gas (GHG) Mitigation Behaviors: An Agent Based Model of US Population, 2010-2030. SwarmFest2015: 19th Annual Meeting on Agent-Based Modeling & Simulation, Columbia, SC.

Other Publications

Patents

Technologies or Techniques

Thesis/Dissertations

- Cho EC. *Application of Algebraic Topology to Data Analysis*. (2015). Seoul National University, South Korea. Acknowledgement of Federal Support = Yes
- McCandlish DM. *Evolution on arbitrary fitness landscapes when mutation is weak*. (2012). Duke University. Acknowledgement of Federal Support = Yes
- Guo X. *Master's thesis: Agent-based modeling of colony energetics*. (2014). East Tennessee State University. Acknowledgement of Federal Support = Yes
- Levy B. *Modeling Feral Hogs in Great Smoky Mountains National Park*. (2016). University of Tennessee Knoxville. Acknowledgement of Federal Support = Yes
- Sullivan AM. *Multiscale Modeling of Toxoplasma gondii*. (2013). University of Tennessee, Knoxville. Acknowledgement of Federal Support = Yes
- Iacona GD. *The economic costs and ecological benefits of protected areas*. (2014). University of Tennessee, Knoxville. Acknowledgement of Federal Support = Yes

Websites

Back to the top

Participants/Organizations

What individuals have worked on the project?

Name	Most Senior Project Role	Nearest Person Month Worked
Jonsson, Colleen	PD/PI	8
Gross, Louis	Co PD/PI	1
Gavrilets, Sergey	Co-Investigator	3
Lenhart, Suzanne	Co-Investigator	4
Armsworth, Paul	Faculty	3
Bishop, Pam	Faculty	11
Brothers, Ernest	Faculty	3
Buchan, Alison	Faculty	2
Fitzpatrick, Ben	Faculty	3
Jantz, Michael	Faculty	1
Larsen, Jeff	Faculty	1
Ledder, Glenn	Faculty	4
Maroulas, Vasileios	Faculty	2
Nebenfuehr, Andreas	Faculty	1
Price, Charles	Faculty	12
Riechert, Sue	Faculty	2
Schugart, Richard	Faculty	11
Shen, Tongye	Faculty	1
Farrior, Caroline	Postdoctoral (scholar, fellow or other postdoctoral position)	11
Ferguson, Jake	Postdoctoral (scholar, fellow or other postdoctoral position)	3
Hoban, Sean	Postdoctoral (scholar, fellow or other postdoctoral position)	3
Hobson, Elizabeth	Postdoctoral (scholar, fellow or other postdoctoral position)	9
Johnson, Nels	Postdoctoral (scholar, fellow or other postdoctoral position)	12
Johnson, Quentin	Postdoctoral (scholar, fellow or other postdoctoral position)	12
Kawano, Sandy	Postdoctoral (scholar, fellow or other postdoctoral position)	11
O'Regan, Suzanne	Postdoctoral (scholar, fellow or other	12

Name	Most Senior Project Role	Nearest Person Month Worked
	postdoctoral position)	
Rúa, Megan	Postdoctoral (scholar, fellow or other postdoctoral position)	12
Sqouralis, Ioannis	Postdoctoral (scholar, fellow or other postdoctoral position)	11
Tarasov, Sergei	Postdoctoral (scholar, fellow or other postdoctoral position)	2
Zefferman, Mathew	Postdoctoral (scholar, fellow or other postdoctoral position)	2
Carr, Eric	Other Professional	12
Comiskey, Jane	Other Professional	11
Eskridge, Chandra	Other Professional	12
Koosman, Toby	Other Professional	11
LoRe, Sondra	Other Professional	6
Peek, Mike	Other Professional	12
Richters, Ana	Other Professional	12
Spar, Jennifer	Other Professional	12
Sturner, Kelly	Other Professional	12
Crawley, Catherine	Staff Scientist (doctoral level)	12
Welsh, Chris	Staff Scientist (doctoral level)	12
Auerbach, Anna Jo	Graduate Student (research assistant)	2
Dumoulin, Christine	Graduate Student (research assistant)	5
Levy, Benjamin	Graduate Student (research assistant)	5
Martin, John	Graduate Student (research assistant)	6
Massana, Kathryn	Graduate Student (research assistant)	5
Pantha, Buddhi	Graduate Student (research assistant)	5
Walpitage, Lakmal	Graduate Student (research assistant)	5
Balthrop, Lindsey	Undergraduate Student	1
Denison, Elizabeth	Undergraduate Student	2
Parkman, Virginia	Undergraduate Student	2
Voorhees, Victor	Undergraduate Student	2
Cooper, Alana	Research Experience for Undergraduates (REU) Participant	2
Darville, Joshua	Research Experience for Undergraduates (REU) Participant	2
DeSalu, Jeff	Research Experience for Undergraduates (REU) Participant	2

Name	Most Senior Project Role	Nearest Person Month Worked
Gary, Alanna	Research Experience for Undergraduates (REU) Participant	2
Gonzales, Elman	Research Experience for Undergraduates (REU) Participant	2
Horton, Emily	Research Experience for Undergraduates (REU) Participant	2
Igoe, Morganne	Research Experience for Undergraduates (REU) Participant	2
Iselin, Samuel	Research Experience for Undergraduates (REU) Participant	2
Kugathasan, Howsikan	Research Experience for Undergraduates (REU) Participant	2
Liu, Zhengquing	Research Experience for Undergraduates (REU) Participant	2
Miller, Jacob	Research Experience for Undergraduates (REU) Participant	2
Moran, Elliott	Research Experience for Undergraduates (REU) Participant	2
Reagan, Kelly	Research Experience for Undergraduates (REU) Participant	2
Sheets, Theresa	Research Experience for Undergraduates (REU) Participant	2
Siess, Jan	Research Experience for Undergraduates (REU) Participant	2
Wu, Zhimin	Research Experience for Undergraduates (REU) Participant	2

Full details of individuals who have worked on the project:

Colleen Jonsson
Email: cjonsson@utk.edu
Most Senior Project Role: PD/PI
Nearest Person Month Worked: 8

Contribution to the Project: Dr. Jonsson is the NIMBioS Director and oversees all activities and future planning.

Funding Support: NSF, UT

International Collaboration: No
International Travel: No

Louis J Gross
Email: gross@NIMBioS.org
Most Senior Project Role: Co PD/PI
Nearest Person Month Worked: 1

Contribution to the Project: Dr. Gross is the NIMBioS Director Emeritus. He is an active member of the NIMBioS Leadership Team and provides input on NIMBioS activities and planning.

Funding Support: NSF, UT

International Collaboration: Yes, france, germany, united kingdom
International Travel: No

Sergey Gavrilets
Email: sergey@nimbios.org
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 3

Contribution to the Project: Dr. Gavrilets is the NIMBioS Associate Director for Scientific Activities and member of the NIMBioS Leadership Team. He leads the assessment of requests for support in conjunction with the rest of the Leadership Team and Board of Advisors. He was co-organizer of the workshop on Evolution and Warfare. He mentored NIMBioS post-doc Matt Zimmerman.

Funding Support: NSF, University of Tennessee

International Collaboration: Yes, japan, netherlands, norway, russian federation, spain, sweden, switzerland, united kingdom
International Travel: Yes, switzerland - 0 years, 0 months, 5 days; united kingdom - 0 years, 0 months, 10 days; greece - 0 years, 0 months, 5 days; spain - 0 years, 0 months, 5 days; netherlands - 0 years, 0 months, 3 days

Suzanne Lenhart
Email: lenhart@math.utk.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 4

Contribution to the Project: Dr. Lenhart is the Associate Director for Education and Outreach and member of the NIMBioS Leadership Team. She oversees all education and outreach activities and supervises the Outreach and Education Coordinator. She is a regular contributor to many of the activities hosted at NIMBioS, coordinator and mentor for the 2016 Summer Research Experience for Undergraduates.

Funding Support: NSF, University of Tennessee

International Collaboration: Yes, indonesia, mexico, netherlands, tanzania, united republic of, united kingdom

International Travel: Yes, china - 0 years, 0 months, 10 days; namibia - 0 years, 0 months, 6 days

Paul Armsworth
Email: parmsworth@nimbios.org
Most Senior Project Role: Faculty
Nearest Person Month Worked: 3

Contribution to the Project: Dr. Armsworth is the NIMBioS Associate Director for Post-doctoral Activities. He manages the NIMBioS post-doctoral training program, planning monthly workshops and conducting performance reviews for all post-docs.

Funding Support: University of Tennessee

International Collaboration: Yes, australia
International Travel: No

Pam Bishop
Email: pbaird@utk.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 11

Contribution to the Project: Dr. Bishop is the NIMBioS Associate Director for STEM Evaluation. She has developed evaluation instruments for NIMBioS activities to support NSF reporting requirements and to assess the success of individual activities and the Center as a whole. She is a leader in developing methods for Center-scale assessment. She has a significant role in planning and managing the NIMBioS participant database and online interface.

Funding Support: NSF, University of Tennessee

International Collaboration: No
International Travel: No

Ernest Brothers
Email: ebrother@utk.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 3

Contribution to the Project: Dr. Brothers is the NIMBioS Associate Director for Diversity Enhancement. He has been instrumental in developing diversity and cultural training opportunities for NIMBioS post-docs and plays a key role in developing and implementing a strategy to increase participation by under-represented groups in NIMBioS activities.

Funding Support: University of Tennessee

International Collaboration: No
International Travel: No

Alison Buchan

Email: abuchan@utk.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 2

Contribution to the Project: Dr. Buchan is the NIMBioS Associate Director for Graduate Education. She manages NIMBioS programs for graduate research.

Funding Support: University of Tennessee

International Collaboration: No
International Travel: No

Ben Fitzpatrick
Email: bfitzpatrick@lmu.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 3

Contribution to the Project: Dr. Fitzpatrick was a sabbatical fellow at NIMBioS working on Bayesian uncertainty quantification and control for agent-based models of biological and social systems. He is a professor of Mathematics at Loyola Marymount University in Los Angeles, California.

Funding Support: NSF

International Collaboration: No
International Travel: No

Michael Jantz
Email: mrjantz@utk.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Mentor for Summer Research Experience for Undergraduates program

Funding Support: University of Tennessee

International Collaboration: No
International Travel: No

Jeff Larsen
Email: jeff.larsen@utk.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Mentor for Summer Research Experience for Undergraduates program

Funding Support: University of Tennessee

International Collaboration: No
International Travel: No

Glenn Ledder
Email: gledder@unl.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 4

Contribution to the Project: Dr. Ledder is a sabbatical visitor working on Dynamic energy budget modeling and multi-component systems during Spring 2016. He is a professor of Mathematics at the University of Nebraska and co-organizer of the NIMBioS working group "Dynamic Energy Budget for Trees."

Funding Support: NSF

International Collaboration: Yes, belgium, canada, netherlands, sweden
International Travel: Yes, united kingdom - 0 years, 0 months, 7 days

Vasileios Maroulas
Email: maroulas@math.utk.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 2

Contribution to the Project: Dr. Maroulas is Assistant Professor of Mathematics. He is mentoring postdocs Jake Ferguson and Ioannis Sgouralis and serving as a mentor for the Summer Research Experience.

Funding Support: University of Tennessee

International Collaboration: Yes, china, greece
International Travel: No

Andreas Nebenfuehr
Email: nebenfuehr@utk.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Mentor for Summer Research Experience for Undergraduates program

Funding Support: University of Tennessee

International Collaboration: No
International Travel: No

Charles A. Price
Email: charles.price@uwa.edu.au

Most Senior Project Role: Faculty
Nearest Person Month Worked: 12

Contribution to the Project: Dr. Price began his NIMBioS sabbatical fellowship in June 2015. During his 12-month fellowship he has worked to understand the physical drivers of allometric patterns in trees. Dr. Price is an Assistant Professor in the School of Plant Biology at the University of Western Australia.

Funding Support: NSF

International Collaboration: Yes, australia
International Travel: No

Sue Riechert
Email: riechert@utk.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 2

Contribution to the Project: Dr. Riechert is a Distinguished Service Professor in the Department of Ecology & Evolutionary Biology at the University of Tennessee. She brings a major outreach program to the Institute: the Biology in a Box Project provides K-12 schools throughout the state of Tennessee materials and exercises that address biological concepts and that are designed to enrich science and math curriculum content.

Funding Support: University of Tennessee

International Collaboration: No
International Travel: No

Richard Schugart
Email: richard.schugart@wku.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 11

Contribution to the Project: Richard Schugart is a sabbatical visitor investigating optimal treatment protocols for the treatment of a bacterial infection in a wound using oxygen therapy. He is professor of Mathematics at Western Kentucky University in Bowling Green, Kentucky.

Funding Support: NSF

International Collaboration: No
International Travel: No

Tongye Shen
Email: tshen@utk.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Mentor for Summer Research Experience for Undergraduates program

Funding Support: University of Tennessee

International Collaboration: Yes, philippines
International Travel: No

Caroline Farrior
Email: cfarrior@nimbios.org
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 11

Contribution to the Project: Caroline Farrior (Ecology and Evolutionary Biology, Princeton, 2012) examines the roles of frequency, severity and predictability of wind storms and drought in determining properties of forest stands.

Funding Support: NSF

International Collaboration: Yes, netherlands
International Travel: Yes, netherlands - 0 years, 0 months, 3 days

Jake Ferguson
Email: jakeferguson@nimbios.org
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 3

Contribution to the Project: Jake Ferguson (Ph.D. Biology, Univ. of Florida, 2014) was using semi-discrete models to address questions about how the differing timescales of resource acquisition and reproduction inherent in animal populations can resolve existing paradoxes in population ecology and can improve predictions of animals coupled to seasonally varying environments. Upon completing his fellowship at NIMBioS in December 2015, Dr. Ferguson accepted a position as a postdoctoral fellow at the Center for Modeling Complex Interactions at the University of Idaho, Moscow.

Funding Support: NSF

International Collaboration: No
International Travel: No

Sean Hoban
Email: shoban@nimbios.org
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 3

Contribution to the Project: Dr. Hoban was a part-time postdoc at NIMBioS through December 2015. His research focuses on developing simulation-based sampling guidelines for conserving the genetic resources of rare or economically important plant species. He is now a

tree conservation biologist at the Morton Arboretum in Lisle, Illinois.

Funding Support: NSF

International Collaboration: Yes, canada, united kingdom
International Travel: Yes, united kingdom - 0 years, 0 months, 7 days

Elizabeth Hobson
Email: emoseman@nmsu.edu
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 9

Contribution to the Project: Dr. Hobson is a current post-doctoral fellow at NIMBioS. Her research is on the evolution of social complexity across taxa. She is finishing her postdoc in May 2016 and will move on to a fellowship at the Santa Fe Institute.

Funding Support: NSF

International Collaboration: Yes, canada, denmark
International Travel: Yes, netherlands - 0 years, 0 months, 8 days

Nels G. Johnson
Email: Nels.Johnson@rams.colostate.edu
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 12

Contribution to the Project: Dr. Nels Johnson (Ph.D. Statistics, Virginia Tech) started his NIMBioS post-doctoral fellowship in June 2015. He is investigating novel approaches for biodiversity, multiple species distributions, and community models.

Funding Support: NSF

International Collaboration: No
International Travel: No

Quentin Johnson
Email: quentin.johnson@nimbios.org
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 12

Contribution to the Project: Dr. Johnson is a postdoctoral fellow developing a model to identify allostery and the mechanism by which the allosteric signal is initiated and propagated in the peroxisome proliferator-activated receptor and retinoid X receptor complex, which are proteins involved in preventing growth of cancer cells.

Funding Support: NSF

International Collaboration: Yes, philippines

International Travel: No

Sandy Kawano
Email: skawano@nimbios.org
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 11

Contribution to the Project: Sandy Kawano (Ph.D. Biology, Clemson Univ., 2014) is conducting a quantitative comparison of the analytical methods for estimating phenotypic selection in order to gain a better understand the strengths and weaknesses of each approach, and is developing software to facilitate experimental and synthetic analyses on patterns of phenotypic selection.

Funding Support: NSF

International Collaboration: No
International Travel: No

Suzanne O'Regan
Email: soregan@nimbios.org
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 12

Contribution to the Project: Suzanne O'Regan (Applied Mathematics, University College Cork, Ireland, 2011) is developing a mathematical framework to elucidate the influence of changing environmental drivers on infectious disease risk.

Funding Support: NSF

International Collaboration: Yes, argentina, france, germany, greece, mexico, netherlands, peru
International Travel: Yes, united kingdom - 0 years, 0 months, 5 days

Megan Rúa
Email: meganrua@nimbios.org
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 12

Contribution to the Project: Dr. Rúa is a postdoctoral fellow at NIMBioS. Her research explores the relative importance of biotic and abiotic sources of selection for mycorrhizal interactions.

Funding Support: NSF

International Collaboration: Yes, canada, china, ecuador, france, germany, netherlands, sweden, thailand, united kingdom
International Travel: No

Ioannis Sqouralis

Email: sgouralis@nimbios.org
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 11

Contribution to the Project: Ioannis Sgouralis (Mathematics, Duke, 2014) is developing a computational model of renal autoregulation that dynamically represents the myogenic response and tubuloglomerular feedback at the whole kidney level.

Funding Support: NSF

International Collaboration: Yes, australia, france
International Travel: No

Sergei Tarasov
Email: sergxf@yandex.ru
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 2

Contribution to the Project: Dr. Tarasov begins his postdoctoral fellowship in July 2016. His project is modeling and exploring the evolution of anatomy ontologies using innovative stochastic process and two focal groups of insects.

Funding Support: NSF

International Collaboration: No
International Travel: No

Mathew Zefferman
Email: mrz1@nimbios.org
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 2

Contribution to the Project: Dr. Zefferman was a post-doctoral fellow at NIMBioS through October 2015. His research focuses on the evolutionary origins of complex institutions. Upon completing his fellowship at NIMBioS, Dr. Zefferman accepted a postdoctoral fellowship at the School of Human Evolution and Social Change at Arizona State University.

Funding Support: NSF

International Collaboration: No
International Travel: No

Eric Carr
Email: carr@nimbios.org
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 12

Contribution to the Project: Eric is the full-time NIMBioS Computational Data Engineer. He

provides support for all participant and staff HPC. He provides scientific computing support for groups as needed, provides IT support for all participants, and researches and recommends resources for virtual collaborations. He is also a doctoral student in Geography.

Funding Support: NSF

International Collaboration: No
International Travel: No

Jane Comiskey
Email: ecomiske@nimbios.org
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 11

Contribution to the Project: Jane is a Senior Analyst and Webmaster for NIMBioS. She developed and maintains the award-winning NIMBioS website, provides IT support, provides coding support for scientific activities, and supports web-communications for activity participants.

Funding Support: NSF

International Collaboration: No
International Travel: No

Chandra Eskridge
Email: ceskridge@nimbios.org
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 12

Contribution to the Project: Chandra serves as Executive and Business Assistant for NIMBioS, supporting the Director and operating as a key member of the business and travel staff. She manages the main office and processes reimbursement requests for all staff and visitors.

Funding Support: NSF

International Collaboration: No
International Travel: No

Toby Koosman
Email: tkoosman@nimbios.org
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 11

Contribution to the Project: Toby is the NIMBioS Business Manager. She handles all accounting, inventory, contracting, and personnel procedures and has primary responsibility for all purchasing and financial management ofparticipant support activities. She is the direct supervisor of the Event and Travel Coordinator and generally oversees the entire business office.

Funding Support: NSF, University of Tennessee

International Collaboration: No
International Travel: No

Sondra LoRe
Email: sondra@utk.edu
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 6

Contribution to the Project: Sondra LoRe is an Evaluation Associate for NIMBioS Evaluation Services where she assists with both internal and external evaluations related to STEM programs and projects.

Funding Support: University of Tennessee

International Collaboration: No
International Travel: No

Mike Peek
Email: peek@nimbios.org
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 12

Contribution to the Project: Michael is the NIMBioS Information Technology (IT) Manager. He provides all IT support, basic hardware and connectivity, software and applications for collaborative services. He oversees the IT staff, which includes a computational data engineer, a senior analyst, and a graduate technician/programmer.

Funding Support: University of Tennessee

International Collaboration: No
International Travel: No

Ana Richters
Email: richters@nimbios.org
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 12

Contribution to the Project: Ana is a full-time Database Specialist and manages the NIMBioS participant database as well as video archives.

Funding Support: NSF

International Collaboration: No
International Travel: No

Jennifer Spar
Email: jthomas@nimbios.org

Most Senior Project Role: Other Professional
Nearest Person Month Worked: 12

Contribution to the Project: Jennifer is the NIMBioS Event and Travel Coordinator. She handles all aspects of event management, contracting with hotels, planning catering, providing support for visitors, and arranging travel for all participants.

Funding Support: NSF

International Collaboration: No
International Travel: No

Kelly Sturner
Email: ksturner@nimbios.org
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 12

Contribution to the Project: Kelly is the NIMBioS Outreach and Education Coordinator. She works closely with Associate Director for Outreach and Education Lenhart to develop and manage all NIMBioS outreach and education activities.

Funding Support: NSF

International Collaboration: No
International Travel: No

Catherine Crawley
Email: ccrawley@nimbios.org
Most Senior Project Role: Staff Scientist (doctoral level)
Nearest Person Month Worked: 12

Contribution to the Project: Dr. Crawley is the NIMBioS Communications Manager. She is the main point of administrative contact for media, writes press releases on NIMBioS activities, conducts interviews with visiting scientists, produces print and video pieces highlighting NIMBioS activities and research, and consults with other staff on strategies to increase awareness of NIMBioS opportunities worldwide.

Funding Support: NSF

International Collaboration: No
International Travel: No

Chris Welsh
Email: cwelsh@nimbios.org
Most Senior Project Role: Staff Scientist (doctoral level)
Nearest Person Month Worked: 12

Contribution to the Project: Dr. Welsh is the NIMBioS Deputy Director and member of the

NIMBioS Leadership Team. He is responsible for overseeing day-to-day operations of the center, supervises most of the staff, and interacts regularly with activity organizers, visitors, and other collaborators. He is also involved in Outreach and Education efforts with the Discover Birds program.

Funding Support: NSF

International Collaboration: No
International Travel: No

Anna Jo Auerbach
Email: ajone139@utk.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 2

Contribution to the Project: Anna Jo Auerbach is a doctoral student in Ecology and Evolutionary Biology. At NIMBioS, she is working on projects related to the development of the Quantitative Biology Concept Inventory.

Funding Support: NSF

International Collaboration: No
International Travel: No

Christine Dumoulin
Email: cdumouli@vols.utk.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 5

Contribution to the Project: Christine Dumoulin is a doctoral student in ecology and evolutionary biology. Her research focuses on spatial questions in ecology and conservation biology, in particular conservation planning and population dynamics.

Funding Support: University of Tennessee

International Collaboration: No
International Travel: No

Benjamin Levy
Email: levy@math.utk.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 5

Contribution to the Project: Ben Levy is a doctoral student studying mathematical ecology. His research focuses on modeling feral hogs in Great Smoky Mountains National Park.

Funding Support: University of Tennessee

International Collaboration: Yes, botswana, kenya, south africa
International Travel: Yes, namibia - 0 years, 0 months, 7 days

John Martin
Email: jmartin@nimbios.org
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 6

Contribution to the Project: John is a doctoral student in computer science. He is developing and implementing an administrative database system to be used for all NIMBioS activities, beginning with submission of requests for support and including tracking of products from participants and activities.

Funding Support: University of Tennessee

International Collaboration: No
International Travel: No

Kathryn Massana
Email: kmassana@utk.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 5

Contribution to the Project: Kathryn Massana is a doctoral student in ecology and evolutionary biology. Her research focuses on developing a new continuous biogeography model that will infer the ancestral geographic range of taxa and will incorporate dispersal barriers, allow for heterogeneity in dispersal estimation and have the ability to use multi-gene data.

Funding Support: University of Tennessee

International Collaboration: Yes, australia, mexico
International Travel: No

Buddhi Pantha
Email: bpantha@vols.utk.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 5

Contribution to the Project: Buddhi Pantha is a doctoral student in mathematics. His research is in applied mathematics with specific areas of interests in mathematical biology (epidemiology, ecology, host-pathogen interaction, immune systems and co-infections), optimal control, mathematical and computational modeling, dynamical system and differential equations. His current research focuses on optimal control for anthrax outbreak and host pathogen interaction in pulmonary anthrax infection.

Funding Support: University of Tennessee

International Collaboration: No

International Travel: No

Lakmal Walpitage
Email: dwalpita@vols.utk.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 5

Contribution to the Project: Lakmal Walpitage is a doctoral student in the Evaluation, Statistics, and Measurement Program in the Department of Educational Psychology. At NIMBioS, he is working on projects related to NIMBioS Evaluation Services.

Funding Support: University of Tennessee

International Collaboration: No
International Travel: No

Lindsey Balthrop
Email: lbalthro@utk.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Lindsey is an undergraduate majoring in Public Relations. She works with event planning staff for meeting support and assists with other projects as needed.

Funding Support: NSF

International Collaboration: No
International Travel: No

Elizabeth Denison
Email: edenison@utk.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 2

Contribution to the Project: Elizabeth is an undergraduate majoring in Wildlife and Fisheries Science. She works with event planning staff for meeting support and assists with other projects as needed.

Funding Support: NSF

International Collaboration: No
International Travel: No

Virginia Parkman
Email: vparkman@vols.utk.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 2

Contribution to the Project: Virginia is an undergraduate majoring in mathematics. She is

working with the NIMBioS Education and Outreach program.

Funding Support: NSF

International Collaboration: No
International Travel: No

Victor Voorhees
Email: tor@nimbios.org
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 2

Contribution to the Project: Victor is an undergraduate majoring in Industrial Engineering. He handles video-editing of recorded seminars and assists with variety of project tasks as needed.

Funding Support: NSF

International Collaboration: No
International Travel: No

Alana Cooper
Email: acoope31@vols.utk.edu
Most Senior Project Role: Research Experience for Undergraduates (REU) Participant
Nearest Person Month Worked: 2

Contribution to the Project: Participant in the NIMBioS' summer 2016 Summer Research Experience for undergraduate program.

Funding Support: NSF

International Collaboration: No
International Travel: No
Year of schooling completed: Sophomore
Home Institution: University of Tennessee
Government fiscal year(s) was this REU participant supported: 2016

Joshua Darville
Email: joshua.darville.96@gmail.com
Most Senior Project Role: Research Experience for Undergraduates (REU) Participant
Nearest Person Month Worked: 2

Contribution to the Project: Participant in the NIMBioS' summer 2016 Summer Research Experience for undergraduate program.

Funding Support: NSF

International Collaboration: No
International Travel: No

Year of schooling completed: Sophomore
Home Institution: Fisk University
Government fiscal year(s) was this REU participant supported: 2016

Jeff DeSalu
Email: jmdesalu@gmail.com
Most Senior Project Role: Research Experience for Undergraduates (REU) Participant
Nearest Person Month Worked: 2

Contribution to the Project: Participant in the NIMBioS' summer 2016 Summer Research Experience for undergraduate program.

Funding Support: NSF

International Collaboration: No
International Travel: No
Year of schooling completed: Junior
Home Institution: Ohio State University
Government fiscal year(s) was this REU participant supported: 2016

Alanna Gary
Email: alannagary@uchicago.edu
Most Senior Project Role: Research Experience for Undergraduates (REU) Participant
Nearest Person Month Worked: 2

Contribution to the Project: Participant in 2016 Summer Research Experience for Undergraduates program

Funding Support: NSF

International Collaboration: No
International Travel: No
Year of schooling completed: Junior
Home Institution: University of Chicago
Government fiscal year(s) was this REU participant supported: 2016

Elman Gonzales
Email: gonzaleseo@goldmail.etsu.edu
Most Senior Project Role: Research Experience for Undergraduates (REU) Participant
Nearest Person Month Worked: 2

Contribution to the Project: Participant in 2016 Summer Research Experience for Undergraduates Program

Funding Support: NSF

International Collaboration: No
International Travel: No

Year of schooling completed: Freshman
Home Institution: East Tennessee State University
Government fiscal year(s) was this REU participant supported: 2016

Emily Horton
Email: horton_e@lynchburg.edu
Most Senior Project Role: Research Experience for Undergraduates (REU) Participant
Nearest Person Month Worked: 2

Contribution to the Project: Participant in 2016 Summer Research Experience for Undergraduates Program

Funding Support: NSF

International Collaboration: No
International Travel: No
Year of schooling completed: Sophomore
Home Institution: Lynchburg College
Government fiscal year(s) was this REU participant supported: 2016

Morganne Igoe
Email: igoex006@umn.edu
Most Senior Project Role: Research Experience for Undergraduates (REU) Participant
Nearest Person Month Worked: 2

Contribution to the Project: Participant in 2016 Summer Research Experience for Undergraduates Program

Funding Support: NSF

International Collaboration: No
International Travel: No
Year of schooling completed: Junior
Home Institution: University of Minnesota - Twin Cities
Government fiscal year(s) was this REU participant supported: 2016

Samuel Iselin
Email: samuel.iselin@valpo.edu
Most Senior Project Role: Research Experience for Undergraduates (REU) Participant
Nearest Person Month Worked: 2

Contribution to the Project: Participant in 2016 Summer Research Experience for Undergraduates Program

Funding Support: NSF

International Collaboration: No
International Travel: No

Year of schooling completed: Freshman
Home Institution: Valparaiso University
Government fiscal year(s) was this REU participant supported: 2016

Howsikan Kugathasan
Email: howsikan@hotmail.com
Most Senior Project Role: Research Experience for Undergraduates (REU) Participant
Nearest Person Month Worked: 2

Contribution to the Project: Participant in the NIMBioS' summer 2016 Summer Research Experience for undergraduate program.

Funding Support: NSF

International Collaboration: No
International Travel: No
Year of schooling completed: Junior
Home Institution: Fisk University
Government fiscal year(s) was this REU participant supported: 2016

Zhengquing Liu
Email: zl33@rice.edu
Most Senior Project Role: Research Experience for Undergraduates (REU) Participant
Nearest Person Month Worked: 2

Contribution to the Project: Participant in 2016 Summer Research Experience for Undergraduates Program

Funding Support: NSF

International Collaboration: No
International Travel: No
Year of schooling completed: Junior
Home Institution: Rice University
Government fiscal year(s) was this REU participant supported: 2016

Jacob Miller
Email: jomi224@g.uky.edu
Most Senior Project Role: Research Experience for Undergraduates (REU) Participant
Nearest Person Month Worked: 2

Contribution to the Project: Participant in 2016 Summer Research Experience for Undergraduates Program

Funding Support: NSF

International Collaboration: No
International Travel: No

Year of schooling completed: Sophomore
Home Institution: University of Kentucky
Government fiscal year(s) was this REU participant supported: 2016

Elliott Moran
Email: EMoran14@unity.edu
Most Senior Project Role: Research Experience for Undergraduates (REU) Participant
Nearest Person Month Worked: 2

Contribution to the Project: Participant in 2016 Summer Research Experience for Undergraduates Program

Funding Support: NSF

International Collaboration: No
International Travel: No
Year of schooling completed: Junior
Home Institution: Unity College
Government fiscal year(s) was this REU participant supported: 2016

Kelly Reagan
Email: kreagan2@elon.edu
Most Senior Project Role: Research Experience for Undergraduates (REU) Participant
Nearest Person Month Worked: 2

Contribution to the Project: Participant in the NIMBioS' summer 2016 Summer Research Experience for undergraduate program.

Funding Support: NSF

International Collaboration: No
International Travel: No
Year of schooling completed: Junior
Home Institution: Elon University
Government fiscal year(s) was this REU participant supported: 2016

Theresa Sheets
Email: sheetst1@umbc.edu
Most Senior Project Role: Research Experience for Undergraduates (REU) Participant
Nearest Person Month Worked: 2

Contribution to the Project: Participant in 2016 Summer Research Experience for Undergraduates program

Funding Support: NSF

International Collaboration: No
International Travel: No

Year of schooling completed: Sophomore
Home Institution: University of Maryland Baltimore County
Government fiscal year(s) was this REU participant supported: 2016

Jan Siess
Email: jsiess93@gmail.com
Most Senior Project Role: Research Experience for Undergraduates (REU) Participant
Nearest Person Month Worked: 2

Contribution to the Project: Participant in the NIMBioS' summer 2016 Summer Research Experience for undergraduate program.

Funding Support: NSF

International Collaboration: No
International Travel: No
Year of schooling completed: Junior
Home Institution: Rutgers University
Government fiscal year(s) was this REU participant supported: 2016

Zhimin Wu
Email: zhimin.wu17@houghton.edu
Most Senior Project Role: Research Experience for Undergraduates (REU) Participant
Nearest Person Month Worked: 2

Contribution to the Project: Participant in the NIMBioS' summer 2016 Summer Research Experience for undergraduate program.

Funding Support: NSF

International Collaboration: No
International Travel: No
Year of schooling completed: Junior
Home Institution: Houghton College
Government fiscal year(s) was this REU participant supported: 2016

What other organizations have been involved as partners?

Name	Type of Partner Organization	Location
4H	Other Nonprofits	Knoxville, TN
AAAS-American Association for Advancement of Science	Academic Institution	Washington, D.C.
Center for Synthesis and Analysis of Biodiversity	Academic Institution	Aix-en-Provence, France
Centre for Disease Modeling	Academic Institution	Toronto, Ontario, Canada

Name	Type of Partner Organization	Location
DIMACS-Center for Discrete Mathematics & Theoret. Comp. Sci.	Academic Institution	Rutgers University
Fields Institute	Academic Institution	Toronto, Ontario, Canada
Fisk University	Academic Institution	Nashville, TN
Great Smoky Mountains Institute at Tremont	Other Nonprofits	Townsend, TN
Great Smoky Mountains National Park	Other Organizations (foreign or domestic)	Gatlinburg, TN
Greater Knoxville Math/Science Coalition	Academic Institution	Knoxville, TN
Howard University	Academic Institution	Washington, D.C.
Innovative Computing Laboratory	Academic Institution	Knoxville, TN
AIBS-American Institute of Biological Sciences	Academic Institution	Reston, VA
Institute of Biomedical Engineering	Academic Institution	University of Tennessee
JICS-Joint Institute for Computational Science	Academic Institution	University of Tennessee
MBI-Mathematical Biosciences Institute	Academic Institution	Ohio State University
MSRI-Mathematical Sciences Research Institute	Academic Institution	Berkeley, CA
Mathematics of Planet Earth	Academic Institution	University of Montreal, Canada
NCEAS-National Center for Ecological Analysis and Synthesis	Academic Institution	University of California - Santa Barbara
NEON-National Ecological Observatory Network, Inc.	Academic Institution	Boulder, CO
NICS-National Institute for Computational Science	Academic Institution	Oak Ridge, TN
NSF Mathematical Sciences Diversity Committee	Academic Institution	various
NSF Mathematical Sciences Institutes	Academic Institution	various
AWM-Association for Women in Mathematics	Other Nonprofits	Fairfax, VA
NSF-XSEDE Extreme Science and Engineering Environment	Academic Institution	various
Oak Ridge National Laboratory	Other Organizations (foreign or domestic)	Oak Ridge, TN
PEER-Program for Equity and Excellence in Research	Academic Institution	University of Tennessee

Name	Type of Partner Organization	Location
QUBES (Quantitative Undergraduate Biology Education and Synt	Academic Institution	Unity College, Unity, ME
SACNAS-Society for the Advancement of Chicanos and Native Am	Academic Institution	Santa Cruz, CA
SAMSI-Statistical and Applied Mathematical Sciences Institut	Academic Institution	Research Triangle Park, NC
SESYNC-National Social-Environmental Synthesis Center	Academic Institution	University of Maryland
SHADES-Sharing Adventures in Engineering & Science	Academic Institution	Knoxville, TN
SIAM-Society for Industrial and Applied Mathematics	Academic Institution	Philadelphia, PA
SMB-Society for Mathematical Biology	Academic Institution	international
American Society of Naturalists	Other Nonprofits	University of Chicago
TN-SCORE (Tennessee Solar Conversion and Storage using Outre	Academic Institution	Knoxville, TN
Tennessee Ornithological Society	Other Nonprofits	Clarksville, TN
Tennessee Science Teachers Association	Other Nonprofits	Tennessee
Tennessee State University	Academic Institution	Nashville, TN
Tuskegee University	Academic Institution	Tuskegee, AL
U.S. Army Research Office	Other Organizations (foreign or domestic)	Research Triangle Park, NC
USDA - APHIS - WS - National Wildlife Research Center	Other Organizations (foreign or domestic)	Fort Collins, CO
University of Tennessee - Biology in a Box	Academic Institution	Knoxville, TN
University of Texas El Paso	Academic Institution	El Paso, TX
VolsTeach	Academic Institution	University of Tennessee
BioQUEST Curriculum Consortium	Other Nonprofits	Madison, WI
iPlant Collaborative	Academic Institution	Tucson, AZ
CAMBAM-Centre for Applied Mathematics in Bioscience & Med.	Academic Institution	McGill University, Montreal, Canada
CEEMS-UT Center for Enhancing Education in Mathematics & Sci	Academic Institution	University of Tennessee
CURENT: Center for Ultra-wide-area Resilient Electric Energy	Academic Institution	University of Tennessee
California State University San Marcos Foundation	Academic Institution	San Marcos, CA

Full details of organizations that have been involved as partners:

4H

Organization Type: Other Nonprofits
Organization Location: Knoxville, TN

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: NIMBioS collaborated with CURENT and 4-H to offer a week-long summer day camp for rising 7th and 8th grade girls on STEM (Science, Technology, Engineering, Mathematics) (Date: July 2016)

AAAS-American Association for Advancement of Science

Organization Type: Academic Institution
Organization Location: Washington, D.C.

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: NIMBioS is involved in the AAAS-led effort on Vision and Change in Undergraduate Biology Education. NIMBioS Director Emeritus Gross is a member of the steering committee.

AIBS-American Institute of Biological Sciences

Organization Type: Academic Institution
Organization Location: Reston, VA

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: NIMBioS has cooperated with the AIBS to communicate opportunities and discuss co-sponsoring an outreach and education symposium.

AWM-Association for Women in Mathematics

Organization Type: Other Nonprofits
Organization Location: Fairfax, VA

Partner's Contribution to the Project:
Collaborative Research
Personnel Exchanges

More Detail on Partner and Contribution: NIMBioS' June 2015 Research Collaboration Workshop for Women in Mathematical Biology was organized in cooperation with AWM and

led to a follow up meeting at NIMBioS in February 2016.

American Society of Naturalists

Organization Type: Other Nonprofits
Organization Location: University of Chicago

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: The American Society of Naturalists is a co-sponsor of the NIMBioS Quantitative Evolutionary Genetics tutorial.

BioQUEST Curriculum Consortium

Organization Type: Other Nonprofits
Organization Location: Madison, WI

Partner's Contribution to the Project:
Collaborative Research
Personnel Exchanges

More Detail on Partner and Contribution: BioQUEST and NIMBioS have collaborated to conduct several workshops at NIMBioS, and NIMBIoS and BioQUEST staff continue to develop plans for joint activities. BioQUEST's Kristin Jenkins is a member of the NIMBioS Board of Advisors.

CAMBAM-Centre for Applied Mathematics in Bioscience & Med.

Organization Type: Academic Institution
Organization Location: McGill University, Montreal, Canada

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: NIMBioS co-sponsored a summer graduate workshop jointly with MBI and CAMBAM in summer 2016. The theme of this workshop, held at MBI in June 2016, was "Mathematical Modeling of Infectious Disease Spread".

CEEMS-UT Center for Enhancing Education in Mathematics & Sci

Organization Type: Academic Institution
Organization Location: University of Tennessee

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: NIMBioS collaborates with CEEMS on a variety of programs, including VolsTeach, to improve preparation of math and science teachers and

STEM education.

CURENT: Center for Ultra-wide-area Resilient Electric Energy

Organization Type: Academic Institution
Organization Location: University of Tennessee

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: NIMBioS is collaborating with the engineering research center CURENT (Center for Ultra-wide-area Resilient Electric Energy Transmission Networks), an NSF and DOE engineering research center, to coordinate a week-long Adventures in STEM summer day camp for middle school girls in July 2016.

California State University San Marcos Foundation

Organization Type: Academic Institution
Organization Location: San Marcos, CA

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: NIMBioS staff are working with CSUSM faculty and staff to increase underrepresented individuals in science careers, with particular connections through the NIH-funded MARC Phase II award at CSUSM. NIMBioS and CSUSM have signed a formal partnership agreement, and NIMBioS scientists have visited and presented at CSUSM.

Center for Synthesis and Analysis of Biodiversity

Organization Type: Academic Institution
Organization Location: Aix-en-Provence, France

Partner's Contribution to the Project:
Other: See detail

More Detail on Partner and Contribution: NIMBioS and CESAB Directors continue to discuss potential collaborations.

Centre for Disease Modeling

Organization Type: Academic Institution
Organization Location: Toronto, Ontario, Canada

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: NIMBioS co-sponsored a summer graduate workshop jointly with the Centre for Disease Modeling, the Fields Institute, MBI, CAMBAM,

and others in summer 2016. The theme of this workshop, held at MBI in June 2016, was "Mathematical Modeling of Infectious Disease Spread".

DIMACS-Center for Discrete Mathematics & Theoret. Comp. Sci.

Organization Type: Academic Institution
Organization Location: Rutgers University

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: NIMBioS staff and leadership are collaborated with DIMACS on the planning of the Mathematics of Planet Earth 2013+ workshop held in September 2015.

Fields Institute

Organization Type: Academic Institution
Organization Location: Toronto, Ontario, Canada

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: NIMBioS co-sponsored a summer graduate workshop jointly with the Fields Institute, MBI, the Centre for Disease Modeling, CAMBAM, and others in summer 2016. The theme of this workshop, held at MBI in June 2016, was "Mathematical Modeling of Infectious Disease Spread".

Fisk University

Organization Type: Academic Institution
Organization Location: Nashville, TN

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: NIMBioS staff are working with Fisk University faculty and staff to increase underrepresented individuals in science careers. Fisk students and faculty have participated in the NIMBioS REU program, the undergraduate research conference, and as short-term visitors. NIMBioS and Fisk have signed a formal partnership agreement, and NIMBioS researchers have visited and presented at Fisk.

Great Smoky Mountains Institute at Tremont

Organization Type: Other Nonprofits
Organization Location: Townsend, TN

Partner's Contribution to the Project:

Collaborative Research

More Detail on Partner and Contribution: Each summer NIMBioS co-organizes the Girls in Science program at Tremont to increase involvement of girls in the STEM fields. The NIMBioS Outreach Coordinator also conducted teaching workshops at Tremont, and Tremont is a collaborator with NIMBioS on planning future activities.

Great Smoky Mountains National Park

Organization Type: Other Organizations (foreign or domestic)
Organization Location: Gatlinburg, TN

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: NIMBioS led quantitative biology sessions for the Girls in Science week at Tremont in June 2016.

Greater Knoxville Math/Science Coalition

Organization Type: Academic Institution
Organization Location: Knoxville, TN

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: NIMBioS hosted and led math activities at the SHADES program geared toward encouraging middle school girls' interest in math and science. (October 2015)

Howard University

Organization Type: Academic Institution
Organization Location: Washington, D.C.

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: NIMBioS has signed a formal partnership with Howard University, a minority-serving institution, to increase the representation of underrepresented minorities in the STEM disciplines. NIMBioS staff and post-docs have visited Howard to discuss research in mathematical biology. Dr. Talitha Washington is a member of the NIMBioS Advisory Board.

Innovative Computing Laboratory

Organization Type: Academic Institution
Organization Location: Knoxville, TN

Partner's Contribution to the Project:
In-Kind Support
Facilities
Collaborative Research

More Detail on Partner and Contribution: The ICL is a large computer science research and development group co-located with NIMBioS. NIMBioS and ICL staff communicate regularly to discuss possible joint activities. NIMBioS hosted ICL's workshop on Batched, Reproducible, and Reduced Precision BLAS in May 2016.

Institute of Biomedical Engineering

Organization Type: Academic Institution
Organization Location: University of Tennessee

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: iBME co-sponsored the NIMBioS investigative Workshop on modeling heart rhythm disorders in December 2014, and this led to a NIMBioS working group on Prediction and Control of Cardiac Alternans that met in May 2016.

JICS-Joint Institute for Computational Science

Organization Type: Academic Institution
Organization Location: University of Tennessee

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: JICS is a joint institute between the University of Tennessee and Oak Ridge National Laboratory. JICS staff have collaborated with NIMBioS staff on applications of high-performance computing in biological research as well as on facilitating access to JICS HPC resources at ORNL. JICS and NIMBioS staff are actively working on methods for virtual collaboration and on joint efforts for future activities.

MBI-Mathematical Biosciences Institute

Organization Type: Academic Institution
Organization Location: Ohio State University

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: The leadership teams of NIMBioS and MBI are in regular contact regarding potential collaborations. NIMBioS co-sponsors a summer graduate workshop jointly with MBI and CAMBAM. The theme of this workshop in June 2016 was "Mathematical Modeling of Infectious Disease Spread".

MSRI-Mathematical Sciences Research Institute

Organization Type: Academic Institution
Organization Location: Berkeley, CA

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: NIMBioS collaborates with MSRI and the other U.S.-based mathematics institutes on the Modern Math Workshop. This year's workshop was held immediately preceding the SACNAS annual conference.

Mathematics of Planet Earth

Organization Type: Academic Institution
Organization Location: University of Montreal, Canada

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: NIMBioS staff and leadership planned and hosted a workshop Sept. 30 - 2 Oct. 2015 on Mathematics of Planet Earth+: Education for the Planet Earth of Tomorrow. One of the goals of the workshop was to develop an education plan for the wider mathematical sciences community.

NCEAS-National Center for Ecological Analysis and Synthesis

Organization Type: Academic Institution
Organization Location: University of California - Santa Barbara

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: NIMBioS communicates with NCEAS, NEON, IPlant, and SESYNC to talk about possible avenues of collaboration between the institutions and centers. The BIO Center Directors have discussed potential collaborations on research and communication.

NEON-National Ecological Observatory Network, Inc.

Organization Type: Academic Institution
Organization Location: Boulder, CO

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: NIMBioS communicates with NEON, NCEAS, IPlant, and SESYNC to talk about possible avenues of collaboration between the institutions and

centers. The BIO Center Directors have discussed potential collaborations on research and communication.

NICS-National Institute for Computational Science

Organization Type: Academic Institution
Organization Location: Oak Ridge, TN

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: NICS staff have collaborated with NIMBioS in development of tutorials increasing awareness and ability of biological researchers in use of high-performance computing and have consulted with NIMBioS staff on high-performance computing needs and possible future tutorials. Time on the KRAKEN super-computer operated by NICS is available as appropriate for activities based at NIMBioS.

NSF Mathematical Sciences Diversity Committee

Organization Type: Academic Institution
Organization Location: various

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: NIMBioS Associate Director for Outreach & Education attended the Diversity Committee meeting in the January 2016.

NSF Mathematical Sciences Institutes

Organization Type: Academic Institution
Organization Location: various

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: NIMBioS Director and Associate Directors communicate regularly with their counterparts at the various math institutes to develop ideas for collaborative activities. NIMBioS regularly hosts a reception with the other math institutes at the annual Joint Math Meeting. NIMBioS is collaborating on organizing workshops and short courses with these institutes at SACNAS. [AIM, ICERM, IMA, IPAM, MBI, MSRI, NIMBioS, PCMI, and SAMSI]. NIMBioS staff contribute to activities to support participation of underrepresented groups in the mathematical sciences. NIMBioS co-sponsors the annual Joint Mathematics Meetings to advance mathematical achievement, encourage research, and provide communication necessary for progress in the field and contributes to the Modern Math Workshop.

NSF-XSEDE Extreme Science and Engineering Environment

Organization Type: Academic Institution
Organization Location: various

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: The NSF-XSEDE program provides an HPC time allotment to NIMBioS, and NIMBioS staff work with XSEDE staff to facilitate access for NIMBioS-associated researchers. NIMBioS was a host site with XSEDE for a virtual HPC tutorial.

Oak Ridge National Laboratory

Organization Type: Other Organizations (foreign or domestic)
Organization Location: Oak Ridge, TN

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: A number of ORNL scientists are NIMBioS senior personnel or collaborators.

PEER-Program for Equity and Excellence in Research

Organization Type: Academic Institution
Organization Location: University of Tennessee

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: Program for Excellence and Equity in Research (PEER) is an NIH-funded graduate student support program at UTK. NIMBioS faculty and staff collaborated in development of this 'program of excellence' designed to increase numbers of under-represented minority Ph.D.s in science, technology, engineering, and mathematics (STEM) fields. PEER has an emphasis on quantitative biology. NIMBioS regularly provides space for PEER meetings, and Associate Director Lenhart assists PEER with outreach.

QUBES (Quantitative Undergraduate Biology Education and Synt

Organization Type: Academic Institution
Organization Location: Unity College, Unity, ME

Partner's Contribution to the Project:
Collaborative Research
Personnel Exchanges

More Detail on Partner and Contribution: NIMBioS has ongoing discussions with the QUBES Consortium (Quantitative Undergraduate Biology Education and Synthesis) on methods

for program evaluation.

SACNAS-Society for the Advancement of Chicanos and Native Am

Organization Type: Academic Institution
Organization Location: Santa Cruz, CA

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: NIMBioS contributed to the Modern Math Workshop immediately preceding the Society for the Advancement of Chicanos and Native Americans in Science annual meeting. Goals for this workshop were to reinvigorate the research careers of minority faculty and post docs and mathematics faculty at minority-serving institutions by recruiting them to participate in the 2015-2016 research programs and workshops of US-based Mathematics Institutes and to increase awareness of math-based career paths among minority undergraduates.

SAMSI-Statistical and Applied Mathematical Sciences Institut

Organization Type: Academic Institution
Organization Location: Research Triangle Park, NC

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: NIMBioS Director and Associate Directors communicate regularly with their counterparts at the various math institutes to develop ideas for collaborative activities. NIMBioS regularly hosts a reception with the other math institutes at the annual Joint Math Meeting. NIMBioS is collaborating on organizing workshops and short courses with these institutes at SACNAS. [AIM, ICERM, IMA, IPAM, MBI, MSRI, NIMBioS, PCMI, and SAMSI].

SESYNC-National Social-Environmental Synthesis Center

Organization Type: Academic Institution
Organization Location: University of Maryland

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: NIMBioS communicates with NEScent, NEON, NCEAS, iPlant, and SESYNC to talk about possible avenues of collaboration between the institutions and centers. The BIO Center Directors have discussed potential collaborations on research and communication. NIMBioS and SESYNC are co-sponsors of a joint working group on Human Risk Perception and Climate.

SHADES-Sharing Adventures in Engineering & Science

Organization Type: Academic Institution
Organization Location: Knoxville, TN

Partner's Contribution to the Project:
Collaborative Research
Personnel Exchanges

More Detail on Partner and Contribution: NIMBioS hosted the SHADES program geared toward encouraging middle school girls' interest in math and science. (October 2015)

SIAM-Society for Industrial and Applied Mathematics

Organization Type: Academic Institution
Organization Location: Philadelphia, PA

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: NIMBioS and SIAM have discussed opportunities to continue collaborations on workshops and tutorials.

SMB-Society for Mathematical Biology

Organization Type: Academic Institution
Organization Location: international

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: NIMBioS and SMB have discussed opportunities to continue collaborations on workshops and tutorials. SMB is a member of the QUBES consortium.

TN-SCORE (Tennessee Solar Conversion and Storage using Outre

Organization Type: Academic Institution
Organization Location: Knoxville, TN

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: NIMBioS, CURENT, and TN-SCORE (Tennessee Solar Conversion and Storage using Outreach, Research and Education) co-host a summer UT STEM REU Symposium. TN-SCORE is Tennessee's first NSF RII Track 1 research infrastructure award which aims to enhance research capacity and competitiveness within Tennessee academic institutions.

Tennessee Ornithological Society

Organization Type: Other Nonprofits
Organization Location: Clarksville, TN

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: NIMBioS staff were part of the organizing committee and designed two math and biology activities for TOS' Discover Birds program. During this reporting period Deputy Director Welsh served on a team delivering the program to an elementary school group reaching over 200 students and teachers.

Tennessee Science Teachers Association

Organization Type: Other Nonprofits
Organization Location: Tennessee

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: NIMBioS Outreach and Education Coordinator Sturner maintains contact with and collaborates with TSTA on topics related to STEM education in Tennessee.

Tennessee State University

Organization Type: Academic Institution
Organization Location: Nashville, TN

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: NIMBioS has entered a partnership with Tennessee State University, a minority-serving institution, to increase the representation of underrepresented minorities in the STEM disciplines. Tennessee State students participate in the NIMBioS Undergraduate Research Conference. NIMBioS staff and post-docs visit the university and discuss their research with students and faculty.

Tuskegee University

Organization Type: Academic Institution
Organization Location: Tuskegee, AL

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: NIMBioS Associate Director for Diversity Enhancement Ernest Brothers has been exploring potential connections between NIMBioS and Tuskegee, a Historically Black College and University, particularly with respect to recruitment

and training of graduate students from underrepresented groups.

U.S. Army Research Office

Organization Type: Other Organizations (foreign or domestic)
Organization Location: Research Triangle Park, NC

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: NIMBioS Director Louis Gross is on the Army Research Office Mathematical Sciences Division Board of Visitors, and Army Research Office staff have visited and participated in activities at NIMBioS. NIMBioS co-sponsored the summer graduate workshop Mathematical Modeling of Infectious Disease Spread supported by ARO.

USDA - APHIS - WS - National Wildlife Research Center

Organization Type: Other Organizations (foreign or domestic)
Organization Location: Fort Collins, CO

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: USDA-APHIS personnel have been regular participants in NIMBioS scientific activities.

University of Tennessee - Biology in a Box

Organization Type: Academic Institution
Organization Location: Knoxville, TN

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: Biology in a Box is a fun and challenging way for entire schools to enhance their life sciences curriculum at all grade levels and to encourage student interest in STEM (science, technology, engineering, and mathematics) disciplines. NIMBioS has been revising existing themes to add grade-level appropriate math exercises and working on development of two new themes (Biomechanics and Cells and Cell Processes). A NIMBioS education intern worked on these projects.

University of Texas El Paso

Organization Type: Academic Institution
Organization Location: El Paso, TX

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: UTEP and NIMBioS have signed a formal partnership agreement to enhance the participation of under-represented minorities in STEM disciplines. These efforts are underway through the NIH-funded MARC Phase II award at UTEP and the Bioinformatics MS program at UTEP. NIMBioS staff and post-docs have visited UTEP to discuss research in mathematical biology.

VolsTeach

Organization Type: Academic Institution
Organization Location: University of Tennessee

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: VolsTeach is a program targeted for undergraduate math, science, or engineering majors who are interested in expanding their professional skills and exploring a career in Secondary Teaching. NIMBioS co-organizes a monthly VolsTeach seminar on issues in teaching STEM (science, technology, engineering and mathematics). NIMBioS and VolsTeach interns worked on the Biology in a Box program.

iPlant Collaborative

Organization Type: Academic Institution
Organization Location: Tucson, AZ

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: NIMBioS communicates with NEON, NCEAS, iPlant, and SESYNC to talk about possible avenues of collaboration between the institutions and centers. The BIO Center Directors have discussed potential collaborations on research and communication.

What other collaborators or contacts have been involved?

See full NIMBioS participant listing in Section Y8-3 of the Addendum to this report.

Back to the top

Impacts

What is the impact on the development of the principal discipline(s) of the project?

Activities supported by NIMBioS have had strong impact on a number of biological sub-disciplines. The following provides highlights grouped by activity type. We chose these examples as they cover most subject areas present in Figure 1 under Accomplishments. A number of the publications resulting from NIMBioS activities appeared in top national and international journals with high impact factors, including Science, Trends in Ecology and Evolution, Ecology Letters, Systematic Biology, PLOS Biology, Proceedings of the National Academy of Sciences, and Philosophical Transactions of the Royal Society B. Table 1 in the Accomplishments section provides details on NIMBioS-derived publications in certain high-impact journals.

Post-doctoral Fellow, Caroline Farrior, was the corresponding author on a paper in Science entitled "Dominance of the suppressed: Power-law size structure in tropical forests." Her paper studies the tropical tree size distributions, which are remarkably consistent despite differences in their environments. With data analysis and theory, Dr. Farrior and her co-authors found a simple and biologically intuitive hypothesis to explain this property, which is the foundation of forest dynamics modeling and carbon storage estimates. After a disturbance, new individuals in the forest gap grow quickly in full sun until they begin to overtop one another. The two-dimensional space-filling of the growing crowns of the tallest individuals relegates a group of losing, slow-growing individuals to the understory. Those left in the understory follow a power-law size distribution, the scaling of which depends on only the crown area–to–diameter allometry exponent: a well-conserved value across tropical forests.

Postdoctoral Fellow Megan Rúa was a senior author on a paper in the Frontiers in Microbiology entitled "Associations between Ectomycorrhizal Fungi and Bacterial Needle Endophytes in Pinus radiata: Implications for Biotic Selection of Microbial Communities." Conifers host a suite of microorganisms including mutualistic ectomycorrhizal (ECM) fungi and foliar bacterial endophytes. To investigate the potential role ECM fungi play in structuring foliar bacterial endophyte communities, Dr. Rúa and co-authors sampled three isolated, native populations of Monterey pine (Pinus radiata) and used constrained analysis of principal coordinates to relate the community matrices of the ECM fungi and bacterial endophytes. Their results suggest that ECM fungi may be important factors for explaining variation in bacterial endophyte communities, but the effect is influenced by population and environmental characteristics, emphasizing the potential importance of other factors — biotic or abiotic — in determining the composition of bacterial communities.

Former Graduate Research Assistant Mauricio Gonzalez-Forero has published a paper in the Journal of Evolutionary Biology entitled "Stable eusociality via maternal manipulation when resistance is costless." Mauricio showed that a queen's honest signaling could result from ancestral maternal manipulation. He developed a mathematical model to study the coevolution of maternal manipulation, offspring resistance to manipulation and maternal resource allocation that indicated both eusociality and its commonly associated queen honest signaling may to originate from ancestral manipulation.

Members of a Working Group on "Ocean Viral Dynamics" wrote a paper in Nature Microbiology: "Re-examination of the relationship between marine virus and microbial cell abundances." Marine viruses are critical drivers of ocean biogeochemistry, and their abundances

vary spatiotemporally in the global oceans, with upper estimates exceeding 108 per ml. Over many years, consensus has emerged that virus abundances are typically ten-fold higher than microbial cell abundances. The true explanatory power of a linear relationship and its robustness across diverse ocean environments is unclear. The authors compiled 5,671 microbial cell and virus abundance estimates from 25 distinct marine surveys and found substantial variation in the virus-to-microbial cell ratio. Virus abundances were better described as nonlinear, power-law functions of microbial cell abundances. The fitted scaling exponents are typically less than 1, implying that the virus-to-microbial cell ratio decreases with microbial cell density, rather than remaining fixed. The observed scaling implies that viral effect sizes derived from "representative" abundances require refinement to be extrapolated to regional or global scales.

A Working Group on "Hierarchy and Leadership" published a review in Trends in Ecology & Evolution, "Leadership in Mammalian Societies: Emergence, Distribution, Power, and Payoff." Leadership is an active area of research in both the biological and social sciences. The authors provided a transdisciplinary synthesis of biological and social-science views of leadership from an evolutionary perspective, and examined patterns of leadership in a set of small-scale human and non-human mammalian societies. They reviewed empirical and theoretical work on leadership in four domains: movement, food acquisition, within-group conflict mediation, and between-group interactions. They categorized patterns of variation in leadership in five dimensions: distribution (across individuals), emergence (achieved versus inherited), power, relative payoff to leadership, and generality (across domains). The authors found human leadership exhibits commonalities with and differences from the broader mammalian pattern, raising interesting theoretical and empirical issues.

The Investigative Workshop "Animal Social Networks" led to a publication in "Current Zoology": "Higher-order interactions: Understanding the knowledge capacity of social groups using simplicial sets." A benefit of social living is the ability to share knowledge that cannot be gained through personal experience alone. Traditional computational models portray sharing knowledge through interactions among members of social groups via dyadic networks. However, many real-world interactions are not solely pairwise. The authors developed a modeling framework based on the simplicial set, a concept from algebraic topology, which allows encapsulation of multi-agent interactions. This model system allows analysis of how individual information within groups accumulates as the group's collective set of knowledge, which may be different than the simple union of individually contained information. Furthermore, the simplicial modeling approach they propose allows investigating how information accumulates via sub-group interactions, offering insight into complex aspects of multi-way communication systems.

Sabbatical Visitor Jemal Mohammed-Awel published a paper in the Journal of Theoretical Biology entitled "Interplay between insecticide-treated bed-nets and mosquito demography: implications for malaria control." Malaria constitutes a major health and economic problem, especially to low-income countries. Insecticide-treated nets (ITNs) remain a primary measure for preventing the disease. Unfortunately, ITN campaign success is hampered by improper use and natural decay in ITN-efficacy over time. Models aimed at studying malaria transmission and

control fail to account for this decay or mosquito demography and feeding preferences exhibited by mosquitoes towards humans. Omitting these factors can misrepresent disease risk, while understanding their effects on malaria dynamics informs control policy. Mohammed-Awel and co-authors performed a systematic study of a mathematical model incorporating these factors. Their results lead to important insights that could assist in design and implementation of better malaria control strategies.

What is the impact on other disciplines?

Social sciences

The review paper from the Working Group on "Hierarchy and Leadership" briefly discussed above has various implications for anthropology and political science.

An Investigative Workshop on "Evolution and Decentralized Warfare" led to a number of new collaborations, manuscripts (to be published in a special issue of Journal of Economic Behavior and Organization), and grant proposals involving modelers, anthropologists, psychologists, economists, and political scientists.

A member of the NIMBioS Leadership Team Paul Armsworth published a series of papers on how well conservation organizations and natural resource management agencies are able to respond to ecological heterogeneity in space and time.

Management and Policies

A Working Group on "Pretty Darn Good Control: Extensions of Optimal Control for Ecological Systems" published a paper studying a classic fisheries management question -- how to manage a stochastically varying population using annually varying quotas in order to maximize profit -- to examine how costs of policy adjustment change optimal management recommendations. The authors show how different forms of policy costs have contrasting implications for optimal policies. Though it is frequently assumed that costs to adjusting policies will dampen variation in the policy, they showed that certain cost structures can actually increase variation through time. The authors further showed that failing to account for adjustment costs has a consistently worse economic impact than would assuming these costs are present when they are not.

NIMBioS Associate Director Paul Armsworth published a paper in Environmental Management studying synergies and tradeoffs among environmental impacts under conservation planning of shale gas surface infrastructure.

Statistics

Former post-doctoral fellow Tony Jhwueng published a paper in Journal of Applied Statistics entitled "Adaptive trait evolution in random environment." Current phylogenetic comparative methods generally employ the Ornstein–Uhlenbeck(OU) process for modeling trait evolution. Being able to track the optimum of a trait within a group of related species, the OU process provides information about the stabilizing selection where the population mean adopts a particular trait value. The optima of a trait may follow certain stochastic dynamics along the evolutionary history. Jhwueng extended the current framework by adopting a rate of evolution, which behaved according to pertinent stochastic dynamics. The novel model is applied to analyze about 225 datasets collected from the existing literature. Results validate that the new framework provides a better fit for the majority of these datasets.

What is the impact on the development of human resources?

In the Summer Research Experiences Program for Undergraduates, the students were given sessions on mathematical modeling, certain software (MATLAB, Linux, R), information on graduate school opportunities, structure of the math biology community, cross-cultural mentoring and research ethics. While learning to formulate research questions, to use background literature, and to make progress on investigating a research problem, students were also learning to work in groups; we also had special sessions to discuss roles of participants in group projects. In summer 2016, there were 16 undergraduate students working on five projects; this group included eight female and eight male students. Three were from underrepresented groups.

At our Undergraduate Conference at the Interface of Biology and Mathematics, about 50 undergraduates gave talk or poster presentations. In addition to the 100 undergraduates in attendance, one high school teacher attended and brought 16 high school students. Three faculty research presentations gave the students new insights to a variety of topics, including biomedical engineering applications. A panel discussion and a graduate school fair gave students ideas for continuing their education. (November 2016)

The Mathematics of Planet Earth+ Workshop: Education for the Planet Earth of Tomorrow brought together scientists, mathematicians, educators, graduate students, and communication experts to discuss ideas for preparing students to be in a new type of workforce, trained in multidisciplinary and multi-national communication and collaboration. This workshop was in collaboration with the Center for Discrete Mathematics and Theoretical Computer Science (DIMACS, Rutgers University) and was funded mostly through an NSF grant to DIMACS. About 50 participants attended.

More details about our educational workshops and our tutorials (for faculty, post-docs and teachers) are in the training and the professional development section of this report.

Our visitor program with our Minority-Serving Institution Partners (Howard University, Tennessee State University, Fisk University, California State University-San Marcos, and University of Texas-El Paso) fosters research and education interactions and collaborations. The NIMBioS Post-doctoral Fellows gain cross-cultural experiences during these visits. S. Lenhart

served an advisory role on Fisk University's HBCU-TIP project (NSF funded) for curriculum and course development and for research experiences for undergraduates.

K. Sturner and S. Lenhart co-organize and participate in many activities to encourage students and teachers to learn about the interface of biology and mathematics, and we mention some of the activities here. NIMBioS collaborated on an Adventures in STEM Camp to offer a week-long summer day camp for rising 7th and 8th grade girls on STEM in June 2016. S. Lenhart and K. Sturner helped to organize a visit to Greenback School by graduate students in the Program for Equity and Excellence in Research and in the Ecology and Evolutionary Biology Department. We also organized a visit to UT by students and a few teachers from Greenback School. S. Lenhart worked on a modeling research project with four Bearden High School students this school year. K. Sturner and S. Lenhart presented three days of math application activities at teacher workshops for Campbell County Schools in June 2016.

The Biology in a Box Program, first begun by S. Riechert in 1993, offers an engaging solution to the lack of depth in traditional STEM education in the United States. Exercises are provided in a format that teaches important biological concepts through hands-on community learning. Lessons are packaged within 10 current thematic units that are available in boxes at most school systems in Tennessee and offered to the worldwide audience at the project's web-site http://biologyinabox.utk.edu. Recent NIMBioS collaborative activities have included working on two new thematic units (Biomechanics and Cell Processes boxes).

We collaborated on the US-Canadian Institutes Epidemiology Summer School Mathematical Modeling of Infectious Disease Spread, which was attended by 55 graduate students. Lenhart was a co-organizer of this workshop held at the Mathematical Biosciences Institute. Lenhart, Jonsson, and Fefferman gave lectures and led activities at this workshop. (June 2016)

NIMBioS Associate Director for Diversity Enhancement E. Brothers assisted the Office of Research and Engagement with establishing potential partnerships with two Historically Black Colleges and Universities, Tennessee State University and Tuskegee University. Brothers provided information regarding some of the best practices in recruitment and retention of underrepresented minority graduate students, as well as how to provide both networking and cross-cultural mentoring in support of those students. Brothers was invited to give presentations by the following units with the selected topics: University of Tennessee Library Diversity Committee with a presentation on "An Open Conversation About Civility: Establishing Contracts for Civility (September 15, 2015); Office of Research and Engagement Responsible Conduct and Research Lunch and Learn Series on Faculty Mentoring (September 18, 2015); and the Conference of Southern Graduate Schools on "The Impact of Generational Diversity on Graduate Education" (February 19, 2016). Brothers serves on the Tennessee Louis Stokes Alliance for Minority Participation Advisory Council (TLSAMP) and worked collaboratively with Dr. Masood Parang, Associate Dean of the College of Engineering, and Mr. Travis Griffin, Director of Minority Engineering Programs, to develop a proposal for the 2017 NSF Bridge to the Doctorate Program. Brothers was asked to be an external advisor for the University of Minnesota (April 21-23, 2016) to evaluate the Office of Diversity of Graduate Education and its ability to provide resources for the recruitment and retention of underrepresented minority groups. Brothers has provided resources for NIMBioS post-docs on "Writing Diversity

Statements," "Interview Preparation at Minority Serving Institutions," and "Generational Diversity." Efforts to increase the number of URM applicants for NIMBioS post-doctorate research opportunities as well as Working Groups and Investigative Workshops included attending the Southern Regional Education Board (SREB) Institute on Teaching and Mentoring October 29 – November 1, 2015 and the Council of Historically Black Graduate Schools February 28, 2016.

What is the impact on physical resources that form infrastructure?

NIMBioS space in the Claxton Building at the University of Tennessee was renovated prior to our occupying the space in April 2012. The renovation created high-quality meeting rooms controlled by NIMBioS that include two large conference rooms, two classrooms (one equipped for video-conferencing), and a tiered auditorium (with A/V recording capabilities) as well as offices for staff, visitors, and post-doctoral and sabbatical fellows. A movable wall between one classroom and the tiered auditorium allows for expansion of the auditorium to accommodate an audience of up to about 60 participants. NIMBioS has the capability to live-stream presentations from the auditorium, which is done routinely for workshops, tutorials, and seminars. This allows access to individuals dispersed around the world who could not be accommodated locally for these activities. NIMBioS allows use of these high quality meeting rooms by other groups both internal and external to the University when not being used for NIMBioS activities. Part of the University's commitment to the new Director included development of a BSL-3 –rated laboratory housed at the College of Veterinary Medicine that will be a resource for researchers working on a variety of viruses and other materials.

What is the impact on institutional resources that form infrastructure?

NIMBioS has garnered institutional salary support that greatly facilitates collaboration across departments and across campuses as part of the prior negotiated terms of the award and the most recent hire of Dr. Jonsson. Dr. Jonsson has been provided two faculty lines within the College of Arts and Sciences to increase the number of NIMBioS-affiliated faculty and inspire new scientific directions for the sustainment of the Institute. This year, one of those lines was filled in collaboration with the Department of Biochemistry, Cell and Molecular Biology in modeling of gene regulatory networks. Two additional lines were filled due to vacancies from two prior NIMBioS lines as part of commitments to the Institute. These were designed with the intent of enhancing expertise in areas related to the NIMBioS mission. One hire is an assistant professor in the area of spatial biology and the other is an associate level in population modeling. Both will be in the Department of Ecology and Evolution. The Assistant and Associate Professors will be directly involved with NIMBioS as Affiliate faculty and the mathematical biology community. In May 2015, a request was made in collaboration with the Department of Microbiology to hire an Assistant Professor in the area of modeling of microbial community interactions.

NIMBioS staff have been directly involved with establishing University policies and practices that streamline the process of arranging lodging for participants and other visitors.

The University of Tennessee has co-located four major projects, each of which receives NSF

support. These are NIMBioS, the UT/ORNL Joint Institute for Computational Science, the Computational Geography Research Group, and the Innovative Computing Laboratory. This physical proximity on different floors of the same building enhances the likelihood of further collaborations, joint activities, sharing meeting rooms, and also includes a shared computer facility that more efficiently utilizes machine room space for several users.

NIMBioS Evaluation
NIMBioS offers external evaluation services to the Science, Technology, Engineering, and Mathematics (STEM) research and education sector, with an emphasis on interdisciplinary programs. Under the guidance of NIMBioS Associate Director for STEM Evaluation Dr. Pamela Bishop (Ph.D., Evaluation, Statistics, and Measurement), the NIMBioS evaluation team provides independent, rigorous and transparent formative and summative evaluation services targeted at the unique goals for the program. With expertise in evaluation theory, design and implementation, NIMBioS Evaluation Services is capable of evaluating large-scale projects to optimize decision-making and to untangle the complexity of program dynamics in order to understand how and why the project works (or doesn't work) for whom.

What is the impact on information resources that form infrastructure?

NIMBioS has been collaborating with the NSF-XSEDE RDAV project to develop new toolsets, particularly in R, for high-performance computers. These toolsets are designed to allow investigators from several different areas of biology to investigate problems they might have otherwise avoided due to the computational complexity involved. An objective is to facilitate opportunities for their application on platforms of quite different scales, from single workstations with a small number of processors, to clusters with hundreds to thousands of processors, to supercomputers with many thousands of processors.

NIMBioS provides both hardware and software resources to the community. A new 28 core/128 GB ram SMP workstation provides a computational resource for development, simulation and visualization, which enhances the existing 128 core cluster resource. An 8 core/ 32GB windows computational workstation provides a platform for windows based analysis with software tools VENSIM, ARCGIS, etc. installed. Server resources are utilized to host an R SHINY server for interactive R graphs, rstudio, and Limesurvey surveying platform to perform research data acquisition and evaluation. A recording and streaming service is available through NIMBioS' recording platform (323link) and our stream infrastructure(WOWZA).

NIMBioS is developing a database system to effectively manage the variety of data it requests of participants, to manage applications for activities, and to support the variety of evaluation activities carried out under NIMBioS auspices. This database system, use of which was launched in fall of 2015, is being developed with the expectation that it can be deployed at other similar centers with the diverse range of activities and requirements that NIMBioS has. NIMBioS IT staff have developed a general method to manage and deploy the Linux operating system across many machines, including automated reboot procedures that are minimally disruptive to users. The methods to carry this out are being made available through open-source methods.

What is the impact on technology transfer?

Nothing to report.

What is the impact on society beyond science and technology?

Many of the activities supported by NIMBioS have the potential for direct impacts on public policy. A prime example is the Modeling Antimicrobial Resistance (AMR) Intervention Working Group, which is working to identify specific analytical methods and quantitative data appropriate for associating population-level changes in antimicrobial use in livestock with population-level changes in antimicrobial resistance. This Working Group is explicitly mentioned in the National Strategy for Combating Antibiotic-resistant Bacteria put out by the White House in September 2014. Another example is the activity of the Working Group "'Pretty Darn Good' Control: Extensions of Optimal Control for Ecological Systems," which could have direct implications for regulations in fisheries management, but also have broader impacts with regard to regulations that must account for uncertainty in future conditions. The joint NIMBioS/SESYNC (National Socio-Environmental Synthesis Center) Working Group on Human Risk Perception and Climate Change considers the implications of potential changes in climatic conditions to modify societal attitudes towards long-term risk from climatic impacts and considers the feedbacks of these on integrated assessment models that account for economic impacts of climate change.

NIMBioS has sponsored numerous activities related to infectious disease and its potential impacts as well as associated public policy issues related to the control of organisms that might spread the disease. For example, one of Working Groups, Leptospirosis Modeling, is engaging scientists and public health officials from the Pan-American Health Organization. Leptospirosis is a zoonotic disease with complex transmission dynamics and of global importance for public and animal health. This working group uses mathematical approaches for improving our knowledge in the general areas of i) transmission dynamics at a local scale involving multi-host systems as well as one or more circulating Leptospira strains and ii) mechanisms underlying temporal and spatial patterns of leptospirosis transmission. An Investigative Workshop on Modeling Microbial Contamination of Fresh Produce along the post-harvest supply chain led to a new Working Group that had its first meeting in April 2016 and may provide scientific input to policies on food safety.

NIMBioS supports numerous education and outreach activities throughout the year as a part of its mission to enhance broad public appreciation for the unity of mathematics and science. Outreach to K-12 teachers and students (teacher professional development, field trips, Biology in a Box, research experiences for teachers) aim to inspire the next generation and their teachers about the value of science and math to society, whether they pursue careers in STEM fields or otherwise. Many of our outreach activities have an additional goal to specifically reach out to under-represented groups. NIMBioS also distributes many press releases that get picked up by mainstream media each year, another effort aimed to support greater public understanding of various discoveries that are at the forefront of interdisciplinary life science and mathematics.

Back to the top

Changes/Problems

Changes in approach and reason for change

Nothing to report.

Actual or Anticipated problems or delays and actions or plans to resolve them

Nothing to report.

Changes that have a significant impact on expenditures

Nothing to report.

Significant changes in use or care of human subjects

Nothing to report.

Significant changes in use or care of vertebrate animals

Nothing to report.

Significant changes in use or care of biohazards

Nothing to report.

Addendum to NIMBioSAnnual Report

Sep 1, 2015 –Aug 31, 2016

Y8-1. NIMBioS Board of Advisors Meeting Summaries

Summary Report of NIMBioS Board of Advisors Meeting held November 2-3, 2015

Board Members attending:

Linda Allen, Zhilan Feng, John Glasser, Kristen Jenkins, Simon Kahan, Jake LaRiviere, Mark Lewis, Mark McPeek, Anne Pusey, Pete Richerson, Raina Robeva, Jorge Velasco Hernandez, Talitha Washington, and Joshua Weitz. In addition, the following members participated remotely: Lydia Bourouiba, Sandy Liebhold, Raymond Mejia, Claudia Munoz-Zanzi, Gustavo Palacios, Josh Plotkin, and Lea Popovic. Sam Scheiner (NSF) also joined remotely for part of the meeting.

Board Chair Raina Robeva managed this meeting. This is a brief summary of the discussions and recommendations made by the Advisory Board during the meetings held from 09:00 on November 2 through noon on November 3. The agenda for the meeting is included below. Six weeks prior to the meeting, information on all requests for support submitted by the September 1, 2015 deadline was provided to the Board via a password-protected link off the NIMBioS website. This included links to original requests, and Board members were each assigned 4-6 requests to review for the various activities, with the assignments made based upon Board member expertise, the topic of the application, and the member's stated preference for evaluating postdoc applications or other requests. An online review form allowed all Board members to report their comments and overall rating for the variety of requests, and these were collated and summarized just prior to the meeting. These reviews were open to all Board members at the time of the meeting and served as the starting point for discussions during the meeting. In addition, NIMBioS leadership provided access to a variety of documents including the most recent Annual Report, Evaluation Policy, and an Evaluation Summary.

After introductions and a brief welcome from NIMBioS Director Colleen Jonsson, NIMBioS Associate Director for Scientific Activities Sergey Gavrilets gave the Board an overview of NIMBioS scientific activities to help the new members of the Board understand the types of activities supported and the procedures for evaluating them. Focus then turned to evaluation of current requests for support.

Requests for support. Discussion of the various support requests proceeded following the order in the agenda. Any individual who had a conflict of interest regarding any request did not participate in the discussion of that request and left the room so as not to hear the comments. Those attending remotely who had a conflict were asked to hang up and call back when the discussion on the request for which there was a conflict was completed. The Board discussion led to the following recommendations:

1. Working Groups – Of the thirteen requests, the Board recommended that three of the requests be approved and five others be considered for resubmission. For those recommended to be approved or resubmitted, the Board provided advice to the Leadership Team regarding potential changes to the suggested participants.

2. Workshops – There were three requests submitted and the Board recommended approval of two of these.

3. Postdoctoral Fellowships – Of the total of 22 complete applications received, the NIMBioS Leadership Team submitted 16 post-doc requests for review by the Board. These applicants

were reviewed and discussed in detail during the meeting. The Board recommended that the Leadership Team consider four of these for possible approval but were also generally positive toward five others. The Board noted that, due to the limited number of postdocs available over the remaining time period of the base NSF award, and the need to have some positions available for the usually large number of strong applicants for the December 2015 applicant pool, that final decision of how many to accept at this time should be left to the Leadership Team.

4. Sabbatical visitors – the Board recommended accepting the one sabbatical applicant.

Updates and Discussions concerning other Programs and Plans

NIMBioS Evaluation Services: Review of requests was completed in time to begin discussion of NIMBioS evaluation programs at the end of Day 1, but a campus power outage resulted in delaying that discussion to the morning of Day 2. Dr. Pamela Bishop, NIMBioS Associate Director for STEM Evaluation, presented an overview of the evaluation program and led discussion of future directions for evaluation. NIMBioS evaluation follows a systems approach looking at context, inputs, process, and product. As part of NIMBioS sustainment activities, the evaluation program is expanding to become NIMBioS Evaluation Services with the goal of becoming a self-sustaining evaluation institute within NIMBioS. The Institute will look to secure funding to conduct external evaluations of projects in the STEM research and evaluation sectors, building in areas closely related to the NIMBioS mission. Dr. Bishop also sought and received Board approval to modify the NIMBioS Evaluation Policy to include language that aggregated and de-identified data may be used for other reporting purposes, such as research papers about institutional efficiency.

Diversity Enhancement: Dr. Ernest Brothers, NIMBioS Associate Director for Diversity Enhancement and Associate Dean of the UTK Graduate School led discussion of NIMBioS efforts to encourage representation of underrepresented groups in NIMBioS activities. With the assistance of members of the Advisory Board and Leadership Team, NIMBioS regularly recommends qualified minority individuals for inclusion in groups and is building a network to help link such individuals to potential opportunities. Discussion touched on the minority pool and challenges with connecting with people of different cultures and backgrounds.

Education and Outreach: Dr. Suzanne Lenhart, NIMBioS Associate Director for Education and Outreach, gave an overview of NIMBioS outreach activities and discussed plans to host the Blackwell-Tapia Conference and Awards Ceremony in October with co-organizer SAMSI. The conference and prize honors David Blackwell, the first African-American member of the National Academy of Science, and Richard Tapia, winner of the National Medal of Science in 2010, two seminal figures who inspired a generation of African-American, Native American and Latino/Latina students to pursue careers in mathematics.

Long-term Planning: Director Colleen Jonsson outlined ideas for and led discussion on future paths for NIMBioS. The Board posed a number of questions for discussion, including how to find a direction that keeps the academic community interested but also has more direct applications. Does NIMBioS want to serve the broader academic community as it has to date or shift to a more UT-centric approach? NIMBioS needs to look to facilitate activities that will lead to next steps for the Center. Having PIs run grants through the Center is one possible mechanism for generating funds to maintain support for staff.

The Board recommended that NIMBioS Leadership focus on areas of NIMBioS strength and consider a variety of funding options from foundations, to industry, to fee-for-service, to multiple concurrent grants.

Agenda for the Fall 2015 meeting of the NIMBioS Board of Advisors

Sunday, November 1

6:30 pm	For those able to attend, meet Director Colleen Jonsson in Hotel Lobby to walk to dinner

Monday, November 2

8:00-9:00	Breakfast at NIMBioS
9:00-9:15	Welcome and Introductions (Jonsson)
9:15-9:30	Overview of research activities (Sergey Gavrilets)
9:30-10:40	Review of requests for support - Working Groups, Investigative Workshops (Gavrilets)
10:40-10:50	Break
10:50-12:00	Review of requests for support (cont.)
12:00-1:00	Lunch at NIMBioS (joined by Leadership Team, postdocs, graduate students)
1:00-3:00	Review of requests for support - Postdocs and Sabbaticals (Paul Armsworth)
3:00-3:10	Break
3:10-5:00	Completion of reviews of requests and summary recommendations
5:00-6:00	Reception with postdocs and faculty
6:30-	Dinner

Tuesday November 3

8:00-8:45	Breakfast at NIMBioS; meetings with NIMBioS post-docs
8:45-9:15	Overview of developments in Program Evaluation and revision of Evaluation Policy (Bishop)
9:15-9:45	Diversity enhancement and education (Ernest Brothers, Suzanne Lenhart)
9:45-10:30	Discussion of NIMBioS leadership transition and plans for sustainability (Jonsson)
10:30-10:45	Break
10:45-11:15	Discussion of current and future funding opportunities
11:15-12:00	Discussion of Strategic Plan, NIMBioS policies including Advisory Board
12:00-12:15	Wrap up
12:15-	Lunch at NIMBioS

NIMBIOS VIRTUAL BOARD MEETING – JANUARY 21, 2016

Board members participating: Linda Allen, Troy Day, Zhilan Feng, John Glasser, Alexander Hoffman, Kristen Jenkins, Simon Kahan, Jake LaRiviere, Mark Lewis, Sandy Liebhold, Mark McPeek, Raymond Mejia, Claudia Munoz-Zanzi, Josh Plotkin, Anne Pusey, Raina Robeva, Jorge Velasco Hernandez, and Talitha Washington.

The NIMBioS Board met via teleconference and using Zoom Video Conferencing to review applications received in December 2015 for Postdoctoral Fellowships. The Board was provided access to all 40 applications three and a half weeks prior to the meeting, and each Board member was asked to review 3-4 applications. Each Board member provided feedback on the applicants, and a summary of their comments was provided to guide discussion during the meeting. The Board recommended the Leadership Team consider five applicants as candidates for offers with two as alternates. NIMBioS leadership noted during this meeting that the December call would likely be the last open call for Postdoctoral Fellow applications for the current funding cycle although a targeted call for one or two additional fellows is a possibility.

NIMBIOS VIRTUAL BOARD MEETING – APRIL 1, 2016

Board members participating: Linda Allen, Lydia Bourouiba, Troy Day, John Glasser, Simon Kahan, Jake LaRiviere, Sandy Liebhold, Raymond Mejia, Claudia Munoz-Zanzi, Pete Richerson, Raina Robeva, and Joshua Weitz.

The NIMBioS Board met via teleconference and using Zoom Video Conferencing to review applications received in March 2016 for Sabbatical Fellowships, Working Groups and Investigative Workshops. The Board was provided access to all applications three and a half weeks prior to the meeting and each Board member was asked to review 2-3 applications. Each Board member provided feedback on the applicants and a summary of their comments was provided to guide discussion during the meeting. The Board recommended approval of the one of four Sabbatical Fellow requests. Of the two Investigative Workshop requests, the Board encouraged revision of one followed by an expedited review. Of the eight Working Group requests, the Board recommended approval of one outright and one be reconsidered in an expedited review process after being revised to address Board reservations. The Board suggested organizers of four additional Working Group requests be encouraged to substantially revise their requests based upon its comments and resubmit in the fall.

Addendum to NIMBioSAnnual Report

Sep 1, 2015 –Aug 31, 2016

Y8-2. NIMBioS Evaluation Report

NIMBIOS EVALUATION REPORT

REPORTING PERIOD EIGHT

SEPTEMBER 1, 2015-APRIL 30, 2016

NATIONAL INSTITUTE FOR MATHEMATICAL AND BIOLOGICAL SYNTHESIS

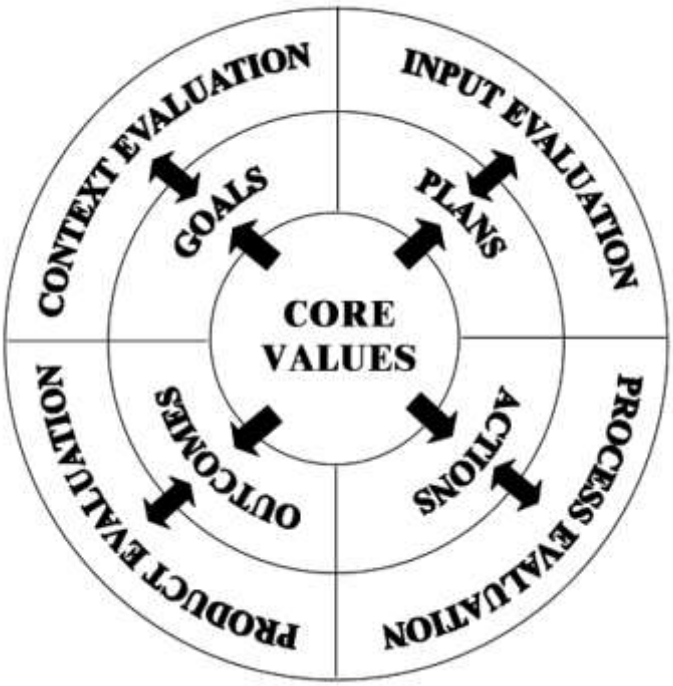
May, 2016

CONTENTS

INTRODUCTION

This is an evaluation summary of NIMBioS activities during the eighth annual reporting period (RP 8) to the National Science Foundation. This report covers the period of September 1, 2015-April 30, 2016. The NIMBioS evaluation program follows the CIPP systems approach, which takes into account not only the outcomes of the center, but how the outcomes are achieved. The evaluation addresses four main interconnected evaluation phases as seen in **Figure 1**[1]:

Figure 1. The CIPP Model for Evaluation used to guide the NIMBioS evaluation process



For all parts of the system, the NIMBioS evaluation process is grounded in its core values of (1) taking a collaborative approach to science and science education, and (2) increasing the diversity of researchers and educators at the interface of mathematics and biology.

CONTEXT (GOALS)

Context is not a specific phase of the evaluation process, but rather a constant form of evaluation that takes place during the input, process, and product evaluations as NIMBioS seeks to ensure that it is meeting its goals for each part of the system and that those goals are relevant and in line with its core values.

INPUTS

The input evaluation seeks to assess the responsiveness of NIMBioS' inputs to its goals. Specifically, NIMBioS is interested in ensuring that we are continuously maintaining a diverse atmosphere in a number of ways. Data sources for input evaluations include the participant demographic survey and accepted requests for support. At this phase, several goals comprise the context for the input evaluation:

[1] Stufflebeam, D.L. (2003). The CIPP model for evaluation. In T. Kelleghan & D.L. Stufflebeam (Eds.) *International Handbook of Education Evaluation* (pp. 31-61). London: Kluwer Academic Press.

1. NIMBioS participants will represent diverse gender, racial, ethnic, institutional, career, disciplinary, and geographic backgrounds.
2. NIMBioS will meet or exceed its participant diversity benchmarks.
3. NIMBioS will support activities across the spectrum of categories of requests for support.
4. NIMBioS will support Working Group and Investigative Workshop requests from a range of discipline areas.

PROCESS

The process evaluation seeks to evaluate congruence between goals and activities. This type of evaluation is situated in monitoring and judging activities at NIMBioS, mainly through periodic evaluative feedback surveys from participants and organizers. Other process evaluation data sources include evaluation case studies which look more closely at what factors of NIMBioS participation contribute to positive changes in participants' research and/or academic careers. Although the context at this phase will differ for different types of NIMBioS events, several overarching goals comprise the context for the process evaluation:

1. Participants will be satisfied with the event/program overall.
2. The event/program will meet participant expectations.
3. Participants will feel the event/program made adequate progress toward its stated goals.
4. Participants will feel they gained knowledge during the event/program.
5. Participants feel that participating in the event/program will have an impact on their future research/academic career.
6. Participants will be satisfied with the accommodations offered by NIMBioS.

PRODUCTS

The products evaluation seeks to monitor, document, and assess the quality and significance of the outcomes of NIMBioS activities. It provides guidance for continuing, modifying, or terminating specific efforts. Data sources for product evaluations include participant self-report of NIMBioS products resulting from affiliation (e.g. journal articles, student education, software), Web of Science data, data collected from participant evaluation forms and follow-up surveys. At this phase, several goals comprise the context for the evaluation:

1. NIMBioS publications will be highly interdisciplinary.
2. NIMBioS publications will be highly cited.
3. NIMBioS publications will be highly collaborative.
4. NIMBioS participants will produce other scholarly products, including book chapters, presentations, proposals for follow-on research, meetings/Workshops, student education, data/software, and/or publicity in other media.

INPUT EVALUATION

The input evaluation seeks to assess the responsiveness of NIMBioS' inputs to its goals. Specifically, NIMBioS is interested in ensuring that it is continuously maintaining a diverse atmosphere in a number of ways. Data sources for input evaluations include the participant demographic survey and accepted requests for support.

CONTEXT

1. NIMBioS participants will represent diverse gender, racial, ethnic, institutional, career, disciplinary, and geographic backgrounds.
2. NIMBioS will meet or exceed its participant diversity benchmarks.
3. NIMBioS will support activities across the spectrum of categories of requests for support.
4. NIMBioS will support Working Group and Investigative Workshop requests from a range of discipline areas.

SUMMARY OF ACTIVITIES

Research program activities during RP 8 included:

- 24 Working Group meetings
- 2 Investigative Workshops
- 1 Tutorial
- 40 Short-term visitors
- 11 Postdoctoral Fellows
- 1 Visiting Graduate Student Fellow
- 5 Graduate Research Assistantships

Education and Outreach (EO) program activity highlights during RP 8 included (see Annual Report for more details on these and other EO events):

- NIMBioS Interdisciplinary Seminar Series
- Biology in a Box Program
- Summer Research Experiences (SRE) Program
- Undergraduate Research Conference at the Interface of Biology and Mathematics
- UT STEM REU Symposium
- Joint MBI-CAMBAM-NIMBioS Summer Graduate Workshop
- SHADES (Sharing Adventures in Engineering and Science)
- STEM Education Seminar Series
- Southern Appalachian Science & Engineering Fair
- Adventures in STEM Camp

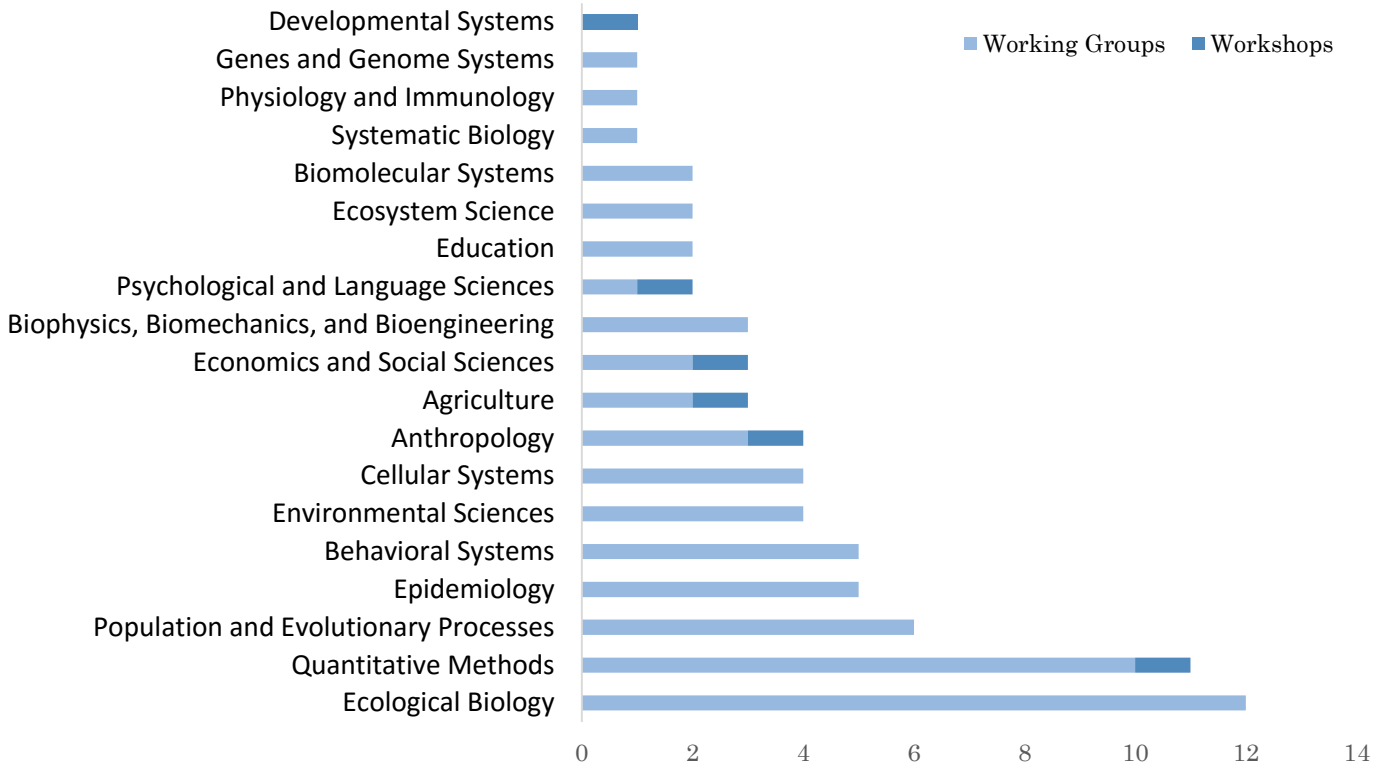
Other events included: 3 Advisory Board Meetings (1 in-person and 2 virtual)

DIVERSITY OF RESEARCH ACTIVITIES

NIMBioS is interested in supporting research activities from diverse subject areas. Working Group and Investigative Workshop Organizers are asked to categorize their proposed events into preselected research categories to help NIMBioS leadership ensure that a broad range of research areas are covered.

Figure 2 shows the diversity of subject areas associated with NIMBioS Working Group Meetings and Investigative Workshops during RP 8 (each supported event may have up to three subject areas).

Figure 2. Diversity of Subject Areas of Working Group Meetings and Investigative Workshops, RP 8

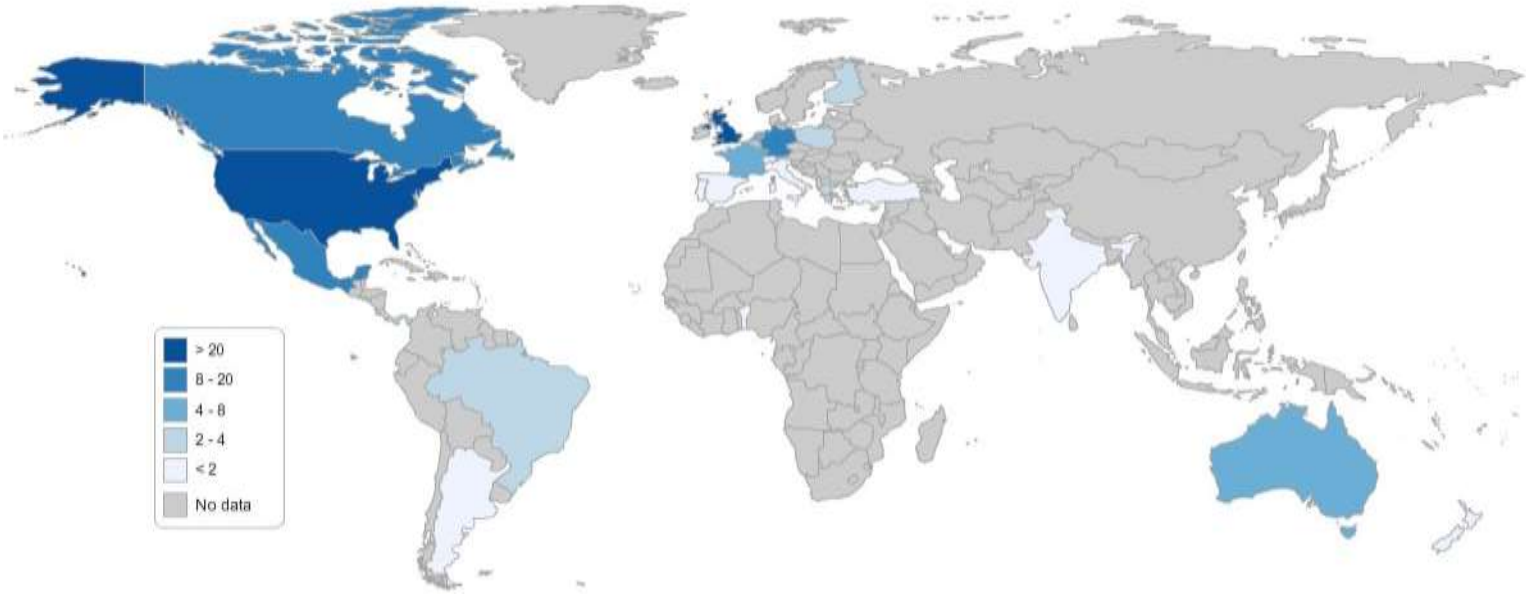


DIVERSITY OF PARTICIPANTS

One of the core values of NIMBioS is to increase the diversity of researchers and educators at the interface of mathematics and biology. NIMBioS collects voluntary demographic data from event applicants to gauge whether our program is fairly reaching and benefitting everyone regardless of demographic category and to ensure that those in under-represented groups have the same knowledge of and access to programs and other research and educational opportunities, and to assess involvement of international participants in the program. An electronic demographic survey aligned to the reporting requirements of the National Science Foundation was sent to all participants before their arrival at NIMBioS. Four weeks before the date of each event, a link to the survey was sent to each participant who had not visited NIMBioS within the last year. Reminder emails were sent to non-responding participants at one and two weeks after the initial contact date. The overall response rate for the demographic survey during RP 8 was 95%. Demographic questions regarding gender, race, ethnicity, and disability status were optional. When feasible, the evaluation staff supplied missing demographic data from other sources (e.g. institution, primary field of study). The evaluation staff did not assume race, ethnicity, or disability status for any participant who did not report this information. All demographic information is confidential, and results are reported only in the aggregate.

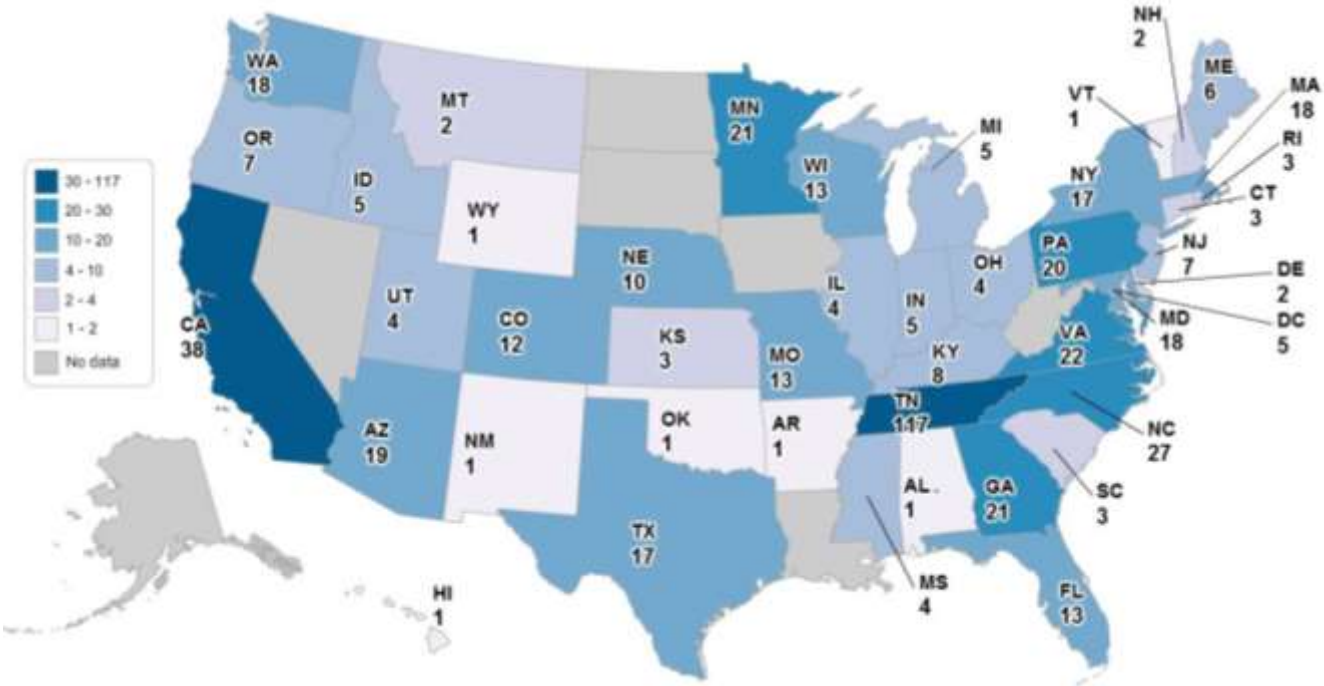
GEOGRAPHIC DIVERSITY. During RP 8, 624 participants (473 different individuals) from 23 countries participated in NIMBioS events. Most participants came from the United States (84%), followed by The United Kingdom (4%) and Canada (3%) (FIGURE 3).

Figure 3. NIMBioS RP 8 participants by country



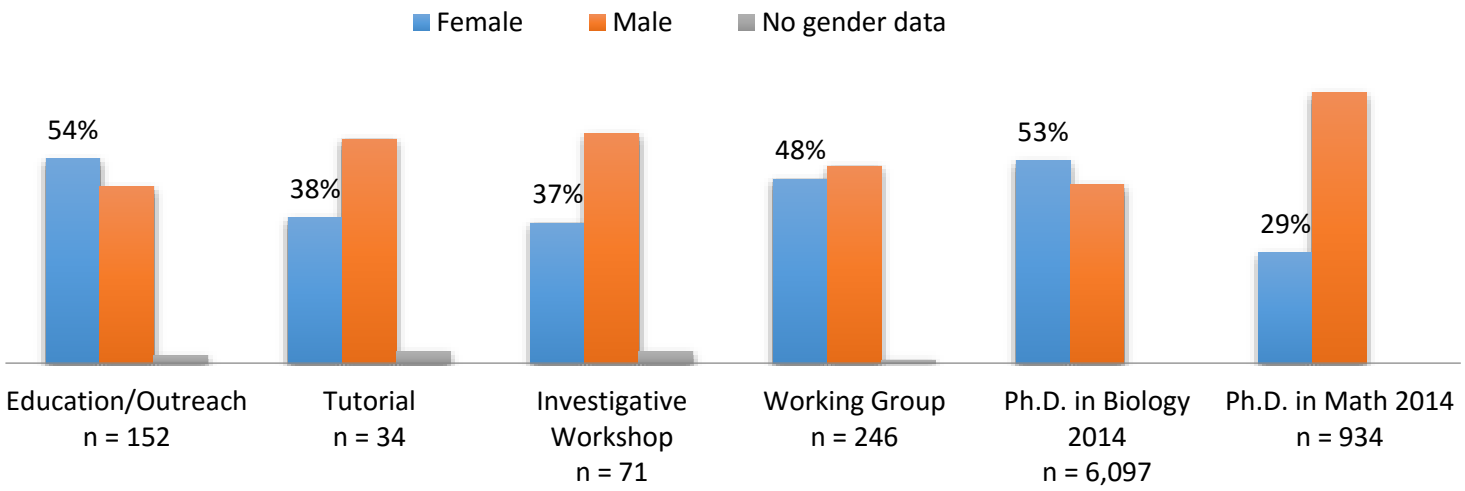
Within the U.S., 44 different states, as well as the District of Columbia, were represented. The largest percentage of participants came from within Tennessee (22%), followed by California (7%), North Carolina (5%), Virginia (4%), Minnesota (4%), and Georgia (4%) (**Figure 4.** NIMBioS RP 8 Participants by U.S. State).

Figure 4. NIMBioS RP 8 Participants by U.S. State



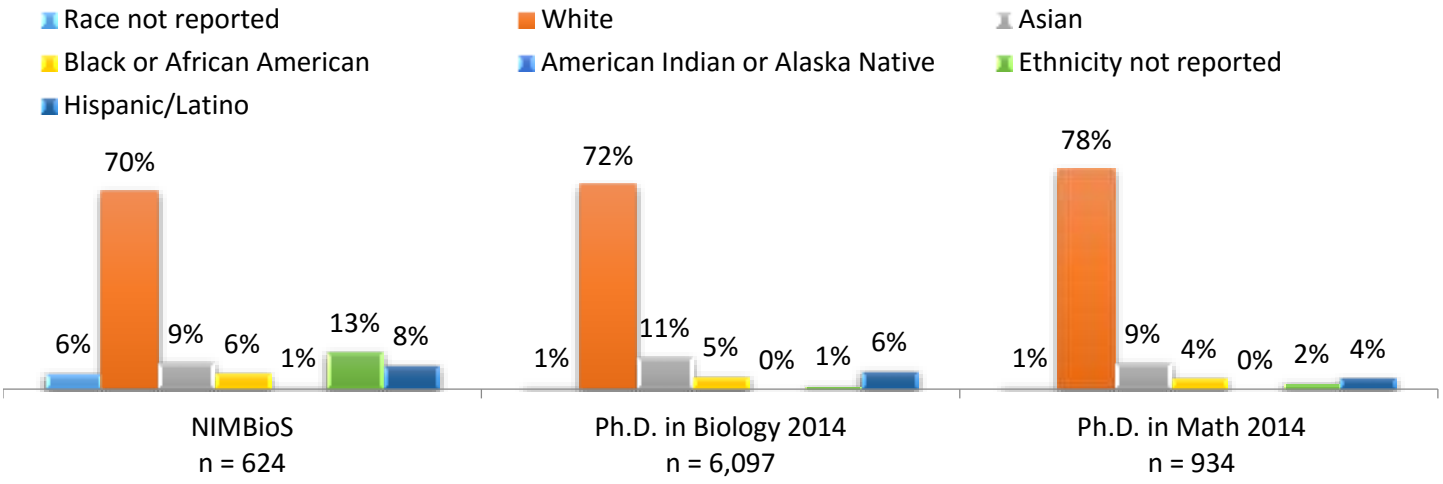
GENDER, RACIAL, AND ETHNIC DIVERSITY. Across all events during RP 8, female participation was 45% (no gender data for 5%). Within specific activity types, the gender ratio varied slightly, with the greatest gender equity seen in education and outreach activities and the least in Investigative Workshops (**Figure 5**). Two comparison groups shown are all individuals receiving doctorates in biology and mathematics in the U.S. In 2014[2]. The overall distribution of females in NIMBioS activities falls within the range of practicing Ph.D.'s in biology and mathematics in the U.S.

Figure 5. Gender composition of participants by event type



Overall minority representation[2] during RP 8 was around 14%. Representation of various minority categories was greater than current trends for doctoral recipients in the biological and mathematical sciences **(Figure 6)**. Comparison groups shown are all U.S. citizen and permanent residents receiving doctorates in biology and mathematics in the U.S. in 2014[3].

Figure 6. Minority representation of NIMBioS participants

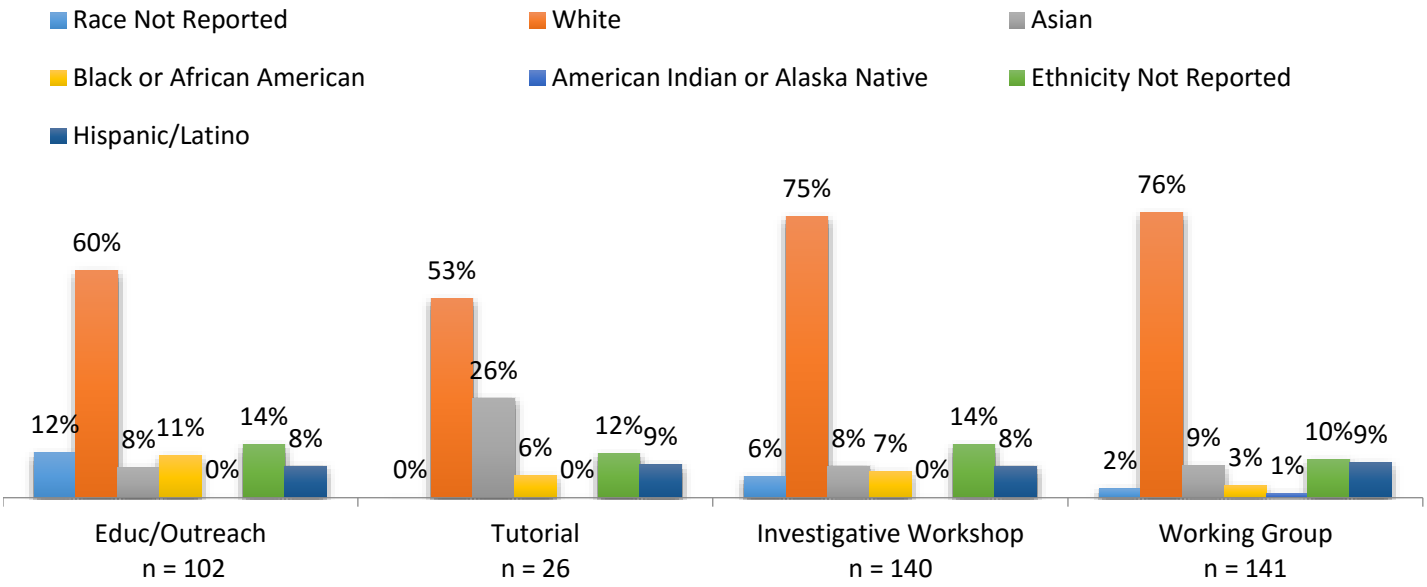


[2] For the purposes of this report, "minority" refers to those who self-identify as American Indian or Alaska Native, black or African American, and/or Hispanic or Latino (NSF Survey of Earned Doctorates, 2014)

[3] Data from the 2014 NSF Survey of Earned Doctorates, http://www.nsf.gov/statistics/sed/2014/data_table.

Minority representation varied among programs (Tutorials are considered part of Education and Outreach at NIMBioS, but are reported upon separately). Hispanic/Latino participants were represented between 8%-9% for all activity types. Among the different event types, participants self-identifying racially as white were always in the majority. Black or African American participants were represented most strongly in Education/Outreach Events (11%) (**Figure 7**).

Figure 7. Minority representation of participants, by major event type



DIVERSITY BENCHMARKS. Per the suggestion of the site review carried out at NIMBioS in June 2010, the NIMBioS leadership team has consulted with the NIMBioS advisory board in response to the recommendation by the site review that we establish a variety of benchmarks for our programs.

The Site Review particularly recommended that benchmarks be developed on participation in Working Groups and Investigative Workshops relative to gender and under-represented groups, and on geographical diversity of participants.

Benchmarks for diversity in participants at NIMBioS activities:

1. Gender: Across all Working Groups and Investigative Workshops, the proportion of female participants will be at least 30%.

2. Geographic - International participation: Across all Working Groups and Investigative Workshops, at least 10% of participants will be from outside the USA.

3. Under-represented groups (overall): Across all NIMBioS activities, we will increase the percent of participants from under-represented groups by approximately 10% per year. [$F(t+1) = 1.1\ F(t)$ where $F(t)$ is the proportion of total participants from underrepresented groups in Year t, and $F(t+1)$ is the proportion of total participants from underrepresented groups in Year (t+1)].

4. Underrepresented groups (Working Groups and Investigative Workshops): Comparable to the overall goal for all activities, we aim to increase the proportion of participants from under-represented groups in Working Groups and Investigative Workshops by 10% per year.

5. Local participants: To avoid overrepresentation of the University of Tennessee community in activities, we will limit participation by UT/ORNL faculty/staff to approximately 15% of the total participants in Working Groups and Investigative Workshops.

Benchmarks for diversity in activity organizers:

1. Gender: Across all Working Groups and Investigative Workshops, approximately 30% of the organizers will be female.

2. Local: No more than 25% of Working Group/Investigative Workshop organizers will be UT faculty/staff.

3. Underrepresented groups: We will encourage researchers from underrepresented groups to be organizers/co-organizers of requests for support, but no specific goal is set because of the small number of organizers.

Table 1 shows values by year for the above benchmarks.

Table 1. Diversity measures for NIMBioS Working Groups, Investigative Workshops, and all events (including Tutorials and Education and Outreach activities in addition to Working Groups and Workshops) by year

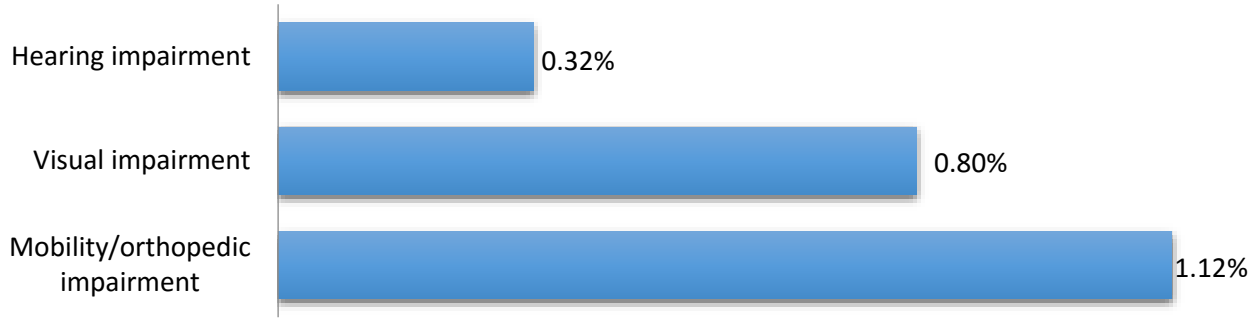
		Yr 1*	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr7	Yr8**	Overall
Participant diversity										
Gender	(Benchmark: approximately 30% female)									
	Working Groups	19%	22%	27%	34%	34%	36%	45%	48%	33%
	Investigative Workshops	40%	40%	38%	39%	39%	43%	29%	37%	38%
	All events	37%	42%	38%	39%	39%	44%	41%	45%	41%
International	(Benchmark: approximately 10% outside USA)									
	Working Groups	20%	19%	19%	18%	24%	26%	18%	22%	21%
	Investigative Workshops	10%	22%	21%	19%	5%	23%	16%	24%	18%
	All events	7%	12%	14%	16%	14%	11%	16%	15%	13%
URG										
	Working Groups	9%	10%	7%	8%	9%	9%	7%	11%	9%
	Investigative Workshops	7%	10%	14%	14%	11%	12%	17%	15%	13%
	All events	9%	11%	11%	13%	11%	13%	13%	14%	12%
Local	(Benchmark: No more than 15% from UT/ORNL)									
	Working Groups	14%	15%	16%	18%	14%	9%	7%	4%	12%
	Investigative Workshops	22%	23%	10%	7%	11%	4%	13%	6%	12%
	All events	35%	20%	16%	13%	16%	5%	12%	8%	16%
Organizer diversity										
Gender	(Benchmark: approximately 30% female)									
	Working Groups	11%	13%	16%	28%	27%	23%	28%	35%	23%
	Investigative Workshops	25%	29%	38%	39%	0%	52%	44%	17%	31%
	All events	23%	28%	27%	34%	30%	36%	33%	36%	31%
Local	(Benchmark: No more than 25% UT Faculty/Staff)									
	Working Groups	28%	22%	20%	28%	21%	16%	6%	2%	18%
	Investigative Workshops	75%	36%	12%	17%	0%	12%	22%	17%	24%
	All events	57%	42%	33%	27%	21%	21%	18%	7%	28%

*Year 1 includes activities from March-August 2009

** Year 8 includes activities from September 2015-April 2016

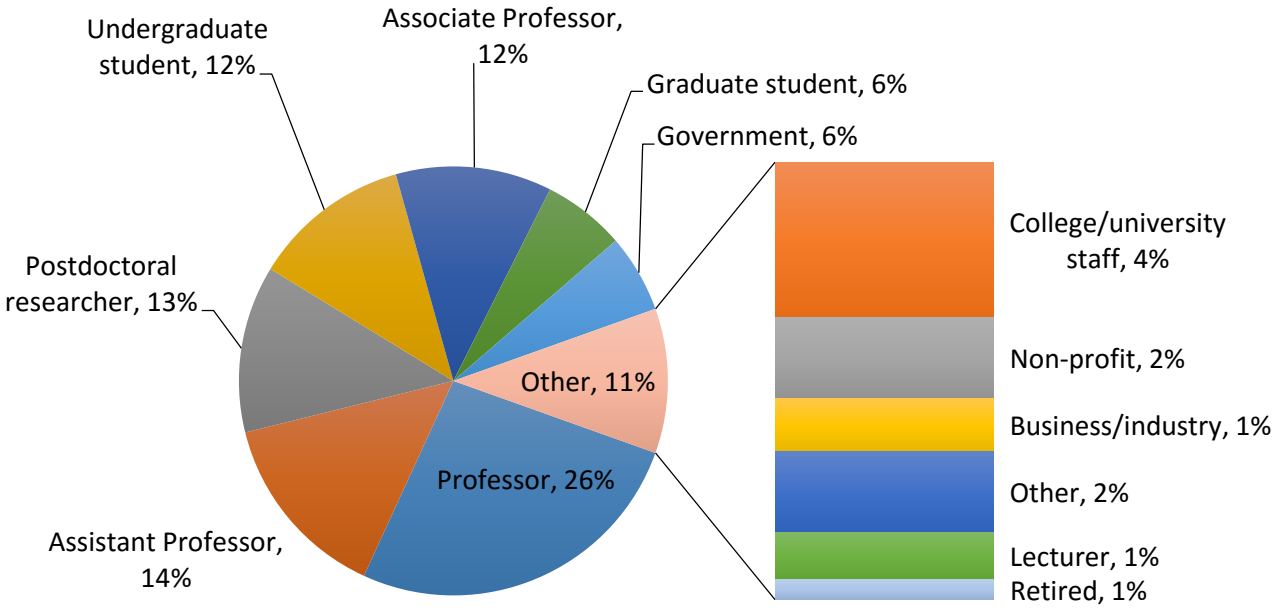
ABILITY DIVERSITY. Disclosure of disability status by participants to NIMBioS is optional. Around 2% overall indicated having some sort of disability during RP 8 **(Figure 8).**

Figure 8. Disability status of participants (n = 595)



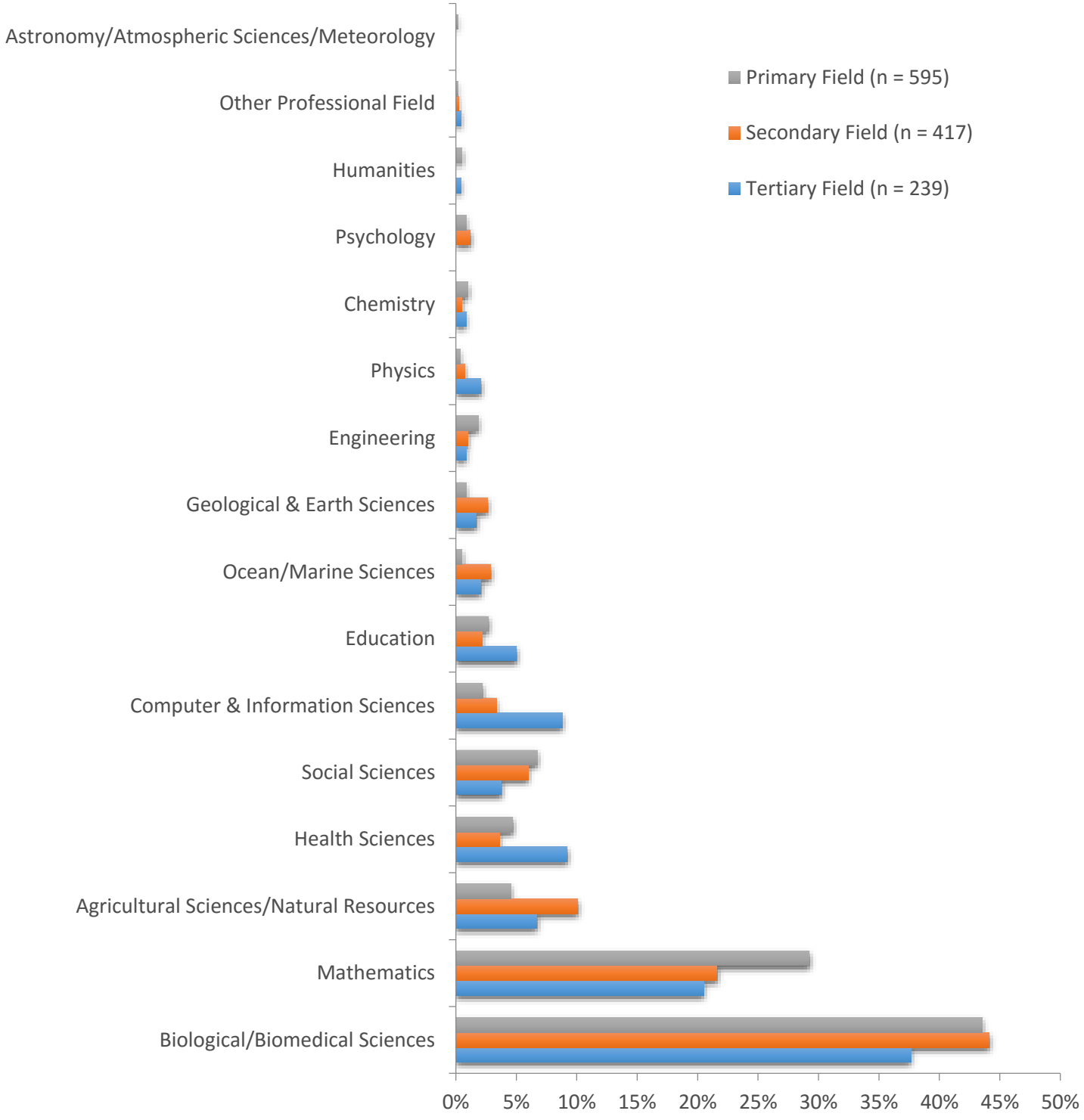
OCCUPATIONAL DIVERSITY. The majority of NIMBioS participants were college/university faculty or staff, undergraduate students, or postdoctoral researchers; however, participants came from government, industry, non-profit, or other positions as well (**Figure 9**).

Figure 9. Employment status of participants (n = 595)



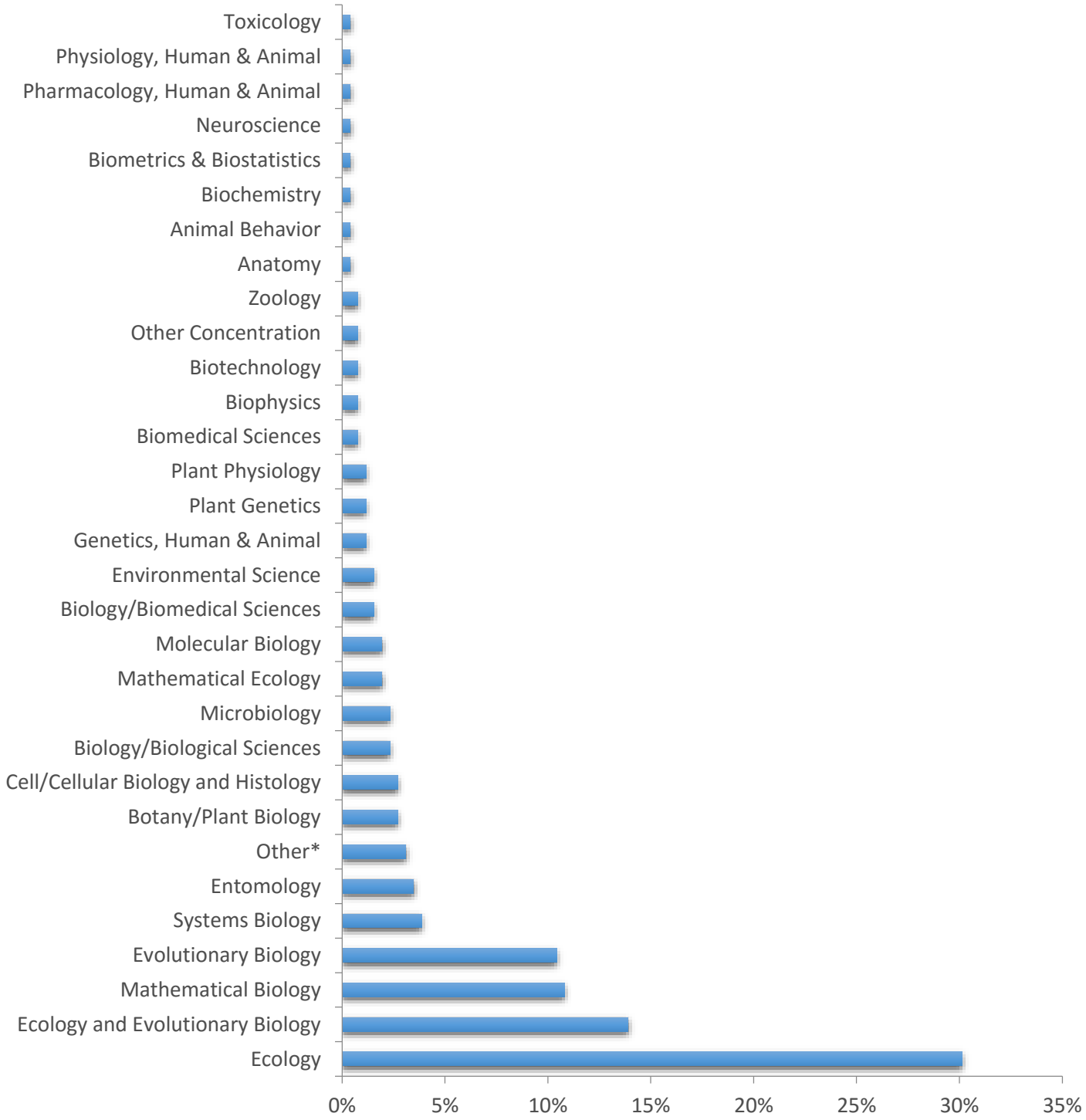
DISCIPLINARY DIVERSITY. Most participants at NIMBioS indicated their primary fields of study, as well as areas of concentration within those fields. Many indicated their secondary and tertiary fields of study as well. The most commonly reported fields of study included biological/biomedical sciences and mathematics although many other disciplines were represented (**Figure 10**).

Figure 10. Primary, secondary, and tertiary discipline areas of participants



The 259 participants indicating Biological/Biomedical Sciences as their primary field of study indicated 30 different areas of concentration within which they would classify their primary areas of research/expertise. The most commonly indicated area of concentration was ecology (30%), followed by ecology & evolutionary biology (14%), and mathematical biology (11%) (**Figure 11**).

Figure 11. Participant expertise area concentrations within biological/biomedical sciences field of study (n = 259)



* Other concentrations having one participant each: Anatomy, Animal Behavior, Biochemistry, Biometrics & Biostatistics, Neuroscience, Pharmacology, Human & Animal, Physiology, Human & Animal, Toxicology

INSTITUTIONAL DIVERSITY. Participants during RP 8 represented 218 different institutions, including colleges and universities, government institutions, industry, non-profits, and high schools (**Figure 12**). Of the 176 universities represented, most were classified as comprehensive (having undergraduate and graduate programs) (**Figure 13**).

Figure 12. Types of institutions represented (n = 218)

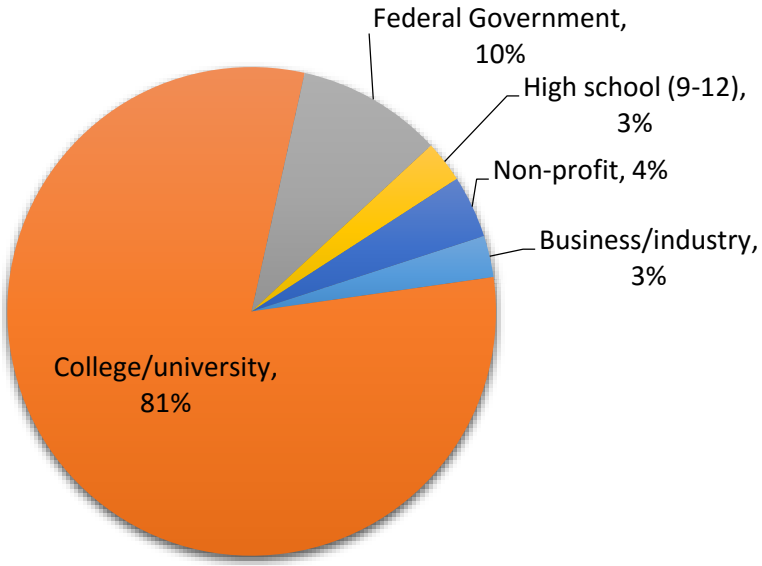
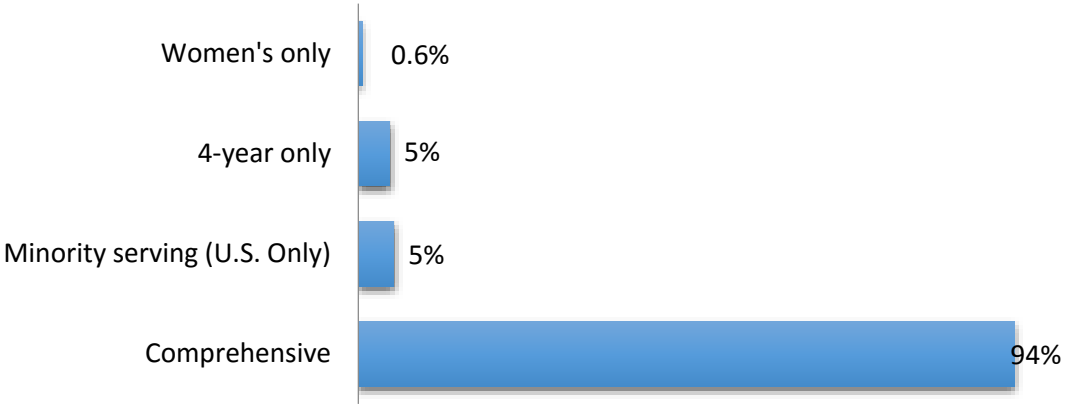


Figure 13. Characteristics of participants' universities (n = 176)



PROCESS EVALUATION

The process evaluation seeks to evaluate congruence between activities and goals. This type of evaluation is situated in monitoring and judging activities at NIMBioS, mainly through periodic evaluative feedback surveys from participants and event organizers. Other process evaluation data sources include evaluation case studies, which look more closely at what factors of NIMBioS participation contribute to positive changes in participants' research and/or educational careers.

NIMBioS conducted formal process evaluations of its first and last Working Group meetings, Investigative Workshops, Undergraduate Research Conference at the Interface of Biology and Mathematics, Postdoctoral Fellowship program, Tutorial, and Summer Research Experience programs. Evaluations were carried out via electronic surveys sent to all participants either after participation in a NIMBioS event, or both before and after participation if a pre/post comparison of responses was warranted. Evaluation findings, along with suggestions for improvement, were shared with event organizers, as well as NIMBioS staff as needed. Improvements to program content and format, as well as NIMBioS' overall operations, are made accordingly. Following is a brief summary of the process evaluations of NIMBioS' major activities during RP 8.

CONTEXT

1. Participants will be satisfied with the event overall.
2. The event will meet participant expectations.
3. Participants will feel the group made adequate progress toward its stated goals.
4. Participants will feel they gained knowledge about the main issues related to the research problem.
5. Participants will feel they gained a better understanding of the research across disciplines related to the group's research problem.
6. Participants feel that participating in the event will have on their future research.
7. Participants will be satisfied with the accommodations offered by NIMBioS.

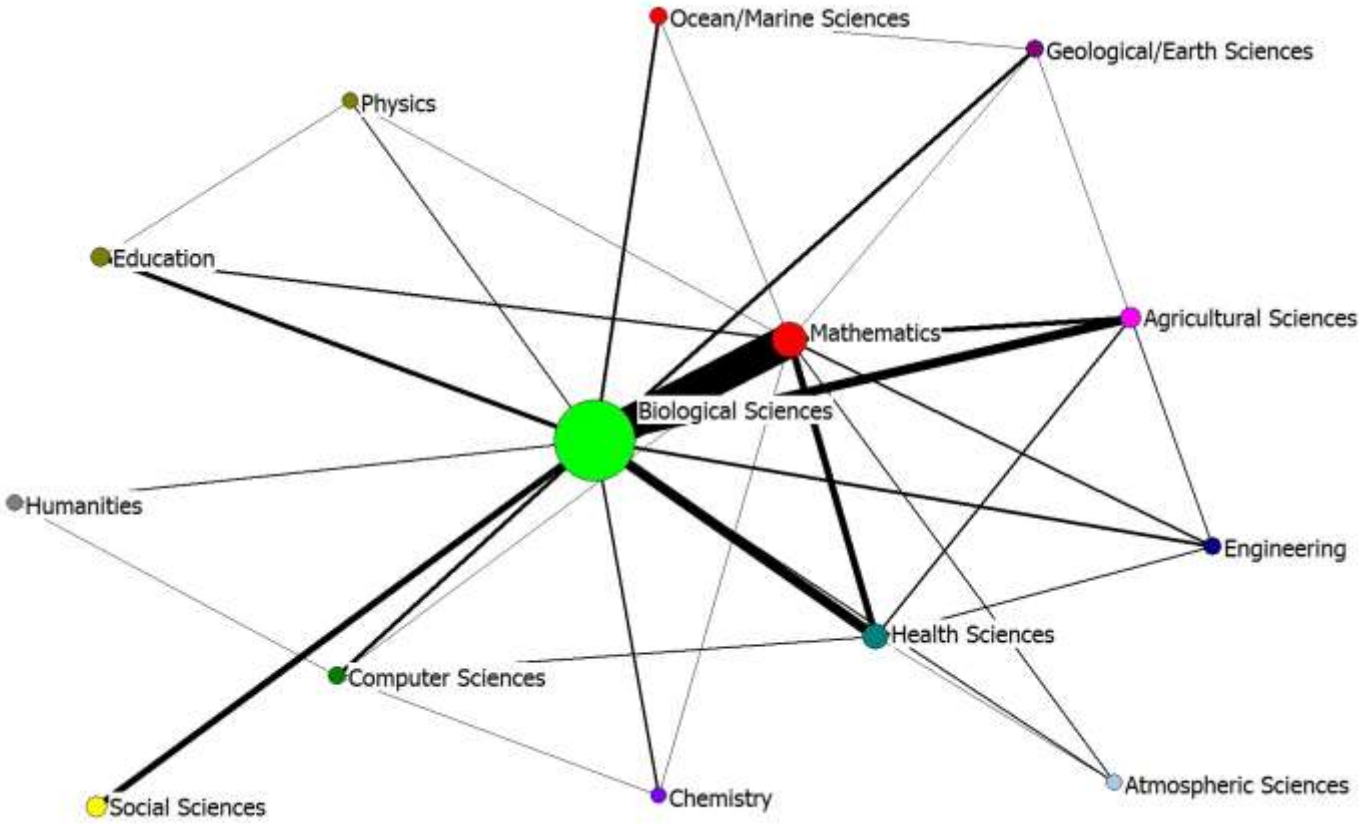
WORKING GROUPS. NIMBioS Working Groups are chosen to focus on major scientific questions at the interface between biology and mathematics that require insights from diverse researchers. The questions to be addressed may be either fundamental, applied or both, and may be focused around a particular biological topic, or one from mathematics that is driven by biological insight. NIMBioS is particularly interested in questions that integrate diverse fields, require synthesis at multiple scales, and/or make use of or require development of new mathematical/computational approaches.

Working Groups are relatively small (10-12 participants, with a maximum of 15), focus on a well-defined topic and have well-defined goals and metrics of success (e.g., publications, databases, software). Selection of Working Groups is based upon the potential scientific impact and inclusion of participants with a diversity of backgrounds and expertise that match the scientific needs of the effort. Organizers are responsible for identifying and confirming participants with demonstrated accomplishments and skills to contribute to the Working Group. Given this emphasis, Working Group activities rarely involve recently-trained researchers such as postdocs and graduate students. Participation by international researchers is encouraged; though generally there will not be more than 2-3 individuals from outside North America in a Working Group. Working Groups typically meet 2-4 times over a two-year period, with each meeting lasting 3-5 days; however, the number of participants, number of meetings, and duration of each meeting is flexible, depending on the needs and goals of the Group. Plans can include visits to NIMBioS for subsets of Working Group members to collaborate with NIMBioS IT staff and researchers on Working Group needs. Working Group evaluation highlights are aggregated across all events in their respective categories.

WORKING GROUP SUMMARY. During RP 8, NIMBioS hosted 24 Working Group meetings, including the start of eight new groups and the return of nine established groups. A total of 246 participants (179 unique) from 112 institutions took part in the Working Groups. During RP 8, participants came together from 15 different major fields of study to focus on the respective scientific questions of their groups.

Figure 14 shows the cross-disciplinary connections fostered among Working Group members through the meetings hosted at NIMBioS during RP 8. Node radius is representative of the log scaled number of participants in each field of study. Line size is representative of the number of times researchers from each field were brought together to collaborate and problem-solve at NIMBioS.

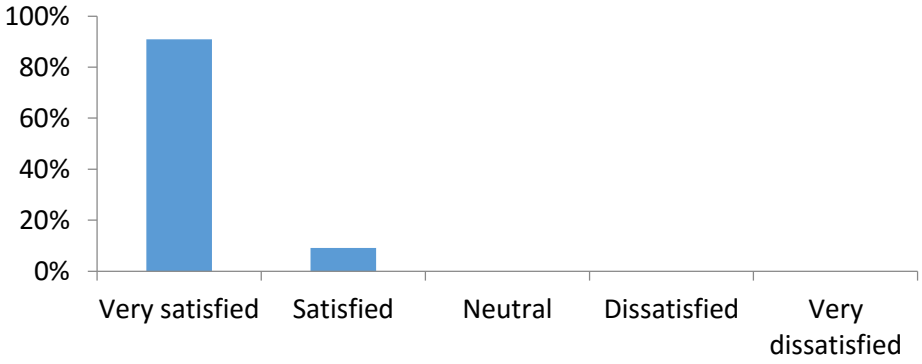
Figure 14. Working Group cross-disciplinary collaboration



WORKING GROUP ORGANIZER FEEDBACK

NIMBioS collects overall satisfaction feedback from Working Group organizers to the following question: As an event organizer, how satisfied were you overall with the way your event was managed by NIMBioS? Figure 15 summarizes the responses to this question for RP 8 organizers for all Working Group meetings.

Figure 15. Working Group organizer satisfaction with NIMBioS handling of event (n = 44)



Working Group organizer comments:

In both this Working Group and a workshop that I previously co-organized through NIMBIOS, I have been thrilled with the level of support that NIMBIOS has provided with respect to helping to organize the event. I would hold it up as a model of how to do things right.

NIMBioS staff make the process so easy. I never had to worry about any logistical details and could focus entirely on the meeting. Also, the guidance we received in adding participants was very helpful.

The organization was fantastic. We love coming to NIMBioS, the staff does an amazing job of making us feel welcome, and comfortable that allows us to focus on the science and be productive.

WORKING GROUP FIRST MEETINGS

During RP 8, NIMBioS hosted the first meetings of eight Working Groups, with 84 participants (**Table 2**). (See http://www.NIMBioS.org/workinggroups/ for more details about specific Working Groups). Evaluation surveys were sent to all participants. A total of 67 participants took part in the evaluation of the first meetings of their Working Groups. Eighteen of these participants were organizers and only answered questions about how they felt NIMBioS managed their events.

Table 2. Working Group First Meetings Hosted by NIMBioS

Title of Working Group	Dates	# Participants
Teaching Quantitative Bio	Oct 22-24, 2015	11
Modeling Molecules-to-Organisms	Nov 16-20, 2015	11
Modeling Organisms-to-Ecosystems	Nov 16-20, 2015	12
Spatial Cell Simulations	Dec 1-3, 2015	10
Cooperation and Cognition	Dec 9-11, 2015	8
Multiscale Vectored Plant Viruses	Dec 14-16, 2015	11
Models of Produce Contamination	Apr 13-15, 2016	11
Remotely Sensing Biodiversity	Apr 21-23, 2016	10

HIGHLIGHTS OF WORKING GROUP FIRST MEETING EVALUATION RESPONSES (FIGURES 16-18)

Figure 16. Overall satisfaction with the content and format of the Working Groups

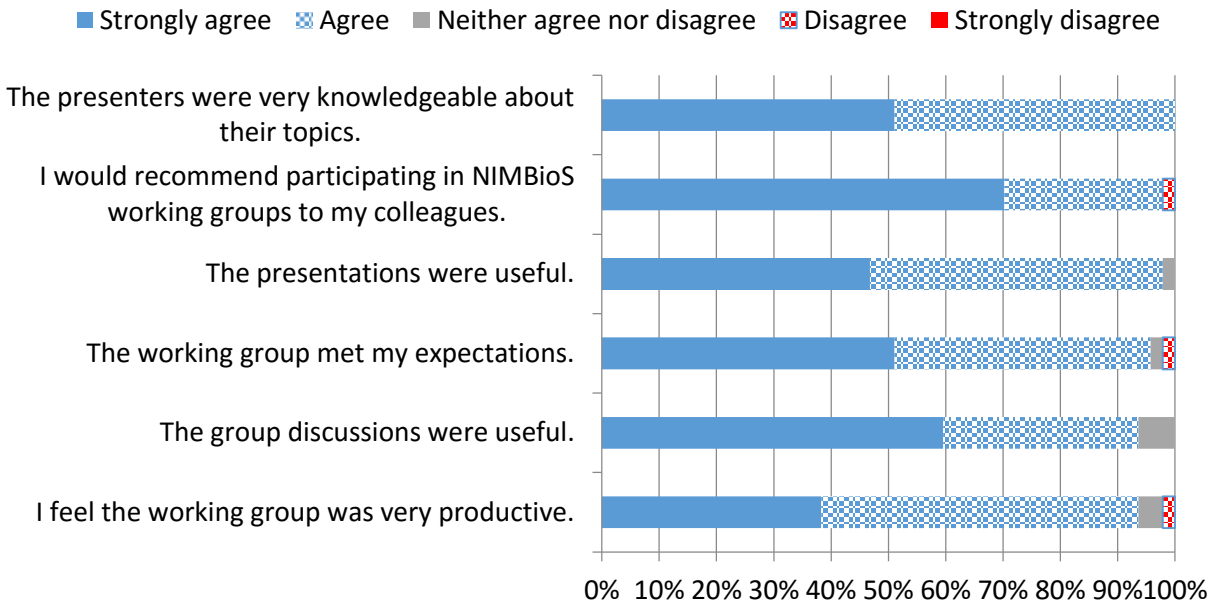


Figure 17. Participant responses to the following question--As a result of participating in this Working Group, I have a better understanding of the research happening in the field in disciplines other than my own:

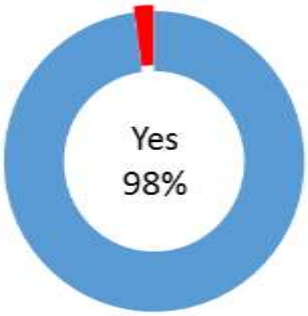
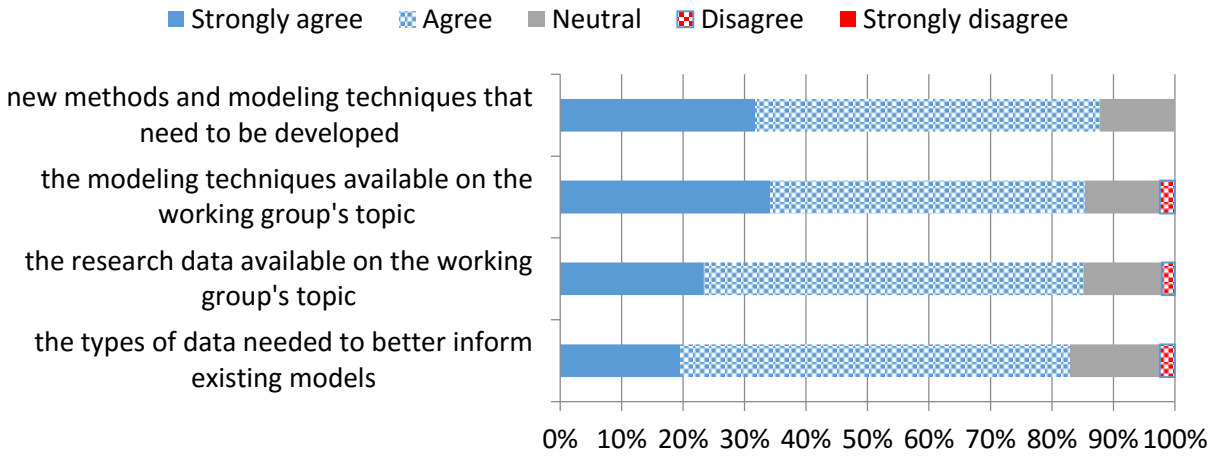


Figure 18. Participants who felt the exchange of ideas during the Working Group would influence their future research:



WORKING GROUP SECOND AND THIRD MEETINGS

During the reporting period, NIMBioS hosted the second meetings of nine Working Groups, with 91 participants, and the third meeting of four Working Groups, with 42 participants (Table 3).

Table 3. Working Group Second and Third Meetings Hosted by NIMBioS

Title of Working Group	Dates	# Participants
Second Meetings		
Leptospirosis Modeling	Sep 14-18	9
Vector Movement and Disease	Oct 26-29	14
Climate Proxies	Nov 3-5	9
Ecological Network Dynamics	Dec 7-11	8
Dispersal Biogeography	Mar 17-19	10
Spatial Cell Simulations	Mar 21-23	9
Teaching Quantitative Bio	Mar 24-26	10
Modeling Organisms-to-Ecosystems	Apr 4-7	10
Modeling Molecules-to-Organisms	Apr 18-21	13
Third Meetings		
Evolutionary Approaches to Sustainability	Oct 26-30	9
Modeling Antimicrobial Resistance Intervention	Mar 7-9	8
Vector Movement and Disease	Mar 29-Apr 2	16
Climate Proxies	Apr 4-6	9

Beginning in March 2011, NIMBioS changed its policy on evaluation of Working Group meetings to only sending full evaluation surveys to participants after the first and final meetings, rather than after every meeting, however, comments were solicited about the general feeling about the group's progress.

Participant comments from Working Group meetings 2-3:

The Working Group is progressing well and NIMBIOS provides us a frame for great interactions. I could not attend to the last meeting but I could connect by skype and interact with the group.

I think this is a very productive Working Group composed of members who work quite well together. A very positive experience for me as a young scientist.

Great experience! I enjoyed every meeting and every interaction. Nimbios helps to develop and support productive collaborations and stimulate new ideas.

Overall, the experience was GREAT!!! It provided an opportunity to meet a number of very "interesting" researchers doing work on topics previously unknown to me. Also, several (possible) research collaborations may materialize.

I am deeply grateful to NIMBioS for the support for our Working Group - we would otherwise not have had the support/opportunity to come together in this way and our resulting collaborations have been very exciting and productive.

The organization was fantastic. We love coming to NIMBioS, the staff does an amazing job of making us feel welcome, and comfortable that allows us to focus on the science and be productive.

Excellent interactions. We are able to calibrate model, review datasets, implement data fitting code, and decided on model parameter ranges.

CONCLUDED WORKING GROUPS

NIMBioS received notification that three Working Groups had reached their conclusions as of April 2016 (**Table 4**). It is the policy of NIMBioS to send follow-up evaluation surveys to Working Group participants after the final meeting summary has been received from Working Group organizers. A total of 24 participants responded to the final evaluation for their groups.

Table 4. Concluded Working Groups, RP 8

Title of Working Group	Dates	# Participants
Climate Change and Vector-borne Diseases	Dec 15-17	12
Computational Landscape Genomics	Mar 21-23	7
Evolutionary Approaches to Sustainability	Mar 28-Apr 1	9

HIGHLIGHTS OF WORKING GROUP FOLLOW-UP EVALUATION RESPONSES (FIGURES 19-20)

Figure 19. Evaluation of various aspects of Working Groups

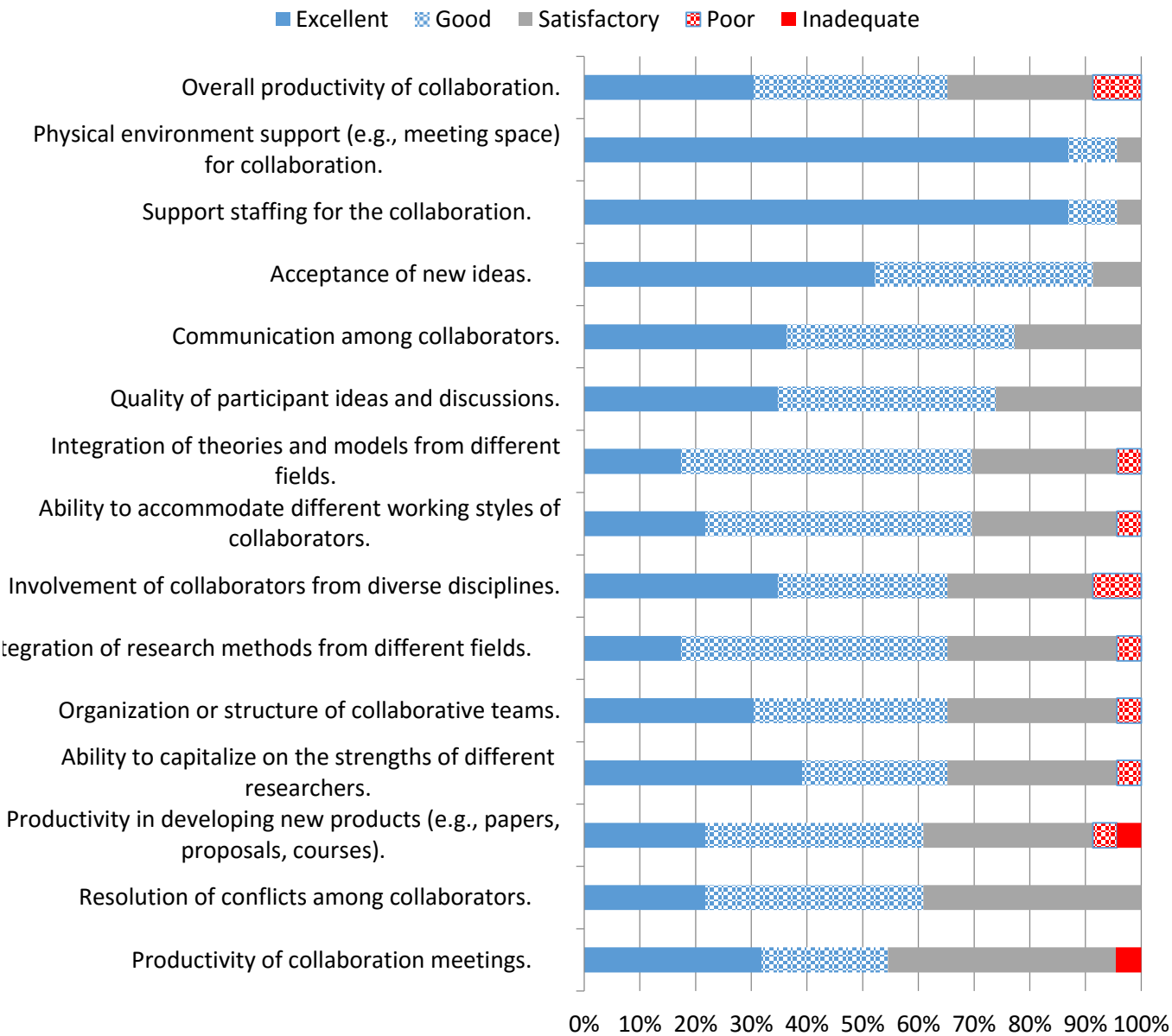
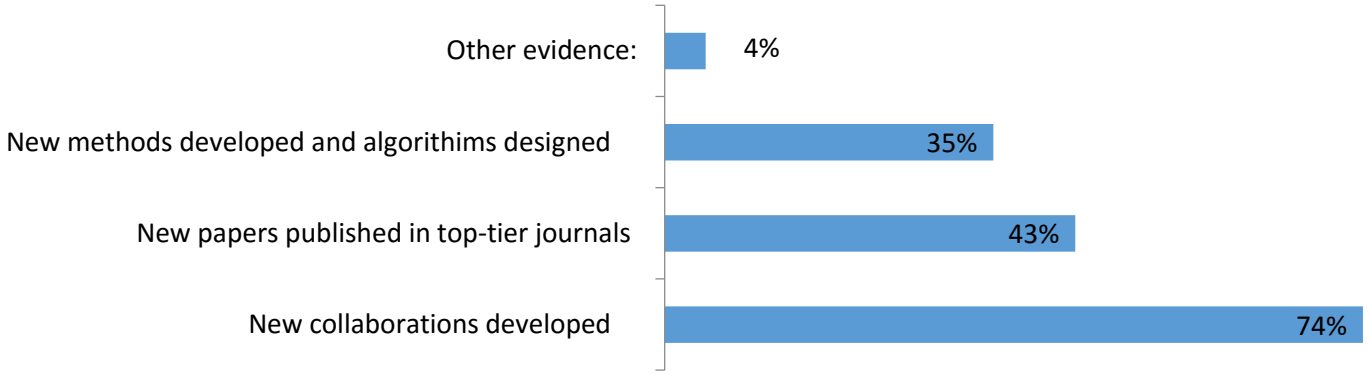


Figure 20. Evidence to support new insights and collaborations within the group



Concluded Working Group participant comment:

It has been a great working environment, open, multi-methodological in principle (though data for the effort are not yet existing if not in very small cases) and great people to work with! Fun and productive, great meetings!

INVESTIGATIVE WORKSHOPS

NIMBioS Investigative Workshops differ from Working Groups in that they focus on a broader topic or set of related topics at the interface of biology and mathematics and have relatively large size (30-40 participants). Workshops attempt to summarize/synthesize the state of the art and identify future directions, and they have potential for leading to one or more future Working Groups. Organizers invite 15-20 key participants, and the remaining 15-20 participants are filled through open application from the scientific community.

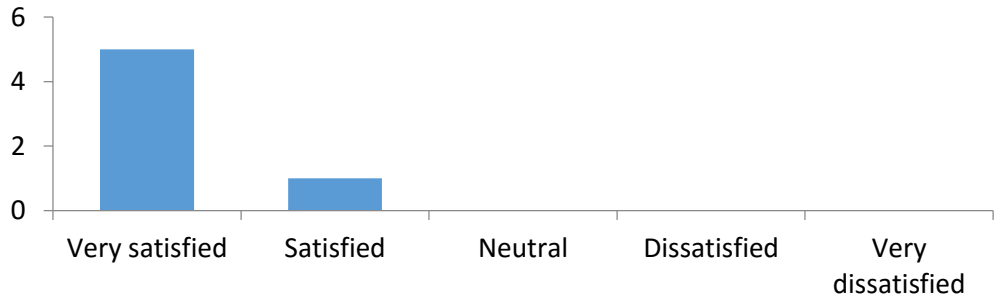
NIMBioS hosted two Investigative Workshops during RP 8 with a total of 71 on-site participants and 66 virtual participants (**Table 5**). Evaluation surveys were sent to all on-site Workshop participants. A total of 69 participants took part in the evaluation of the Workshops.

Table 5. Investigative Workshops Hosted by NIMBioS

Title of Workshop	Dates	# Participants
Morphological Plant Models	Sep 02-04	38
Evolution and Warfare	Sept 16-18	33

HIGHLIGHTS OF WORKSHOP EVALUATION RESPONSES (FIGURES 21-23)

Figure 21. Workshop organizer satisfaction with NIMBioS handling of event (n = 6)



Investigative Workshop organizer comments:

I have never experienced a more efficient, hassle-free workshop as an organizer than with NIMBioS. Because everything was set-up, this allowed me to focus on the workshop itself and the resulting collaborations and future projects that developed from this meeting. I have nothing but praise for NIMBioS and I wish their model was emulated more.

I greatly appreciated that NIMBioS handled many details (e.g., the website, travel and lodging arrangements) that would have been very difficult for me as an organizer to handle on my own. The NIMBioS staff were helpful and professional throughout.

Figure 22. Overall satisfaction with the content and format of the Workshop

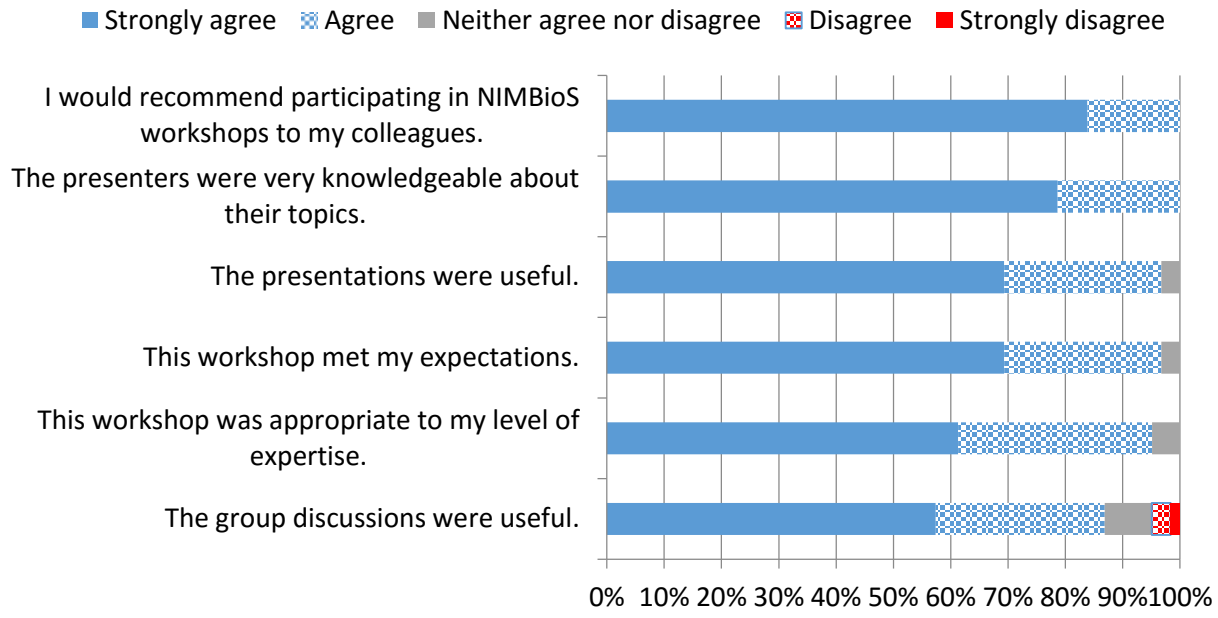
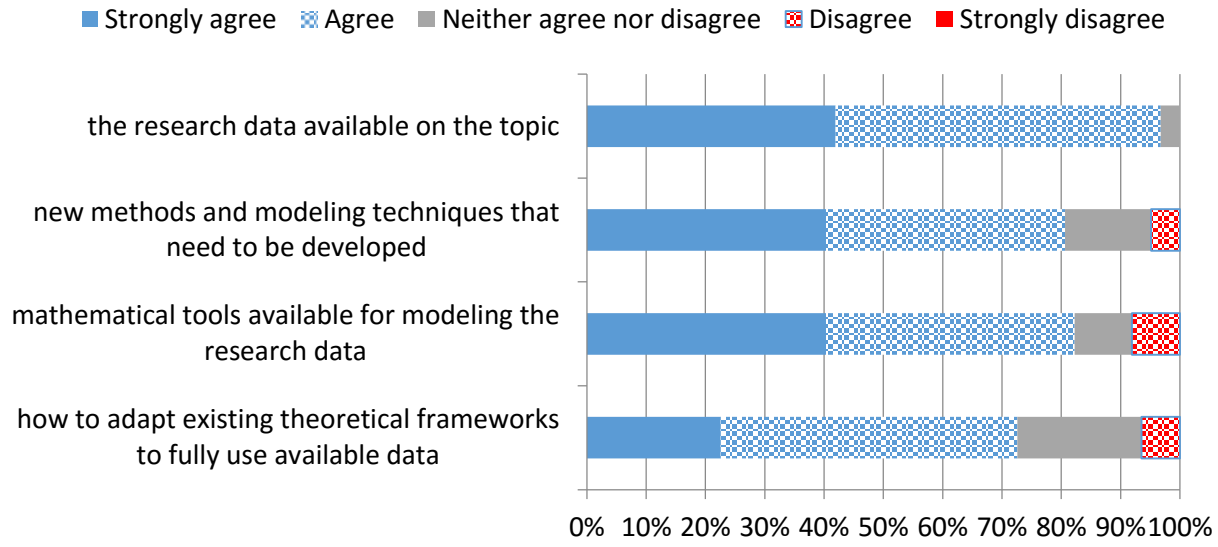


Figure 23. Participant responses to the following question-- As a result of participating in this Workshop, I have a better understanding of:



Investigative Workshop participant comments:

Having participated over the years in many meetings that bring together people from different disciplines, I think this was one of the most successful in quickly establishing a very productive cross-disciplinary dialogue

The mix of people with very different approaches to the topic of the workshop was excellent. The talks identified many questions that will be important to take into consideration in my own future studies, so I think the workshop will have a lasting positive impact on my research at least.

A great workshop and definitely much needed in plant biology. This workshop served to fill a hole in the plant research community and bring together different disciplines.

EDUCATION AND OUTREACH PROGRAM ACTIVITIES

TUTORIAL: GAME THEORETICAL MODELING OF EVOLUTION IN STRUCTURED POPULATIONS

The Game Theoretical Modeling of Evolution in Structured Populations Tutorial took place April 25-27 at NIMBioS. Organizers were Mark Broom (City University, London), Jeremy Van Cleve (University of Kentucky), Jonathan Rowell and Jan Rychtar (University of North Carolina, Greensboro). This Tutorial introduced participants to the discrete graph theory methods and models of structured population as well as classical continuous models based on differential equations. A total of 30 participants (plus four organizers) attended the tutorial. The evaluation survey was sent to all attendees and organizers, and 28 participants completed the survey.

HIGHLIGHTS OF TUTORIAL EVALUATION RESPONSES (FIGURES 24-25)

Figure 24. Overall satisfaction with the content and format of the Tutorial

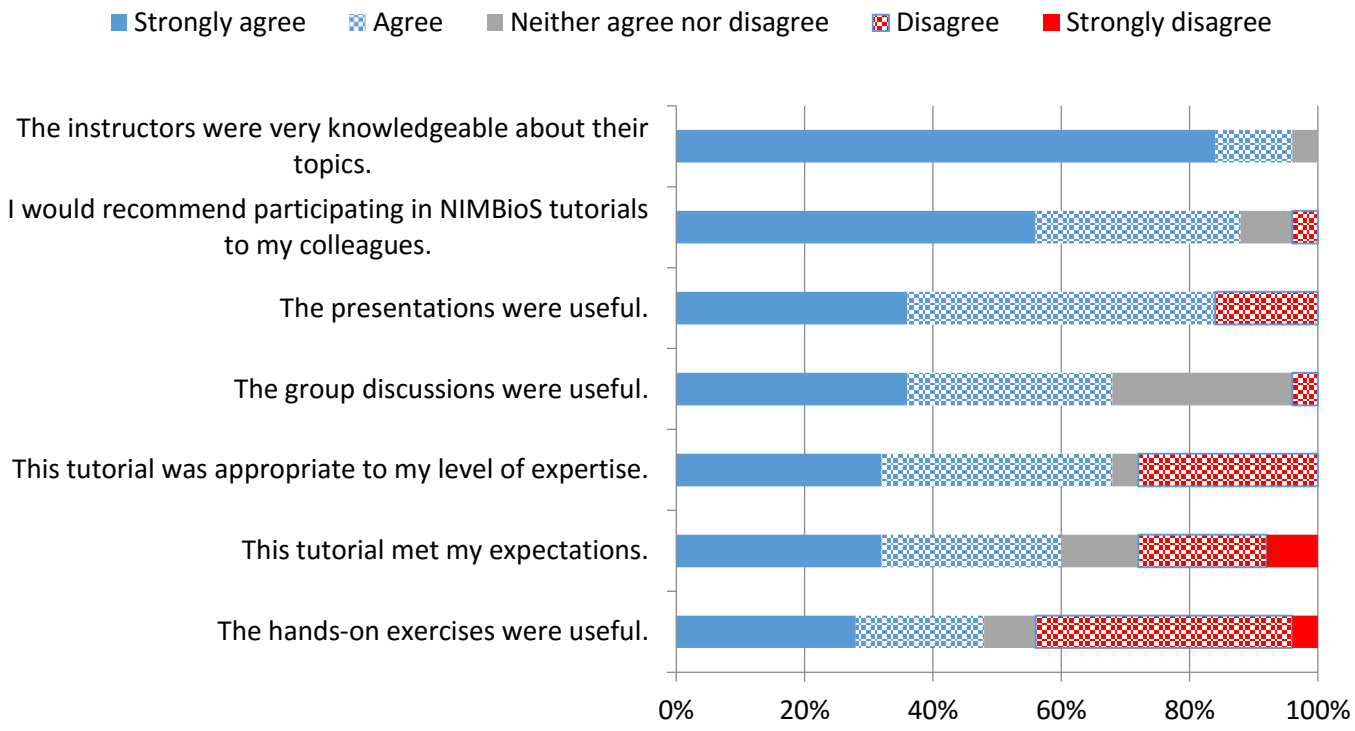
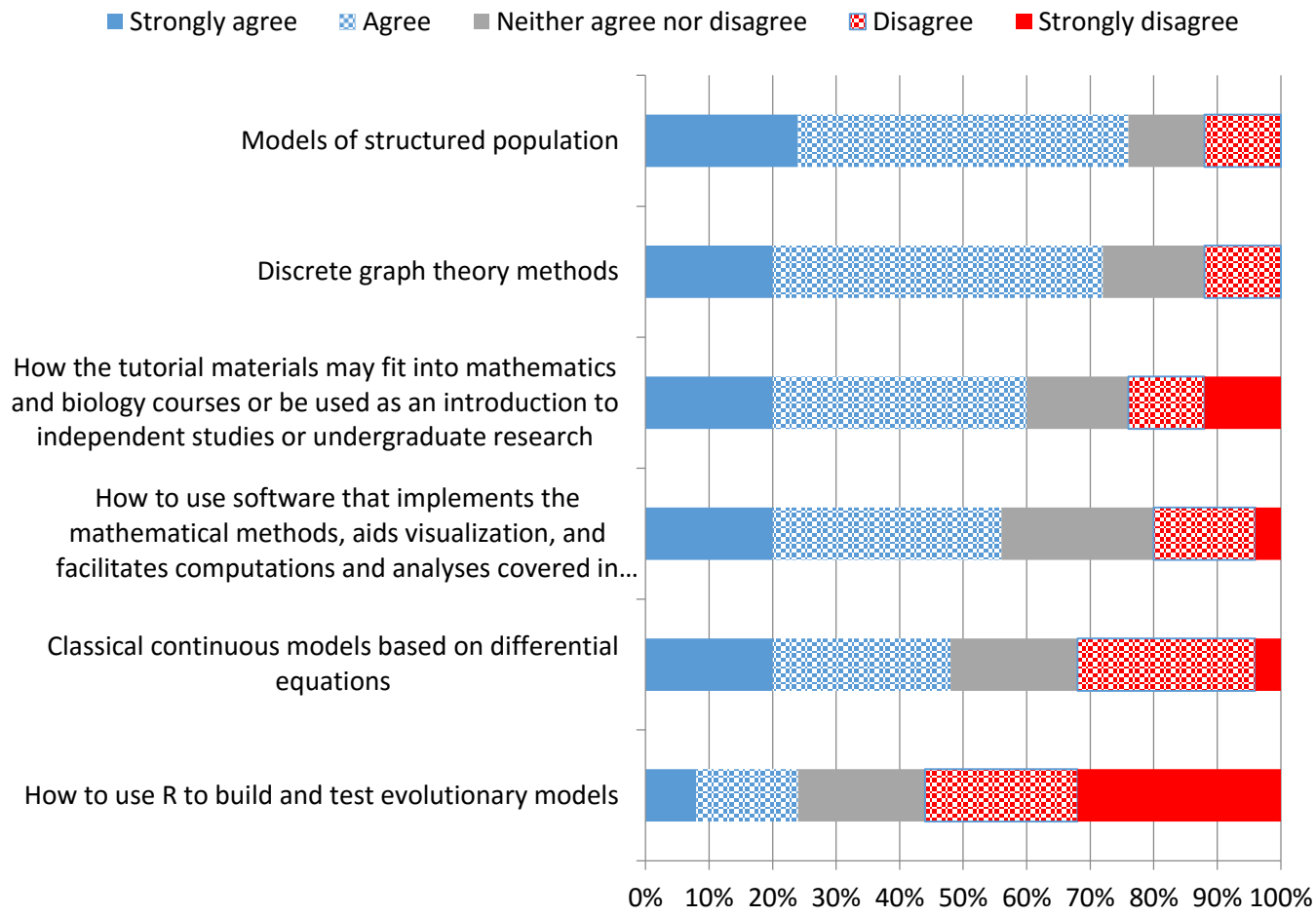


Figure 25. Participant responses to the following question-- As a result of participating in this Tutorial, I have a better understanding of:



Tutorial participant comments:

The venue and facilities were excellent. I really enjoyed my stay in Knoxville and at NIMBioS in particular.

SUMMER RESEARCH EXPERIENCE

The NIMBioS *Summer Research Experience (SRE*) program took place on the University of Tennessee, Knoxville (UT) Knoxville campus June 8-July 31, 2015. Fifteen undergraduates and two high school teachers were chosen to participate in the program. (While this SRE program technically fell within the dates of reporting period seven (RP 7), the SRE program for 2016 will not conclude until after the RP 8 annual report is due, so results from the previous year's SRE evaluation are provided each year.)

During the eight-week program, participants lived on campus at UT, and worked in teams with UT faculty to conduct research at the interface of mathematics and biology. The award included a stipend, housing and some funding to support travel. Program organizers were Suzanne Lenhart (Dept. Mathematics/NIMBioS), and Kelly Sturner (NIMBioS).

The five research projects for the 2015 program included:

- Modeling the distribution of fluid pressure in the kidney
- Development of mathematical models of Mycobacterium tuberculosis in mice
- Canine distemper modeling
- Exploring stressors in the host-pathogen interaction: Can a host use self-harming defenses to adequately protect itself?
- Ships, ports, invasions and math: Invasive species movements through global shipping routes

CONTEXT

1. Participants will be satisfied with the program overall.
2. The research experience will meet participant expectations.
3. The research experience will impact participant plans to go to graduate school.
4. Participants will increase their research skills during the program.
5. Participant will feel they gained knowledge about the research process.
6. Participants will be satisfied with their mentors.
7. Participants will be satisfied with the accommodations offered by NIMBioS.

HIGHLIGHTS OF REU EVALUATION RESPONSES (FIGURES 26-28)

Figure 26. Participant pre-and post-program skills, response scale of 1 = extremely poor at the skill to 5 = excellent at the skill

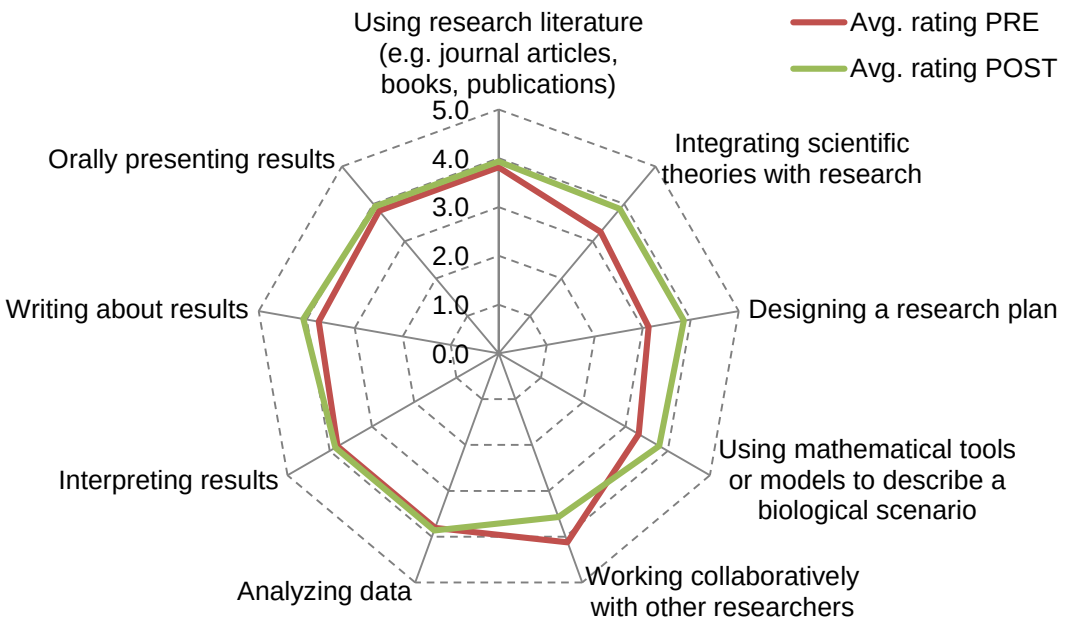


Figure 27. Participant pre- and post-program knowledge, response scale of 1 = extremely poor understanding to 5 = excellent understanding

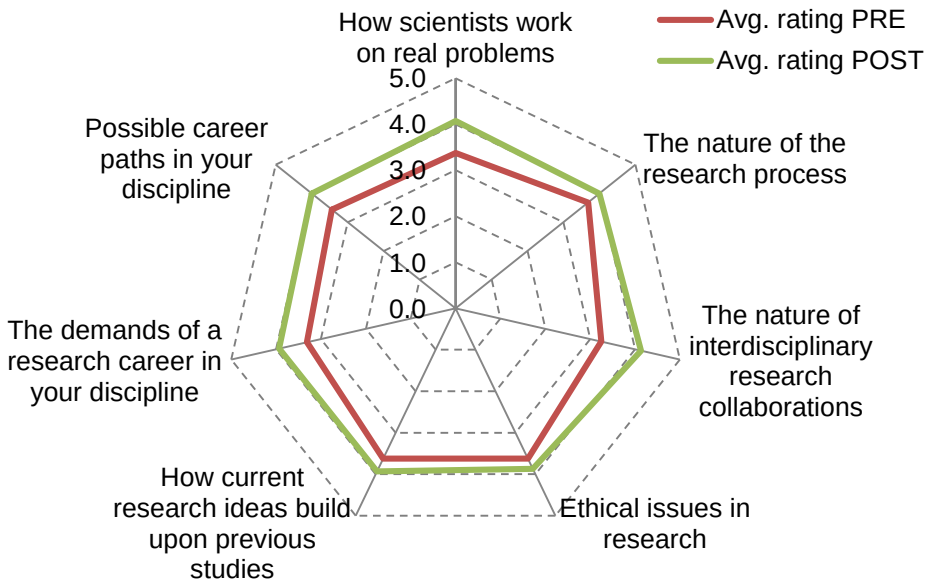
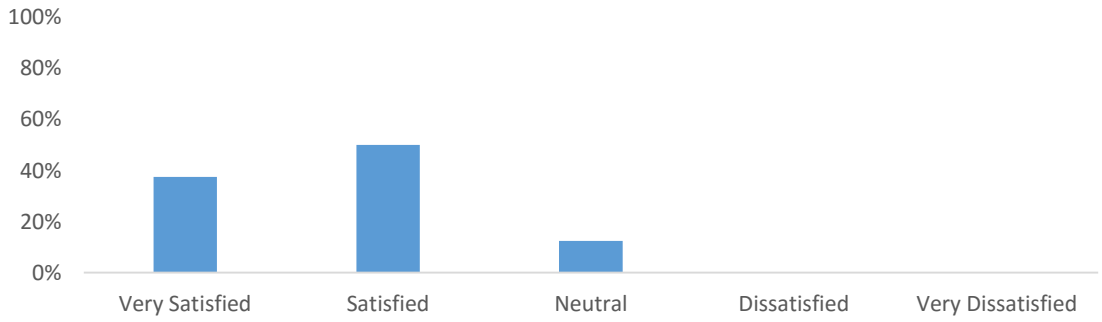


Figure 28. Overall satisfaction with the research experience



SRE participant comments:

It is an incredible opportunity to work in an interdisciplinary, collaborative environment as an undergraduate. There aren't many programs in biomathematics that offer this experience. The program also really exceeded my expectations in the amount of lectures, opportunities to meet graduate students and postdocs, and social events. The other SRE students were incredibly talented, and having us all housed on one floor of Laurel Hall was great so we got to get to know each other well. Overall, I learned an incredible amount and had a great summer.

I would recommend the program because of the large impact it has made on shaping who I become after my undergraduate career. I learned much about myself from this program, as well as learned much about the people who will become my peers one day. Additionally, the administration staff is top-notch along with Suzanne, which really makes the whole process enjoyable.

UNDERGRADUATE RESEARCH CONFERENCE AT THE INTERFACE OF BIOLOGY AND MATHEMATICS (URC)

The NIMBioS seventh annual Undergraduate Research Conference at the Interface of Biology and Mathematics took place at the University of Tennessee's Conference Center in downtown Knoxville November 21-22, 2015. The event was organized by the NIMBioS Education and Outreach Associate Director for Education, Outreach, and Diversity, Suzanne Lenhart, and the Education and Outreach Coordinator Kelly Sturner.

A total of 90 participants (plus 2 organizers) attended the seventh annual Undergraduate Research Conference, which provided opportunities for undergraduates to present their research at the interface of biology and mathematics. Student talks and posters were featured as well as a panel discussion on career opportunities. Evaluation surveys were sent to all participants in the conference, with the exception of event organizers. A total of 71 participants took part in the evaluation.

CONTEXT

1. Participants will be satisfied with the conference overall.
2. The conference will meet participant expectations.
3. Participants will feel the conference allowed them to make new connections with others in math and biology.
4. Participants will feel they gained a better understanding of undergraduate research happening at the interface of mathematics and biology.
5. Undergraduate participants feel the conference will have an impact on their future career plans.
6. Participants will be satisfied with the accommodations offered by NIMBioS.

HIGHLIGHTS OF URC EVALUATION RESPONSES (FIGURES 29-30)

Figure 29. Respondent agreement levels with statements about various aspects of the conference

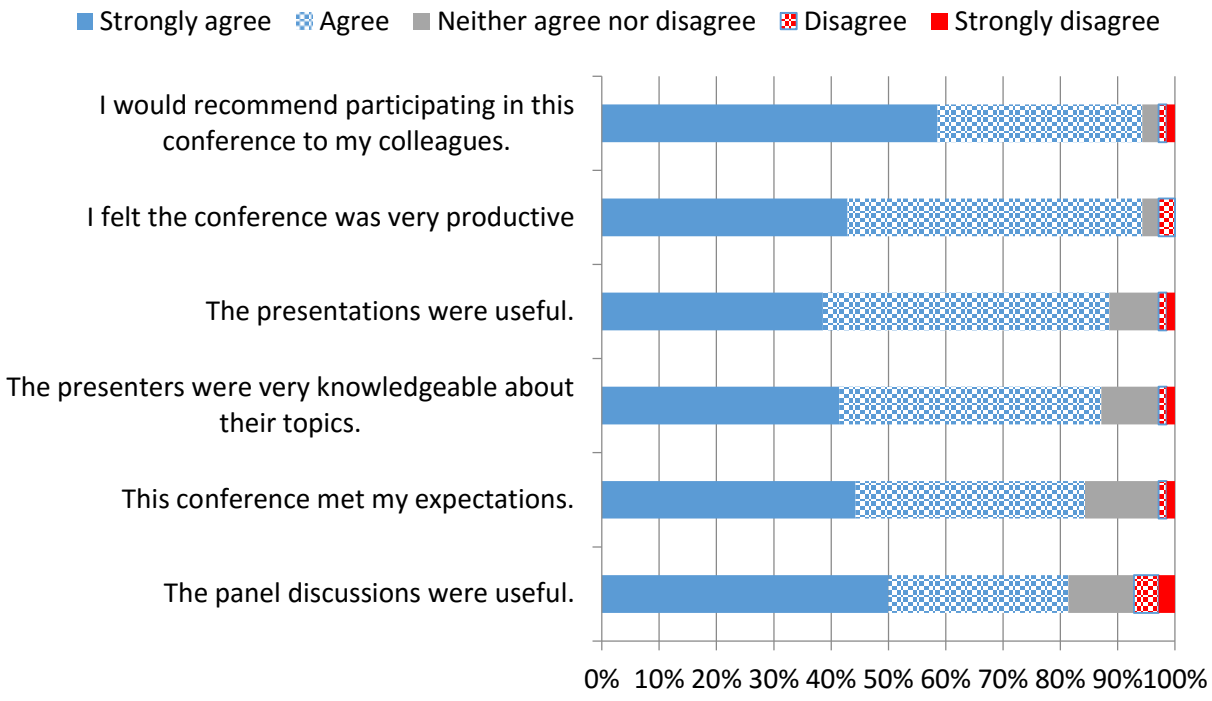
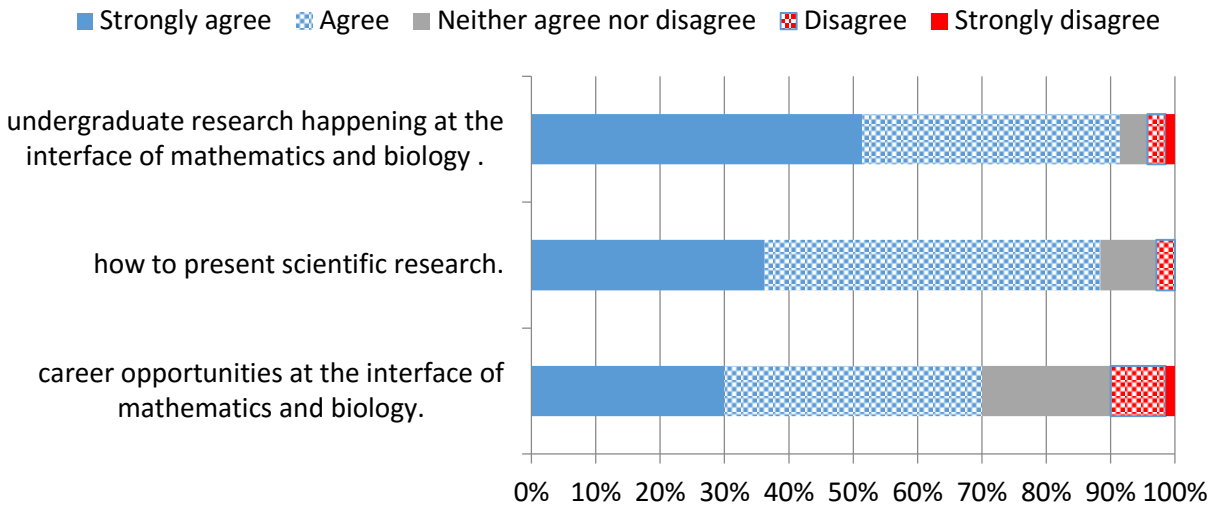


Figure 30. As a result of attending this conference, I have a better understanding of:



Tutorial participant comments:

It was a great opportunity to see others doing similar work but with varying approaches. The conference definitely manifested many ideas within me to augment my research, and new research ideas entirely that involve meshing the two disciplines even more.

I have been hesitant to go into a math heavier field, but after the panel discussion, I think I would be successful in the field as long as I am eager to work hard to greater my understanding

Great conference. This experience was only possible due to NIMBioS generous funding to our group!

NIMBIOS POSTDOCTORAL FELLOW EXIT SURVEY HIGHLIGHTS

NIMBioS provides an opportunity for postdoctoral scholarship at the interface between mathematics and biological science that builds upon the experiences gained through the many successful postdoctoral fellows who have been in residence at the University of Tennessee, Knoxville over the past decades. Postdoctoral scholars propose synthetic projects that require an amalgam of mathematical and biological approaches, and are expected to include explicit opportunities to expand the scholar's previous education. Projects should not require the collection of additional empirical data, but may involve many aspects (collating, formulating databases, and developing models) of synthesizing existing data. Applications are welcome from those with a range of both biological and mathematical prior experience, with highest priority given to those with explicit plans to develop their ability to effectively carry on research across these fields.

Postdoctoral Fellowships are for two years (assuming satisfactory progress toward research goals in year one). Under appropriate circumstances applicants may request periods shorter than two years, and in special circumstances a Fellow may request an extension beyond two years. NIMBIOS Postdoctoral Fellows are encouraged to participate in grant proposal development Workshops offered through UT and Fellows are permitted to serve as a Principal Investigator on grant proposals submitted through NIMBioS.

Upon leaving the Postdoctoral Fellowship program at NIMBioS, program participants are asked to fill out a short exit evaluation form that examines several aspects of satisfaction with the program's operations. To date, 27 (84%) alumni from the program have filled out the form.

CONTEXT

1. Participants will be satisfied with the structure of the program.
2. Participants will feel the program has been valuable to their academic careers.
3. Participants will be satisfied with the accommodations offered by NIMBioS to conduct research.
4. Participants will be with their mentors overall.
5. Participants will be satisfied with the types of advice/assistance received from their mentors.
6. Participants will be satisfied with the opportunity to participate in education and outreach activities.

HIGHLIGHTS OF POSTDOCTORAL FELLOWSHIP PROGRAM RESPONSES (FIGURES 31-33)

Figure 31. Postdoctoral fellow satisfaction with program mentors

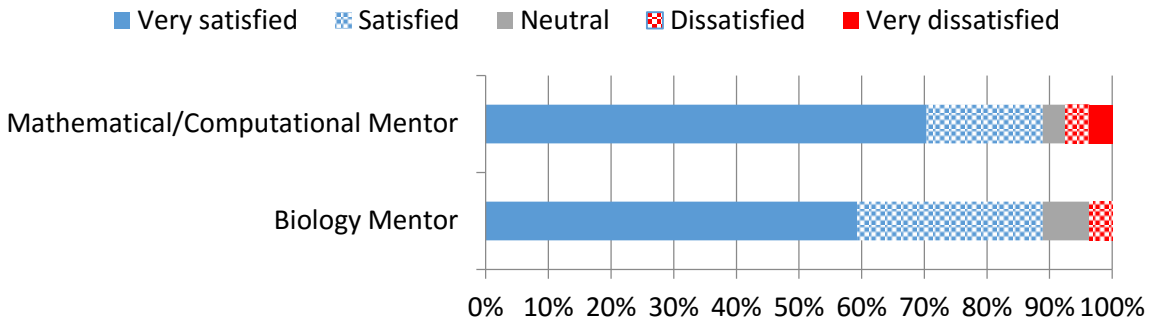


Figure 32. Postdoctoral fellow satisfaction with advice/assistance received from program mentors

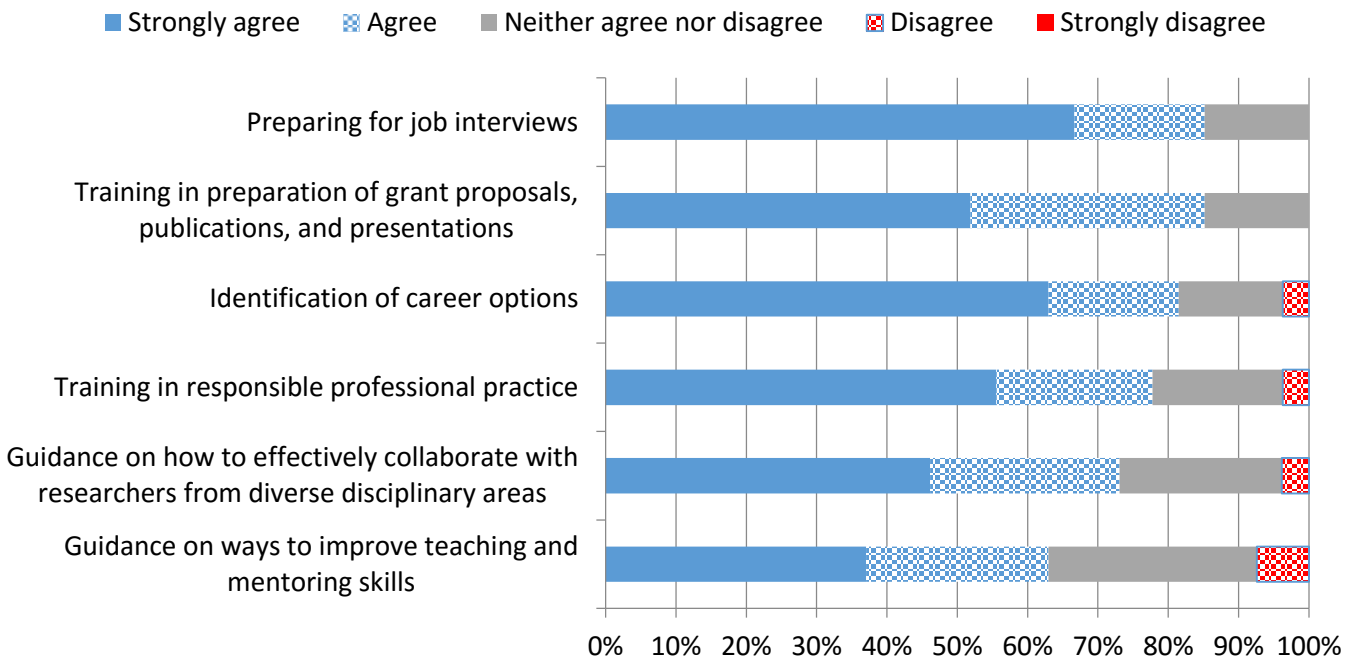
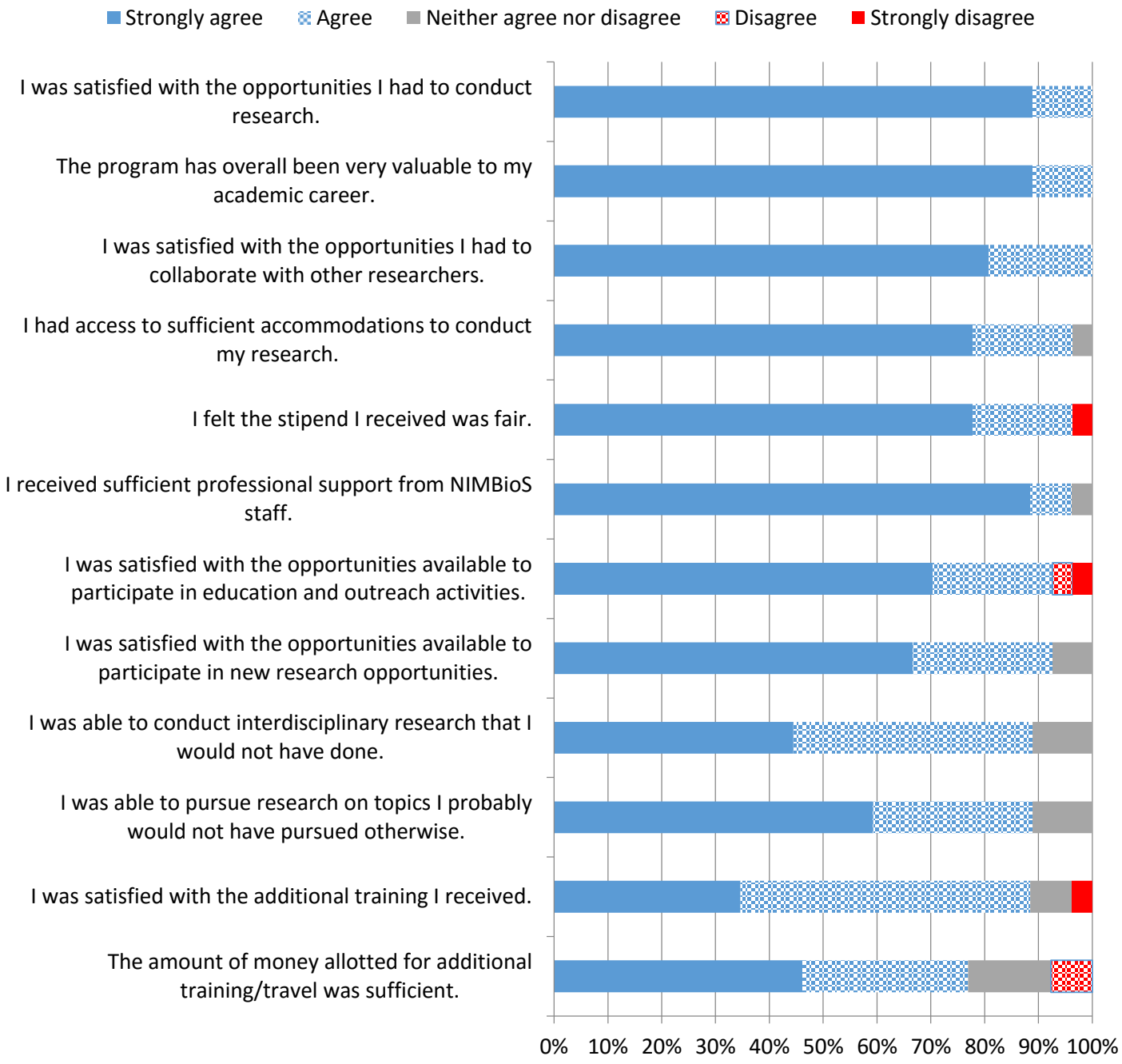


Figure 33. Postdoctoral fellow satisfaction with overall program experience



NIMBioS Postdoctoral Fellowship alumni comments:

I had a wonderful experience at NIMBioS. The opportunity to interact with a large number of other postdocs and see them dealing with job interviewing etc., was a really great opportunity for me.

Thank you for the amazing opportunity. It definitely made my career! I was able to do work I could do nowhere else. This remains the single most amazing part of NIMBioS- the synthesis and modeling work we do just doesn't have support elsewhere. The second most amazing is the support- job training, development, admin, and more. It was the best two years of science I've had so far!

The NIMBioS postdoc program is fantastic and I feel so fortunate to have had the opportunity to grow there.

PRODUCT EVALUATION

The results produced from NIMBioS research activities are important in measuring its success. The product evaluation seeks to monitor, document, and assess the quality and significance of the outcomes of NIMBioS activities. Data sources for product evaluations include participant self-report of NIMBioS products resulting from affiliation (e.g. journal articles, student education, and software), Web of Science data, and data collected from participant evaluation forms and follow-up surveys.

CONTEXT

1. NIMBioS publications will be highly interdisciplinary.
2. NIMBioS publications will be highly cited.
3. NIMBioS publications will highly collaborative.
4. NIMBioS participants will produce other scholarly products, including book chapters, presentations, proposals for follow-on research, meetings/Workshops, student education, data/software, and/or publicity in other media.

PUBLICATIONS

Activities at NIMBioS have led to 678 published journal articles on a range of subjects from January 2009- April 2016, (**Figures 34 and 35** and **Table 6**). An additional two are in press at writing and 17 have been submitted for review. The articles cover research ranging across many areas of ecology, evolutionary biology, applied mathematics, and computational biology.

Figure 34. Most common words from NIMBioS publication abstracts, all years

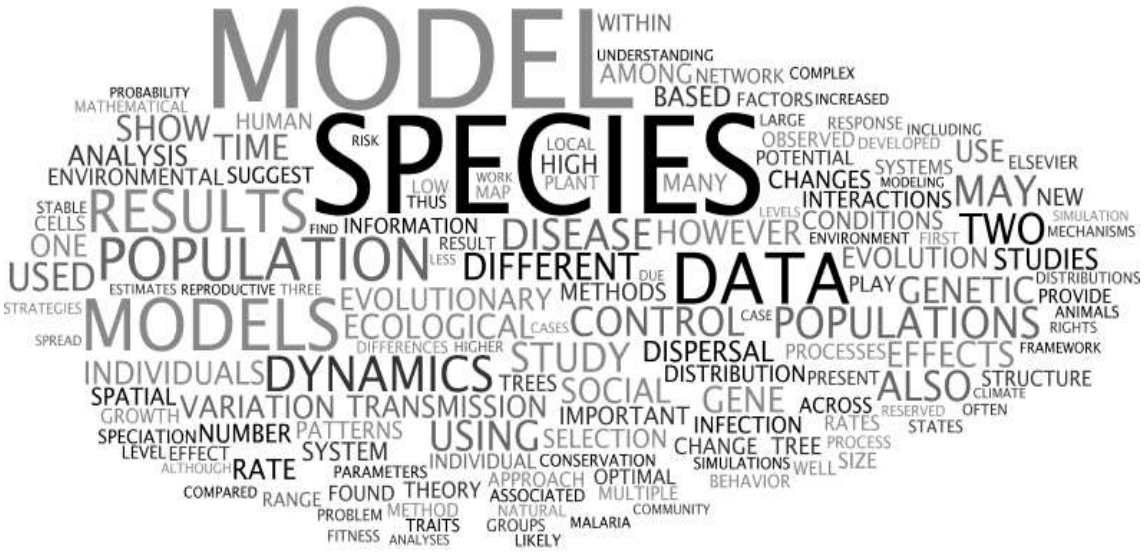
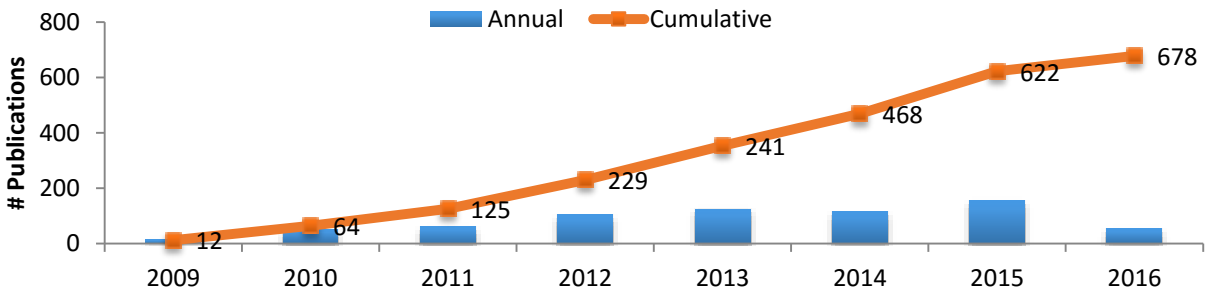


Figure 35. Number of publications reported from NIMBioS activities since 2009, by publication year



*2016 includes publications submitted by participants to NIMBioS through April 2016

NIMBioS products are published in many high-ranking journals in their respective fields. **Table 6** highlights the number of products in a selection of high-impact journals according to the Web of Science impact factor. Prominent high impact journals include Nature, Cell, Science, Ecology Letters, and Trends in Ecology and Evolution.

Table 6. Number of NIMBioS articles published in a selection of high-impact journals during the current reporting period (through April 2016) and since NIMBioS' inception, sorted by journal 5-Year Impact Factor

Journal Title	5-Year Impact Factor *	# of NIMBioS Publications in Year 8 **	# of NIMBioS Publications Since Inception ***
Nature	41.30	-	5
Cell	35.53	-	1
Science	35.26	2	7
Trends in Ecology and Evolution	19.82	2	7
Ecology Letters	16.78	2	10
Systematic Biology	14.79	2	7
PLoS Biology	11.9	1	3
Nature Communications	11.9	-	2
Proceedings of the National Academy of Sciences	10.56	1	16
Current Biology	10.13	-	1
PLoS Genetics	8.56	-	2
Nucleic Acids Research	8.87	-	3
Phil Trans of the Royal Soc B-Biological Sciences	7.89	2	6
Molecular Ecology	6.33	3	10
Ecology	6.16	-	6
Proc of the Royal Soc B-Biological Sciences	5.65	1	10
PLoS Computational Biology	5.28	2	8
Evolution	5.25	2	17
Journal of Animal Ecology	5.32	1	4
The American Naturalist	4.96	2	13
Journal of the Royal Society Interface	4.65	-	5
PLoS One	3.7	9	35
Animal Behaviour	3.42	2	9
BMC Bioinformatics	3.45	-	2

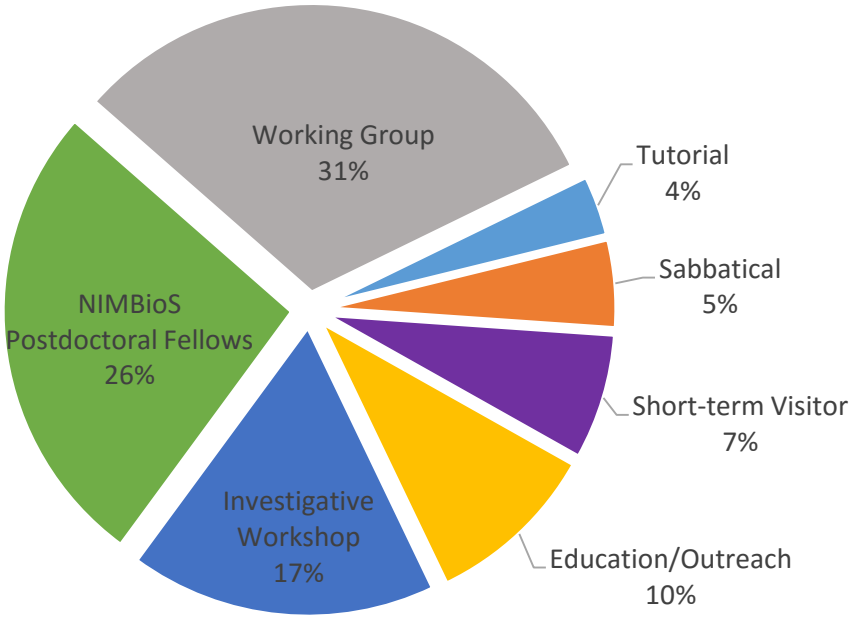
* The journal impact factor is a measure of the frequency with which the "average article" in a journal has been cited in a particular year. The impact factor is an indicator of a journal's relative importance, especially as compared to other journals in the same field. Impact factor calculation: cites in year n to articles published in year (n-1 + n-2)/number of articles published in year(n- 1 + n-2).

** Number of publications in Year 8 includes all publications reported since compilation of the previous Annual Report (April 2015) through April 2016.

*** September 2008 – April 2016

NIMBioS publications come from a variety of activities, although Working Group participants tend to publish the largest portion of journal articles (31%), followed by NIMBioS Postdoctoral Fellows (26%) (**Figure 36**).

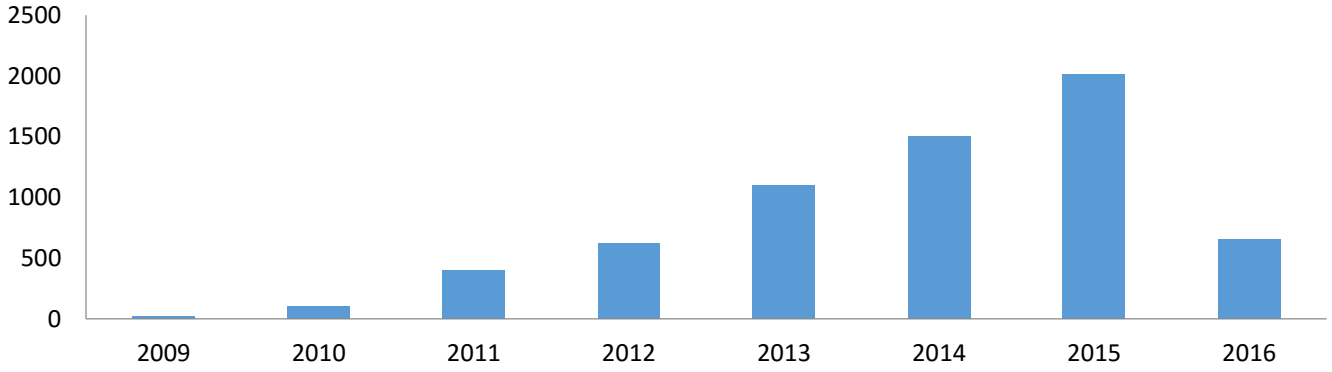
Figure 36. Distribution of journal publications submitted to NIMBioS by participants



BIBLIOMETRIC INDICATORS

CITATION ANALYSIS OF PUBLICATIONS. Of the 678 journal articles reported by NIMBioS participants, 530 are indexed in the Institute for Scientific Information's (ISI) Web of Science (WOS). Data in the following sections are based on these articles, which involved 1,455 researchers from 610 unique institutions spanning 52 countries. These articles have appeared in 214 different journals, many of which are considered to have high-impact in the academic community. These articles have been collectively cited 6,641 times, with an average of 12.70 cites per article, and an h-index of 35 (Figure 37). The cites per article falls within the range of the two major research fields of the publications during the last 10 years; mathematics (4.14 citers/paper) and biology (16.91 cites/paper). Forty-four participants have authored five or more papers each as a result of NIMBioS affiliated collaborations.

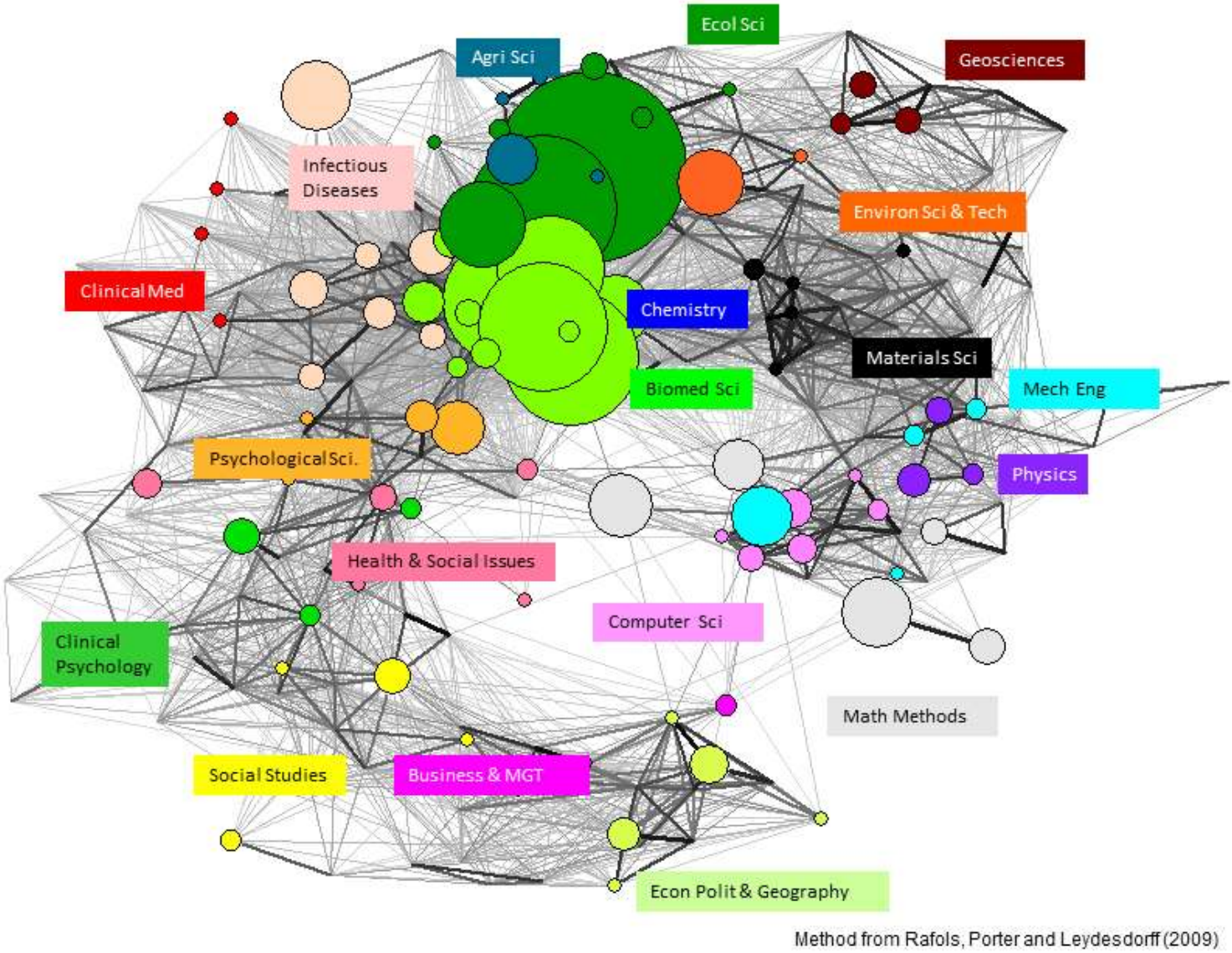
Figure 37. Citations per year for NIMBioS articles



DISCIPLINARY SPAN OF PUBLICATIONS. The 530 published articles span 97 discipline areas, as designated by the ISI WOS Categories. Categories are assigned at the journal level based upon a combination of citation patterns and editorial judgment at the ISI. Subject categories are used in bibliometric research as a representation of the research areas in which scientists work.

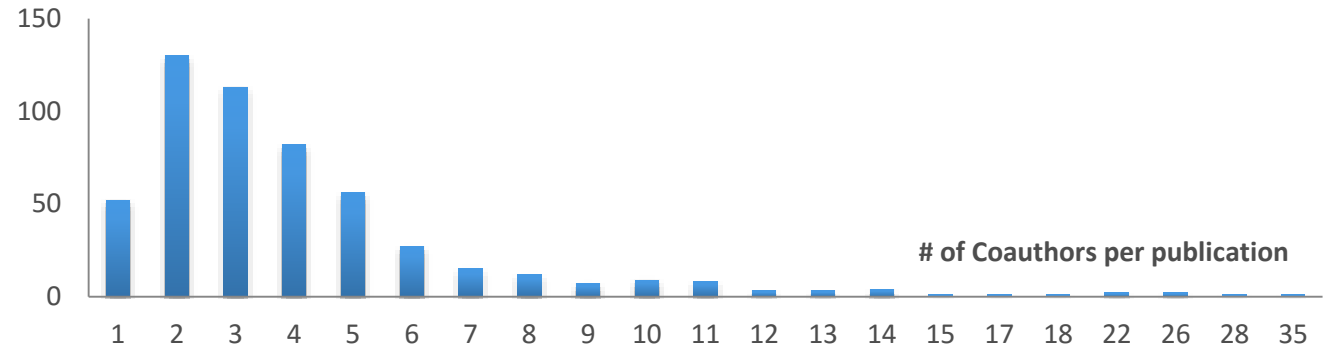
Figure 38 locates the subject categories of the 530 NIMBioS articles on a network map of the WOS Categories. The gray background intersections are the 224 WOS Categories, located based on cross-citation relationships among all WOS journals in 2007 (from Rafols, Porter, and Leydesdorff, 2009). The 19 labeled "macro-disciplines" are based on factor analysis of that cross-citation matrix also. Nearness on the map indicates a closer relationship among disciplines. Circular node sizes reflect the relative number of NIMBioS participant publications. The most common subject category in which NIMBioS publications fell was Ecology (153), followed by Evolutionary Biology (91), Mathematical & Computational Biology (79), Biology (72), Multidisciplinary Sciences (70), and Genetics & Heredity (48).

Figure 38. Web of Science Categories for 530 WoS journal articles to date



COAUTHORSHIP. One of the core values of NIMBioS is to take a collaborative approach to science and science education. We are interested, therefore, in examining the number of co-authors on NIMBioS-related publications as one indicator of scientific collaboration. For the 530 publications reported thus far, the average number of co-authors per paper is 4.2 **(Figure 39)**.

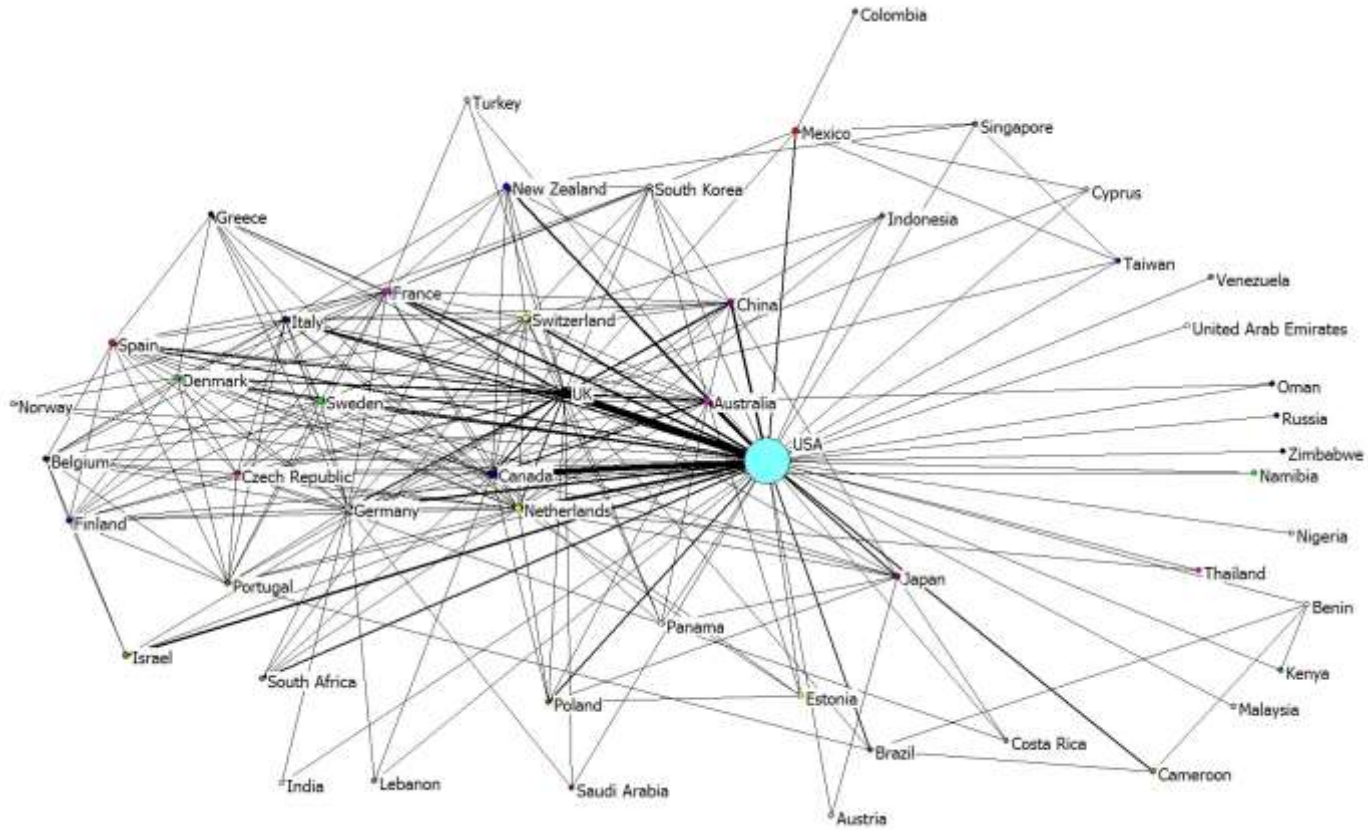
Figure 39. Coauthorship frequency of NIMBioS publications



INTERNATIONAL COAUTHORSHIP. NIMBioS also fosters international collaboration among researchers. While 52 different countries have been represented by NIMBioS coauthorship through the current reporting period, the average number of countries of coauthors per paper is 1.7, with a range of 1-12 countries represented per paper (**Figure 40**).

Node radius represents the log scaled number of NIMBioS-affiliated papers from each country, and line size represents the number of collaborations among countries on these papers.

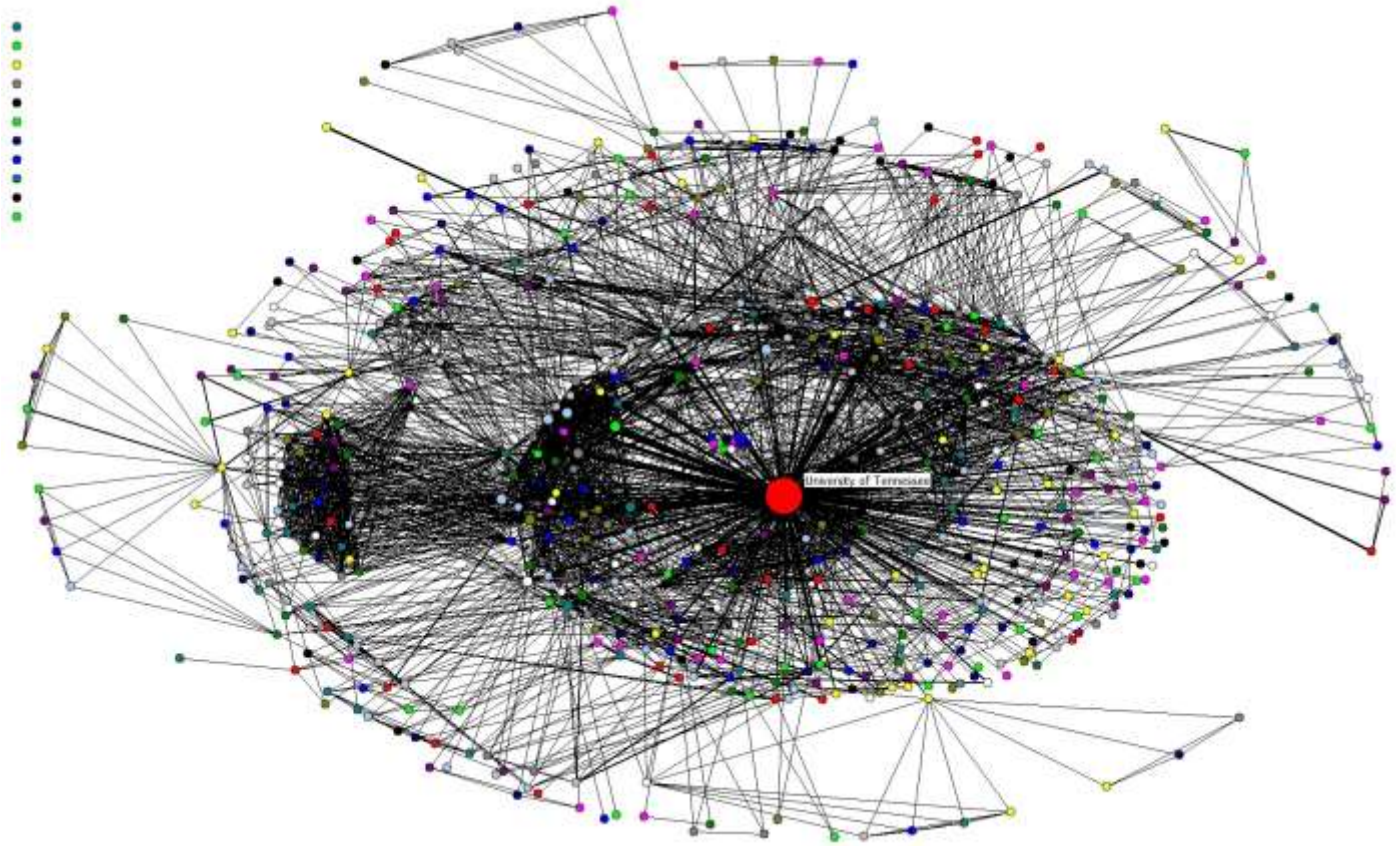
Figure 40. International collaboration on NIMBioS publications



CROSS-INSTITUTIONAL COAUTHORSHIP. Coauthors of NIMBioS publications through the current reporting period came from 610 unique institutions **(Figure 41)**. The average number of institutions represented per paper was 3.0, with a range of 1-32 institutions per paper.

Node radius represents the log scaled number of NIMBioS-affiliated papers from each institution, and line size represents the number of collaborations among institutions on these papers. Only 11 of the 610 institutions represented have published single-institution papers. The University of Tennessee is at the center of the graph.

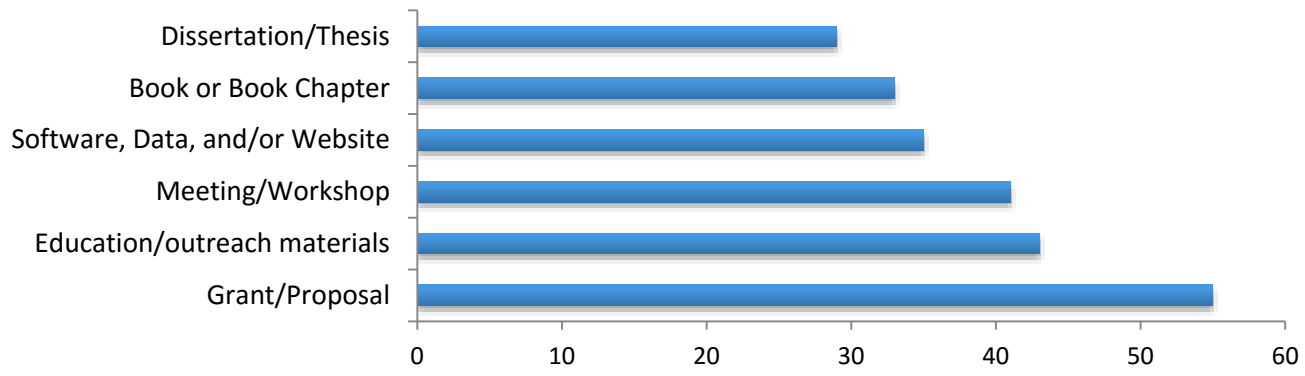
Figure 41. Cross-institutional collaboration of NIMBioS publications



OTHER SCHOLARLY PRODUCTS

In addition to journal publications, participants report other types of products that have resulted from their activities at NIMBioS. **Figure 42** summarizes these types of products for the eight-year period. In addition to the items listed in Figure 42, NIMBioS participants have reported 619 conference presentations related to NIMBioS affiliation.

Figure 42. Number of non-journal publication products arising from NIMBioS events



Addendum to NIMBioSAnnual Report

Sep 1, 2015 –Aug 31, 2016

Y8-3. Participant List for NIMBioS Events and Activities

Participant List for Reporting Period 8

BoA Meeting November 2015		11/2/2015	11/3/2015
Linda Allen	Invited		
Zhilan Feng	Invited		
John Glasser	Invited		
Kristin Jenkins	Invited		
Simon Kahan	Invited		
Jacob LaRiviere	Invited		
Mark Lewis	Invited		
Mark McPeek	Invited		
Anne Pusey	Invited		
Peter (Pete) Richerson	Invited		
Raina Robeva	Invited		
Jorge Velasco-Hernandez	Invited		
Talitha Washington	Invited		
Joshua Weitz	Invited		
Lydia Bourouiba	Remote		
Andrew (Sandy) Liebhold	Remote		
Raymond Mejia	Remote		
Claudia Munoz-Zanzi	Remote		
Gustavo Palacios	Remote		
Josh Plotkin	Remote		
Lea Popovic	Remote		
Sam Scheiner	Remote		

BoA Virtual Meeting April 2016		4/1/2016	4/1/2016
Linda Allen	Invited		
Paul Armsworth	Invited		
Pamela Bishop	Invited		
Lydia Bourouiba	Invited		
Alison Buchan	Invited		
Troy Day	Invited		
Sergey Gavrilets	Invited		
John Glasser	Invited		
Louis (Lou) Gross	Invited		
Colleen Jonsson	Invited		
Simon Kahan	Invited		
Jacob LaRiviere	Invited		
Suzanne Lenhart	Invited		
Andrew (Sandy) Liebhold	Invited		
Raymond Mejia	Invited		

Claudia Munoz-Zanzi	Invited		
Peter (Pete) Richerson	Invited		
Raina Robeva	Invited		
Chris Welsh	Invited		

BoA Virtual Meeting January 2016		**1/21/2016**	**1/21/2016**
Pamela Bishop	Invited		
Sergey Gavrilets	Invited		
Louis (Lou) Gross	Invited		
Colleen Jonsson	Invited		
Suzanne Lenhart	Invited		
Chris Welsh	Invited		
Linda Allen	Remote		
Troy Day	Remote		
Zhilan Feng	Remote		
John Glasser	Remote		
Alexander Hoffmann	Remote		
Kristin Jenkins	Remote		
Simon Kahan	Remote		
Jacob LaRiviere	Remote		
Mark Lewis	Remote		
Andrew (Sandy) Liebhold	Remote		
Mark McPeek	Remote		
Raymond Mejia	Remote		
Claudia Munoz-Zanzi	Remote		
Josh Plotkin	Remote		
Anne Pusey	Remote		
Raina Robeva	Remote		
Jorge Velasco-Hernandez	Remote		
Talitha Washington	Remote		

Graduate Research Assistant 2015		**8/1/2015**	**4/30/2016**
Christine Dumoulin	Open		
Benjamin (Ben) Levy	Open		
John Martin	Open		
Katie Massana	Open		
Buddhi Pantha	Open		

Mathematics of Planet Earth 2015 WS		**9/30/2015**	**10/2/2015**
Weinberg Andrea	Invited		
David Black	Invited		
Carlos Castillo-Garsow	Invited		

Barbara Cozzens	Invited		
Catherine Crawley	Invited		
Wayne Getz	Invited		
Louis (Lou) Gross	Invited		
Gabriela Hamerlinck	Invited		
Kristin Jenkins	Invited		
John Jungck	Invited		
Scott Kulp	Invited		
Larisa DeSantis	Invited		
Joanne Logan	Invited		
Katrina Palmer	Invited		
Leslie Ries	Invited		
Olivia Walch	Invited		
Jane White	Invited		
Mary Lou Zeeman	Invited		
Jason Bintz	Open		
Claudia Rodriguez	Open		
Carrie Eaton	Open		
Benjamin (Ben) Levy	Open		
Marco Martinez	Open		
Anarina Murillo	Open		
Nicholas Boros	Open		
Christiane Rousseau	Open		
Richard Schugart	Open		
James Walsh	Open		
Abdul-Aziz Yakubu	Open		
Carlos Castillo-Chavez	Organizer		
Margaret Cozzens	Organizer		
Eugene Fiorini	Organizer		
Holly Gaff	Organizer		
Suzanne Lenhart	Organizer		
Fred Roberts	Organizer		
Kelly Sturner	Organizer		

NES Graduate Research Assistant 2015

Dammika Walpitage	Open	10/1/2015	8/1/2017

NIMBioS Seminar Series 2015

Liz Bradley	Invited	9/22/2015	9/22/2015
Nels Johnson	Invited	9/8/2015	9/8/2015
Quentin Johnson	Invited	10/20/2015	10/20/2015
Glenn Ledder	Invited	9/28/2015	9/28/2015

Urszula Ledzewicz	Invited	10/6/2015	10/6/2015
Alex Mogilner	Invited	10/13/2015	10/13/2015
Chongle Pan	Invited	11/10/2015	11/10/2015
Stuart Pimm	Invited	11/3/2015	11/3/2015
Charles (Chuck) Price	Invited	4/14/2016	4/14/2016
Megan Rua	Invited	4/19/2016	4/19/2016
Richard Schugart	Invited	3/22/2016	3/22/2016
Maria Servedio	Invited	1/19/2016	1/19/2016
Michael (Mike) Whitlock	Invited	3/29/2016	3/29/2016
Steven (Steve) Wise	Invited	2/16/2016	2/16/2016
Alison Power	Open	4/12/2016	4/12/2016

NIMBioS Senior Personnel			
Michael Berry	Open	8/1/2009	
Barry Bruce	Open	9/1/2011	
Virginia Dale	Open	8/1/2009	
Judy Day	Open	8/1/2010	
Shigetoshi Eda	Open	6/7/2010	
Vitaly Ganusov	Open	1/1/2010	
Michael (Mike) Gilchrist	Open	8/1/2009	
Henriette (Yetta) Jager	Open	6/29/2009	
Jaewook Joo	Open	8/1/2009	
Agricola Odoi	Open	8/1/2009	
Brian O'Meara	Open	8/1/2009	
Dan Simberloff	Open	8/1/2009	
Jeremy Smith	Open	8/1/2009	
Xiaopeng Zhao	Open	12/1/2009	

Undergraduate Research Conference (URC) 2015		**11/21/2015**	**11/22/2015**
Charles Allee	Open		
Cody Blankenship	Open		
Vishnu Boyareddygari	Open		
Sharee Brewer	Open		
Maya Bryant	Open		
Tianna Burke	Open		
Price Carson	Open		
Johlie Christopher	Open		
Isis Christopher	Open		
Caleb Corona	Open		
Victoria Cox	Open		
Henry Daniels	Open		
Gabriella de Cardenas	Open		

Rohan Deshpande	Open
Marisa Draper	Open
Justin Eastman	Open
Ezell Evan	Open
Wesley Falk	Open
Haley Felts	Open
Christina Fennell	Open
Rebekah Frye	Open
Adolfo Dino Garcia	Open
Rebecca Gasper	Open
Wyatt Goff	Open
Miranda Goodman	Open
Rachael Hagenbarth	Open
Jennifer Houser	Open
Timothy Ireland	Open
D'von Jackson	Open
Abria Jefferson	Open
Erin Jennings	Open
Michele Joyner	Open
Kara Montgomery	Open
Kathleen Staller	Open
Ariel Kaylor	Open
Dakota Kobler	Open
John Lagergren	Open
Curtis Lamp	Open
Aprillya Lanz	Open
Chelsea Lawhorn	Open
Rachel Lenhart	Open
Bailey Levine	Open
Thomas Lewis	Open
Alun Lloyd	Open
Matt Miller	Open
Paezha McCartt	Open
Luis Melara	Open
Jacob Menix	Open
Abigail Miller	Open
Alan Miramontes-Flores	Open
Kenneth Moody	Open
Christopher Murphy	Open
Morgan Musick	Open
Annalise Paaby	Open
Virginia Parkman	Open
Amanda Patrick	Open

Maranda Pepe	Open
Peter Agaba	Open
Christopher Poteet	Open
Ayush Prasad	Open
Anna Ptasznik	Open
Samantha Pulido	Open
Lei Qian	Open
Robert Smith?	Open
Nicola Robertson	Open
Carrie Robinson	Open
Michael Rohly	Open
Jan Rychtar	Open
Julian Sass	Open
Monika Satkauskas	Open
Emma Schlagenhauff	Open
Richard Schugart	Open
Keyana Scott	Open
Katie Sipes	Open
Amber Smith	Open
Marissa Stewart	Open
Tamara Stonebraker	Open
Elizabeth Swallow	Open
Laura Vaughan	Open
Anh Vo	Open
Jinchuan Wei	Open
Zakar White	Open
Rebekah White	Open
Imani-Michelle White	Open
Nathan Wikle	Open
Dylana Wilhelm	Open
Taylor Williams-Hamilton	Open
Ryan Yan	Open
Bongeka Zuma	Open
Suzanne Lenhart	Organizer
Kelly Sturner	Organizer

Undergraduate Worker

Lindsey Balthrop	Open
Elizabeth Denison	Open
Virginia Parkman	Open
Tor Voorhees	Open

Evolution and Warfare WS		9/16/2015	9/18/2015
Mark Allen	Invited		
Michelle Brown	Invited		
Erica Chenoweth	Invited		
Aaron Clauset	Invited		
Dominic Johnson	Invited		
Anthony Lopez	Invited		
Vera Mironova	Invited		
James (Jim) Sidanius	Invited		
Lisa Troyer	Invited		
Barbara Walter	Invited		
Polly Wiessner	Invited		
Richard Wrangham	Invited		
Lance Blyth	Open		
Robert Bohm	Open		
Joanna Bryson	Open		
Fernanda Buril Almeida	Open		
Valerio Capraro	Open		
Kristin Crouse	Open		
Tassie Hirschfeld	Open		
Elizabeth Hobson	Open		
Lauren Landau-Wells	Open		
Shane Macfarlan	Open		
Michael McCullough	Open		
David Pietraszewski	Open		
Mikael Puurtinen	Open		
Hannes Rusch	Open		
Roman Sheremeta	Open		
Rob Walker	Open		
Matthew Zefferman	Open		
Sergey Gavrilets	Organizer		
Luke Glowacki	Organizer		
Anna Simons	Organizer		
Michael Wilson	Organizer		
William Carpenter	Virtual Participant		
Chrissy Keuper	Virtual Participant		
Christina Collins	Virtual Participant		
Dan Monster	Virtual Participant		
Tamas David-Barrett	Virtual Participant		
Eric Pedersen	Virtual Participant		
Fisher David	Virtual Participant		
Alex Georgiev	Virtual Participant		
Gretchen Merten	Virtual Participant		

Stephen Heap	Virtual Participant
Jaakko Junikka	Virtual Participant
Jenny Meyer	Virtual Participant
Susan Kalisz	Virtual Participant
Ken Mayes	Virtual Participant
Kyle Dahlin	Virtual Participant
Laura Martinez Inigo	Virtual Participant
Bonaventura Majolo	Virtual Participant
Mary McGuire	Virtual Participant
Philip Brookins	Virtual Participant
Seamus Power	Virtual Participant
Randy Yessler	Virtual Participant
Alicia Rich	Virtual Participant
Rui Sa	Virtual Participant
Rutger Jansma	Virtual Participant
Caitlin Schrein	Virtual Participant

Morphological Plant Models WS		**9/2/2015**	**9/4/2015**
Mathilde Balduzzi	Invited		
Siobhan Braybrook	Invited		
Diego Hernan Diaz Martinez	Invited		
Alexander Fletcher	Invited		
Malia Gehan	Invited		
Anjali Iyer-Pascuzzi	Invited		
Jonathan Lynch	Invited		
Ciera Martinez	Invited		
Washington Mio	Invited		
Hendrik Poorter	Invited		
Christophe Pradal	Invited		
Charles (Chuck) Price	Invited		
Edgar Spalding	Invited		
Chris Topp	Invited		
Acheampong Atta-Boateng	Open		
Akomian Azihou	Open		
Dorjsuren Battogtokh	Open		
Aly Baumgartner	Open		
Brad Binder	Open		
Cynthia Chang	Open		
Viktoriya Coneva	Open		
Thomas DeWitt	Open		
Lilan Hong	Open		
Laura Klein	Open		
Samuel Leiboff	Open		

Mao Li	Open
Alexis Maizel	Open
Julin Maloof	Open
Robert Markelz	Open
Laura Miller	Open
Wojtek Palubicki	Open
Eetu Puttonen	Open
John Reese	Open
Ruben Rellan-Alvarez	Open
Erin Sparks	Open
Joe Williams	Open
Alexander Bucksch	Organizer
Dan Chitwood	Organizer
Alejandro Morales	Virtual Participant
Xiongwen Chen	Virtual Participant
Christian Fankhauser	Virtual Participant
Dan Peppe	Virtual Participant
Daniel Koenig	Virtual Participant
Daniel Stanton	Virtual Participant
Devin O'Connor	Virtual Participant
Elizabeth Waring	Virtual Participant
Brian Enquist	Virtual Participant
Feldman Max	Virtual Participant
Felipe Zapata	Virtual Participant
Guillaume Lobet	Virtual Participant
Guy Wachsmann	Virtual Participant
Susan Harrison	Virtual Participant
Ignacio Rubio Somoza	Virtual Participant
Irene Liao	Virtual Participant
Jacob Scott	Virtual Participant
Jens Fangerau	Virtual Participant
John Hodge	Virtual Participant
Henrik Jonsson	Virtual Participant
Joop Vermeer	Virtual Participant
Joseph Cammarata	Virtual Participant
Sandy Kawano	Virtual Participant
Kelly Diamond	Virtual Participant
Kenneth Parker	Virtual Participant
Kristal Jones	Virtual Participant
Liam Langan	Virtual Participant
Paul Macklin	Virtual Participant
Magnus Lindh	Virtual Participant
Marjan Behzadirad	Virtual Participant

Mark Wilson	Virtual Participant		
Wenbin Mei	Virtual Participant		
Mike Smorul	Virtual Participant		
Natsuko Kinoshita	Virtual Participant		
Cesar Ojeda	Virtual Participant		
Virginia Pasour	Virtual Participant		
Pauline Durand	Virtual Participant		
Rodrigue Idohou	Virtual Participant		
Sam Barnett	Virtual Participant		
Surya Sapkota	Virtual Participant		
Joshua Weitz	Virtual Participant		

Postdoctoral Fellow

Caroline Farrior	Open	8/25/2014	7/13/2016
Jake Ferguson	Open	8/11/2014	12/11/2015
Sean Hoban	Open	9/30/2013	12/28/2015
Elizabeth Hobson	Open	6/2/2014	
Nels Johnson	Open	7/1/2015	
Quentin Johnson	Open	9/1/2015	
Sandy Kawano	Open	7/28/2014	7/31/2016
Suzanne O'Regan	Open	1/5/2015	
Megan Rua	Open	9/1/2015	
Ioannis (John) Sgouralis	Open	8/29/2014	7/31/2016
Matthew Zefferman	Open	9/23/2013	10/13/2015

Sabbatical Research

Benjamin (Ben) Fitzpatrick	Open	2/1/2016	4/30/2016
Glenn Ledder	Open	2/1/2016	4/30/2016
Charles (Chuck) Price	Open	6/1/2015	5/31/2016
Richard Schugart	Open	8/17/2015	7/31/2016

Game Theoretical Modeling of Evolution in Structured Populations Tutorial		**4/25/2016**	**4/27/2016**
Andrew August	Invited		
Sergey Gavrilets	Invited		
Alun Lloyd	Invited		
Karan Pattni	Invited		
Paulo Shakarian	Invited		
Folashade Agusto	Open		
Bert Baumgaertner	Open		
Shane Blowes	Open		
Philipp Boersch-Supan	Open		

Katrina Brock	Open		
Charlotte Chang	Open		
Shi Chen	Open		
Eungchun Cho	Open		
Karen Cumings	Open		
Yao Dai	Open		
Joyati Debnath	Open		
Igor Erovenko	Open		
Caroline Farrior	Open		
Auriel Fournier	Open		
Orou Gaoue	Open		
Nancy Hernandez Ceron	Open		
Elizabeth Hobson	Open		
Sanjukta Hota	Open		
Amiyaal Ilany	Open		
Holly Moeller	Open		
Michael Neubert	Open		
Garrett Street	Open		
Cinthia Tanaka	Open		
Carl Veller	Open		
Luis Zaman	Open		
Mark Broom	Organizer		
Jonathan Rowell	Organizer		
Jan Rychtar	Organizer		
Jeremy Van Cleve	Organizer		

STV Research

Noelle Beckman	Open	3/16/2016	3/18/2016
Liz Bradley	Open	9/22/2015	9/23/2015
Eleanor Brush	Open	3/7/2016	3/10/2016
Maya Chhetri	Open	9/1/2015	9/11/2015
Tom Currie	Open	10/11/2015	10/17/2015
Erida Gjini	Open	3/20/2016	3/27/2016
Allan Strand	Open	2/15/2016	2/19/2016
Sean Hoban	Open	2/15/2016	2/19/2016
Daniel Doak	Open	3/2/2016	3/6/2016
Christopher Steenbock	Open	3/2/2016	3/6/2016
Jason Hoeksema	Open	3/2/2016	3/6/2016
Huda Sarraj	Open	10/15/2015	10/18/2015
Maria-Veronica Ciocanel	Open	2/25/2016	2/28/2016
Aurelie Edwards	Open	2/25/2016	2/28/2016
Anita Layton	Open	2/25/2016	2/28/2016
Tracy Stepien	Open	2/25/2016	2/28/2016

Ying Chen	Open	2/25/2016	2/28/2016
Jennifer Sullivan	Open	2/25/2016	2/28/2016
Urszula Ledzewicz	Open	4/19/2016	4/20/2016
Lauren Gollahon	Open	3/31/2016	4/3/2016
Qingxia Li	Open	3/31/2016	4/3/2016
Xinyao Yang	Open	3/31/2016	4/3/2016
Anton (Tony) Weisstein	Open	3/31/2016	4/3/2016
Gesham Magombedze	Open	12/7/2015	12/11/2015
Nicholas (Nick) Matzke	Open	10/23/2015	11/6/2015
Sean Maxwell	Open	11/4/2015	11/10/2015
Sean Hoban	Open	3/23/2016	3/25/2016
Jason McLachlan	Open	3/23/2016	3/25/2016
Lumibao Candice	Open	3/23/2016	3/25/2016
Samares Pal	Open	10/11/2015	10/17/2015
Stuart Pimm	Open	9/28/2015	9/28/2015
Maria Servedio	Open	2/16/2016	2/17/2016
Sarah Usher	Open	9/7/2015	9/14/2015
Michael (Mike) Whitlock	Open	4/11/2016	4/13/2016
Wayne Thogmartin	Open	11/11/2015	11/13/2015
Ruscena Wiederholt	Open	11/11/2015	11/13/2015
Robert Barclay	Open	11/11/2015	11/13/2015
Gary McCracken	Open	11/11/2015	11/13/2015
Rodrigo Medellin	Open	11/11/2015	11/13/2015
Laura Lopez Hoffman	Open	11/11/2015	11/13/2015
Luis Viquez	Open	11/11/2015	11/13/2015

Visiting Graduate Student Fellow		**10/1/2015**	**12/1/2015**
Yaojie Lu	Open		

Climate Change and Vector-borne Diseases WG M4		**12/15/2015**	**12/17/2015**
Folashade Agusto	Invited		
Katherine (Kate) Evans	Invited		
Holly Gaff	Invited		
Shannon LaDeau	Invited		
Suzanne Lenhart	Invited		
Ronald Mickens	Invited		
Elena Naumova	Invited		
Paul Ready	Invited		
Huaiping Zhu	Invited		
Nina Fefferman	Organizer		
Abba Gumel	Organizer		
Richard Ostfeld	Organizer		

Climate Proxies WG M2		11/3/2015	11/5/2015
Alexander Correa-Metrio	Invited		
Brian Enquist	Invited		
Nicholas Gotelli	Invited		
Grace Hwang	Invited		
Crystal McMichael	Invited		
Arzu Unal	Invited		
Stuart (Joe) Wright	Invited		
Mark Bush	Organizer		
Robert van Woesik	Organizer		

Climate Proxies WG M3		4/4/2016	4/6/2016
Alexander Correa-Metrio	Invited		
Grace Hwang	Invited		
Crystal McMichael	Invited		
Miles Silman	Invited		
Stuart (Joe) Wright	Invited		
Mark Bush	Organizer		
Robert van Woesik	Organizer		
Andrew Parnell	Remote		
Brian Enquist	Remote		

Computational Landscape Genomics WG M3		3/21/2016	3/23/2016
Sean Hoban	Invited		
Joanna Kelley	Invited		
Katie Lotterhos	Invited		
David Lowry	Invited		
Laura Reed	Invited		
Michael (Mike) Antolin	Organizer		
Andrew Storfer	Organizer		

Cooperation and Cognition WG M1		12/9/2015	12/11/2015
Susan Alberts	Invited		
Margaret Crofoot	Invited		
Rufus Johnstone	Invited		
Daniel Blumstein	Organizer		
Arik Kershenbaum	Organizer		
Marie Roch	Organizer		
Yu Shiu	Organizer		
Sara Waller	Organizer		

Cooperation and Cognition WG M2		5/4/2016	5/6/2016
Margaret Crofoot	Invited		
Elizabeth Hobson	Invited		
Daniel Blumstein	Organizer		
Arik Kershenbaum	Organizer		
Marie Roch	Organizer		
Yu Shiu	Organizer		
Sara Waller	Organizer		
Susan Alberts	Remote		
Iain Couzin	Remote		
Rufus Johnstone	Remote		

Dispersal Biogeography WG M2		3/16/2016	3/20/2016
Priyanga Amarasekare	Invited		
Benjamin Bolker	Invited		
Elizabeth Crone	Invited		
Cristian Dambros	Invited		
Nicholas (Nick) Matzke	Invited		
Katriona Shea	Invited		
James Bullock	Organizer		
Mark Lewis	Organizer		
Brittany Teller	Organizer		
Anna (Michelle) Lawing	Remote		

Ecological Network Dynamics WG M2		12/7/2015	12/11/2015
Laura Burkle	Invited		
Cecilia Diaz Castelazo	Invited		
Marie-Josee Fortin	Invited		
Ulrich Mueller	Invited		
Erica Newman	Invited		
David Hembry	Organizer		
James (Jimmy) O'Donnell	Organizer		
Timothee Poisot	Remote		

Evolution of Sustainability WG M3		10/26/2015	10/30/2015
Jacopo Baggio	Invited		
Vicken Hillis	Invited		
Cristina Moya	Invited		
Karthik Panchanathan	Invited		
Paul Smaldino	Invited		
Matthew Zefferman	Invited		
Marco Janssen	Organizer		

Karolina Safarzynska	Organizer		
Timothy Waring	Organizer		
Evolution of Sustainability WG M4		**3/28/2016**	**4/2/2016**
Jacopo Baggio	Invited		
Vicken Hillis	Invited		
Paul Smaldino	Invited		
Marco Janssen	Organizer		
Karolina Safarzynska	Organizer		
Timothy Waring	Organizer		
Karin Frank	Remote		
Cristina Moya	Remote		
Karthik Panchanathan	Remote		
Habitat for Migratory Species WG M4		**5/10/2016**	**5/13/2016**
Julia Earl	Invited		
Richard Erickson	Invited		
Paula Federico	Invited		
John Fryxell	Invited		
Kevin Long	Invited		
Laura Lopez Hoffman	Invited		
Gary McCracken	Invited		
Sam Nicol	Invited		
Dale Norris	Invited		
Christine Sample	Invited		
Darius Semmens	Invited		
James (Jay) Diffendorfer	Organizer		
Brady Mattsson	Organizer		
Wayne Thogmartin	Organizer		
Ruscena Wiederholt	Organizer		
Leptospirosis Modeling WG M2		**9/14/2015**	**9/18/2015**
Matteo Convertino	Invited		
Rudolf (Rudy) Hartskeerl	Invited		
Suzanne Lenhart	Invited		
Suzanne O'Regan	Invited		
Andrea Previtali	Invited		
Maria Cristina Schneider	Invited		
Claudia Munoz-Zanzi	Organizer		
Jorge Velasco-Hernandez	Organizer		
Alejandro de la Pena-Moctezuma	Remote		

Leptospirosis Modeling WG M3		5/10/2016	5/13/2016
Ibrahim Aslan	Invited		
Matteo Convertino	Invited		
Zhilan Feng	Invited		
Matthew Gompper	Invited		
Rudolf (Rudy) Hartskeerl	Invited		
Vincent Herbreteau	Invited		
Suzanne Lenhart	Invited		
Suzanne O'Regan	Invited		
Andrea Previtali	Invited		
Elizabeth Santiago	Invited		
Claudia Munoz-Zanzi	Organizer		
Jorge Velasco-Hernandez	Organizer		
Alejandro de la Pena-Moctezuma	Remote		
Maria Cristina Schneider	Remote		

Modeling Antimicrobial Resistance (AMR) Intervention WG M3		3/7/2016	3/9/2016
Kathe Bjork	Invited		
Carolee Carson	Invited		
Beth Karp	Invited		
Cristina Lanzas	Invited		
Laura Pullum	Invited		
Victoriya Volkova	Invited		
Yrjo Grohn	Organizer		
Craig Lewis	Organizer		

Modeling Molecules-to-Organisms WG M1		11/16/2015	11/20/2015
Philipp Antczak	Invited		
Andrea Gergs	Invited		
Dina Lika	Invited		
Erik Muller	Invited		
Diane Nacci	Invited		
Garcia-Reyero Natalia	Invited		
Christopher (Chris) Remien	Invited		
Irvin Schultz	Invited		
Karen Watanabe	Invited		
Cheryl Murphy	Organizer		
Roger Nisbet	Organizer		

Modeling Molecules-to-Organisms WG M2		4/18/2016	4/21/2016
Philipp Antczak	Invited		

Andrea Gergs	Invited
Dina Lika	Invited
Terry Mathews	Invited
Erik Muller	Invited
Diane Nacci	Invited
Garcia-Reyero Natalia	Invited
Angela (Angie) Peace	Invited
Christopher (Chris) Remien	Invited
Irvin Schultz	Invited
Karen Watanabe	Invited
Cheryl Murphy	Organizer
Roger Nisbet	Organizer

Modeling Organisms-to-Ecosystems WG M1	**11/16/2015**	**11/20/2015**
Bjorn Birnir	Invited	
Virginie Ducrot	Invited	
Nika Galic	Invited	
Kristina (Kris) Garber	Invited	
Henriette (Yetta) Jager	Invited	
Andrew Kanarek	Invited	
Robert Pastorok	Invited	
Steven Railsback	Invited	
Richard Rebarber	Invited	
Perrnille Thorbek	Invited	
Valery Forbes	Organizer	
Christopher Salice	Organizer	

Modeling Organisms-to-Ecosystems WG M2	**4/4/2016**	**4/7/2016**
Randall Bruins	Invited	
Virginie Ducrot	Invited	
Nika Galic	Invited	
Robert Pastorok	Invited	
Steven Railsback	Invited	
Richard Rebarber	Invited	
Perrnille Thorbek	Invited	
Valery Forbes	Organizer	
Christopher Salice	Organizer	
Andrew Kanarek	Remote	

Models of Produce Contamination WG M1	**4/13/2016**	**4/15/2016**
Ana Allende	Invited	
Maria Brandl	Invited	

Aamir Fazil	Invited
Rongsong Liu	Invited
David Oryang	Invited
Parthasarathy (Partha) Srinivasan	Invited
Martin Wiedmann	Invited
Lydia Bourouiba	Organizer
Renata Ivanek	Organizer
Daniel Munther	Organizer
Jianhong Wu	Organizer

Multiscale Vectored Plant Viruses WG M1		**12/14/2015**	**12/16/2015**
Cheryl Briggs	Invited		
Nicholas Cunniffe	Invited		
Zhilan Feng	Invited		
Karen Garrett	Invited		
Louis (Lou) Gross	Invited		
Frederic Hamelin	Invited		
Frank Hilker	Invited		
Carrie Manore	Invited		
Alison Power	Invited		
Linda Allen	Organizer		
Vrushali Bokil	Organizer		

Prediction and Control of Cardiac Alternans WG M1		**5/2/2016**	**5/4/2016**
Elizabeth Cherry	Invited		
Flavio Fenton	Invited		
Roman Grigoriev	Invited		
Trine Krogh-Madsen	Invited		
Laura Munoz	Invited		
Yohannes Shiferaw	Invited		
Ling Xia	Invited		
Sharon Zlochiver	Invited		
Alena Talkachova	Organizer		
Xiaopeng Zhao	Organizer		

Remotely Sensing Biodiversity WG M1		**4/21/2016**	**4/23/2016**
John Gamon	Invited		
Michael Schaepman	Invited		
Franziska Schrodt	Invited		
Anna Schweiger	Invited		
Aditya Singh	Invited		
Susan Ustin	Invited		

Jeannine Cavender-Bares	Organizer		
Jose Eduardo Meireles	Organizer		
Brian O'Meara	Organizer		
Townsend Philip	Organizer		

Spatial Cell Simulations WG M1		**12/1/2015**	**12/3/2015**
Margaret Johnson	Invited		
Margaret Johnson	Invited		
Igor Jouline	Invited		
Igor Jouline	Invited		
Carlos Lopez	Invited		
Martin Meier-Schellersheim	Invited		
Alex Mogilner	Invited		
Ion Moraru	Invited		
Ion Moraru	Invited		
Linda Petzold	Invited		
Richard Schugart	Invited		
Julie Theriot	Invited		
Julie Theriot	Invited		
Adelinde Uhrmacher	Invited		
Adelinde Uhrmacher	Invited		
Richard Schugart	Observer		
James Faeder	Organizer		
James Faeder	Organizer		
Robert Murphy	Organizer		

Teaching Quantitative Bio WG M1		**10/22/2015**	**10/24/2015**
Melissa Aikens	Invited		
Kam Dahlquist	Invited		
Gregory Goins	Invited		
Dauer Joe	Invited		
John Jungck	Invited		
Robert Mayes	Invited		
Richard Schugart	Observer		
Sam Donovan	Organizer		
Carrie Eaton	Organizer		
Kristin Jenkins	Organizer		
Michael LaMar	Organizer		
Edward (Joe) Redish	Remote		

Teaching Quantitative Bio WG M2		**3/24/2016**	**3/26/2016**
Melissa Aikens	Invited		

Hannah Callender	Invited
Kam Dahlquist	Invited
Benjamin (Ben) Fitzpatrick	Invited
Dauer Joe	Invited
Robert Mayes	Invited
Glenn Ledder	Observer
Richard Schugart	Observer
Sam Donovan	Organizer
Carrie Eaton	Organizer
Kristin Jenkins	Organizer
Michael LaMar	Organizer

Vector Movement and Disease WG M2		**10/26/2015**	**10/29/2015**
Elizabeth Borer	Invited		
Nilsa Bosque-Perez	Invited		
Ariel Cintron-Arias	Invited		
Deborah Finke	Invited		
Yang Kuang	Invited		
Jo Ann Lee	Invited		
James Legg	Invited		
Suzanne Lenhart	Invited		
Jing Li	Invited		
Angela (Angie) Peace	Invited		
Alison Power	Invited		
Rakefet Sharon	Invited		
Chelsea Lewis	Observer		
Jan Medlock	Organizer		
Allison Shaw	Organizer		

Vector Movement and Disease WG M3		**3/29/2016**	**4/2/2016**
Nilsa Bosque-Perez	Invited		
Ariel Cintron-Arias	Invited		
Yang Kuang	Invited		
Jo Ann Lee	Invited		
Suzanne Lenhart	Invited		
Jing Li	Invited		
David Pattemore	Invited		
Angela (Angie) Peace	Invited		
Alison Power	Invited		
Rakefet Sharon	Invited		
Chelsea Lewis	Observer		
David Crowder	Organizer		

Allison Shaw	Organizer
Elizabeth Borer	Remote
Deborah Finke	Remote
James Legg	Remote
Jan Medlock	Remote

Addendum to NIMBioSAnnual Report

Sep 1, 2015 –Aug 31, 2016

Y8-4. Description of Activities

Addendum-Description of Activities

DESCRIPTION OF MAJOR ACTIVITIES SEPTEMBER 1, 2015 – AUGUST 31, 2016

During September 1, 2015 through August 31, 2016 reporting period, NIMBioS hosted (or will host this summer) 32 meetings of 22 different Working Groups, three Investigative Workshops, and two Tutorials. There are projected to be more than 630 participants (and 67 virtual participants) in NIMBioS-hosted activities during this period with 11 Postdoctoral Fellows in residence, and 40 Short-term Visitors, and one visiting Graduate Student Fellow.

Demographics data on all participants are available for events from September 1, 2015 through April 30, 2016 and are presented in detail in the NIMBioS Evaluation Report (see Section Y8-2 of the attached addendum to this Annual Report) and summarized below. There were 624 participants through April 30, 2016, from 23 countries and 44 U.S. states as well as the District of Columbia representing 218 different institutions. International participants amounted to 16% of all participants. Most participants were college or university faculty (52%), but postdoctoral researchers (13%), undergraduates (12%), and graduate students (6%) accounted for a significant fraction of participants. Across all events female representation was 45%, and minority representation was near 14%. Representation of various minority categories was slightly above levels of minority representation for doctoral recipients in the biological sciences and the mathematical sciences. Short-term Visitors from September 1, 2015 through April 30, 2016 were from 34 different institutions and collaborated with NIMBioS postdoctoral and sabbatical fellows, faculty from four University of Tennessee departments, and 22 external researchers.

Below is a short description of each of the Working Groups, Investigative Workshops, and Tutorials held September 1, 2015 and planned through August 31, 2016 as well as a listing of short-term visitors and their projects and Outreach and Education activities. A listing of participants in each activity is provided in Section Y8-3 of this addendum.

WORKING GROUPS

Working Group: Leptospirosis Modeling
http://www.nimbios.org/workinggroups/WG_leptospira
Organizers: Claudia Munoz-Zanzi (Division of Epidemiology and Community Health, School of Public Health, Univ. of Minnesota) and Jorge Velasco-Hernandez (Inst. of Mathematics, Universidad Nacional Autonoma de Mexico)
This working group uses mathematical approaches for improving our knowledge in the general areas of i) transmission dynamics at a local scale involving multi-host systems as well as one or more circulating Leptospira strains and ii) mechanisms underlying temporal and spatial patterns of leptospirosis transmission. A diverse and multidisciplinary team of experts are developing new approaches to gain insight into the processes influencing the ecology and epidemiology of leptospirosis in complex natural systems. Mathematical models are used to provide scientifically-based recommendations on optimal interventions and surveillance programs, which can assist with effective implementation of public and animal health programs. Broader impacts include innovations in mathematical methods and in methods to investigate zoonotic infections in general.
Meeting dates: Sept. 14-18, 2015; May 10-13, 2016

Working Group: Teaching Quantitative Bio
http://www.nimbios.org/workinggroups/WG_quantbio

Organizers: Carrie Diaz Eaton (Mathematics, Unity College), Sam Donovan (Biology, Univ. of Pittsburgh), M. Drew LaMar (Biology, College of William and Mary), and Kristin Jenkins (Director, BioQUEST)
This working group brings together representatives of diverse quantitative and biological education communities to develop an instructional model that supports the integration of quantitative and biological problem solving practices. The goal of this instructional model is to provide an accessible framework for integrating broad types of biological reasoning with diverse quantitative disciplinary skills. By bridging mathematical, computational, statistical and other quantitative approaches with biological problem solving, this instructional model will act as a resource for developing, evaluating, modifying, and implementing instructional materials across the biological and quantitative spectrum.
Meeting dates: Oct. 22-24, 2015; March 24-26, 2016

Working Group: Vector Movement and Disease
http://www.nimbios.org/workinggroups/WG_vector
Organizers: Allison Shaw (Ecology, Evolution and Behavior, Univ. of Minnesota), David Crowder (Entomology, Washington State Univ.) and Jan Medlock (Biomedical Sciences, Oregon State Univ.)
We currently lack a comprehensive understanding, both empirically and theoretically, of the role that vector movement plays in the spread of plant pathogens. The goals of this working group are to (i) develop a general understanding of how vector movement is driven by vector population dynamics, characteristics of host plants and landscapes, and community dynamics, and (ii) investigate the implications of vector movement for the dispersal of vector-borne plant pathogens. The working group brings together expertise from the fields of mathematics, ecology, entomology, plant sciences, epidemiology, and animal movement. The approach combines existing modeling techniques from the broader animal movement literature with mathematical models for vector-borne pathogen transmission.
Meeting dates: Oct. 26-29, 2015; March 29-April 2, 2016

Working Group: Evolution of Sustainability
http://www.nimbios.org/workinggroups/WG_sustainability
Organizers: Timothy Waring (Sustainability Solutions Initiative, Univ. of Maine), Marco Janssen (School of Human Evolution and Social Change, Arizona State Univ.), and Karolina Safarzynska (Warsaw Univ.)
Understanding the processes of change in social-ecological systems is a pressing problem in our world of dwindling resources, but a unifying framework has remained absent. The goal is to develop a new modeling framework by integrating models of endogenous cultural evolution with models of social-ecological system change. This project brings together scholars who work on cultural evolution with modelers of social and ecological systems to develop a collaborative network on the evolutionary dynamics of social-ecological systems. The Working Group developed a series of models that couple environmental resource use with multilevel selection processes, following three themes of inquiry: environmental and resource dynamics; individual strategic and informational environments; and populations of organizations and their environments.
Meeting dates: Oct. 26-30, 2015; March 28-April 1, 2016

Working Group: Climate Proxies
http://www.nimbios.org/workinggroups/WG_proxies
Organizers: Mark Bush (Biological Sciences, Florida Institute of Technology) and Robert van Woesik (Biological Sciences, Florida Institute of Technology)

This NIMBioS Working Group is taking advantage of improved pollen identification, newly-available-large datasets, and rigorous geospatial analysis techniques to produce the next generation of algorithms that will translate Neotropical pollen records into reliable paleo-temperature and paleo-precipitation parameters. The biological and computational challenges that they face, including independent validation of the climatic proxies, are unlikely to be solved by any single researcher, and yet are tractable with effort that cuts across traditional disciplines. The results will be useful to a suite of academic disciplines, particularly climate modelers, biogeographers, ecologists, evolutionary biologists, archaeologists, and anthropologists.
Meeting dates: Nov. 3-5, 2015; April 4-6, 2016

Working Group: Modeling Molecules-to-Organisms
http://www.nimbios.org/workinggroups/WG_m2o
Organizers: Cheryl A. Murphy (Fisheries and Wildlife, Lyman Briggs College, Michigan State Univ.) and Roger Nisbet (Ecology, Evolution, and Marine Biology, Univ. of California at Santa Barbara)
This Working Group brings together a multi-disciplinary group of molecular biologists, systems biologists, DEB (dynamic energy budget) and AOP (adverse outcome pathway) modelers, ecotoxicologists and mathematicians with interest and expertise in developing dynamic, mechanistic models to predict impacts on individuals from high throughput assays used to screen chemicals for potential risk. Using a case study approach to demonstrate proof of concept, the Group will aim to develop not only example models but a general framework for model development, evaluation, and communication that can be applied across different levels of biological organization and ecotoxicological endpoints relevant to the individual. This Group closely coordinates with the NIMBioS Working Group on Modeling Organisms-to-Ecosystems using the same case study species (i.e. daphnids and trout) with the intent to develop a modeling framework that ultimately can link from molecular responses (AOPs) through whole organism responses to ecosystem service delivery.
Meeting dates: Nov. 16–20, 2015; Apr. 18–21, 2016

Working Group: Modeling Organisms-to-Ecosystems
http://www.nimbios.org/workinggroups/WG_o2e
Organizers: Valery E. Forbes (Biological Sciences, University of Nebraska-Lincoln) and Christopher Salice (Director of Environmental Science and Studies, The Jess and Mildred Fisher College of Science and Mathematics, Towson University, Towson, MD)
This multidisciplinary Working Group brings together population-, community-, and ecosystem ecologists, ecotoxicologists, and mathematicians with interest and expertise in developing dynamic, mechanistic models of complex systems to predict impacts on ecosystem function and service delivery from data typically collected to support chemical risk assessments. In particular, the models that we develop will be designed to bridge the gap between the properties of populations and the delivery of ecosystem services. This Group works closely with the NIMBioS Working Group on Modeling Molecules-to-Organisms.
Meeting dates: Nov. 16-20, 2015; April 4-7, 2016

Working Group: Spatial Cell Simulations
http://www.nimbios.org/workinggroups/WG_cellsim
Organizers: Robert F. Murphy (Computational Biology, School of Computer Science, Carnegie Mellon Univ.) and James R. Faeder (Computational and Systems Biology, Univ. of Pittsburgh)
This Working Group addresses the critical issues in creating realistic mathematical/computational simulations of the inner workings and dynamics of eukaryotic cells, especially by accurately simulating changes in shape and organization over time. The issues to be addressed include methods for simulation that can consider dynamic cell and organelle

shapes and positions (movable boundary conditions) and methods for learning joint probability distributions for thousands of cellular components. The Group's goal is to develop new approaches and implement them in software. Activities also include development of proposals for funding and development of training materials for biomedical researchers.
Meeting dates; Dec. 1-3, 2015; March 21-23, 2016

Working Group: Ecological Network Dynamics
http://www.nimbios.org/workinggroups/WG_econetworks
Organizers: David Hembry (Molecular and Cell Biology, Univ. of California, Berkeley), Dominique Gravel (Biology, Univ. of Quebec, Rimouski, Canada), Paulo Guimaraes Jr. (Ecology, Univ. of Sao Paulo (USP), Brazil) and James O'Donnell (School of Marine and Environmental Affairs, Univ. of Washington, Seattle)
The rapidly advancing field of spatial ecology has demonstrated that processes operating over spatial and temporal scales have strong effects on ecosystems and their constituent organisms. However, research in either field seldom incorporates information from the other. In part, this endeavor has been hindered by the limited availability of datasets spanning suitably large spatial or temporal scales. More problematic is the lack of a theoretical framework and the analytical tools needed to interpret the spatio-temporal dynamics of ecological networks. This working group brings together a diverse group of scientists whose expertise spans both fields, including field biologists along with theoreticians and computational biologists. This group will develop working hypotheses for factors driving network dynamics based on empirical patterns; explore one or more case studies of variation across space or time in ecological networks; and develop a new model of network dynamics based on the theory of island biogeography, incorporating biogeography, coevolution, and community ecology, to be used in interpreting empirical patterns.
Meetings dates: Dec. 7-11, 2015

Working Group: Cooperation and Communication in the Evolution of Cognition
http://www.nimbios.org/workinggroups/WG_cognition
Organizers: Arik Kershenbaum (Zoology, Univ. of Cambridge), Dan Blumstein (Ecology and Evolutionary Biology, UCLA), Marie Roch (Computer Science, San Diego State Univ.), Sara Waller (Philosophy, Montana State Univ.), and Yu Shiu (Bioacoustics, Cornell Univ.)
The goal of this Working Group is to build mathematical models of complex behavior, such as cooperative hunting, based on a range of assumptions, such as degree of self-awareness, the extent to which individuals can and do predict the choices of their pack-mates, and the amount of information transferred between individuals communicatively. The models aim to provide a framework for testing the evolutionary advantage of theory of mind when performing complex cooperative tasks.
Meeting dates: Dec. 9-11, 2015; May 4-6, 2016

Working Group: Multiscale Vectored Plant Viruses
http://www.nimbios.org/workinggroups/WG_plantviruses
Organizers: Vrushali A. Bokil (Mathematics, Oregon State Univ., Corvallis), Linda J. S. Allen (Mathematics and Statistics, Texas Tech Univ., Lubbock), and Alison Power (Ecology & Evolutionary Biology, Cornell Univ.)
This group is working on current problems related to multiscale aspects of the spatial and temporal transmission and the evolution of vectored plant viruses. The group's goals are to derive novel mathematical, statistical, and computational methods that incorporate multiple hosts and multiple pathogens operating at varying spatial and temporal scales to bring insight into the effects of climate change and human activities on the emergence of new plant viruses.
Meeting dates: Dec. 14-16, 2015; June 22-24, 2016

Working Group: Climate Change and Vector-borne Diseases
http://www.nimbios.org/workinggroups/WG_vbds
Organizers: Nina Fefferman (Ecology, Evolution, and Natural Resources, Rutgers Univ.), Abba Gumel (Mathematics, Univ. of Manitoba), and Richard Ostfeld (Ecology, Cary Institute for Ecosystem Studies)
Vector-borne diseases (VBDs), such as malaria, dengue fever, Lyme disease, West Nile virus, yellow fever and leishmaniasis, continue to pose major public health and socio-economic burdens in many regions of the world, especially the tropical and sub-tropical regions. Climatic factors, such as temperature, humidity, rainfall and vapor pressure, are known to significantly affect the incidence of VBDs. Although mathematical modeling has been extensively used to gain insight into the transmission dynamics of VBDs, the resulting models only rarely incorporate the effect of climate change. The purpose of this Working Group is to bring together a cross-disciplinary team of relevant experts, notably modelers, ecologists, and epidemiologists, to study the impact of climate change on the spread of VBDs. The short-term objective of the Working Group is to develop a new and realistic modeling framework for studying the effects of climate change on the transmission dynamics and control of VBDs. Although the emphasis is on the two most important VBDs, malaria and dengue fever, the framework will be robust enough to be applicable to other VBDs, such as Lyme disease and West Nile virus. The long-term objective is to contribute to the concerted global effort to find effective ways to combat the spread of VBDs in animal and human populations.
Meeting dates: Dec. 15-17, 2015

Working group: Modeling Antimicrobial Resistance Intervention
http://www.nimbios.org/workinggroups/WG_amr
Organizers: Craig A. Lewis (Food and Drug Administration Center for Veterinary Medicine, Rockville, MD) and Yrjö T. Gröhn (Cornell Univ. College of Veterinary Medicine, Ithaca NY)
The FDA is preparing to implement new risk mitigation strategies to promote judicious use of medically-important antimicrobials in food-producing animals. However, the connection between antimicrobial use and resistance is complex and a suitable mathematical framework to analyze this relationship is currently unavailable. This NIMBioS Working Group is identifying specific analytical methods and quantitative data that are appropriate for associating population-level changes in antimicrobial use in livestock with population-level changes in antimicrobial resistance. This is a unique opportunity to use a systems approach to inform monitoring and assessment of an imminent intervention. The group's work is identifying strategic methods for data collection, analysis and synthesis to address research and regulatory questions and to allocate limited resources efficiently.
Meeting dates: March 7-9, 2016

Working Group: Dispersal Biogeography
http://www.nimbios.org/workinggroups/WG_dispersal
Organizers: Brittany Teller (Ecology, Utah State Univ.), James Bullock (Centre for Ecology and Hydrology, Oxford, UK) and Mark Lewis (Mathematical Sciences and Biological Sciences, Univ. of Alberta, Canada)
The two most widely used predictive approaches to species' spatial distribution, species distribution models (SDMs) and demography and dispersal models (DDMs), follow different research traditions and thereby treat distributions and species' traits in fundamentally different ways. We seek to determine the contexts in which these two popular approaches can be mutually informative. During a short-term visit to NIMBioS, we developed a mathematical framework that brings together SDMs and DDMs, and we conjectured that our new synthesis could be a powerful tool for predicting species distributions under both static and changing environmental conditions. This working group will refine this framework for empirical

applications and test it with real data, especially for species and regions under a particular threat from environmental change. Indeed, predicting species distributions with higher precision and confidence is a research priority in our climatically, agriculturally, and economically changing world.
Meeting dates: March 17-19, 2016

Working Group: Computational Landscape Genomics
http://www.nimbios.org/workinggroups/WG_genomics
Organizers: Andrew Storfer (Biological Sciences, Washington State Univ.), Gilles Guillot (Applied Mathematics, Technical Univ. of Denmark), Mike Antolin (Biology, Colorado State Univ.), and Mary Poss (Biology, Penn State Univ.)
Rapid advances in our ability to obtain genomic data have also caused a paradigm shift in the way we view "genes." Once thought to be directly related to phenotype, genes operate in complex genomic landscapes, rather than in isolation. A gene's location and copy number within a genome may regulate its expression, as well as its interaction with other genes and noncoding RNA. Genes are expressed differently in different environments, and selection varies spatially across the ecological landscape. A major challenge, then, is to analyze data sets that integrate both the genomic landscape and the ecological landscape to understand the spatial distribution of adaptive genetic variation. This Working Group addresses this challenge by advancing analytical and computational methods with an interdisciplinary collaboration of experts in genomics, statistics, mathematics, bioinformatics and population genetics.
Meeting dates: March 21-23, 2016

Working Group: Models of Produce Contamination
http://www.nimbios.org/workinggroups/WG_produce
Organizers: Lydia Bourouiba (Civil and Environmental Engineering, MIT), Renata Ivanek (Population Medicine and Diagnostic Sciences, Cornell Univ.), Daniel Munther (Mathematics, Cleveland State Univ.), and Jianhong Wu (Mathematics, York Univ.)
Foodborne illnesses associated with fresh produce continue to impose heavy public health and socio-economic burdens. To advance produce food safety, it is critical to adopt a mechanistic approach that uses mathematical modeling for holistic understanding of processes shaping pathogen introduction and transfer at the preharvest level. Toward that goal, we have assembled researchers from food science, microbiology, epidemiology, mathematics and bio-statistics, and government agencies to develop detailed pathogen/produce specific mathematical models. The developed models will elucidate how underlying small-scale processes, such as raindrops or irrigation types, contribute to the patterns of spread of contaminants in a field. These results are expected to inform future experimental work and redesign of the existing macroscale (e.g., risk assessments) models, both of which will uniquely support submission of research grant proposals. Ultimately, these efforts will lead to development of improved tools to prioritize prevention and surveillance efforts in produce food safety.
Meeting dates: April 13-15, 2016

Working Group: Remotely Sensing Biodiversity
http://www.nimbios.org/workinggroups/WG_biodiversity
Jeannine Cavender-Bares (Ecology, Evolution and Behavior, Univ. of Minnesota), Phil Townsend (Forest and Wildlife Ecology, Univ. of Wisconsin), Brian O'Meara (Ecology and Evolutionary Biology, Univ. of Tennessee), and Jose Meireles (Ecology, Evolution and Behavior, Univ. of Minnesota)
Remote sensing of biodiversity is critical at a time when the Earth's biodiversity loss due to human activities is accelerating at an unprecedented rate. Functional plant diversity is highly

associated with plant biodiversity, and recent technological and computational advances allow the detection of plant functional traits and trait diversity from spectral data that can be remotely sensed. Although biodiversity itself cannot practically be observed everywhere, if functional traits and trait diversity can be remotely sensed using spectral data, the potential exists to at least globally inventory the diversity of traits associated with terrestrial biodiversity. Moreover, spectral data and the functional traits they predict can be linked to phylogenetic data as a means to estimate changes in biodiversity patterns globally. However, the mathematical models and computational approaches to integrate multiple complex multidimensional datasets are underdeveloped. We bring together biological and computational experts from three disciplines—remote sensing and leaf optics, plant functional biology and systematics—to develop a framework and set of computational tools for linking spectral data, functional traits, and phylogenetics. Our goal is to transform the ability of humanity to detect and interpret the changing functional biodiversity of Planet Earth.
Meeting dates: April 21-23, 2016

Working Group: Prediction and Control of Cardiac Alternans
http://www.nimbios.org/workinggroups/WG_arrhythmias
Alena Talkachova (Biomedical Engineering, Univ. of Minnesota) and Xiaopeng Zhao (Mechanical, Aerospace, and Biomedical Engineering, Univ. of Tennessee, Knoxville)
Cardiac alternans manifests at the cellular level as a beat-to-beat alternation in action potential duration (APD) and at the whole heart level as an alternating change in the amplitude or shape of the T-wave in the electrocardiogram (ECG). Specifically, we use a system-based approach to develop and test new algorithms for APD alternans prediction, both at cellular and tissue levels; translate the criteria for predicting APD alternans into whole-heart ECG recording; and develop novel control schemes to suppress alternans using bifurcation control and optimization techniques.
Meeting dates: May 2-4, 2016

Working Group: Habitat for Migratory Species
http://www.nimbios.org/workinggroups/WG_migratoryspp
Organizers: Wayne Thogmartin (US Geological Survey, Upper Midwest Environmental Sciences Center), Jay Diffendorfer (US Geological Survey, Geosciences and Environmental Change Science Center), Ruscena Wiederholt (Univ. of Arizona, Tucson), and Brady Mattsson (Univ. of Natural Resources and Life Sciences, Vienna, Austria)
Understanding the value of specific areas used by a migratory species is important to theoretical ecology, decision analyses, habitat conservation, and conservation spending. The objective of this Working Group is to define a comprehensive framework for estimating the contribution of discrete habitat areas for migratory population viability. While similar metrics have been defined in a metapopulation context, translating these ideas to migratory populations, which spend time in multiple habitats over the course of their annual cycle, poses challenges. One goal is to continue development and refinement of a generalizable framework for habitat-specific contributions that accounts for (1) various migratory patterns, (2) density-dependence, and (3) carry-over effects. Optimal spatial prioritization approaches identify robust strategies for reserve design, and the group is considering the consequences of area contribution for migratory species for identifying optimal reserve networks. These efforts will be useful for conservation and management activities for migratory species. The Working Group includes participation by statisticians, quantitative ecologists, and landscape ecologists with experience in metapopulation theory, parameter estimation, decision analysis, scenario analysis and population modeling.
Meeting dates: May 10-13, 2016

Working group: DEB Model for Trees
http://www.nimbios.org/workinggroups/WG_deb
Organizers: Glenn Ledder (Mathematics, Univ. of Nebraska, Lincoln), Sabrina E. Russo (Biological Sciences, Univ. of Nebraska, Lincoln) and Roger M. Nisbet (Ecology, Evolution, and Marine Biology, Univ. of California, Santa Barbara)
By working at the interface of state-of-the art mathematical process modeling and tree biology, this Working Group is developing a mechanistic dynamic energy budget model to predict the growth and survival of individual tropical trees. The model will simulate plant growth and survival based on measured functional trait values and responses to environmental variation, including irradiance, soil moisture and nutrients, and temperature. The model will identify combinations of functional and biomass- and nutrient-allocation traits that maximize net photosynthetic carbon gain (C-gain) and survival at the level of the whole tree. The model will enable prediction of (1) species distributions based on differences in performance of trees in response to variation in resources, such as along natural environmental gradients and (2) responses of trees to environmental shifts caused by global change.
Meeting dates: May 16-20, 2016

Working Group: *Caulobacter* Cell-Cycle Model
http://www.nimbios.org/workinggroups/WG_cellcycle
Yang Cao (Computer Science, Virginia Tech), Srividya Iyer-Biswas (Physics, Purdue Univ.) and John Tyson (Biological Sciences, Virginia Tech)
The free-living aquatic bacterium *Caulobacter crescentus* is a model organism for studying the cell cycle. The Group goal is to combine the wealth of available data at the molecular, single-cell and population levels, to build a multiscale, highly constrained, predictive model of the cell cycle of *C. crescentus*. Additionally this integrative model must also capture the inherent stochasticity of the underlying processes, and thus the resultant stochasticity in cell-division times for this model organism. This Group brings together active researchers working on various aspects of *C. crescentus* cell-cycle dynamics, including experimentalists, modelers and theorists, to discuss recent progress in this field, accelerate collaboration among them, and to produce an integrative model. The Group consists of active researchers, including six biologists, and eight others from mathematics, physics, chemistry, computer science, and bioengineering.
Meeting dates: Summer 2016

Working Group: Human Risk Perception and Climate Change
http://www.nimbios.org/workinggroups/WG_risk
Organizers: Brian Beckage (Plant Biology, Univ. of Vermont), Louis Gross (NIMBioS and Univ. of Tennessee), and Asim Zia (Community Development and Applied Economics, Univ. of Vermont)
The integrative, multidisciplinary team in this Working Group is considering feedbacks between climate, ecological, and human belief systems using a quantitative modeling approach. It seeks to link models of human belief systems concerning risk associated with climate change with models of the ecological and climate systems into a coupled earth system model. This is a joint Working Group with NIMBioS and the National Socio-Environmental Synthesis Center.
Meeting dates: July 25-27, 2016

INVESTIGATIVE WORKSHOPS

Investigative Workshop: Morphological Plant Models
http://www.nimbios.org/workshops/WS_plantmorph
Organizers: Alexander Bucksch (Schools of Interactive Computing and Biology, Georgia

Institute of Technology, Atlanta) and Dan Chitwood (Donald Danforth Plant Science Center, St. Louis)
The workshop's mathematical/computational focus was to identify current cutting edge mathematical and computational techniques to analyze, model, and describe plants from the cell to the organ level and identify mathematical challenges in plant science applications. The biological focus was on how biologists can develop datasets and provide perspectives to establish simple model systems that employ favorable mathematical and technological constraints to discover special cases for later generalization. The scientific goal was to develop a suite of biological questions that allow workshop members to jointly pioneer the use and development of geometric and topological methods within the plant sciences. The synergy provided from uniting these disparate disciplines will potentially fuel future collaborations and hasten new studies and perspectives in plant phenotyping.
Meeting dates: September 2-4, 2015

Investigative Workshop: Evolution and Warfare
Organizers: Michael L. Wilson (Biology, Univ. of Minnesota), Luke Glowacki (Anthropology, Harvard Univ.), Anna Simons (Defense Analysis, Naval Postgraduate School), and Sergey Gavrilets (Ecology & Evolutionary Biology, Univ. of Tennessee, Knoxville)
This workshop began toward an integrated approach to the study of warfare under decentralized or only loosely controlled conditions, combining empirical data, evolutionary theory, and mathematical models. Participants developed working hypotheses to answer several key questions about between-group conflict in general, and the nature of 'decentralized warfare' in particular. These hypotheses were informed by evolutionary theory using data from diverse conflict settings. Hypotheses were articulated in a framework amenable to formal modeling that will point the way toward a multi-level predictive understanding of warfare.
Meeting dates: September 16-18, 2015

Investigative Workshop: Algebraic Mathematical Biology
Organizers: Raina Robeva (Mathematics, Randolph-Macon College, VA), Matthew Macauley (Mathematical Sciences, Clemson Univ., SC), and John Jungck (Biological Sciences, Center for Bioinformatics and Computational Biology, Univ. of Delaware)
This workshop will bring together a diverse group of faculty from the field of algebraic and discrete mathematical biology to survey existing educational resources in discrete and algebraic mathematical biology; to identify topics appropriate for undergraduates not yet featured in the existing literature; to identify target courses in the mathematics and biology curricula that would benefit most from featuring those topics; to initiate the development of new curricular materials and ultimately publishing the materials for those topics; and to facilitate the growth of a community of faculty actively involved in creating and using curricular resources for algebraic mathematical biology.
Meeting dates: July 25-27, 2015

SHORT-TERM VISITORS

[Missing From Previous Year's Report]

Chris Baker (BioSciences, The Univ. of Melbourne) collaborated on a project with P. Armsworth and S. Lenhart to use multiple control methods to investigate optimal control of invasive species eradication. (May 9-15, 2015)

Guihong Fan (Mathematics and Philosophy, Columbus State Univ.) collaborated on a project with S. Lenhart on optimal control of vector populations in vector-borne diseases taking into account the influence of daily weather. (May 14-June 14, 2015)

John Hopkins (Biological Sciences, Univ. of California, San Diego) collaborated on a project with J. Ferguson to couple proportional diet estimates from stable isotope analysis with time series data to improve inferences on the intake rate of a consumer. (June 1-5, 2015)

Maria Leite (Math & Statistics, Univ. of South Florida); Benito Chen (Math, Univ. of Texas, Arlington); Folashade Agusto (Math, Austin Peay Univ.) collaborated on a project to investigate the mechanisms of harvesting-beetles outbreaks-forest interactions via mathematical models. (June 4-7, 2015)

Adriane Lam (Geological Sciences, Ohio Univ.) collaborated on a project with N. Matzke to model dispersal routes of invertebrate taxa. (June 4-6, 2015)

David Gurarie (Mathematics & Statistics, Case Western Reserve Univ.) collaborated with V. Ganusov on a project to analyze an in-host malaria system with multiple parasite strains and variants. (June 21-28, 2015)

Allan Strand (Biology College of Charleston), Eric Archer (Marine Mammal Genetics Group, Southwest Fisheries Science Center, NOAA), Michelle DePrenger-Levin (Denver Botanic Gardens), Libby Liggins (Evolutionary Ecology, Massey Univ.), Christian Parobek (Medicine, Genetics, and Molecular Biology, Univ. of North Carolina, Chapel Hill) collaborated on a project with S. Hoban to further development of an R package to increase accessibility of population genetic simulation frameworks. (July 13-16, 2015)

Ilyssa Summer (Math, Arizona State Univ.) collaborated with A. Peace on a project to develop and analyze mathematical models of oncolytic viral therapy strategies. (July 14-18, 2015)

Tony Jhwueng (Statistics, Feng-Chia Univ.) continued collaborations with B. O'Meara and others in his lab on phylogenetic comparative methods. (July 15-Aug 31, 2015)

Souvik Bhattacharya (Mathematics, Univ. of Trento) collaborated on a project with S. Lenhart to develop a model to predict West Nile behavior under influence of seasonality and preferential vector feeding patterns. (August 9-21, 2015)

[This Year's Reporting Period]

Maya Chhetri (Mathematics and Statistics, Univ. of North Carolina, Greensboro) collaborated with S. Lenhart on the topic of optimal control of harvesting in a steady state PDE model with allee effect. (September 1-11, 2015)

Sara Usher (Politics and International Relations, Oxford Univ.) collaborated on a project with M. Zefferman to develop novel methods for the field of political ecology to answer questions about why some societies are more prone to conflict or cooperation in response to climate change. (September 7-14, 2015)

Elizabeth Bradley (Computer Science, Univ. of Colorado, Boulder) visited with NIMBioS Postdoctoral Fellows as an Invited Distinguished Visitor and gave a seminar on chaos and control. (September 22-23, 2015)

Stuart Pimm (Doris Duke Professor of Conservation, Nicholas School of the Environment, Duke Univ.) visited with NIMBioS Postdoctoral Fellows as an Invited Distinguished Visitor and gave a seminar on the topic, “The laws of biodiversity and what we do not understand about them.” (September 28, 2015)

Samares Pal (Mathematics, Univ. of Kalyani) collaborated on a project with S. Lenhart to model macroalgal allelopathy in the emergence of coral diseases. (October 2-5, 2015)

Thomas Currie (Biosciences, Univ. of Exeter) collaborated on a project with S. Gavrilets to construct statistical and computational models to examine the emergence of complex societies. (October 11-17, 2015)

Huda Sarraj (Educational Psychology, Univ. of Texas, Arlington) collaborated on a project with P. Bishop to expand NIMBioS Evaluation Services. (October 15-18, 2015)

Nick Matzke (Research School of Biology, The Australian National University) collaborated on a project with B. O'Meara and J. Beaulieu to develop methods to convert the output from the R package, OUwie, into a form suitable for use in estimating the phyloSDM (Phylogenetic Species Distribution Modeling). (October 23-November 6, 2015)

Sean Maxwell (ARC Center of Excellence for Environmental Decisions, The Univ. of Queensland) collaborated on a project with P. Armsworth to link biophysical and socio-economic conditions with models of forest preservation and loss. (November 4-10, 2015)

Erin Baerwald (American Wind Energy Inst.), Robert Barclay (EEB, Univ. of Calgary), Laura López-Hoffman (Environmental Policy, Univ. of Arizona), Gary McCracken (EEB, Univ. of Tennessee), Rodrigo Medellin (Ecology, Univ. of Mexico), Wayne Thogmartin (Quantitative Ecology, USGS), Luis Viquez (Ecology, Univ. Ulm), and Ruscena Widerholt (Ecology, Univ. of Arizona). This subgroup on bat migration analysis of the NIMBioS Working Group: Habitat for Migratory Species met at the UT Field Station to test the application of the Working Group's habitat metrics to three different migratory bat species. (November 11-13, 2015)

Gesham Magombedze (Infectious Disease Epidemiology, Imperial College) visited to work on a project to develop deterministic and stochastic mathematical models to predict and explain combinations of potential cattle immune response mechanisms that can explain the fecal shedding patterns observed in cattle with Johne's disease. (December 7-11, 2015)

Sean Hoban (Morton Arboretum, Lisle, IL) and Allan Strand (Biology, College of Charleston) collaborated on a project to lay ground for future studies as well as make better use of existing datasets for synthesizing knowledge of how species respond to climate change. (February 15-19, 2016)

Maria Servedio (Biology, Univ. North Carolina, Chapel Hill) visited to collaborate with S. Gavrilets and to present a seminar on the topic, "Models and Mechanisms of Male Mate Choice." (February 16, 2016)

Anita Layton (Math, Duke Univ.); Aurelie Edwards (Laboratory of Metabolism and Renal Physiology, Centre de Recherche des Cordeliers, France); Jennifer Sullivan (Physiology,

Georgia Regents Univ.); Ying Chen (Center for Computational Biology and Bioinformatics); Veronica Ciocanel (Applied Mathematics, Brown Univ.); and Tracy Stepien (Mathematics and Statistics, Arizona State Univ.). This group collaborated on two projects with I. Sgouralis modeling blood flow in the kidney: (1) a model of a key autoregulatory process in the kidney and (2) a model to simulate blood flow in hypertensive kidneys in male and female rats to gain a better understanding of gender differences in hypertension. The project was initiated during the Research Collaboration Workshop for Women in Mathematical Biology at NIMBioS in June 2015. (February 25-28, 2016)

Jason Hoeksema (Biology, Univ. of Mississippi); Dan Doak (Environmental Studies, Univ. of Colorado-Boulder); and Christopher Steenbock (EEB, Univ. of Colorado-Boulder) collaborated with M. Rúa on a project to utilize an existing dataset tracking population dynamics of Monterey Pine (*Pinus radiata*) over a 13-year period in order to create population dynamic models that incorporate ectomycorrhizal fungal communities. (March 2-6, 2016)

Eleanor Brush (Biology, Univ. of Maryland) Eleanor Brush collaborated with E. Hobson to develop a model to improve understanding of animal recognition systems and sociality. (March 7-10, 2016)

Noelle Beckman (National Socio-Environmental Synthesis Center) collaborated on a project with C. Farrior to combine strengths in simulation, statistical, and mathematical modeling to understanding of empirical patterns of plant mortality and dispersal. (March 16-18, 2015)

Erida Gjini (Mathematical Biology, Instituto Gulbenkian de Ciencia, Portugal) collaborated on a project with V. Ganusov to develop mathematical models for optimal treatment dynamics of infections with *Mycobacterium* tuberculosis. (March 20-27, 2016)

Candice Lumibao (Ecology, Univ. of Minnesota, Twin Cities); Sean Hoban (The Morton Arboretum, Lisle, IL); and Jason McLachlan (Biological Sciences, Univ. of Notre Dame) collaborated on a project to synthesize and analyze existing data from phylogeographic studies in eastern North America and test, evaluate, improve and apply new statistics for comparative work with Europe. (March 23-25, 2016)

Qingxia Li (Mathematics, Fisk Univ.); Lauren Gollahon (Biology, Texas Tech Univ.); Anton Weisstein (Biology Education, Truman State Univ.) and Xinyao Yang (Mathematics, Univ. of Missouri) collaborated with S. Lenhart and L. Gross to promote the development of materials and practices for case teaching in mathematics and biology. (March 31- April 3, 2016)

Michael Whitlock (Zoology, Univ. of British Columbia, Vancouver) visited with NIMBioS Postdoctoral Fellows as an Invited Distinguished Visitor and gave a seminar on the topic, “Selection in complex spatial settings.” (April 12, 2016)

Urszula Ledzewicz (Mathematics and Statistics, Southern Illinois Univ., Edwardsville, and Lodz Univ. of Technology, Poland) visited with NIMBioS Postdoctoral Fellows as an Invited Distinguished Visitor and gave a seminar on the topic, “Optimal protocols for combination therapies in cancer: How much, how often, in what sequence?” (April 18-20, 2016)

Michael Renton (School of Plant Biology, Univ. of Western Australia) collaborated on a project with C. Price to conduct evolutionary modeling of optimal plant structure and growth. May 15-June 20, 2016

Barbara Han (Cary Institute of Ecosystem Studies) will work with NIMBioS post-doctoral fellow Suzanne O'Regan to look at machine learning and mathematical modeling of pace of life in disease ecology. (planned July 18-22, 2016)

Clinton Leach (Biology, Colorado State Univ.) will collaborate with NIMBioS post-doctoral fellow Nels Johnson to review nonparametric Bayesian methods in ecology. (planned for August 14-20, 2016)

Education & Outreach Activities:

Outreach and Education are a significant component of NIMBioS activities. These activities cover a broad audience from elementary school (Biology in a Box (K-12)), middle school (Girls in Science, SHADES, Adventures in STEM Camp), high school (math/biology curriculum programs, SASEF, teacher workshops), and undergraduates (undergraduate math/biology research conference, visits to MSI partners, SRE program) to graduate students and general science population (summer graduate school with MBI, seminars, presentations). Various institutional partner visits were also made for partnering with minority-serving institutions.

The section below describes NIMBioS outreach and education activities completed between September 1, 2015 and August 31, 2016.

2016 Summer Research Experience (SRE) for Undergraduates Program

Sixteen undergraduates are participating in the 2016 NIMBioS Summer Research Experience (SRE) for undergraduates. During the eight-week program, participants live on campus at the University of Tennessee, Knoxville (UT), and work in teams with NIMBioS postdocs and UT faculty to conduct research at the interface of mathematics and biology. The award includes a stipend, housing and some funding to support travel. The projects this year are: (1) Using statistical filters to follow fast organelle movements in plant cells (2) Mouse trap! Modeling the spread of mice & hantavirus in pressured landscapes (3) Dynamic modeling of human emotion (4) Decoding allostery by mathematical analysis of molecular dynamics simulations and (5) Developing computer games for teaching biology. (Dates: June-July, 2016)

Minority-Serving Institution Partner Visits

Visits were arranged for NIMBioS researchers and leadership to visit our minority-serving institution partners: Fisk University (I. Sgouralis, March 2016), Howard University (C. Farrior, September 2015), Tennessee State University (Q. Johnson, November 2015) and University of Texas-El Paso (Q. Johnson, February 2016). S. Lenhart participated in discussion and evaluation of curriculum and course issues related to Fisk University's NSF-funded HBCU-UP-TIP project (February 2016).

Joint Math Meetings

Co-sponsored with NSF Mathematics Institutes, the Joint Mathematics Meetings are held for the purpose of advancing mathematical achievement, encouraging research, and to provide the communication necessary to progress in the field. Annually, NIMBioS and the Mathematics

Institutes sponsor a reception with presentations on opportunities available through these NSF-funded Institutes.

At the January 2016 meeting in Seattle, WA, S. Lenhart attended Directors meeting of the Mathematical Sciences Institutes and the corresponding Diversity Committee meeting. S. Lenhart also displayed NIMBioS opportunities at the Mathematics Institutes Reception and presented two talks: one about some elementary level math activities developed at NIMBioS in an education session and one on our SRE program (with a particular project).

Mathematics of Planet Earth+ Workshop: Education for the Planet Earth of Tomorrow

The issues facing the planet call for a new type of workforce, trained in multidisciplinary and multi-national communication and collaboration. This workshop focused on planning for the multidisciplinary education of students as well as workforce development. Discussion sessions and panels were included, as well as invited speakers with expertise in green education, communications, and undergraduate mathematics education. This workshop was supported by the Center for Discrete Mathematics and Theoretical Computer Science (DIMACS) and funded by the National Science Foundation. It was presented under the auspices of the DIMACS Special Program: Mathematics of Planet Earth 2013+. This workshop was partially funded by NIMBioS. (Dates: September 30 - October 2, 2015)

Great Smoky Mountains National Park (GSMNP) Outreach

NIMBioS led a quantitative biology session for the Girls in Science Camp at Tremont. (Date: June 2016)

Undergraduate Research Conference at the Interface Between Biology and Mathematics

Undergraduate students engaged in research in biology and mathematics, their faculty mentors, Minority Serving Institution partners and high school teachers were invited to this seventh annual conference. The conference included student talks and posters, two guest plenary speakers, a career panel to take questions about research and careers in math biology, and a graduate school showcase. Over 100undergraduates and faculty from academic institutions across North America were in attendance. There were over 50 undergraduate research talks and posters. (Date: November 2015)

NIMBioS Interdisciplinary Seminars

The NIMBioS Interdisciplinary Seminar Series is held on Tuesdays during the fall and spring semesters. On Tuesdays when a formal seminar is scheduled, NIMBioS hosts an Afternoon Tea for NIMBioS staff, visitors, faculty, and post-docs as well as faculty and students from across the UT community. The teas provide an opportunity for informal collaboration, discussion and networking. (Dates: Fall 2015 and Spring 2016)

Biology in a Box

The Biology in a Box Program, first begun by Riechert in 1993 offers an engaging solution to the lack of depth in traditional STEM education in the United States. Exercises are provided in a

format that teaches important biological concepts through hands-on community learning. Lessons are packaged within 10 current thematic units that are offered to the worldwide audience at the project's web-site http://biologyinabox.utk.edu. Our activities this last year under collaboration with NIMBioS are outlined below.

Partners

One new Tennessee School System added this year bringing the total to 109 school system partners: Humphreys County. St. Ann (Bartlett Area Schools)/ Wanda Blurton, Upgraded Unit 1 – 10 components (December 2015).

Unit Development

Completed development and *alpha* testing of new unit by VolsTeach Interns, 11 Biomechanics Unit which includes the following exercise series: 1 Borrowing Designs from Nature, 2 From Skeletons to Bridges, 3 Jaws are Levers, 4 Drop, Squirt, Throw: Projectile Motion, 5 Similar Things to Wings: Drag and 6 Bioacoustics. The manual for the series is 206 pages in length and the materials cost per copy of the unit is $671. Nineteen copies of the unit have been produced to date. The Unit is now under *BETA* testing by Dr. Beth Adler and her students at Oak Ridge High School.

Box Set Loans and Demonstrations

Unit 2 loan; Penny Baugh/Shelby Collins, for Clinton Middle School science lesson (October 2016).

Unit 11 Rocket Launcher loan; Melissa Horning, for Apprentice Teaching lesson at Oak Ridge H.S. (January 2016)

Various unit materials, Lisa LaForest and Joseph Benthal, demonstration at AL Lotts Elementary School's Science Night for students, parents, and teachers (March 2016).

Daniel Rose (VolsTeach AT) loan of fans, windpitch kits, and anemometers for lessons he and others were developing at Oak Ridge H.S. These lessons may be incorporated into potential Part II of *Biology in a Box* STEM unit (April 2016).

Biology in a Box related Grant requests

Title: Preliminary Proposal NSF – INCLUDES: Broadening Participation in Quantitative Biology Through a Team-Based Interdisciplinary Undergraduate Research Network Partnering Minority-Serving Institutions with Research Centers- Senior Personnel Role

Title: Preliminary Proposal NSF- INCLUDES "Unlocking the STEM Universe: Expanding Appalachian Student Participation" CO-PI
Program Solicitation: NSF 16-544

Title: Full Proposal NSF INCLUDES: "Unlocking the STEM Universe: Expanding Appalachian Student Participation" CO-PI submission June 25 2016

NSF PRIME grant proposal –CO PI Aug 2015

Current NSF Noyce Phase I Grant PI with *Biology in a Box* & NIMBioS partnering

Submitted NSF Noyce Phase II grant with *Biology in a Box* partnering: PI

Talks & Workshops on Biology in a Box

1) Informal presentation to East Tennessee State University Biology Department as part of invited speaking engagement-'Introduction to the *Biology in a Box* Outreach Project'

2) SFKAS, a UTK Faculty group 'Exploring Biomechanics through Skeletons, Fish Jaws & Bird Beaks, The Monkey & The Zoo Keeper, Similar Things to Wings, and Bioacoustics'.

NIMBioS SRE Collaboration with Biology in a Box
2D quiz screen window games are under development for the *Virtual Biology in a Box* Project. S. Riechert, M. Jantz and K. Sturner will co-mentor 3 SRE undergraduates.

Scientific Papers (prepared for submission)

1) Does an Extended Black Box Problem Offer Student NOS & Statistical Probability Learning Gains?(Prepared for International Journal of Science Education) Riechert
2) The Slap Snack Card Game Introduction to Natural Selection for Students of All Ages (Prepared for American Biology Teacher) Riechert & T.C. Jones

Advancing Hispanics/Chicanos & Native Americans in Science (SACNAS) Annual Conference

NIMBioS contributed to the annual Modern Math Workshop immediately preceding the SACNAS annual conference. The goal of this project was twofold: to reinvigorate the research careers of minority faculty and post docs and mathematics faculty at minority-serving institutions by recruiting them to participate in the 2015-2016 research programs and workshops of US-based Mathematics Institutes and to increase awareness of math-based career paths among minority undergraduates. The workshop took place in Washington DC, October 28-29, 2015. This directly preceded the Annual Meeting of SACNAS, the Society for Advancement of Chicanos and Native Americans in Science in Los Angeles. This allowed people who were already coming to the SACNAS meeting to attend the Modern Math workshop and also allowed people who came for the Modern Math workshop to stay for the SACNAS meeting. Programs of all NSF-funded mathematics institutes were represented at this workshop, and a representative of each institute was present: AIM, ICERM, IMA, IPAM, MBI, MSRI, NIMBioS, PCMI, and SAMSI. NIMBioS sent postdoc S. O'Regan to speak about NIMBioS and his research, and K. Sturner presented about opportunities at NIMBioS. Also, NIMBioS co-sponsored ecology and evolutionary biology events at SACNAS organized by NESCent, and postdoc M. Rúa also presented in an ecology-themed symposium with researchers from NESCent and NCEAS. (Date: October 2015)

SHADES (Sharing Adventures in Engineering and Science)

NIMBioS helped inspire sixth and seventh grade girls about careers in math, science and engineering at this annual workshop organized by the Greater Knoxville Math/Science Coalition. S. Lenhart volunteered, helped find additional volunteers and led math activities at this event. The workshop was hosted at NIMBioS. (Date: October 2015)

Teaching Workshops

K. Sturner presented high school biology activities with mathematics at the National Association of Biology Teachers Annual Professional Development Conference in Providence, RI (Date: November 2015)

K. Sturner, representing NIMBioS, served on the organizing committee for the “Teaching Evolution Without Tears” workshop for 13 area K-12 teachers as a part of the week of Darwin Day events on the UTK campus. K. Sturner and S. Lenhart helped facilitate the workshop. The theme for the workshop was paleontology. Teachers participated in activities to teach the science supporting evolution, discussed the challenges of teaching evolution in their classrooms, and also had the opportunity to ask questions about evolution. (Date: February 2016)

K. Sturner presented on Biology in a Box activities linking math and science at the National Science Teacher’s Association Annual Conference in Nashville, TN (Date: March 2016)

S. Lenhart and K. Sturner presented activities showing real world mathematical modeling for a teacher professional development workshop in rural Campbell County, TN. Approximately 25 high school teachers were expected. (June 2016)

S. Lenhart and K. Sturner presented activities showing real world applications of mathematics concepts for the teacher professional development workshop Math Counts II in rural Campbell County, TN. Approximately 50 grades 3-8 teachers were expected. (June 2016)

Southern Appalachian Science & Engineering Fair

K. Sturner, S. Lenhart and M. Ghatar (a UTK mathematics undergraduate) served as judges for several awards: a special NIMBioS award (the Senior NIMBioS Prize for Research at the Interface of Mathematics and Biology), the Association for Women in Science and the Mu Alpha Theta prizes. (Date: April 2016)

Adventures in STEM Camp

NIMBioS collaborated with CURENT to offer a week-long summer day camp for rising 7th and 8th grade girls on STEM (Science, Technology, Engineering, Mathematics) (Date: July 2016)

NIMBioS Tutorial: Game Theoretical Modeling of Evolution in Structured Populations

Recent models of evolution have begun to study structured populations using evolutionary graph theory. These models embed standard games such as the Prisoner’s Dilemma or the Hawk–Dove game within a graph structure that dictates allowable interactions. One limitation of this otherwise quite general framework is that interactions in these models typically are restricted to those of a pairwise nature, despite the fact that animal interactions can involve many actors. The next phase in the development of this model system is to include such multi-player interactions. An alternative to this approach is an area of research that has instead explored spatially structured populations competing over continuously varying resource environments. In these models, interactions occur between an individual and the rest of the community with both relative trait frequency and absolute population levels influencing payoffs.

In this tutorial, we will explore both discrete and continuous game theoretical models of evolution in structured populations that address both pairwise and multi-player interactions.

The tutorial format included interactive lectures with quick exercises on each topic, followed by structured hands-on activities during which participants will work in small groups on exercises and projects. During these sessions, participants learned simple machine learning algorithms, MATLAB® programming, and intuitive analytic tools. The tutorial also featured research lectures by:

- Sergey Gavrilets, Ecology & Evolutionary Biology and Mathematics, Univ. of Tennessee, and Director of Scientific Activities, NIMBioS;
- Alun Lloyd, Mathematics, North Carolina State Univ. Director of Biomathematics Graduate Program and Center for Quantitative Sciences in Biomedicine
- Paulo Shakarian, Director of the Cyber-Socio Intelligent Systems Laboratory, Arizona State Univ.

This tutorial was appropriate for both mathematics and biology faculty as well as advanced graduate students. In particular, it targeted those working in evolutionary and behavioral ecology, economics and game theory, and evolutionary anthropology, linguistics, psychology, and sociology. (Date: April 2016)

NIMBioS Tutorial: Evolutionary Quantitative Genetics 2016

In this tutorial, we will review the basics of theory in the field of evolutionary quantitative genetics and its connections to evolution observed at various time scales. Quantitative genetics deals with the inheritance of measurements of traits that are affected by many genes. Quantitative genetic theory for natural populations was developed considerably in the period from 1970 to 1990 and up to the present, and it has been applied to a wide range of phenomena including the evolution of differences between the sexes, sexual preferences, life history traits, plasticity of traits, as well as the evolution of body size and other morphological measurements. Textbooks have not kept pace with these developments, and currently few universities offer courses in this subject aimed at evolutionary biologists. There is a need for evolutionary biologists to understand this field because of the ability to collect large amounts of data by computer, the development of statistical methods for changes of traits on evolutionary trees and for changes in a single species through time, and the realization that quantitative characters will not soon be fully explained by genomics. This workshop aims to fill this need by reviewing basic aspects of theory and illustrating how that theory can be tested with data. Participants will learn to use R, an open-source statistical programming language, to build and test evolutionary models. The intended participants for this workshop are graduate students, postdocs, and junior faculty members in evolutionary biology. (Date: August 2016)

School Visits, Field Trips, Conferences and Meetings

S. Lenhart visits Bearden High School once a week during the school year for math club enrichment activities. S. Lenhart and C. Collins worked regularly with a group of Bearden H.S. students to teach math modeling as a part of a STEM Certificate Program. (Dates: 2015-2016).

S. Lenhart and L. Gross represented NIMBioS at a conference at Quantitative Biology Education Conference at Spelman College. (March 2016). They also serve on panels at the three mathematics conferences, giving feedback on math biology education: Common Vision, Transforming Post-Secondary Education in Mathematics, and the Joint Math Meetings. (September 2015, January 2016, March 2016)

S. Lenhart gave seminars presenting ideas about NIMBioS at these locations: South African Mathematical Sciences Association Conference (Winhoek, Namibia in November 2015) and Augusta University (Augusta, GA in October 2015).

S. Lenhart served as a judge at the St. Joseph School Science Fair (January 2016).

NIMBioS helped organize and host a field trip by 6th graders from Greenback School in Loudon County, TN, which brought 48 students and two teachers for a day learning about capture-recapture methods of sampling in ecology, touring the university library, and engineering lab tours at CURENT, an engineering research center across campus. (April 2016)

NIMBioS helped to organize a group of UT graduate students to visit Greenback School to lead biological activities with middle school students (April 2016).

Exhibiting & Presenting About NIMBioS Outreach

S. Lenhart and K. Sturner exhibited NIMBioS opportunities at the UT Women in STEM Research Symposium (April 2016) and at the Tennessee LSAMP Conference (February 2016).

S. Lenhart presented about NIMBioS opportunities at the UT Undergraduate Mathematics Conference. (April 2016).

Discover Birds

C. Welsh and K. Sturner previously designed two math and biology activities to be included in the Discover Birds activity booklet, published by the Tennessee Ornithological Society. The books were donated to schools that the Knoxville Chapter of the Tennessee Ornithological Society visited. C. Welsh visited one of the schools during this reporting period. (May 2016 – Sevier Elementary; ~200 students)

Joint MBI-CAMBAM-NIMBioS Summer Graduate Workshop

NIMBioS is co-organizing this annual 10-day workshop for graduate students in math and biology, where the theme this year is “Mathematical Modeling of Infectious Disease Spread”. This graduate workshop had instructors from across North America whose research expertise on the topic. The program will feature researchers from the mathematical and biological sciences, who will deliver lectures, case study presentations, and mentor the school participants in special project groups. The case study lectures will focus on public health issues and will be open to the university community. Each student will work on a research project in a team of approximately five participants. Topics to be covered include: deterministic and stochastic frameworks for modeling disease dynamics; disease dynamics on social networks;

metapopulations; host behavior and disease evolution; vector-borne diseases; zoonotic diseases; pathogen dynamics and co-infection.

The summer school will provide students with broad high-level training in Mathematical Biology that is unattainable at most institutions. The school will focus on the mathematical modeling of infectious diseases, a field that is growing in importance because of the many issues in disease spread and control arising from new or newly emerging diseases (e.g., SARS, Ebola, West Nile virus) and because new data sources are now available to study disease transmission, pathogen evolution, and the impact of the social behavior of hosts (e.g., genotyping databases, cell phone networks and air travel tickets, social networks). Capitalizing on new data sources to understand and control these impacts on disease spread requires detailed modeling of interactions amongst pathogens and hosts, the training of sophisticated modelers, and the development of new mathematics. This summer school will seek to prepare students to study such models in their future research.

The summer school is co-sponsored by the Mathematical Biosciences Institute (MBI, Ohio State), the National Institute for Mathematical and Biological Synthesis (NIMBioS, Tennessee – Knoxville), the Fields Institute (Toronto), the Centre for Disease Modelling (CDM, York University), the Centre for Applied Mathematics in Bioscience and Medicine (CAMBAM), and the Atlantic Association for Research in the Mathematical Sciences (AARMS). The Army Research Office (ARO), the National Science Foundation (DMS/NSF) and the Society for Mathematical Biology (SMB) have also provided support. (June 2016)

UT STEM REU Symposium

NIMBioS co-organized a poster symposium with several STEM-oriented REU programs on the campus of the University of Tennessee during the summer of 2015. The CURENT NSF engineering research center co-hosted. NIMBioS SRE students presented. (July 2015)

Addendum to NIMBioSAnnual Report

Sep 1, 2015 –Aug 31, 2016

Y8-5. Additional Products

Featured Articles

Websites

Media Coverage

Addenda -- Additional Products (featured articles, websites, media coverage)

Feature Articles

[This Year's Reporting Period]
April 27, 2016. NIMBioS hosts field trip for rural middle school students
April 13, 2016. Vazquez to receive 2016 Blackwell-Tapia Prize
April 1, 2016. Lenhart receives Cox Professorship
March 15, 2016. Announcing the new roster of participants for the 2016 Summer Research Experience at NIMBioS
March 4, 2016. Welcome new evaluation associate
January 25, 2016. Study shows large variability in abundance of viruses that infect ocean microorganisms
February 29, 2016. Congratulations to Dr. Brothers
February 18, 2016. Teachers explore local fossils with paleontologists
February 5, 2016. You're invited to celebrate Darwin
January 21, 2016. Simon Levin wins National Medal of Science
January 7, 2016. Study reveals deep ties between diverse tropical rainforests
January 4, 2016. New methods help advance infectious disease forecasting
December 17, 2015. The evolution of antievolution policies: Study shows ancestral relationships of modern creationist legislation
December 16, 2015. Special collection explores origin and evolution of play
December 15, 2015. NIMBioS collaboration targets HIV infection
December 1, 2015. 2015 NIMBioS Undergraduate Conference attendance tops 100
November 30, 2015. Strolling salamanders provide clues on how animals evolved to move from water to land
November 11, 2015. Evaluating science: New approaches to assess science education and research efforts
November 24, 2015. SRE students win award for ComFlow
November 6, 2015. Lenhart receives Lorayne Lester Award
November 6, 2015. What makes a leader? Clues from the animal kingdom
November 5, 2016. Bishop joins NIMBioS leadership team
October 28, 2015. NIMBioS workshop inspires new theme issue
October 15, 2015. Alfred P. Sloan Foundation awards grant to NIMBioS for 2016 Blackwell-Tapia Conference
October 12, 2015. Postdoc collaboration yields results
October 3, 2015. Q&A with Megan Rúa
September 26, 2015. Q&A with Nels Johnson
September 10, 2015. Mental math helps monk parakeets find their place in pecking order
September 8, 2015. Parasitic disease: Contact rates, competition matter in transmission

[Missing From Previous Year's Report]
August 24, 2015. NIMBioS receives NSF grant to assess student learning in mathematics
August 21, 2015. Nose picking and other notes from the microbiome workshop
August 5, 2015. Students create tool to stop pests in their tracks
July 30, 2015. Math and biology interface meets steampunk
July 28,2015. Prepare to collaborate: Here's how to do it well
July 17, 2015. NIMBioS staff, postdocs & graduate students give middle school girls STEM

adventures
July 9, 2014. Congratulations to Paul Armsworth
July 6, 2015. Testing the waters: Summer research good preparation
June 30, 2015. Location isn't everything but timing is for certain spawning fish
June 30, 2015. NIMBioS Evaluation Services now available
June 29, 2015. Fireflies, farms, food: NIMBioS SRE 2015 underway
June 24, 2015. Productive Working Group leads to special issue
May 20, 2015. NIMBioS welcomes new researchers
May 15, 2015. It's best to make friends of friends - Even the spotted hyena knows that
May 12, 2015. The mighty seed: Best conservation practices consider both genetics and biology
April 29, 2015. Study advances new tool in the fight against invasive species
April 28, 2015. Workshop to support research collaboration between junior and senior women
April 27, 2015. Tracking an invasive bird: Study reveals similar genetic, geographic patterns in monk parakeet
April 23, 2015. NIMBioS undergrads – Where are they now?
April 21, 2015. Fractals and fruit flies win awards at regional science fair
April 1, 2015. NIMBioS postdocs join the mammal March madness fun

Websites

Title: The NIMBioS Website
URL: www.nimbios.org
Short Description of the Website: This is the main website for NIMBioS. As of April 2016, the website contained 1390 pages and 1501 pdf documents.

NIMBioS maintains a number of WordPress sites for Tutorials and Investigative Workshops. The site are designed to facilitate group communication and information sharing before, during and after the event, and are typically open to the public, although some areas can be set to private. These sites include the following titles and URLs:

Title: NIMBioS Tutorial: Evolutionary Quantitative Genetics 2016
URL: http://www.nimbios.org/wordpress-training/eqg3/

Title: NIMBioS Tutorial: Evolutionary Quantitative Genetics 2015
URL: http://www.nimbios.org/wordpress-training/eqg2/

Title: NIMBioS Tutorial: Evolutionary Quantitative Genetics 2014
URL: http://www.nimbios.org/wordpress-training/eqg/

Title: NIMBioS Investigative Workshop: Algebraic Mathematical Biology
URL: http://www.nimbios.org/wordpress-training/algebraicmathbio/

Title: Mathematics of Planet Earth+ Workshop: Education for the Planet Earth of Tomorrow
URL: http://www.nimbios.org/wordpress-training/mpe/

Title: NIMBioS Investigative Workshop: Morphological Plant Models
URL: http://www.nimbios.org/wordpress-training/plantmorph/

Title: NIMBioS Investigative Workshop: Evolution and Warfare
URL: http://www.nimbios.org/wordpress-training/warfare/

Title: NIMBioS Investigative Workshop: Computational Advances in Microbiome Research
URL: http://www.nimbios.org/wordpress-training/microbiome/

Title: NIMBioS Investigative Workshop: Malaria-Leishmania Co-infection
URL: http://www.nimbios.org/wordpress-training/coinfection/

Title: NIMBioS Investigative Workshop: Many-cell System Modeling
URL: http://www.nimbios.org/wordpress-training/manycell/

Title: NIMBioS Graduate Workshop on Current Issues in Statistical Ecology
URL: http://www.nimbios.org/wordpress-training/gradconf2015/

Title: NIMBioS Investigative Workshop: Information and Entropy
URL: http://www.nimbios.org/wordpress-training/entropy/

Title: NIMBioS Investigative Workshop: Olfactory Modeling
URL: http://www.nimbios.org/wordpress-training/olfactory/

Title: NIMBioS Investigative Workshop: Neurobiology of Expertise
URL: http://www.nimbios.org/wordpress-training/expertise/

Title: NIMBioS Investigative Workshop: Lymphoid Cells in Acute Inflammation
URL: http://www.nimbios.org/wordpress-training/lymphoid/

Title: NIMBioS Investigative Workshop: Heart Rhythm Disorders
URL: http://www.nimbios.org/wordpress-training/cardiac/

Title: NIMBioS Tutorial: Algebraic and Discrete Biological Models for the Undergraduate Classroom
URL: http://nimbios.org/wordpress-training/mathbio/

Title: NIMBioS Investigative Workshop: Leptospirosis Modeling
URL: http://nimbios.org/wordpress-training/leptospirosis/

Title: NIMBioS Tutorial: Parameter Estimation for Dynamic Biological Models
URL: http://nimbios.org/wordpress-training/parameter/

Title: NIMBioS Investigative Workshop: Predictive Models for ERA
URL: http://nimbios.org/wordpress-training/era/

Title: NIMBioS Tutorial: Computing in the Cloud
URL: http://nimbios.org/wordpress-training/cloud/

Title: NIMBioS Investigative Workshop: Vectored Plant Viruses
URL: http://nimbios.org/wordpress-training/plantviruses/
Title: NIMBioS Investigative Workshop: Interface Disease Models
URL: http://nimbios.org/wordpress-training/interface/

Title: NIMBioS Investigative Workshop: Modeling Contamination of Fresh Produce
URL: http://nimbios.org/wordpress-training/produce/

Title: NIMBioS Investigative Workshop: Animal Social Networks
URL: http://nimbios.org/wordpress-training/animalsocialnet/

Title: NIMBioS Investigative Workshop: Insect Pest Resistance Evolution
URL: http://nimbios.org/wordpress-training/insectpest/

Title: NIMBioS Investigative Workshop: Analyzing Animal Vocal Communication Sequences
URL: http://www.nimbios.org/wordpress-training/animalvocalsequences/

Title: NIMBioS Investigative Workshop: Modeling Blood Cell Interactions
URL: http://www.nimbios.org/wordpress-training/bloodcell/

Title: NIMBioS Tutorial: Mathematical Modeling for the Cell Biology Researcher and Educator
URL: http://www.nimbios.org/wordpress-training/cellbiology/

Title: NIMBioS Twitter
URL: https://twitter.com/nimbios
Short Description of the Website:
The NIMBioS Twitter account is an interactive social media site that features NIMBioS news events and happenings as well as re-tweets of relevant news to the scientific community.

Title: NIMBioS Facebook
URL: https://www.facebook.com/nimbios
Short Description of the Website: NIMBioS Facebook page is an interactive social media site that features NIMBioS news, events and photos of interest to the NIMBioS Facebook community.

Title: NIMBioS Storify
URL: http://storify.com/NIMBioS
Short Description of the Website: The NIMBioS Storify site is an interactive social media site with stories created by NIMBioS that comprise all related URL content and photos.

Title: NIMBioS Flickr
URL: http://www.flickr.com/photos/nimbios/
Short Description of the Website: The NIMBioS Flickr features sets of posed and candid photos from various NIMBioS activities and events.

Title: NIMBioS Blog
URL: http://www.nimbios.org/wordpress/
Short Description of the Website: The NIMBioS blog is an interactive social media site established in August 2010 to showcase NIMBioS news and provide an outlet for readers' commentary.

Media Coverage

[Missing From Previous Year's Report]

2/2/15, Barrier Reef coral genetically altered in hope of surviving climate change, The Guardian, http://www.theguardian.com/environment/2015/feb/03/barrier-reef-coral-genetically-altered-in-hope-of-surviving-climate-change

2/4/15, The Great Barrier Reef is doing so badly, scientists are testing genetic modification to help it survive, Smithsonian, http://www.smithsonianmag.com/smart-news/australia-considers-genetically-altering-coral-help-it-survive-climate-change-180954139/?no-ist

4/6/15, Langston Hughes professor to look at malaria's spread, University of Kansas News, http://news.ku.edu/spring-2015-langston-hughes-professor-look-malarias-spread

4/14/15, Online tutorial sets participation records for NICS, NIMBioS and XSEDE, Tennessee Today, http://tntoday.utk.edu/2015/04/14/online-tutorial-sets-participation-records-nics-nimbios-xsede/

4/27/15, The monk parakeet: Tracking an invasive bird, Science Daily, http://www.sciencedaily.com/releases/2015/04/150427145127.htm

4/27/15, The monk parakeet: Tracking an invasive bird, NSF News from the Field, https://www.nsf.gov/news/news_summ.jsp?cntn_id=134975&org=NSF&from=news

4/28/15, Tracking the invasion history of monk parakeets, Nature World News, http://www.natureworldnews.com/articles/14368/20150428/tracking-the-invasion-history-of-monk-parakeets.htm

4/28/15, Scientists track the invasive monk parakeet from Europe to North America, Science World Report, http://www.scienceworldreport.com/articles/24886/20150428/scientists-track-invasive-monk-parakeet-europe-north-america.htm

4/29/15, Study advances new tool in the fight against invasive species, Science Daily, http://www.sciencedaily.com/releases/2015/04/150429101038.htm

4/29/15, Study advances new tool in the fight against invasive species, NSF News from the Field, https://www.nsf.gov/news/news_summ.jsp?cntn_id=135121&org=NSF

4/29/15, Study advances new tool in the fight against invasive species, Science Newsline, http://www.sciencenewsline.com/articles/2015042914190031.html

4/30/15, Unraveling the global invasion of the monk parakeet, Digital Journal, http://www.digitaljournal.com/science/unraveling-the-global-invasion-of-the-monk-parakeet/article/432167

4/30/15, Tracking the invasion history of monk parakeets, Flapping Feathers Parrot Club in New Jersey April Newsletter

5/6/15, Successful invasive species has low genetic diversity, The Wildlife Society, http://wildlife.org/successful-invasive-species-has-low-genetic-diversity/

5/12/15, The mighty seed: Best conservation practices consider both genetics and biology, Science Daily, http://www.sciencedaily.com/releases/2015/05/150512090831.htm

5/12/15, The mighty seed: Best conservation practices consider both genetics and biology, eScienceNews, http://esciencenews.com/sources/science.daily/2015/05/12/the.mighty.seed.best.conservation.practices.consider.both.genetics.biology

5/15/15, Hyena society is founded on friendship, Science, http://news.sciencemag.org/plants-animals/2015/05/hyena-society-founded-friendship

5/15/15, It's best to make friends of friends -- Even the spotted hyena knows that, Tennessee Today, http://tntoday.utk.edu/2015/05/15/nimbios-study-friends-friendsjust-spotted-hyena/

5/15/15, Making friends of friends benefits hyenas, Penn biologist finds, Penn News, http://www.upenn.edu/pennnews/news/making-friends-friends-benefits-hyenas-penn-biologist-finds

5/15/15, Hyenas prefer to buddy up with 'friends of friends', Headline News Global News, http://www.hngn.com/articles/92583/20150515/hyenas-prefer-buddy-up-friends.htm

5/17/15, Why making friends of friends is beneficial, ANI News, http://www.aninews.in/newsdetail9/story216073/why-making-friends-with-friends-039-friends-is-beneficial.html

5/17/15, Animals, too, cosy up with friends, Daiji World, http://www.daijiworld.com/news/news_disp.asp?n_id=319990

5/18/15, It's best to make friends of friends -- Even the spotted hyena knows that, Michigan State News, http://msutoday.msu.edu/news/2015/its-best-to-make-friends-of-friends-even-spotted-hyenas-know-that/

5/18/15, Scientists puzzled by 'social network' of spotted hyenas, Sci-News.com, http://www.sci-news.com/biology/science-spotted-hyenas-02811.html

5/26/15, Tree growth patterns changing amid increase in carbon dioxide, The Australian, http://www.theaustralian.com.au/national-affairs/climate/tree-growth-patterns-changing-amid-increase-in-carbon-dioxide/story-e6frg6xf-1227368996515?nk=b8f728fad91616eccd10d2ba79fc23ac-1434488264

6/30/15, Location isn't everything but timing is for certain spawning fish, Science Daily, http://www.sciencedaily.com/releases/2015/06/150630155212.htm

6/30/15, Location isn't everything but timing is for certain spawning fish, Tennessee Today, http://tntoday.utk.edu/2015/06/30/nimbios-study-location-timing-spawning-fish/

6/30/15, Location isn't everything but timing is for certain spawning fish, NSF News from the Field, http://www.nsf.gov/news/news_summ.jsp?cntn_id=135598

6/30/15, Location isn't everything but timing is for certain spawning fish, Phys.Org, http://phys.org/news/2015-06-isnt-spawning-fish.html

6/30/15, Researchers combine math, biology to find improved tuberculosis vaccine, News Sentinel, http://www.knoxnews.com/news/local-news/researchers-combine-math-biology-to-find-improved-tuberculosis-vaccine_27497643

6/30/15, Researchers combine math, biology to find improved tuberculosis vaccine, NC State In the News, http://webcache.googleusercontent.com/search?q=cache:Sgsqanje0loJ:https://news.ncsu.edu/in-the-news/page/2/+&cd=9&hl=en&ct=clnk&gl=us

7/1/15, Students, mentors study tuberculosis at the University of Tennessee, Channel 6 ABC Knoxville-affiliate, http://wate.com/2015/06/30/students-mentors-study-tb-at-the-university-of-tennessee/

7/1/15, UT combines math, biology to find TB vaccine, World News.com, http://article.wn.com/view/2015/07/01/UT_combines_math_biology_to_find_TB_vaccine/

7/1/15, Location isn't everything but timing is for certain spawning fish, Science Newsline, http://www.sciencenewsline.com/summary/2015070115290024.html

7/1/15, Timing is critical for the success of some spawning fish, University of Hawai‘i – Mānoa Campus News, http://manoa.hawaii.edu/news/article.php?aId=7296

7/8/15, Student-faculty research delves into TB disease, treatment, UT Daily Beacon, http://www.utdailybeacon.com/news/article_3fc21df8-252c-11e5-83dd-5f8b864f3fc7.html

7/20/15, Students conduct research to control canine distemper, Tennessee Today, http://tntoday.utk.edu/2015/07/20/students-conduct-research-control-canine-distemper/

7/20/15, Fisk student selected for summer research experience at national institute, Fisk Univ. Campus News, http://www.fisk.edu/articles/student-summer-research

7/21/15, UT researchers trying to stop the spread of canine distemper, WVLT-Ch8, Knoxville CBS-affiliate, http://www.local8now.com/news/local/headlines/UT-researchers-trying-to-stop-the-spread-of-Canine-Distemper--317993941.html

7/21/15, Two PEER graduate students receive competitive national awards, Tennessee Today, http://tntoday.utk.edu/2015/07/20/peer-graduate-students-receive-competitive-national-awards/

7/23/15, Researchers developing models to understand, fight canine distemper, American Veterinary Medical Association Daily E-Newsletter, http://www2.smartbrief.com/servlet/encodeServlet?issueid=1DFE5F36-FFCB-4702-89C2-F5149DB49CC1&sid=3c16c808-ead0-49f6-acc2-6acbbc9b7c1e

7/29/15, Students research prevention of canine distemper virus, UT Daily Beacon, http://www.utdailybeacon.com/news/article_577f957a-35a2-11e5-bfec-9bf761a458a4.html

7/21/15, UT researchers trying to stop the spread of canine distemper, WVLT-Ch8, Knoxville CBS-affiliate, http://www.local8now.com/news/local/headlines/UT-researchers-trying-to-stop-the-spread-of-Canine-Distemper--317993941.html

8/5/15, NIMBioS students create tool to stop invasive pests, Tennessee Today, http://tntoday.utk.edu/2015/08/05/nimbios-students-create-tool-stop-invasive-pests/

8/5/15, Students create tool to stop invasive pests, Phys.org, http://phys.org/news/2015-08-students-tool-pests-tracks.html

8/23/15, NIMBioS receives NSF grant to assess student learning in mathematics, BioPortfolio.com, http://www.bioportfolio.com/news/article/2438340/NIMBioS-receives-NSF-grant-to-assess-student-learning-in-mathematics.html

8/24/15, NIMBioS receives national grant to assess student learning in mathematics, Tennessee Today, http://tntoday.utk.edu/2015/08/24/nimbios-receives-national-grant-assess-student-learning-mathematics/

8/26/15, Science collaborations and studying Tennessee's twisters, WUOT's The Method, http://wuot.org/post/method-science-collaborations-and-studying-tennessees-twisters

[This Year's Reporting Period]

9/8/15, Parasitic disease: Contact rates, competition matter in transmission, Science Newsline, http://www.sciencenewsline.com/news/2015090915050038.html

9/8/15, Parasitic disease: Contact rates, competition matter in transmission, NSF News in the Field, http://www.nsf.gov/news/news_summ.jsp?cntn_id=136223&org=NSF&from=news

9/8/15, Parasitic disease: Contact rates, competition matter in transmission, Science Daily, http://www.sciencedaily.com/releases/2015/09/150908180455.htm

9/10/15, NIMBioS study: Monk parakeets use mental math to determine pecking order, Tennessee Today, http://tntoday.utk.edu/2015/09/10/nimbios-study-monk-parakeets-mental-math-determine-pecking-order/

9/10/15, Monk parakeets use mental math to determine pecking order, Science Daily, http://www.sciencedaily.com/releases/2015/09/150910144041.htm

9/10/15, How monk parakeets pick their battles, Audubon, http://www.audubon.org/news/how-monk-parakeets-pick-their-battles

9/10/15, Mental math helps monk parakeets find their place in pecking order, NSF News from the Field, http://www.nsf.gov/news/news_summ.jsp?cntn_id=136275&org=NSF&from=news

9/10/15, Mental math helps monk parakeets find their places in the pecking order, Sante Fe Institute, http://www.santafe.edu/news/item/mental-math-helps-monk-parakeets-find-their-place-pecking-orde/

9/11/15, Monk parakeets use mental math to determine pecking order, Scientific Computing, http://www.scientificcomputing.com/news/2015/09/mental-math-helps-monk-parakeets-find-their-place-pecking-order

9/11/15, How do parrots determine the pecking order? They pay attention, BirdChannel, http://www.birdchannel.com/bird-news/2015/09/11/quaker-parrots-determine-pecking-order-with-mental-math-trending.aspx

9/12/15, Parasitic disease: Contact rates, competition matter in transmission, GlobalNewsConnect, http://globalnewsconnect.com/parasitic-disease-contact-rates-competition-matter-in-transmission/

9/14/15, Social status and birds: Monk parakeets establish rank based on aggressive behaviors, Nature World News, http://www.natureworldnews.com/articles/16640/20150914/social-status-monk-parakeets-establish-rank-within-groups-based-aggressive.htm

9/16/15, Finding patterns in the history of human warfare, WUOT's morning and afternoon news programs, http://wuot.org/post/finding-patterns-history-human-warfare#stream/0

9/30/15, Monk parakeets fight to the top, WUOT's The Method, http://wuot.org/post/method-state-park-science-parakeets-fight-top#stream/0

10/1/15, Mental math helps monk parakeets find their place in pecking order, Flapping Feathers Parrot Club National Club Newsletter

11/6/15, World's best leaders aren't human, Discovery, http://news.discovery.com/animals/the-worlds-best-leaders-arent-human-151106.htm

11/16/15, What makes a leader? Clues from the animal kingdom, Science Daily, http://www.sciencedaily.com/releases/2015/11/151106132923.htm

11/6/15, Experts prove animals are better leaders than humans, Examiner, http://www.examiner.com/article/experts-prove-animals-are-better-leaders-than-humans

11/7/15, What makes a leader? Clues from the animal kingdom, Reddit – Science, https://www.reddit.com/r/science/comments/3rwrpv/what_makes_a_leader_clues_from_the_animal_kingdom/

11/8/15, Humans and animals lead social groups in similar ways, researchers say, Nature World News, http://www.natureworldnews.com/articles/18050/20151108/humans-animals-lead-social-groups-similar-ways-researchers.htm

11/8/15, Your boss is not as powerful as you might think-wild animals are true leaders, says a new study, Western Daily Press, http://www.westerndailypress.co.uk/boss-powerful-think-wild-animals-true-leaders/story-28127942-detail/story.html

11/8/15, Qualities of leadership – learned from studying mammalian societies, Market Business News, http://marketbusinessnews.com/qualities-of-leadership-learned-from-studying-mammalian-societies/110650

11/10/15, What makes an effective leader? Leadership in animal kingdom gives clues, Tech Times, http://www.techtimes.com/articles/104555/20151110/what-makes-an-effective-leader-leadership-in-animal-kingdom-gives-clue.htm

11/11/15, What makes a leader? Clues from the animal kingdom, Tennessee Today, http://tntoday.utk.edu/2015/11/11/nimbios-study-leader-clues-animal-kingdom/

11/11/15, Evaluating science: New approaches to assess science education and research efforts, Phys.org, http://phys.org/news/2015-11-science-approaches-efforts.html

11/13/15, NIMBioS: New approaches to assess science education and research efforts, Tennessee Today, http://tntoday.utk.edu/2015/11/13/nimbios-approaches-assess-science-education-research-efforts/

11/13/15, Human and mammal leaders have a lot in common, STEAM Register, http://steamregister.com/human-and-mammal-leaders-have-a-lot-in-common/

11/23/15, The qualities of leaders: Clues about leadership from the animal world, Psychology Today, https://www.psychologytoday.com/comment/802549#comment-802549

11/30/15, Salamander strut: NIMBioS studies how animals moved from water to land, Tennessee Today, http://tntoday.utk.edu/2015/11/30/salamander-strut-nimbios-studies-animals-moved-water-land/

11/30/15, Strolling salamanders provide clues on how animals evolved to move from water to land, Science Daily, http://www.sciencedaily.com/releases/2015/11/151130141334.htm

11/30/15, Strolling salamanders provide clues on how animals evolved to move from water to land, NSF News From the Field, https://www.nsf.gov/news/news_summ.jsp?displayFullSite=true&cntn_id=137080&org=NSF

11/30/15, Strolling salamanders provide clues on how animals evolved to move from water to land, Phys.org, http://phys.org/news/2015-11-strolling-salamanders-clues-animals-evolved.html

11/30/15, Strolling salamanders provide clues on how animals evolved to move from water to land, Science Codex, http://www.sciencecodex.com/strolling_salamanders_provide_clues_on_how_animals_evolved_to_move_from_water_to_land-170714

12/03/15, Salamander strut sheds light on evolution from sea dwelling to land dwelling, Nature World News, http://www.natureworldnews.com/articles/18551/20151203/salamaders-strut-sheds-light-animals-evolved-walk-land-video.htm

12/07/15, GPS collars to help track wild hogs in Smokies, Big South Fork, Knox News Sentinel, http://www.knoxnews.com/news/local/gps-collars-to-help-track-wild-hogs-in-smokies-big-south-fork-ep-1401483069-361256621.html

12/16/15, Special collection explores origin and evolution of play, NSF News in the Field, https://www.nsf.gov/news/news_summ.jsp?cntn_id=137228

12/16/15, Special collection explores origin and evolution of play, BioPortfolio, http://www.bioportfolio.com/news/article/2557456/Special-collection-explores-origin-and-evolution-of-play.html
12/16/15, Special collection explores origin and evolution of play, Health Medicine Network, http://www.healthmedicinet.com/i2/special-collection-explores-origin-and-evolution-of-play/

12/16/15, Special collection explores origin and evolution of play, Science NewsLine, http://www.sciencenewsline.com/news/2015121616050009.html

12/17/15, NIMBioS: Special collection explores origin and evolution of play, Tennessee Today, http://tntoday.utk.edu/2015/12/17/nimbios-special-collection-explores-origin-evolution-play/

12/17/15, Study tracks the evolution of creationism laws in the US, Los Angeles Times, http://www.latimes.com/science/sciencenow/la-sci-sn-evolution-of-creationism-in-schools-20151217-story.html

12/17/15, An evolutionary analysis of anti-evolution legislation, Ars Technica, http://arstechnica.com/science/2015/12/an-evolutionary-analysis-of-anti-evolution-legislation/

12/17/15, How anti-evolution policies evolve, Discovery, http://news.discovery.com/human/evolution/how-anti-evolution-policies-evolve-151217.htm

12/17/15, The evolution of anti-evolution laws, Pacific Standard, http://www.psmag.com/politics-and-law/the-evolution-of-anti-evolution-laws

12/17/15, How creationist legislation has evolved, in one chart, Vox, http://www.vox.com/science-and-health/2015/12/17/10434458/creationism-is-evolving

12/17/15, How have anti-evolution tactics evolved over time? They've gotten sneakier, Washington Post, https://www.washingtonpost.com/news/speaking-of-science/wp/2015/12/17/how-have-anti-evolution-tactics-evolved-over-time-theyve-gotten-sneakier/?wprss=rss_health-science

12/17/15, How anti-evolution legislation has evolved, Science 2.0, http://www.science20.com/news_articles/how_antievolution_legislation_has_evolved-162240

12/17/15, NIMBioS study shows ancestral relationships of modern creationist legislation, Tennessee Today, http://tntoday.utk.edu/2015/12/17/nimbios-study-shows-ancestral-relationships-modern-creationist-legislation/

12/17/15, How the fight to teach creationism in public schools has evolved, The Atlantic (City Lab), http://www.citylab.com/politics/2015/12/creationism-evolution-darwin-intelligent-design-public-school-science/420825/

12/17/15, How anti-evolution bills evolve, Science Codex, http://www.sciencecodex.com/how_antievolution_bills_evolve-172142

12/18/15, God versus nature debate continues between creationism and evolution, Web India, http://news.webindia123.com/news/Articles/India/20151218/2750090.html

1/5/16, NIMBioS: New methods help advance infectious disease forecasting, Tennessee Today, http://tntoday.utk.edu/2016/01/05/nimbios-methods-advance-infectious-disease-forecasting/

1/4/16, New model uses public health statistics to signal when disease elimination is imminent, UGA Today, http://news.uga.edu/releases/article/new-model-public-health-statistics-disease-elimination-0116/

1/4/16, New methods help advance infectious disease forecasting, NSF from the Field, https://www.nsf.gov/news/news_summ.jsp?cntn_id=137321&org=NSF&from=news

1/6/16, New methods help advance infectious disease forecasting, Science Codex, http://www.sciencecodex.com/new_methods_help_advance_infectious_disease_forecasting-172808

1/6/16, New methods help advance infectious disease forecasting, Science Newsline, http://www.sciencenewsline.com/news/2016010613520027.html

1/7/16, NIMBioS: Study reveals deep ties between diverse tropical rainforests, Tennessee Today, http://tntoday.utk.edu/2016/01/07/nimbios-study-reveals-deep-ties-diverse-tropical-rainforests/

1/7/16, Study reveals deep ties between diverse tropical rainforests, NSF News in the Field, https://www.nsf.gov/news/news_summ.jsp?cntn_id=137343&org=NSF&from=news

1/7/16, In rainforests, battle for sunlight shapes forest structure, Science Codex, http://www.sciencecodex.com/in_rainforests_battle_for_sunlight_shapes_forest_structure-172983

1/8/16, In rainforests, battle for sunlight shapes forest structure, Princeton Journal Watch, https://blogs.princeton.edu/research/2016/01/08/in-rainforests-battle-for-sunlight-shapes-forest-structure/

1/11/16, Study reveals deep ties between diverse tropical rainforests, NSF Science 360, http://news.science360.gov/archives/20160111/

1/25/16, NIMBioS: Study shows large variability in abundance of viruses that infect ocean microorganisms, Tennessee Today, http://tntoday.utk.edu/2016/01/25/nimbios-study-shows-large-variability-abundance-viruses-infect-ocean-microorganisms

1/25/16, Study shows large variability in abundance of viruses that infect ocean microorganisms, Georgia Tech College of Sciences,http://www.cos.gatech.edu/content/study-shows-large-variability-abundance-viruses-infect-ocean-microorganisms

2/03/16, Students honor Charles Darwin with Darwin Day birthday celebration, Tennessee Today, http://tntoday.utk.edu/2016/02/03/students-honor-charles-darwin-darwin-day-birthday-celebration/

2/16/16, Experts discuss likelihood of Zika virus in Knoxville, Knox News Sentinel, http://www.utdailybeacon.com/news/article_1ef03870-d464-11e5-8e5e-57904b2bbbb7.html

Addendum to NIMBioSAnnual Report

Sep 1, 2015 –Aug 31, 2016

Y8-6. NSF Budget Office Reporting Requirement: Institutions, Partners, Participants

NSF Budget Office Reporting Requirement: institutions, partners, participants

The NSF Budget Office requests information from all synthesis centers on number of participating institutions, partners, and participants where participating institutions includes all academic institutions that have faculty/staff or students who participated in a NIMBioS activity during the year; number of partners is the total number of non-academic participants, including those from industry, states, and other federal agencies; and number of participants is the total number of people who used NIMBioS facilities during the reporting period, not just those directly supported by NSF. Note that total participants does not include the many participants in educational activities, including K-12, because we do not track those participants individually.

Table 1 includes NIMBioS data from the previous two reporting periods (9/1/2013-8/31/2014 and 9/1/2014-8/31/2015) as well as data through April 30th, 2016 for the current reporting period. The NIMBioS Annual Report is submitted before 8/31/2016, the end of the reporting period, so data for the current reporting period only include the period from 9/1/2015-4/30/2016; they do not include projections for activities occurring between 5/1/2016-8/31/2016. Subsequent annual reports will include updated values for each previous reporting period.

Table 1. Number of participating institutions, partners, and participants at NIMBioS

Area	Academic institutions	Partners	Total participants
Reporting period 9/1/2013-8/31/2014	230	28 [b]	1123 (922 indiv.)
Reporting period 9/1/2014-8/31/2015	239	69 [c]	944 (751 indiv.)
Reporting period 9/1/2015-4/30/2016 [a]	190	42 [d]	630 (479 indiv.)

[a] Numbers reported here only include the period from 9/1/2015-4/30/2016; they do not include projections for activities occurring between 5/1/2016-8/31/2016.

[b] 10 business/industry, 9 federal, 8 non-profit, 1 state

[c] 16 business/industry, 28 federal, 24 non-profit, 1 state

[d] 2 business/industry, 24 federal, 6 non-profit, 10 other