



2015 Annual Report

National Institute for Mathematical and Biological Synthesis

Reporting Period September 2014 – August 2015

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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 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 utilize 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 on 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 which 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, 2014 through August 31, 2015, NIMBioS hosted (or will host this summer) 24 meetings of 18 different Working Groups, 9 Investigative Workshops, and 4 Tutorials. There are projected to be over 860 participants in NIMBioS-hosted activities during this period with 14

Postdoctoral Fellows in residence, and 40 Short-term Visitors.

The Working Groups meeting during this period were: Modeling Antimicrobial Resistance Intervention (September 2014, February 2015), Hierarchy and Leadership (October 2014), Dynamic Energy Budget Models for Trees (October 2014, June 2015), Plant-Soil Feedback Theory (November 2014, May 2015), Nonautonomous Systems and Terrestrial C-cycle (November 2014, July 2015), Evolutionary Approaches to Sustainability (November 2014), Expanding Data Nuggets (January 2015), "Pretty Darn Good Control: Extensions of Optimal Control for Ecological Systems (January 2015), Habitat for Migratory Species (January 2015, July 2015), Evolution of Institutions (February 2015, May 2015), Vector Movement and Disease (March 2015), Leptospirosis Modeling (April 2015), Climate Proxies (April 2015), Biotic Interactions (May 2015), Dispersal Biogeography (May 2015), Climate Change and Vector-borne Disease (June 2015), Computational Landscape Genomics (June 2015), and Ecological Network Dynamics (June 2015).

The Investigative Workshops were: Heart Rhythm Disorders (December 2014), Lymphoid Cells in Acute Inflammation (January 2015), Olfactory Modeling (March 2015), Neurobiology of Expertise (March 2015), Information and Entropy in Biological Systems (April 2015), Malaria-Leishmania Co-infection (May 2015), Research Collaboration for Women in Mathematical Biology (June 2015), Many-cell System Modeling (July 2015), and Computational Advances in Microbiome Research (July 2015).

The Tutorials were: Using R for HPC (February 2015), Current Issues in Statistical Ecology (April 2015), BioQUEST Biology by Numbers: Bringing Math to the High School Biology Classroom (July 2015), and Evolutionary Quantitative Genetics (August 2015).

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. This collaboration resulted in the Tutorial on Using R for High Performance Computing, which included 28 local participants but also attracted 387 virtual participants.

Demographics data on all participants are available for events from September 1, 2014 through March 31, 2015 and are presented in detail in the NIMBioS Evaluation Report (see section Y7-2 of the attached addendum to this Annual Report) and summarized below. There were 496 participants through March 31, 2015 from 24 countries and 39 U.S. states as well as the District of Columbia representing 190 different institutions. International participants amounted to 19% of all participants. Most participants were college or university faculty (49%), but post-doctoral researchers (18%), undergraduates (11%), and graduate students (9%) accounted for a significant fraction of participants. Across all events female representation was 41%, 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, 2014 through March 31, 2015 were from 22 different institutions and collaborated with NIMBioS post-doctoral and sabbatical fellows, faculty from five University of Tennessee departments, and seven researchers external to NIMBioS/University Tennessee.

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 28 requests for Working Groups and Investigative Workshops, and recommending support of 12 of them. The Board also evaluated 58 requests for postdoctoral fellowships of which six were supported and three accepted offers. The Board recommended support for three 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. NIMBioS' teacher collaboration and math/biology curriculum programs, Junior Science and Humanities Symposium, and the Summer Research Experience (SRE) for undergraduates program (which includes two high school teachers this year) help participants gain the skills and make the connections between mathematics and biology that are a core component of the NIMBioS mission.

At other levels of experience, NIMBioS hosted a Summer Research Experience for undergraduates program which included undergraduates in math and biology fields from 15 different institutions, carrying out team research projects on five different topics including 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, and invasive species movements through global shipping routes. The emphasis on these projects is developing quantitative approaches to answering biological questions.

Examples of the influence of the NIMBioS SRE program include former participants who are now conducting doctoral research in systems biology at the Univ. of Oxford, in biostatistics at the Univ. of California, Los Angeles, in mathematical biology at the Univ. of Utah, among others. More information can be found here: <http://www.nimbios.org/wordpress/2015/04/23/nimbios-undergrads-where-are-they-now/>

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.

NIMBioS, Extreme Science and Engineering Discovery Environment (XSEDE), and the National Institute for Computational Science conducted a joint training in use of the R software package for high performance computing, introducing participants to debugging, profiling and performance analysis, optimization, foreign language APIs, and parallel programming with R. In addition to being presented to participants at NIMBioS, the tutorial was also livestreamed to over 380 virtual participants.

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 Research Workshop on Non-linear Dynamics in Biological Systems. NIMBioS supported five UT graduate students to carry out research in collaboration with NIMBioS post-docs and researchers and to provide assistance with specific programs. 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 9 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 five Post-doctoral Fellows who moved on from NIMBioS during this reporting period, one accepted a faculty position and four accepted new post-doctoral positions.

Significant Results: NIMBioS relies upon participants to self-report products that were derived from their participation in NIMBioS activities. There were a total of 315 products reported from the time of preparation of the Sept 2013 - Aug 2014 annual report (June 2014) and April 30, 2015, including 178 journal articles, 8 book chapters, 4 dissertations and theses, 9 software/netware, 96 presentations/posters, 6 grant requests, 2 data and research materials (e.g. cell lines, DNA probes, animal models), 2 educational aids or curricula, 1 class/seminar, and 9 meetings, workshops or symposiums were reported. 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 Y7-5 of the Addendum to this annual report.

NIMBioS-supported activities have resulted in publications in a broad range of topics as designated by ISI Web of Science categories. Ecology was the most common subject category, followed by Evolutionary Biology, Mathematical &

Computational Biology, Multidisciplinary Sciences, Biology, Genetics & Heredity, Zoology, Biochemistry & Molecular Biology, Biochemical Research Methods, and Applied Mathematics. Figure 1 (provided as an attached supporting file to this section) illustrates the diversity of scientific topics covered by working groups and workshops hosted by NIMBioS between September 1, 2014 and March 31, 2015 (more information on interpretation of this figure is available in the NIMBioS Evaluation Report, Section Y7-2 of the addendum to this annual report - see Figure 2 and associated text in Section Y7-2).

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 in the supporting file included with this section 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 (attached as a supporting file for this section). 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/biomedical sciences, mathematical sciences or social sciences, there are a number of participants from the 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, 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. This study seeks to answer the following questions:

- What are the patterns of change in the composition of Working Group participants over time?
- What do the patterns of connectedness look like among Working Group participants across disciplinary and geographic boundaries and over time?
- To what extent do the network characteristics and views of interdisciplinary research of Working Group members correlate with productivity?

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). NIMBioS participated in the second international gathering of synthesis centers, held in January 2015 at sDiv (German Centre for Integrative Biodiversity Research) in Leipzig, Germany and attended by representatives from synthesis centers from the United States, France, Australia, Germany and the United Kingdom. NIMBioS led discussion of center evaluation activities at this gathering, and has collaborated with other attendees in composing a perspectives paper on the benefits of center-scale activities to foster synthetic research submitted to Trends in Ecology and Evolution.

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

NIMBioS carries out extensive training and professional development activities. Detailed listing of activities during this reporting period are included in Section Y7-4 of the Annual Report Addendum. We summarize below activities focused on Graduate Students and Post-doctoral Fellows.

Graduate Students

During AY14-15, NIMBioS funded five UTK graduate student research fellowships using recovered F&A funds. These students represented three departments across campus (Mathematics, Ecology and Evolutionary Biology, and Electrical Engineering and Computer Science [EECS]). Four of the students were granted these awards based on an annual competitive application process. These students performed research in development and application of land-use models to decision-making in conservation ecology, development of analytical methods for estimation of extinction risk in plant-pollinator communities, 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. One of the NIMBioS Fellows, Austin Milt, successfully defended his PhD in Ecology and Evolutionary Biology during spring 2015. The EECS student was supported to assist in development and implementation of an administrative database for NIMBioS. The visiting graduate student fellowship program, which was implemented in AY13-14, supported one visiting student. In addition, seven graduate students participated in NIMBioS Working Groups, 23 in Investigative Workshops, and

four as Short-term Visitors.

Our tutorials provide training on specific research tools. An In-depth Introduction to Using R for HPC tutorial concentrated on using R software with high performance computing (February 2015). The graduate workshop/tutorial on Current Issues in Statistical Ecology brought together a diverse group of graduate students to teach them how to use computational resources for mathematical modeling and simulation of kinetic networks and networks in a spatial context and was co-organized by the Ecological Society of America SEEDS (Strategies for Ecology Education, Diversity and Sustainability) program and SAMSI (Statistical and Applied Mathematical Sciences Institute). The event was a workshop/tutorial mix with 40 graduate students attending presentations on key issues in statistical ecology, break-out sessions organized around participant questions, and two panels providing career opportunity and professional development advice (April 2015).

NIMBioS also cooperated with McGill University's Centre for Applied Mathematics in Bioscience and Medicine (CAMBAM), and the Mathematical Biosciences Institute (MBI) on the CAMBAM-MBI-NIMBioS summer school on Nonlinear Dynamics in Biological Systems for graduate students. This training workshop was held at McGill University (June 2015).

Post-doctoral Fellows

As of the time of writing, there are ten Post-doctoral Fellows in residence, and 26 Fellows have completed their fellowships. During this reporting period five Fellows will have finished and moved on to faculty positions or new post-doctoral 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 Professional Development Seminar series for the Fellows. It meets approximately monthly 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 concerned how new technologies are changing teaching, time management, finding funding sources for research, post-publication strategy, and choosing and managing a research team. Teams of Fellows and their mentors are involved in the design of some of these professional development sessions. Independently, the current cohort of Fellows have self-organized to create a new weekly workshopping environment in which they explore research ideas and challenges together and with the NIMBioS Graduate Research Assistants. 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 but one of our current Post-doctoral Fellows participated in ScienceLives by providing online profiles that required them to succinctly describe their work. These interviews are listed under Media Coverage as LiveScience profiles in Section Y7-5 of the Addendum to this Annual Report. 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. One of the NIMBioS Post-doctoral Fellows will serve as a mentor for undergraduates during the 2015 Summer Research Experiences for Undergraduates and Teachers program.

Undergraduates and teachers

Our Summer Research Experiences for Undergraduates and Teachers 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 2014) 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).

Our workshop, Biology by Numbers: Bringing Math to the High School Biology Classroom, featured hands-on experiences with inquiry activities that used real data, tools for graphing, and modeling. The focus audience was high school biology teachers, and the workshop was co-organized with BioQUEST (July 2015).

*** 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 2015, the website contained 1131 pages and 1125 pdf documents. Its performance is monitored regularly. For the three-month period ending April 1, 2015, unique visitors increased 15%, site visits increased 16%, and pageviews increased 11% compared to the previous year. For both periods, 62% of visitors were new, 38% returning. Table 2 and Figure 3 in the attached supporting file 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](http://www.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. The site is updated with new content on a daily basis.

Another key channel for disseminating information to NIMBioS communities of interest is the bi-monthly newsletter called "NIMBioS News." Each newsletter includes a science story, an education and outreach-related feature, a video from the library of NIMBioS-produced videos, and a listing of future educational and research opportunities. As of April 2015, there are currently more than 5,239 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 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.

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

*** 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.

During the previous reporting period NIMBioS initiated a program for Visiting Graduate Fellows. This program will continue to be expanded based upon demand during the next reporting period with Visiting Graduate Fellows to be in residence for periods of several weeks to months. This program has expanded our efforts to support graduate students from diverse institutions beyond our support for such students to participate in Investigative Workshop and Tutorial activities and as Short-term Visitors. Over the period of this program, we have supported five Fellows, and we will continue to advertise this program for visits for up to several months by graduate students interested in pursuing research with NIMBioS senior personnel, postdoctoral fellows or working group participants. These Visiting Graduate Fellows work on-site at NIMBioS. The program is designed to facilitate graduate student training while fostering research at the interface of mathematics and biology.

Supporting Files

Filename	Description	Uploaded By	Uploaded On
Fig_1_Accomplishments_WS_WG_cat_graph_yr7.pdf	Figure 1 - Diversity of scientific topics for Working Groups and Investigative Workshops	Colleen Jonsson	04/30/2015
Fig_2_Accomplishments_WG_cross-disciplinary_collab.pdf	Figure 2 - Cross-disciplinary connections among Working Group participants	Colleen Jonsson	04/30/2015
Figure_3_and_Table_2_Dissemination_sitevisits.pdf	Figure 3 - Website visits during period and from inception Table 2 - Website visits and unique visitors	Colleen Jonsson	04/30/2015
Table_1_Accomplishments_High_Impact_Journals.pdf	Table 1 - High-impact journal publications	Colleen Jonsson	04/30/2015

Table 1. Number of NIMBioS articles published in a selection of high-impact journals during the current reporting period (through April 2015) and since NIMBioS' inception, sorted by journal 5-Year Impact Factor

Journal Title	5-Year Impact Factor *	# of NIMBioS Publications in Year 7 **	# of NIMBioS Publications Since Inception ***
Nature	42.35	2	5
Cell	35.02	-	1
Science	34.46	-	5
Trends in Ecology and Evolution	18.99	-	5
Ecology Letters	17.79	-	8
Systematic Biology	14.22	2	5
PLoS Biology	12.81	-	2
Nature Communications	11.02	2	2
Proceedings of the National Academy of Sciences	10.73	3	15
Current Biology	10.23	-	1
PLoS Genetics	8.90	-	2
Nucleic Acids Research	8.38	1	3
Phil Trans of the Royal Soc B-Biological Sciences	7.96	2	4
Molecular Ecology	6.54	3	7
Ecology	6.37	1	6
Proc of the Royal Soc B-Biological Sciences	5.81	3	9
PLoS Computational Biology	5.67	1	6
Evolution	5.47	5	15
Journal of Animal Ecology	5.44	1	3
The American Naturalist	5.20	4	11
Journal of the Royal Society Interface	4.88	2	5
PLoS One	4.02	6	26
Animal Behaviour	3.50	3	7
BMC Bioinformatics	3.49	1	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: $\text{cites in year } n \text{ to articles published in year } (n-1 + n-2) / \text{number of articles published in year } (n-1 + n-2)$.

** Number of publications in Year 7 includes all publications reported since compilation of the previous Annual Report (June 2014) through April 2015.

*** September 2008 – April 2015

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 - Mar 31, 2015*	48983	76826

*Partial year

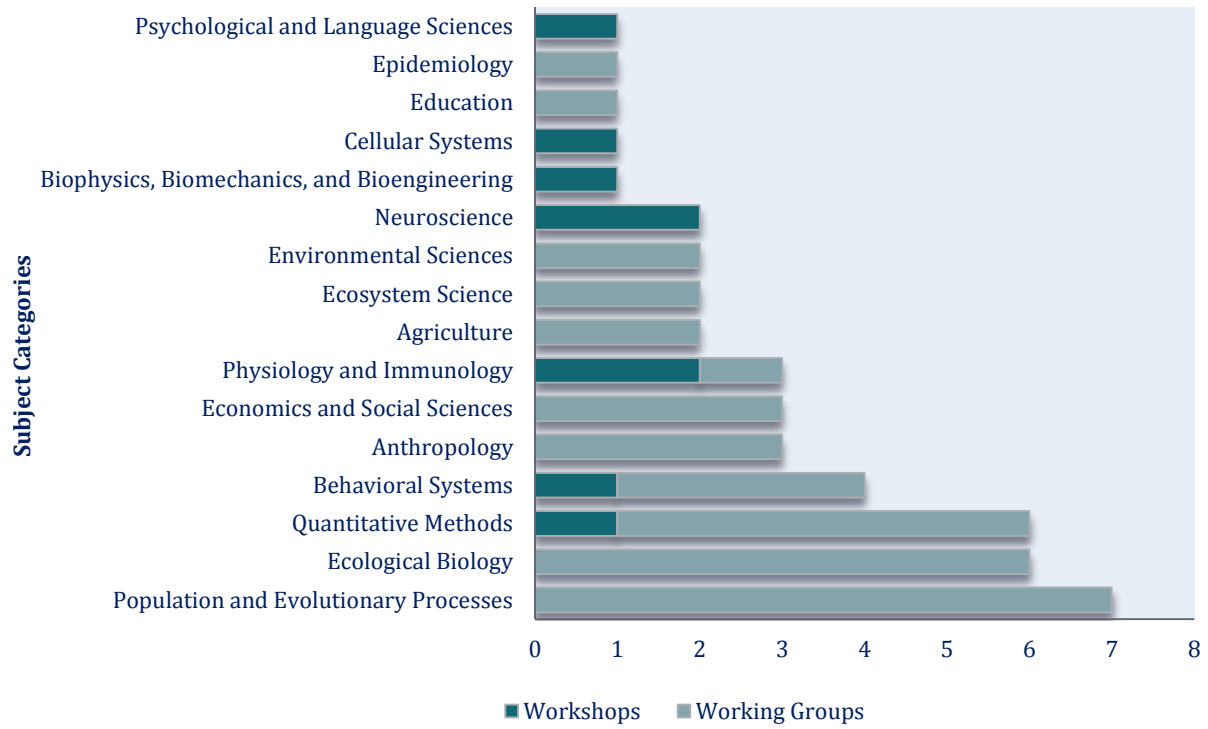


Figure 1. Diversity of scientific topics represented in NIMBioS Working Groups and Investigative Workshops during the period from September 1, 2014 – March 31, 2015.

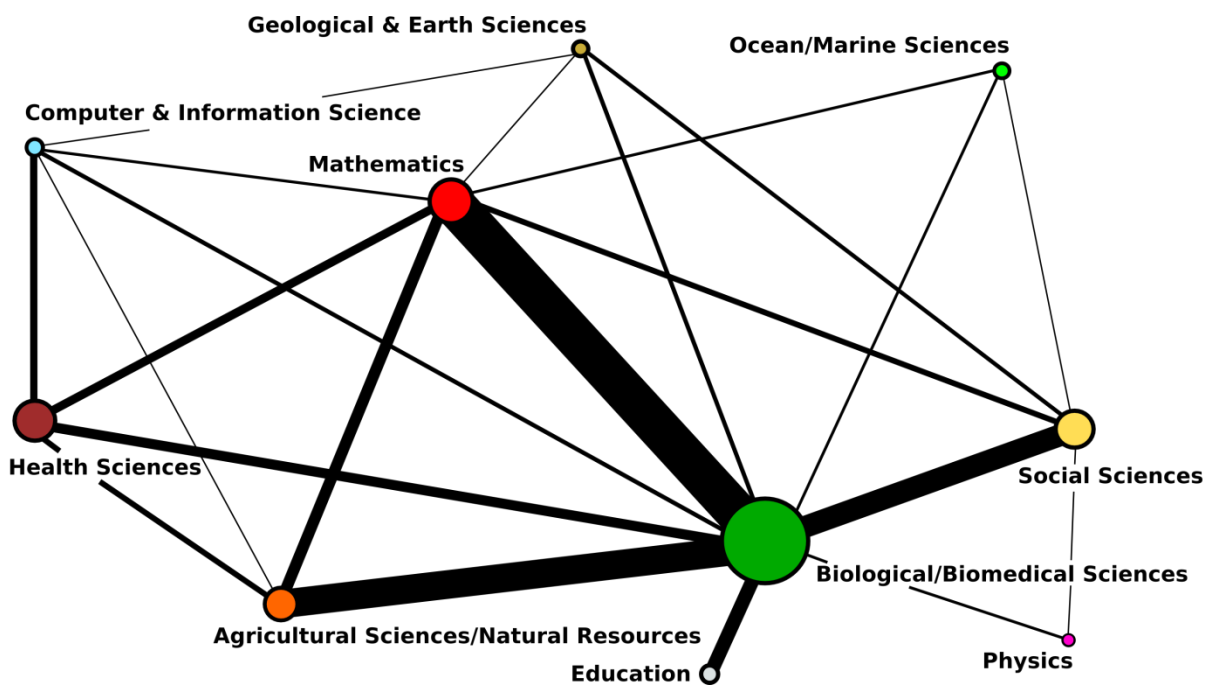
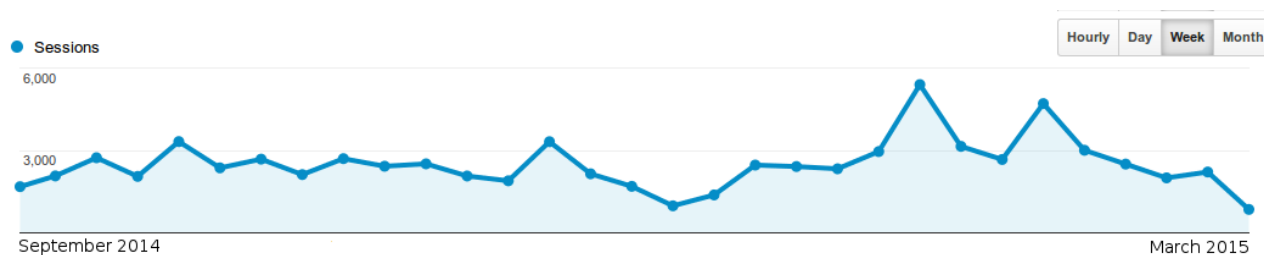


Figure 2. Cross-disciplinary connections fostered among Working Group members through meetings hosted at NIMBioS from September 1, 2014 through March 31, 2015. Node radius is representative of the log-scaled number of participants in each field of study. Line size is representative of the number of times researchers from each field were brought together to collaborate and problem-solve at NIMBioS.

(a)



(b)

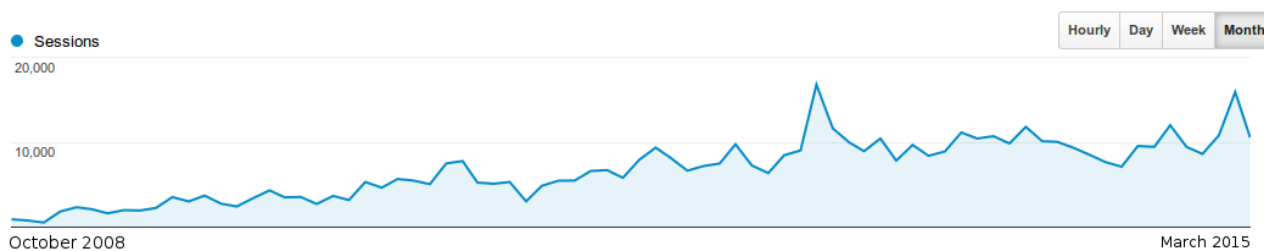


Figure 3. Number of *nimbios.org* website visits for (a) the 2015 reporting year (weekly, September 1, 2014 through March 31, 2015) and (b) monthly for the period October 1, 2008 through March 31, 2015. The peaks in Figure 3 (a) show the impact of significant products on the number of website visits 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).

Products

Books

Book Chapters

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Conference Papers and Presentations

Inventions

Journals

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Mallela A. 2015 January. Joint Mathematics Meetings hosted by AMS and MAA: Topics in Analysis, II, Henry B. Gonzalez Convention Center, San Antonio, TX.

Meeting/Workshop.

Martinez AT et al. 2014 April 16-18. Network for integrating bioinformatics into life sciences education agenda, Omaha, Nebraska.

Meeting/Workshop.

Weedermann M. 2014 May. Dynamic Obesity Prevalence, 1st Short Course on Mathematical Sciences in Obesity

Research, University of Alabama.

Poster.

Auerbach J, Burghardt G. 2014 June. To play, or not to play, that's a resource abundance question. Evolution 2014, Raleigh, NC.

Poster.

Iacona GD, Bode M, Armsworth PR. 2013 July. Measuring the effectiveness of funding biodiversity conservation using a game. Society for Conservation Biology International Conference for Conservation Biology, Baltimore MD.

Poster.

Magombedze G. 2014 April 7-11. Poster: Within cell dynamics: Gene regulatory mechanisms in Mycobacterial tuberculosis latency infection. Within Host Dynamics to the Epidemiology of Infectious Diseases workshop at MBI, OH.

Presentation.

Aguilar C. 2014 July. Prediction and rule extraction of major histocompatibility complex class II epitopes by logic minimization. 14th International Conference on Bioinformatics and Computational Biology.

Presentation.

Auerbach J, Gavrilets S, van Vugt M. 2014 June. Fairness and wisdom: The emergence of leadership. Evolution 2014, Raleigh, NC.

Presentation.

Auerbach J. 2014. Knowledge and fairness: Leadership through reputation. Advanced Research and Methods Seminar, U.S. Government Accountability Office.

Presentation.

Axelrod DE. 2014 September 15-19. Stem Cell Dynamics in the Microenvironment of Normal Colon Crypts, and the Initiation, Progression and Therapy of Colon Cancer. Invited Plenary Talk. Ecology and Evolution of Cancer Workshop, Mathematical Biosciences Institute, Ohio State University, Columbus, OH.

Presentation.

Beaulieu JM. 2013 June. Identifying hidden rate changes in the evolution of a binary morphological character. Evolution, Snowbird, UT.

Presentation.

Beaulieu JM. 2013 October. Exploring the evolution of a very old and widespread angiosperm clade. 60th Systematics Symposium, St. Louis, MO.

Presentation.

Beaulieu JM. 2014 July. Exploring heterogeneity in binary character evolution. Botany 2014, Boise, ID.

Presentation.

Beaulieu JM. 2014 June. Estimating how contemporary taxa will evolve in the future, to understand how island communities were assembled in the past. Evolution, Raleigh, NC.

Presentation.

Beaulieu JM. 2014. Invited Seminar. Department of Botany, Field Museum of Natural History in Chicago, IL.

Presentation.

Beaulieu JM. 2014. Invited Seminar. Department of EEOB, Iowa State University.

Presentation.

Beaulieu JM. 2014. Invited Seminar. Department of Ecology and Evolutionary Biology, Yale University.

Presentation.

Beaulieu JM. 2014. Invited Seminar. Department of OEB and HUH, Harvard University.

Presentation.

Bulger D, Geyer K, Trask J (2010). Biodiversity in the Great Smoky Mountains National Park: Past and present measures. 2010 Undergraduate Research Conference at the Interface of Biology and Mathematics. Knoxville, TN.

Presentation.

Dillon J, Li W, Perez A (2012). Modeling protein translation and genome evolution. University of Tennessee, Knoxville, TN.

Presentation.

Dutkosky R, Newkirk K, Reeder D, Ramsay E, Souza M. 2012 December. Evaluation of a terbinafine impregnated subcutaneous implant in *Geomyces destructans*-infected bats. Annual Conference of the American College of Veterinary Pathologists, Seattle, WA.

Presentation.

Earl JE. 2014 June. Animals as ecosystem connectors: Does their movement path matter?. Biomath Program, Fisk University, Nashville, TN.

Presentation.

Feng Z (2013). A mathematical model for coupling within-host and between-host dynamics in an environmentally-driven infectious disease. MBI Workshop: From Within Host Dynamics to the Epidemiology of Infectious Disease. Ohio State University.

Presentation.

Ferguson J. 2014 November 4. Stochastic models of populations in fluctuating environments. NIMBioS Seminar Series, NIMBioS, University of Tennessee, Knoxville, TN.

Presentation.

Gross L. 2014 April. Space, control and disease. Distinguished Lecturer, Centre for Disease Modelling, York University, Toronto, Canada.

Presentation.

Gross L. 2014 August. Alan as a friend and colleague. Symposium in Honor of Alan Hasting's 60th Birthday, University of California, Davis, CA.

Presentation.

Gross L. 2014 August. Global controls on the distribution of savannas: Discrete and continuous environmental factor impacts. Annual Meeting of the Ecological Society of America, Sacramento, CA.

Presentation.

Gross L. 2014 August. Overview of mathematical approaches to resilience, stability and transitions with particular application to savanna systems. Opening Workshop for the Year in Mathematical and Statistical Ecology, Statistical and Applied Mathematical Sciences Institute, Durham, NC.

Presentation.

Gross L. 2014 August. Quantitative undergraduate ecology education and the "rule-of-five". Annual Meeting of the Ecological Society of America, Sacramento, CA.

Presentation.

Gross L. 2014 August. Simon as a Mensch: Educating and mentoring the world of mathematical biology. Symposium for Naming of Simon A. Levin Center Mathematical Computation and Modeling Center, Arizona State University, Phoenix, AZ.

Presentation.

Gross L. 2014 February. "Best" in a biological context: Optimization across the biological hierarchy. Lyceum Speaker, Emory and Henry College, VA.

Presentation.

Gross L. 2014 January. Fires, forests and savannas: Alternative modeling approaches for theory and practice. Distinguished Lecture, Mathematics Department, Arizona State University, Phoenix, AZ.

Presentation.

Gross L. 2014 March. Math, disease and 100 important questions facing plant biology research. Investigative Workshop on Plant Viral Disease, NIMBioS, Knoxville, TN.

Presentation.

Gross L. 2014 March. Perambulations around biology, control and education with Suzanne. Symposium on Math Ecology and Control in Honor of Suzanne Lenhart, American Mathematical Society Sectional Meeting, Knoxville,

TN.

Presentation.

Gross L. 2014 May. Panel presentation on quantitative biology education. Symposium on Mathematical Biology in the Undergraduate Curriculum, Fields Institute for Research in Mathematical Sciences, University of Toronto, Toronto, Canada.

Presentation.

Gross L. 2015 February. Biology as a driver for undergraduate quantitative sciences education. Invited Panel Speaker, Meeting on Transforming Post-Secondary Education in Mathematics, Institute for Pure and Applied Mathematics, Los Angeles, CA.

Presentation.

Gross L. 2015 February. Data-driven discovery and approaches to model evaluation. Data Science Seminar Series, National Institute of Environmental Health Sciences, Research Triangle Park, NC.

Presentation.

Gross L. 2015 February. Educating a "fearless" biologist in a data-driven world. Seminar Series, Center for Education Innovation in Life Science, University of California, Los Angeles, CA.

Presentation.

Gross L. 2015 February. Quantitative education for "fearless" life science graduate students. Symposium on Graduate Education in Quantitative Biology, AAAS Annual Meeting, San Jose, CA.

Presentation.

Gross L. 2015 January. Preparing "fearless" biologists: Quantitative components for undergraduate life scientists. Symposium on Leading Students and Faculty to Quantitative Biology Through Active Learning, Annual Meeting of the Society for Integrative and Comparative Biology, West.

Presentation.

Gross L. 2015 March. "Best" in a biological context: Optimization across the biological hierarchy. Mathematical Biology Seminar, University of Kentucky, Lexington, KY.

Presentation.

Gurarie D, Ganusov V, Karl S, King CH. 2014 November 2-6. Population biology and immune selection for multi-strain malaria: Modeling approach. The American Society of Tropical Medicine and Hygiene 63rd Annual Meeting, New Orleans, LA.

Presentation.

Hoban S. 2014 August. Using microsatellites and Approximate Bayesian Computation to describe biological invasions. Invasion Genetics Symposium, the Baker and Stebbins Legacy, Asilomar, CA.

Presentation.

Hoban S. 2014 July. Optimal sampling of plant populations for ex-situ conservation of genetic biodiversity. Invited Symposium Speaker, Botany, Boise, ID.

Presentation.

Hoban S. 2014 June. Optimal sampling of plant populations for ex-situ conservation of genetic biodiversity. Evolution, Raleigh, NC.

Presentation.

Hoban S. 2014 November. How to improve sampling protocols in conservation genetics. Invited Speaker, Dept of Biology, College of Charleston, Charleston, SC.

Presentation.

Hoban S. 2014 November. Saving seeds: Improving the effectiveness of ex situ collections. Rancho Santa Ana Botanic Gardens, Claremont, CA.

Presentation.

Hoban S. 2014 October. Saving seeds: Improving the effectiveness of ex situ collections. Invited Speaker, USDA National Seed Lab, Ft. Collins, CO.

Presentation.

Hoban S. 2015 April. How to improve the effectiveness of sampling protocols for ex situ conservation seed collections. National Native Seed Conference, Santa Fe, NM.

Presentation.

Hoban S. January 2015. Improving the effectiveness of ex situ seed sampling.

Presentation.

Hritonenko N, Yatsenko YU, Goetz R. 2012 January. The environmental impact on sustainable forest management. American Mathematical Society, Boston, MA.

Presentation.

Hritonenko N, Yatsenko YU. 2012 May 30 - June 2. Generalized functions in qualitative analysis of population control problems. 12th Viennese Workshop on Optimal Control, Dynamic Games and Nonlinear Dynamics, Vienna, Austria.

Presentation.

Hritonenko N. 2013 February 25. Sustainable development in biological and environmental systems. TAMU, College Station, PVAMU, Prairie View, NSF-UBM-Colloquium.

Presentation.

Iacona GD, Bode M, Armsworth PR. 2013 August. Modeling the effectiveness of funding biodiversity protection as a multiplayer game. INTECOL, London, UK.

Presentation.

Iacona GD, Price FD, Armsworth PR. 2014 December. Predicting invadedness on protected areas. Invited webinar for Conservation Biology Institute.

Presentation.

Iacona GD, Price FD, Armsworth PR. 2014 October. Predicting invadedness on protected areas. Invited webinar for Nature Serve.

Presentation.

Ilany A. 2014 August. Multiple factors affect social network dynamics in a wild spotted hyena population. 51st Annual Conference of the Animal Behavior Society, Princeton University.

Presentation.

Ilany A. 2014 June. How do animals choose their allies? Stochastic actor-based models reveal long term social network dynamics in a wild mammal population. Statistical Inference for Network Model, a NetSci 2014 Satellite Symposium, University of California, Berkeley.

Presentation.

Ilany A. 2014 May. Static and dynamic social network in hyrax and hyena. Dept. of Ecology and Evolutionary Biology, Princeton University.

Presentation.

Ilany A. 2014 May. Static and dynamic social network in hyrax and hyena. Dept. of Ecology, Evolution and Natural Resources, Rutgers University.

Presentation.

Jenkins K. 2015 March 7. Presenting Data Nuggets at the Wisconsin Society of Science Teachers meeting.

Presentation.

Krishna N. 2014 September. Tackling tuberculosis with mathematics: A summer research experience for undergraduates. Mathematics Colloquium, Western Kentucky University.

Presentation.

Langlais M. 2013 August. Spatial spread of a multi-stage parasite through a fragmented landscape. Models in Population Dynamics and Ecology, International Conference, Osnabrueck University, Germany.

Presentation.

Langlais M. 2013 June 4. Predator-prey system within a spatially fragmented environment. North University of

China, Taiyuan Shanxi PRC.

Presentation.

Lenhart S. 2014 April 12. Research, education and outreach at the interface of mathematics and biology. Plenary Talk, Math Alumni Day, Univ. of Kentucky, Lexington, KY.

Presentation.

Lenhart S. 2014 December 20. Modeling Johne's Disease in dairy cattle. Plenary Talk, Workshop on Mathematical Biology and Nonlinear Analysis, Univ. of Miami.

Presentation.

Lenhart S. 2014 November 26. Modeling Johne's Disease in dairy cattle. Plenary Talk, Southern Africa Mathematical Sciences Association Meeting, Victoria Falls, Zimbabwe.

Presentation.

Lenhart S. 2014 October 24. Modeling Johne's Disease in dairy cattle. Plenary Talk, Mississippi State Conference on Differential Equations and Computational Simulations, Mississippi State Univ.

Presentation.

Lenhart S. 2015 February 13. Modeling Johne's Disease in dairy cattle. Colloquium Talk, Univ. of Texas, El Paso, TX.

Presentation.

Lenhart S. 2015 February 27. Modeling Johne's Disease in dairy cattle. Colloquium Talk, Arizona State Univ.

Presentation.

Lenhart S. 2015 March 17. Research, education and outreach at the interface of mathematics and biology. Colloquium Talk, Univ. of Tennessee, Chattanooga, TN.

Presentation.

Lenhart S. 2015 March 2. Modeling Johne's Disease in dairy cattle. Colloquium Talk, Univ. of California, Irvine, CA.

Presentation.

Lenhart S. 26 November 2014. Modeling Johne's Disease in dairy cattle.

Presentation.

Magombedze G. 2013 November 1. Evaluation of the current Johne's disease transmission and persistence paradigm using a mathematical model. Field of Dreams Conference, Phoenix, AZ.

Presentation.

Magombedze G. 2013 October 1-6. Modeling the immune response of cattle infected with Johne's Disease. SACNAS Conference, San Antonio, TX.

Presentation.

Magombedze G. 2013 October 19. Mathematical modelling of the Th1/Th2 immune response in Mycobacterium avium subspecies paratuberculosis infection in ruminants. MDA Annual Conference, San Diego, CA.

Presentation.

Magombedze G. 2014 February 28. Mathematical modeling of the within cell and within host dynamics of Mycobacterial infections. University of Notre Dame, IN.

Presentation.

Magombedze G. 2014 March 13. Mathematical modeling of immunological and molecular biological process in Mycobacterial infections. City University of New York, New York, NY.

Presentation.

Mallela A. 2015 January 13. Optimal treatment program for HIV-TB co-infected populations: A mathematical model. Joint Mathematics Meeting, San Antonio, TX.

Presentation.

Meyer K, Houle D (2013). Sampling based approximation of confidence intervals for functions of genetic covariance matrices. Proceedings from the 20th Conference of the Association for the Advancement of Animal Breeding and Genetics.

Presentation.

Perminov V. 2014 December 1. Agent-based models and ill-posed problems. Keynote, 8th International Conference on Bio-inspired Information and Communications Technologies, Boston, MA. <http://bionetics.org/2014/show/keynotes>

Presentation.

Remien CH. 2013 October. Uncovering mysteries with mathematical models of biological markers. Applied Math Seminar, Tennessee State Univ., Nashville, TN.

Presentation.

Remien CH. 2013 September. Uncovering mysteries with mathematical models of biological markers. Invited Seminar, College of Math and Science, Univ. of Central Oklahoma, Edmond, OK.

Presentation.

Remien CH. 2014 August. Deconvolution of isotope signals mixed from sampling bundles of multiple hairs. SIAM Conference on the Life Sciences, Charlotte, NC.

Presentation.

Remien CH. 2014 February. Mathematical models of biological markers. Middlebury College.

Presentation.

Remien CH. 2014 February. Mathematical models of biological markers. Utah State Univ.

Presentation.

Remien CH. 2014 January. Mathematical models of biological markers. North Carolina State Univ., Raleigh, NC.

Presentation.

Remien CH. 2014 January. Mathematical models of biological markers. Univ. of Idaho.

Presentation.

Ryan D (2011). Modeling avoidance strategies for intraguild prey - Cross-diffusion PDE systems. Differential Equations and Computational Math Seminar. University of Tennessee, Knoxville, TN.

Presentation.

Ryan D (2012). A cross-diffusion model for avoidance behavior in an intraguild predation community. 9th AIMS Conference on Dynamical Systems, Differential Equations and Applications. Orlando, FL.

Presentation.

Ryan D (2012). A cross-diffusion model for avoidance behavior in an intraguild predation community. Annual Meeting of the Society for Mathematical Biology. Knoxville, TN.

Presentation.

Ryan D (2012). Numerical solution of optimal control problems. NIMBioS Seminar. University of Tennessee, Knoxville, TN.

Presentation.

Ryan D. 2013 March 1. An introduction to deep learning. Biomedical Engineering Student Seminar on Machine

Learning, University of Tennessee, Knoxville, TN.

Presentation.

Ryan D. 2013 May 23. Prediction of ICU in-hospital mortality using a deep Boltzmann machine and dropout neural net. ORNL Biomedical Sciences and Engineering Conference.

Presentation.

Ryan D. 2014 May 22. Deriving discrete adjoint equations for the numerical solution of optimal control. NIMBioS Seminar, University of Tennessee, Knoxville, TN.

Presentation.

Shaefer K, Noecker C, Zaccheo, Ganusov V, Day J, Yang Y (2012). Modeling of early SIV/HIV infection. Celebration of Undergraduate Scholarship. Valparaiso University.

Presentation.

Souza MJ, Reeder D, Hines B, Dutkosky R, Ramsay E, Cairns T, Newkirk K, Cox S. 2013 September 3-6. Investigation of a terbinafine impregnated subcutaneous implant for the prevention or treatment of white nose syndrome in little brown bats (*Myotis lucifugus*). White Syndrome Symposium, Boise, ID.

Presentation.

Souza MJ, Yarbrough JW, Cox SK. 2012 June. In vitro investigation of a terbinafine impregnated subcutaneous implant. White nose syndrome symposium, Little Rock, AR.

Presentation.

Souza MJ. 2012 June. Evaluation of a terbinafine impregnated implant for the prevention of white nose syndrome. White nose syndrome symposium, Madison, WI.

Other Publications

Patents

Technologies or Techniques

Thesis/Dissertations

Grunloh NR. *A stochastic dynamic model of the behavioral ecology of play*. (2013). University of California, Santa Cruz. 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

Yang Y. *Senior Thesis: The Kalman filter combined with Hungarian algorithm successfully tracked fast moving peroxisomes.* (2012). Beloit College. 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

Participants/Organizations

What individuals have worked on the project?

Name	Most Senior Project Role	Nearest Person Month Worked
Jonsson, Colleen	PD/PI	6
Gross, Louis	Co PD/PI	7
Gavrilets, Sergey	Co-Investigator	3
Lenhart, Suzanne	Co-Investigator	4
Armsworth, Paul	Faculty	2
Brothers, Ernest	Faculty	3
Buchan, Alison	Faculty	2
Day, Judy	Faculty	2
Eda, Shige	Faculty	1
Ganusov, Vitaly	Faculty	1
Maroulas, Vasileios	Faculty	2
Price, Charles	Faculty	3
Riechert, Sue	Faculty	2
Simberloff, Dan	Faculty	1
Wilkes, Rebecca	Faculty	1
Dantzler, Ashley	K-12 Teacher	2
Sirek, Nick	K-12 Teacher	2

Name	Most Senior Project Role	Nearest Person Month Worked
Aguilar, Clemente	Postdoctoral (scholar, fellow or other postdoctoral position)	3
Beaulieu, Jeremy	Postdoctoral (scholar, fellow or other postdoctoral position)	4
Farrior, Caroline	Postdoctoral (scholar, fellow or other postdoctoral position)	12
Ferguson, Jake	Postdoctoral (scholar, fellow or other postdoctoral position)	12
Hoban, Sean	Postdoctoral (scholar, fellow or other postdoctoral position)	12
Hobson, Elizabeth	Postdoctoral (scholar, fellow or other postdoctoral position)	12
Ilany, Amiyaal	Postdoctoral (scholar, fellow or other postdoctoral position)	4
Johnson, Nels	Postdoctoral (scholar, fellow or other postdoctoral position)	2
Kawano, Sandy	Postdoctoral (scholar, fellow or other postdoctoral position)	12
Matzke, Nicholas	Postdoctoral (scholar, fellow or other postdoctoral position)	9
O'Regan, Suzanne	Postdoctoral (scholar, fellow or other postdoctoral position)	8
Peace, Angela	Postdoctoral (scholar, fellow or other postdoctoral position)	11
Sqouralis, Ioannis	Postdoctoral (scholar, fellow or other postdoctoral position)	12
Zefferman, Mathew	Postdoctoral (scholar, fellow or other postdoctoral position)	12
Carr, Eric	Other Professional	12

Name	Most Senior Project Role	Nearest Person Month Worked
Comiskey, Jane	Other Professional	12
Eskridge, Chandra	Other Professional	12
Koosman, Toby	Other Professional	12
Peek, Mike	Other Professional	11
Richters, Ana	Other Professional	12
Spar, Jennifer	Other Professional	12
Sturner, Kelly	Other Professional	12
Bishop, Pam	Staff Scientist (doctoral level)	11
Crawley, Catherine	Staff Scientist (doctoral level)	12
Welsh, Chris	Staff Scientist (doctoral level)	12
Bintz, Jason	Graduate Student (research assistant)	5
Dumoulin, Christine	Graduate Student (research assistant)	5
Levy, Benjamin	Graduate Student (research assistant)	5
Martin, John	Graduate Student (research assistant)	6
Milt, Austin	Graduate Student (research assistant)	5
Balthrop, Lindsey	Undergraduate Student	2
Denison, Elizabeth	Undergraduate Student	2
Parkman, Virginia	Undergraduate Student	2
Bedell, Mariel	Research Experience for Undergraduates (REU) Participant	2
Gauli, Ashish	Research Experience for Undergraduates (REU) Participant	2

Name	Most Senior Project Role	Nearest Person Month Worked
Hujoel, Margaux	Research Experience for Undergraduates (REU) Participant	2
Johnson, Talon	Research Experience for Undergraduates (REU) Participant	2
Khanal, Januka	Research Experience for Undergraduates (REU) Participant	2
Lin, Yilin	Research Experience for Undergraduates (REU) Participant	2
Mummah, Riley	Research Experience for Undergraduates (REU) Participant	2
Rohly, Michael	Research Experience for Undergraduates (REU) Participant	2
Roman-Melendez, Emmie	Research Experience for Undergraduates (REU) Participant	2
Sashidar, Diya	Research Experience for Undergraduates (REU) Participant	2
Wei, Jinchuan	Research Experience for Undergraduates (REU) Participant	2
Wikle, Nathan	Research Experience for Undergraduates (REU) Participant	2
Wild, Ayana	Research Experience for Undergraduates (REU) Participant	2
Yan, Ryan	Research Experience for Undergraduates (REU) Participant	2

Full details of individuals who have worked on the project:

Colleen Jonsson

Email: cjonsson@nimbios.org

Most Senior Project Role: PD/PI

Nearest Person Month Worked: 6

Contribution to the Project: Dr. Jonsson is the NIMBioS Director effective 12/22/14. She supervises and

coordinates all activities, including hiring staff, coordinating activities of the Associate Directors, interacting with the Advisory Board, communicating the mission of NIMBioS to numerous institutions through formal and informal presentations, and developing relationships with leaders of other NSF BIO Centers.

Funding Support: University of Tennessee; NIH

International Collaboration: Yes, Paraguay

International Travel: Yes, Germany - 0 years, 0 months, 4 days

Louis J Gross

Email: gross@NIMBioS.org

Most Senior Project Role: Co PD/PI

Nearest Person Month Worked: 7

Contribution to the Project: Dr. Gross was NIMBioS Director through December 2014, handling all responsibilities associated with the position. He now serves as Director Emeritus, working with Director Jonsson and the NIMBioS Leadership Team on future planning. He organized the Graduate Workshop on Current Issues in Statistical Ecology (April 2015) and is a mentor for the 2015 Summer Research Experience for Undergraduates Program.

Funding Support: University of Tennessee

International Collaboration: Yes, Australia, China

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 is co-organizer of an active working group on Hierarchy and Leadership and participant in working groups on The Evolutionary Origins of Complex Institutions and Evolutionary Approaches to Sustainability. He is a mentor for NIMBioS post-docs Amiyaal Ilany and Matt Zimmerman and was a member of the Director Search Committee.

Funding Support: University of Tennessee

International Collaboration: Yes, Russian Federation, Sweden, Switzerland, United Kingdom

International Travel: Yes, Russian Federation - 0 years, 0 months, 10 days; United Kingdom - 0 years, 0 months, 7 days; Switzerland - 0 years, 0 months, 7 days; Sweden - 0 years, 0 months, 7 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 2015 Summer Research Experience for Undergraduates, and was also a member of the Director search committee.

Funding Support: University of Tennessee

International Collaboration: Yes, Argentina, Japan, Mexico, Netherlands, Tanzania, United Republic Of
International Travel: No

Paul Armsworth

Email: parmsworth@nimbios.org

Most Senior Project Role: Faculty

Nearest Person Month Worked: 2

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, United Kingdom
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. He was also a member of the Director search committee.

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 graduate research assistants as well as the Visiting Graduate Fellow program.

Funding Support: University of Tennessee

International Collaboration: Yes, Canada, Denmark, Norway

International Travel: No

Judy Day

Email: judyday@utk.edu

Most Senior Project Role: Faculty

Nearest Person Month Worked: 2

Contribution to the Project: Dr. Day is an Assistant Professor in the Department of Mathematics at the University of Tennessee. She is a mentor for post-docs Suzanne O'Regan and Angie Peace and is mentoring a Summer Research Experience group.

Funding Support: University of Tennessee

International Collaboration: Yes, India

International Travel: No

Shige Eda

Email: seda@utk.edu

Most Senior Project Role: Faculty

Nearest Person Month Worked: 1

Contribution to the Project: Dr. Eda (Associate Professor in Forestry, Wildlife, & Fisheries at the University of Tennessee) is one of the Senior NIMBioS Personnel. He is a mentor for the summer 2015 SRE program.

Funding Support: University of Tennessee

International Collaboration: Yes, Denmark, Japan, United Kingdom

International Travel: No

Vitaly Ganusov

Email: vitaly@utk.edu

Most Senior Project Role: Faculty

Nearest Person Month Worked: 1

Contribution to the Project: Dr. Ganusov (Assistant Professor, Microbiology) is one of the Senior NIMBioS Personnel. He served as a mentor for NIMBioS post-doc Clemente Aguilar, and a mentor for the 2015 Summer Research Experience program.

Funding Support: University of Tennessee

International Collaboration: Yes, Australia, Germany, Netherlands

International Travel: No

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, Hong Kong, Macau, Taiwan

International Travel: No

Charles A. Price

Email: charles.price@uwa.edu.au

Most Senior Project Role: Faculty

Nearest Person Month Worked: 3

Contribution to the Project: Dr. Price begins his NIMBioS sabbatical fellowship in June 2015. During his 12-month fellowship he will be working 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

Dan Simberloff

Email: tebo@utk.edu

Most Senior Project Role: Faculty

Nearest Person Month Worked: 1

Contribution to the Project: Dr. Simberloff is Professor of Ecology and Evolutionary Biology. He is serving as mentor for postdoctoral fellow Nick Matzke and mentor for the Summer Research Experience program.

Funding Support: University of Tennessee

International Collaboration: Yes, Italy, Canada

International Travel: No

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
DIMACS-Center for Discrete Mathematics & Theoret. Comp. Sci.	Academic Institution	Rutgers University
Ecological Society of America	Other Nonprofits	Washington, D.C.
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 Hughes Medical Institute	Other Nonprofits	Chevy Chase, MD
Howard University	Academic Institution	Washington, D.C.
Institute of Biomedical Engineering	Academic Institution	University of Tennessee
AIBS-American Institute of Biological Sciences	Academic Institution	Reston, VA
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

Name	Type of Partner Organization	Location
NEON-National Ecological Observatory Network, Inc.	Academic Institution	Boulder, CO
NESCent-National Evolutionary Synthesis Center	Academic Institution	Durham, NC
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
North Carolina A&T University	Academic Institution	Greensboro, NC
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
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

Name	Type of Partner Organization	Location
SIAM-Society for Industrial and Applied Mathematics	Academic Institution	Philadelphia, PA
American Society of Naturalists	Other Nonprofits	University of Chicago
SMB-Society for Mathematical Biology	Academic Institution	international
TN-SCORE (Tennessee Solar Conversion and Storage using Outre	Academic Institution	Knoxville, TN
Tennessee Ornithological Society	Other Nonprofits	Clinton, TN
Tennessee Science Teachers Association	Other Nonprofits	Tennessee
Tennessee State University	Academic Institution	Nashville, TN
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
University of the Virgin Islands	Academic Institution	U.S. Virgin Islands
BioQUEST Curriculum Consortium	Other Nonprofits	Madison, WI
VolsTeach	Academic Institution	University of Tennessee
iPlant Collaborative	Academic Institution	Tucson, AZ
sDiv - German Centre for Integrative Biodiversity Research	Other Organizations (foreign or domestic)	Leipzig, Germany
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

Name	Type of Partner Organization	Location
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 2015)

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' Research Collaboration Workshop for Women in Mathematical Biology is organized in cooperation with AWM (June 2015)

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. During this reporting period NIMBioS hosted BioQuest's Biology by Numbers - Bringing Math to the High School Biology Classroom workshop (July 2015). 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 and hosted a summer graduate workshop jointly with MBI and CAMBAM in summer 2015. The theme of this workshop, held at McGill University in July 2015, was "Nonlinear Dynamics in Biological Systems".

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.

CURRENT: 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 2015. NIMBioS, CURENT, and TNSCORE are co-hosting the July 2015 UT STEM REU Symposium.

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 participated in the 2nd international gathering of synthesis centers, held in January 2015 at sDiv (Synthesis Centre for Biodiversity Sciences) in Leipzig, Germany. NIMBioS led discussion of center evaluation activities at this gathering, and has collaborated with other attendees in composing a perspectives paper on the benefits of center-scale activities to foster synthetic research.

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 collaborating with DIMACS on the planning of workshops for Mathematics of Planet Earth 2013+.

Ecological Society of America

Organization Type: Other Nonprofits

Organization Location: Washington, D.C.

Partner's Contribution to the Project:

Collaborative Research

More Detail on Partner and Contribution: NIMBioS and ESA co-organized NIMBioS' Graduate Workshop on Current Issues in Statistical Ecology in April 2015. Interest in this workshop far exceeded the number of participants we were able to accommodate.

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 in September 2014.

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 and July 2015.

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. (November 2014)

Howard Hughes Medical Institute

Organization Type: Other Nonprofits

Organization Location: Chevy Chase, MD

Partner's Contribution to the Project:

Collaborative Research

More Detail on Partner and Contribution: NIMBioS Director Emeritus Louis Gross has collaborated with HHMI staff and leadership and reviews for the organization.

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.

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 (December 2014).

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.

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 2015 was "Nonlinear dynamics in biological systems".

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 are involved in planning a fall 2015 education workshop as part of Mathematics of Planet Earth. It is now scheduled for Sept. 30 - 2 Oct., 2015.

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 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.

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 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.

NESCent-National Evolutionary Synthesis Center

Organization Type: Academic Institution

Organization Location: Durham, NC

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 co-sponsored ecology and evolutionary biology events organized by NESCent at SACNAS.

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. NIMBioS conducted a joint training tutorial on Using R for HPC with XSEDE and NICS (February 2015).

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 2015.

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: NIMBioS is collaborating with the Remote Data and Visualization

project of NSF-XSEDE to extract biologically meaningful information from genomic sequence data. NIMBioS conducted a joint training tutorial on Using R for HPC with XSEDE and NICS (February 2015).

North Carolina A&T University

Organization Type: Academic Institution

Organization Location: Greensboro, NC

Partner's Contribution to the Project:

Collaborative Research

More Detail on Partner and Contribution: NIMBioS staff are working with NC A&T faculty and staff to increase underrepresented individuals in science careers. NC A&T faculty are participating in activities at NIMBioS, and NC A&T students have participated in the NIMBioS SRE for undergraduates program and undergraduate research conference.

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. Yetta Jager, Research Scientist at ORNL, was a member of the NIMBioS Director Search Committee.

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 assisted PEER with outreach to Pond Gap elementary school.

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 2014-2015 research programs and workshops of US-based Mathematics Institutes and to increase awareness of math-based career paths among minority undergraduates. NIMBioS co-sponsored ecology and evolutionary biology events at SACNAS.

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]. NIMBioS, ESA, and SAMSI co-organized the NIMBioS Graduate Workshop on Current Issues in Statistical Ecology in April 2015.

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. (November 2014)

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) are co-hosting the July 2015 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: Clinton, 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 two elementary school groups, reaching over 150 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 served on the organizing committee for and helped to organize a session on Lactose Intolerance & Evolution at the annual TSTA conference.

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.

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, including organizing the investigative workshop on Neurobiology of Expertise.

What other collaborators or contacts have been involved?

The Addendum to this Annual Report provides a full listing of participants in all activity types.

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 some highlights grouped by the type of activity. We have chosen these examples as they cover most of the subject areas present in Figure 1 in the supporting file uploaded to the Accomplishments portion of this report. However what we present is a sample of the activities in the subject areas.

A number of the publications resulting from NIMBioS activities appeared in top national and international journals with high impact factors, including Nature Reviews Microbiology, Proceedings of the National Academy of Sciences (PNAS), PLOS Currents Outbreaks, PLOS Pathogens, and PLOS Computational Biology. Table 1 in the supporting file included with the Accomplishments section provides details on NIMBioS-derived publications in certain high-impact journals.

Postdoctoral Fellow Jake Ferguson was the senior author on a paper in PNAS entitled “Evidence and implications of higher order scaling in the environmental variation of animal population growth.” His paper examined consequences of environmental fluctuations for the strength of density dependence in animal populations. Ferguson and his co-author used data from the Global Population Dynamics Database on 165 animal populations. Their results suggest that variation in the density dependence is common and leads to a higher-order scaling of the population variance. This scaling will often stabilize populations although dynamics may also be destabilized under certain conditions. This implies that higher-order environmental variation is a potentially ubiquitous and consequential property of animal populations and that extinction risk estimates may often be overestimated when not properly taking into account how environmental fluctuations affect population parameters.

Postdoctoral Fellow Sean Hoban published a review in Molecular Ecology entitled “An overview of the utility of population simulation software in molecular ecology.” The review focuses on stochastic simulation software that simultaneously model genetic, population and environmental processes. Hoban used seven case studies to demonstrate how simulations are employed, their specific advantage/necessity and what alternative or complementary (non-simulation) approaches are available. He also explained how simulations can be integrated with existing spatial, environmental, historical and genetic data sets and described simulation features that may be of interest to molecular ecologists, such as spatial and behavioral considerations and species' interactions, to provide guidance on how particular simulation capabilities can serve particular needs.

Several members of a Working Group on “Ocean Viral Dynamics” wrote a paper in Nature Reviews Microbiology entitled “The elemental composition of virus particles: Implications for marine biogeochemical cycles.” In marine environments, virus-mediated lysis of host cells leads to the release of cellular carbon and nutrients and is hypothesized to be a major driver of carbon recycling on a global scale. However, efforts to characterize the effects of viruses on nutrient cycles have overlooked the geochemical potential of the virus particles themselves, particularly with respect to their phosphorus content. Their paper used a biophysical scaling model of intact virus particles that has been validated using sequence and structural information to quantify differences in the elemental stoichiometry of marine viruses compared with their microbial hosts.

A Working Group on “Coalitions and Aliiances” published a review in Behaviour entitled “Coalitions in theory and reality: a review of pertinent variables and processes.” With the accumulation of empirical data and sophisticated theory, there is now a potential to answer a host of questions about how coalitions emerge and are maintained in a

population over time, and how the psychology of this type of cooperation evolved. Progress can only be achieved, however, by effectively bridging the communication gap that currently exists between empiricists and theoreticians. In the paper, the authors ask and answer three questions: (1) What are the primary questions addressed by theoreticians interested in coalition formation, and what are the main building blocks of their models? (2) Do empirical observations support the assumptions of current models, and if not, how can we improve this situation? (3) Has theoretical work led to a better understanding of coalition formation, and what are the most profitable lines of inquiry for the future?

Participation in an Investigative Workshop on “Modeling Wildlife and Virus Zoonoses” led to a publication of a paper in PLOS Pathogens entitled “Detecting differential transmissibilities that affect the size of self-limited outbreaks.” Our ability to respond appropriately to infectious diseases is enhanced by identifying differences in the potential for transmitting infection between individuals. The authors identified epidemiological traits of self-limited infections that correlate with transmissibility. Their approach provides insight into a variety of scenarios, including the transmission of Middle East Respiratory Syndrome Coronavirus (MERS-CoV) in the Arabian peninsula, measles in North America, pre-eradication smallpox in Europe, and human monkeypox in the Democratic Republic of the Congo. These studies lay the foundation for future investigations regarding how infection source, vaccination status or other putative transmissibility traits may affect self-limited transmission.

A NIMBioS Research Assistantship led to a paper in PLoS Computational Biology entitled “Mathematical modeling reveals kinetics of lymphocyte recirculation in the whole organism.” With a help of a novel mathematical model, the authors analyzed experimental data on migration of ⁵¹Cr-labeled thoracic duct lymphocytes (TDLs) via major lymphoid and non-lymphoid tissues of rats in the absence of systemic antigenic stimulation. Applying the model to a dataset on lymphocyte migration via resting and antigen-stimulated lymph nodes showed that enlargement of antigen-stimulated lymph nodes occurs mainly due to increased entrance rate of TDLs into the nodes and not due to decreased exit rate as has been suggested in some studies.

Sabbatical Visitor David Gurarie published a paper in PLOS ONE entitled “Population biology of schistosoma mating, aggregation, and transmission breakpoints: More reliable model analysis for the end-game in communities at risk.” The authors conducted a systematic analysis of both the classical “mean worm burden” (MWB) and more recent “stratified worm burden” (SWB) modeling that accounts for mating and reproductive hurdles (Allee effect). Their analysis reveals some similarities, including breakpoints, between MWB and SWB, but also significant differences between the two types of model. They also showed the classic MWB has inherent inconsistencies and proposed SWB as a reliable alternative for projection of long-term control outcomes.

Sabbatical Visitor Matthew Spencer published a paper in the Journal of Theoretical Biology entitled “Size change, shape change, and the growth space of a community.” The paper extends a measure of biodiversity change, the Living Planet Index, to deal with colonizations and extinctions. The author applied his measure to data on hoverflies in a garden in Leicester, UK, and the higher plant community of Surtsey.

What is the impact on other disciplines?

Social sciences

Participation in a Working Group on “Synthesizing and Predicting Infectious Disease” led to a publication in PLOS Currents Outbreaks entitled “Internet and free press are associated with reduced lags in global outbreak reporting.” The authors estimated reporting lags between the first record and the first public report of an event for 318 outbreaks occurring 1996-2009. They also evaluated the influence of freedom of the press, Internet usage, per capita health expenditure, and cell phone subscriptions, on the timeliness of outbreak reporting. Greater freedom of the press and increasing Internet usage correlate with reduced time between the first record of an outbreak and the public report. Increasing Internet usage reduced the expected reporting lag from more than one month in nations without Internet users to one day in those where 75 of 100 people use the Internet. A member of

the NIMBioS Leadership Team Paul Armsworth published a series of papers on the economics of land acquisition, benefits of ballot box for species conservation, and the methods of quantifying people's preferences for biodiversity conservation.

Statistics

Participation in a Working Group on "Cross-Topology Registration" led to a publication in *Biometrics* entitled "Warped functional analysis of variance." The article presents an Analysis of Variance model for functional data that explicitly incorporates phase variability through a time-warping component, allowing for a unified approach to estimation and inference in presence of amplitude and time variability. The focus is on single-random-factor models but the approach is generalizable to more complex ANOVA models. Postdoctoral Fellow Tony Jhwueng published a paper in *Statistics and Probability Letters* entitled "Phylogenetic Ornstein-Uhlenbeck regression curves." The paper develops a novel generalized least-squares method for estimating parameters of Ornstein-Uhlenbeck system.

Evaluation

NIMBioS staff member Pam Bishop published a paper in *Research Evaluation* entitled "Impacts of an interdisciplinary research center on participant publication and collaboration patterns: A case study of the National Institute for Mathematical and Biological Synthesis." The study analyzed the effects of an interdisciplinary research center on the publication and collaboration behaviors of faculty affiliated with the center. It also sought to determine through faculty interviews what factors contributed to these effects for participants whose publication and collaboration behaviors were most changed after affiliation.

Outreach

NIMBioS staff member Kelly Sturner published a paper in *Mathematics Teacher* entitled "Activities for students: Measuring biodiversity with probability" and another in *American Biology Teacher* entitled "The difference that data make: Examining bird migration data to build scientific skill" outlining different activities for high school students illustrating the importance of data analysis to science.

What is the impact on the development of human resources?

In our 2015 Summer Research Experience (SRE) for Undergraduates and Teachers program, three of the 15 undergraduate students are from underrepresented groups. Among the students, there are nine females and six males; two high school teachers are participating. Research and presentation skills, working in a group, and learning about future career opportunities are emphasized in this program.

At our Undergraduate Research Conference at the Interface of Biology and Mathematics, about three-fourths of the attendees were students. There were 51 undergraduate research talks and poster presentations. The activities provided students with exposure to the scientific community, career information, and networking opportunities.

Additional research activities and career opportunities sessions for students were held at the Modern Math workshop at the Society for Advancement of Hispanics/Chicanos and Native Americans in Science (SACNAS) meeting.

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 is serving an advisory role on a curriculum development NSF grant at Fisk University.

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. They lead a quantitative biology session for the Girls in Science week at Great Smoky Mountains Institute at Tremont in the Great Smoky Mountains National Park in June 2015. NIMBioS was a 2015 sponsor of the Southern Appalachian Science & Engineering Fair, and K. Sturner organized the judges for our project awards prizes in March 2015. 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 2015. S. Lenhart and K. Sturner helped to organize a visit to Pond Gap Elementary School by graduate students in the Program for Equity and Excellence in Research. C. Welsh visited two schools during this reporting period in connection with math and biology activities related to the Discover Birds program in cooperation with the Tennessee Ornithological Society. S. Lenhart and C. Collins worked on a modeling research project with five Bearden High School students this school year. K. Sturner and S. Lenhart presented two days of math application activities at a teacher workshop for Campbell County Schools in June 2015.

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>. Some of the NIMBioS collaborative activities included working on two new thematic units (Biomechanics and Cell Processes boxes).

NIMBioS Associate Director for Diversity Enhancement E. Brothers provided a presentation on Best Practices for Recruitment and Retention of Underrepresented Minorities (URMs) in STEM on behalf of the Office of Research and Engagement at the University of Tennessee-Knoxville (UTK) to assist faculty on their program solicitations for the 2015 National Science Foundation Research Traineeship Program. He was also invited to attend the University of Iowa Sloan Center Mentoring Conference as a panelist to give insight on best practices and strategies to create "a national network of mentors – faculty at colleges and universities that serve a significant number of undergraduate and Master's level minority students who are eager to see that those of their students who have the ability and the desire to earn a doctoral degree in STEM." Dr. Brothers has been asked to serve on the Tennessee Department of Education– Division of Career and Technical Education (CTE) state-wide Science, Technology, Engineering, and Mathematics (STEM) Industry Advisory Council. Mentoring for URMs in STEM as well as diversity and inclusion continues to be a national topic for debate, dialogue, and deliberation, and Dr. Brothers was asked to give a presentation at the National Association of Graduate Admissions Professional (NAGAP) on "Best Practices and Strategies for Diversity and Inclusion in Graduate Enrollment Management" on January 16, 2015. He was also invited to Florida Agriculture and Mechanic University (FAMU) March 20, 2015 to present to graduate student faculty on "Exploring the Mentoring Process," with a particular emphasis on network mentoring and cross-cultural mentoring for URMs. 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 Society for Advancement of Hispanics/Chicanos and Native Americans in Science (SACNAS) October 16-18, 2014; and the Southern Regional Education Board (SREB) Institute on Teaching and Mentoring October 31-November 2, 2014.

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. Renovations to one of the classrooms and the auditorium were completed during this reporting period to facilitate participant interactions and to increase capacity of the rooms above the previous limit of 49 in the auditorium. Creating more space between rows, adding an extra aisle, and opening up meeting space in the back of the room has resulted in a much more comfortable and functional location for workshops and seminars. A movable wall between the two rooms now allows for expansion of the auditorium to accommodate an audience of up to about 60 participants. This renovation also included the capability for live-streaming of many NIMBioS activities, which is now done routinely, allowing 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 providing the other group's activities complement the NIMBioS mission. 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 staff have been directly involved with establishing University policies and practices that streamline the process of arranging lodging for participants and other visitors. NIMBioS has garnered institutional salary support that greatly facilitates collaboration across departments and across campuses. The NIMBioS Director developed a model for interdepartmental faculty hiring across multiple disciplines that other departments are using now. The NIMBioS Director search resulted in a commitment for a new tenure track faculty line as the new Director holds a departmental faculty appointment. The new Director also has input into two additional faculty lines with the intent of enhancing expertise in areas related to the NIMBioS mission. 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.

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. These toolsets are components of presentations at a Tutorial held at NIMBioS and are being distributed as open source to enhance the opportunity for broad dissemination and use. 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. A compilation of the resources made available at this Tutorial, with guidance on how to apply these, is deployed through the NIMBioS website. NIMBioS hosted a joint R tutorial in February 2015 with the National Institute for Computational Sciences and XSEDE staff that included local participants as well as over 380 people who participated virtually. All presentation materials for the joint tutorial have been made available via the NIMBioS website.

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 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 activities 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. An Investigative Workshop on Modeling Microbial Contamination of Fresh Produce along the post-harvest supply chain has led to a new working group that 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 puts out 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.

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 NIMBioS Annual Report

Sep 1, 2014 –Aug 31, 2015

Y7-1. NIMBioS Board of Advisors Meeting Summaries

Y7-2. NIMBioS Evaluation Report

Y7-3. Participant List for NIMBioS Events and Activities

Y7-4. Description of Activities

Y7-5. Additional Products

Featured Articles

Websites

Media Coverage

**Y7-6. NSF Budget Office Reporting Requirement: Institutions, Partners,
Participants**

Addendum to NIMBioS Annual Report

Sep 1, 2014–Aug 31, 2015

Y7-1. NIMBioS Board of Advisors Meeting Summaries

NIMBioS Board meeting minutes

Summary Report of NIMBioS Board of Advisors Meeting held October 20-21, 2014

Board Members attending:

Sarah Brosnan, Lydia Bourouiba, Erika Camacho, Troy Day, Eli Fenichel, Julius Jackson, Kristin Jenkins, Colleen Jonsson (in role as incoming Director), Laura Kubatko, Sandy Liebhold, Raymond Mejia, Claudia Munoz-Zanzi, Pete Richerson, Raina Robeva, Jorge Velasco Hernández, Talitha Washington, Colleen Webb, Joshua Weitz, and Nancy Zhang. In addition, the following members participated remotely: Priyanga Amarasekare, Lea Popovic, Tamar Schlick, and Marcy Uyenoyama. Sam Scheiner (NSF) and Kim Forde Folle (USDA) also joined remotely for parts of the meeting.

Board Chair Colleen Webb managed this meeting and at the end turned it over to Raina Robeva, the incoming Chair. This is a brief summary of the discussions and recommendations made by the Advisory Board during the meetings held from 09:00 on October 20 to noon on October 21. The agenda for the meeting is included below. A little over three weeks prior to the meeting, information on all requests for support submitted by the September 1, 2014 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 4-5 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, an Evaluation Summary, a draft Project Outcomes report, and a draft paper on the impacts of an interdisciplinary research center on participant publication and collaboration patterns.

After introductions, NIMBioS Director Louis Gross presented the Director's Report, remarking on NIMBioS activities over the year since the renewal, describing his activities as Director, summarizing the new Graduate Fellows program, and introducing Colleen Jonsson as the incoming Director. The summary report from the last physical Board meeting in October 2013 was approved.

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 seven requests, the Board recommended that four of the requests be approved, and two be requested to do a quick revision for expedited review,

and one be possibly considered for resubmission as an Investigative Workshop. 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 8 requests submitted and the Board recommended approval of 1 of these, asking organizers to submit modified requests quickly for two additional ones for an expedited review by the Board, and encouraging two others to resubmit revisions for the next Board meeting for review by the full Board. The Board noted that the remaining three requests had significant weaknesses that should be relayed to the organizers.
3. Postdoctoral Fellowships – Of the total of 22 applications received, the NIMBioS Leadership Team submitted 13 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 4 of these for approval but also considered that 6 others should be considered by the Team as appropriate. 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 2014 applicant pool, that final decision of how many to accept at this time should be left to the Leadership Team. There was considerable discussion concerning whether NIMBioS should limit the pool of candidates to those who have not already had two postdocs, but no firm recommendation was made.
4. Sabbatical visitors – the Board recommended accepting one of the three applicants and rejecting the other two.

There was a discussion of an additional request as a fast-track approval for an Investigative Workshop to be held more rapidly than typically allowed that was being developed in collaboration with a US Government entity. The Leadership Team was apprised of concerns by the Board regarding this request but the Board recommended that the Team proceed, after relaying these concerns to the organizers.

Updates and Discussions concerning other Programs and Plans:

Research Programs: Sergey Gavrilets provided a summary of research outcomes from recent Working Groups, Postdocs and Workshops. There followed a discussion regarding the relative magnitudes of papers produced in different areas, such as mathematical contributions from biological motivation, biological insight provided by mathematical results and general theory in biology. It was suggested that NIMBioS consider compiling a summary of new mathematics that has arisen from biological motivation and consider targeting activities in novel mathematical areas for biology. There was a general discussion of this new initiative which is now attracting applications. Two expected outcomes of the program are diversifying the career status of people at NIMBioS and providing mentoring opportunities for NIMBioS post-docs.

Director Transition and Long-term Planning: Colleen Jonsson introduced herself, noted her background in funded research, and discussed her plans for building a sustainability plan for NIMBioS beyond the period of base NSF support. She noted that we should start with the costs

of various programs and what are valued most highly by the community that requires NIMBioS infrastructure to sustain. She noted how she intended to work with the UT Foundation to build potential donor support, build towards marketable products that could be produced (including evaluation services and building on the Biology-in-a-Box program). She discussed her suggestions for encouraging the Board to be enhanced so as to further connections to Foundations and industry. General discussion with the Board followed and additional suggestions were discussed including math-bio education initiatives, packaged courses in math for biologists, continuing education in modeling for public health officials, certification programs in areas such as biological data analysis, and the potential for focus groups to be developed to assist in identifying market demand for products that NIMBioS could provide.

Diversity Enhancement: Dr. Ernest Brothers, NIMBioS Associate Director for Diversity Enhancement and Associate Dean of the UTK Graduate School led an extensive discussion of the NIMBioS diversity benchmarks, how NIMBioS has been progressing to broaden participation, and broader cultural issues that affect STEM participation across the country. This was followed by a broad discussion including concerns that as the funding/business model for NIMBioS changes, that diversity enhancement continue to be a major objective. Thus, diversity should be part of the central context of the organization and it is necessary to meet the culture of the individuals you are attempting to attract. Sustainability might best be viewed as reinventing yourself so diversity issues should be part of any rethinking of the strategic plan for NIMBioS.

Leadership Evaluation and Future Board Planning: It was noted that in years that there is not a formal NSF site review, the NIMBioS policy is to have a formal leadership evaluation carried out by a committee of the Board, followed by a discussion with the Board and presentation of results to the UTK Vice Chancellor for Research. Given the timing of leadership transition, the Board discussed the evaluation procedures and decided that it was likely not appropriate to have the next leadership evaluation carried out in time for the next NSF site review that would be in late Spring 2015, but that it would be for the Fall 2015 Board meeting.

Chair transition: Raina Robeva accepted the gavel from Colleen Webb and the Board thanked Colleen for her leadership over the previous two years.

Fall 2014 Advisory Board Meeting Agenda:

Sunday October 19

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

Monday, October 20

8:00-9:00 Breakfast at NIMBioS

9:00-9:15 Introductions

9:15-9:45 Quick summary of current status, recent reports, evaluation summary, funding (Lou Gross)

9:45-10:45 Review of requests for support - Working Groups, Investigative Workshops (Sergey Gavrillets)

10:45-11:00 Break

11:00-12:00 Review of requests for support (cont.)

12:00-1:00 Lunch (joined by Leadership Team, post-docs, graduate students)

1:00-3:00 Review of requests for support - Postdocs and Sabbaticals (Paul Armsworth)

3:00-3:15 Break

3:15-5:00 Completion of reviews of requests and summary recommendations

5:00-6:00 Reception with Postdocs, faculty

5:00-5:30 Planning for Renewal Period - discussion of new initiatives, metrics for evaluation, potential methods to improve topical diversity

5:30-6:30 Reception

Tuesday October 21

8:00-9:00 Breakfast meetings with NIMBioS post-docs

9:00-9:30 Summary of research activities and transitions fostered by NIMBioS (Sergey Gavrillets)

9:30-10:00 Discussion of NIMBioS leadership transition and plans for sustainability (Colleen Jonsson)

10:00-10:30 Discussion of potential funding opportunities (Lou Gross)

10:30-10:45 Break

10:45-11:15 Diversity enhancement and education discussion (Ernest Brothers, Suzanne Lenhart)

11:15-11:45 Discussion of Strategic Plan, NIMBioS policies including Advisory Board, and Leadership Evaluation with emphasis on what is needed to plan for sustainability (Lou Gross)

11:45-12:00 Wrap up

1200- Lunch

VIRTUAL BOARD MEETING – JANUARY 20, 2015

Board members participating: Lydia Bourouiba, Erika Camacho, Troy Day, Eli Fenichel, Julius Jackson, Kristen Jenkins, Laura Kubatko, Sandy Liebhold, Raymond Mejia, Claudia Munoz-Zanzi, Lea Popovic, Pete Richerson, Raina Robeva, Marcy Uyenoyama, Jorge Velasco Hernandez, Talitha Washington, Joshua Weitz, and Jianhong Wu.

The NIMBioS Board met via teleconference and using WebEx to review applications received in December 2014 for Postdoctoral Fellowships. The Board was provided access to all applications three weeks prior to the meeting, and each Board member was asked to review 1-3 applications. Each Board member provided feedback on the applicants, and a summary of their comments was provided to guide discussion during the meeting. Of the 16 applications reviewed, the Board recommended the Leadership Team consider six as candidates for offers. An additional application related to science education was discussed extensively, and the Board suggested the Leadership Team consider it in more detail along with the other six.

VIRTUAL BOARD MEETING – APRIL 6, 2015

Board members participating: Erika Camacho, Troy Day, Eli Fenichel, Julius Jackson, Kristin Jenkins, Sandy Liebhold, Raymond Mejia, Claudia Munoz-Zanzi, Pete Richerson, Raina Robeva, Marcy Uyenoyama, Jorge Velasco Hernandez, Talitha Washington, and Jianhong Wu.

The NIMBioS Board met via teleconference and using Zoom Video Conferencing to review applications received in March 2015 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 two Sabbatical Fellow requests. Of the three Investigative Workshop requests, the Board encouraged revision and resubmission of two based upon suggestions from the Board, followed by an expedited review. Revisions were suggested for the third workshop request with the suggestion that organizers be encouraged to resubmit in the fall. Of the ten Working Group requests, the Board recommended approval of two outright and one with further review. The Board suggested three Working Group requests be reconsidered in an expedited review process after being revised to address Board reservations. The Board suggested organizers of three additional Working Group requests be encouraged to substantially revise their requests based upon its comments and resubmit in the fall, and it did not recommend approval of the final request.

Addendum to NIMBioS Annual Report

Sep 1, 2014–Aug 31, 2015

Y7-2. NIMBioS Evaluation Report



NIMBIOS EVALUATION REPORT

REPORTING PERIOD Seven

SEPTEMBER 1, 2014-March 31, 2015

NATIONAL INSTITUTE FOR MATHEMATICAL AND BIOLOGICAL SYNTHESIS

April, 2015

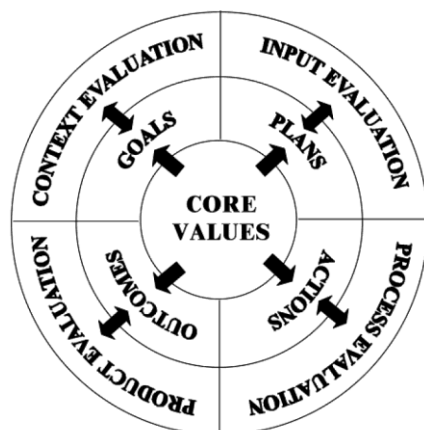
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INTRODUCTION

This is an evaluation summary of NIMBioS activities during the sixth annual reporting period (RP 7) to the National Science Foundation. This report covers the period of September 1, 2014-March 31, 2015. 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. 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.

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.

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 7 included:

- 12 Working Group meetings
- 4 Investigative Workshops
- 1 Tutorial
- 25 Short-term visitors
- 13 Postdoctoral Fellows
- 1 Visiting Graduate Student Fellow
- 5 Graduate Research Assistantships

Education and Outreach (EO) program activity highlights during RP 7 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

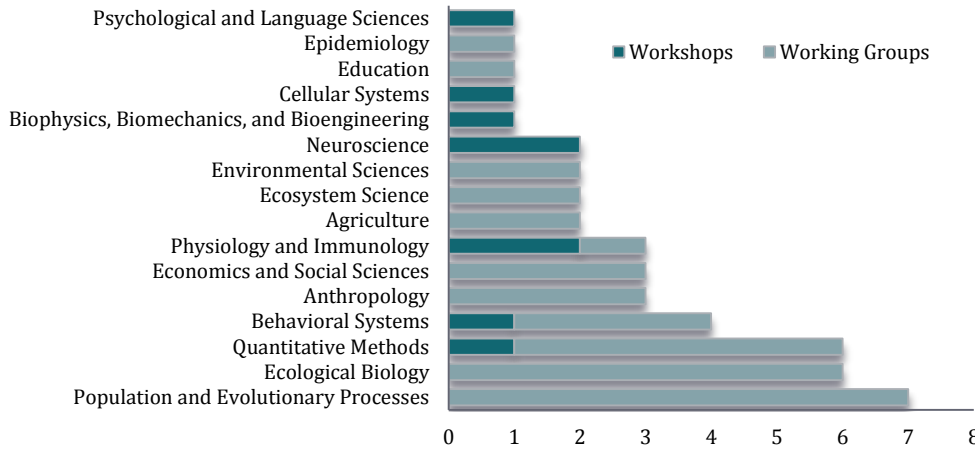
Other events included: 3 Advisory Board Meetings (1 in-person and 2 virtual)

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 Groups and Investigative Workshops during RP 7 (each supported event may have up to three subject areas).

Figure 2. Diversity of Subject Areas of Working Groups and Investigative Workshops, RP 7

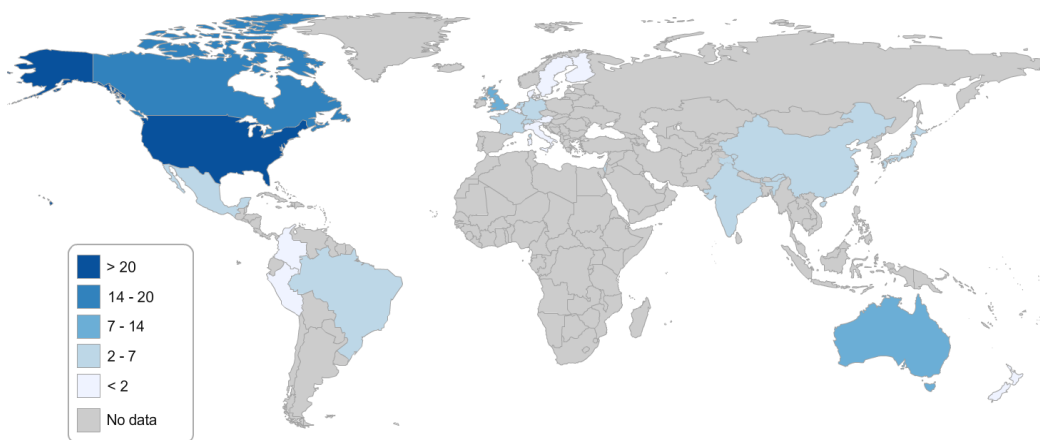


DIVERSITY OF PARTICIPANTS

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 7 was 77%. 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

Figure 3. NIMBioS RP 7 Participants by Country



PARTICIPANT DEMOGRAPHICS

GEOGRAPHIC DIVERSITY. During RP 7, a total of 496 participants (196 different individuals) from 24 countries participated in NIMBioS events. Most participants came from the United States (85%), followed by Canada (4%) (**Figure 3**).

Within the U.S., 39 different states, as well as the District of Columbia, were represented.

The largest percentage of participants came from within Tennessee (28%), followed by California (7%), Arizona (6%), New York (5%), Pennsylvania (4%), and Georgia (4%) (**Figure 4**).

Figure 4. NIMBioS RP 7 Participants by U.S. State

GENDER, RACIAL, AND ETHNIC DIVERSITY. Across all events during RP 7, female participation was 41% (no gender data for 2%). 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 2013². 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.

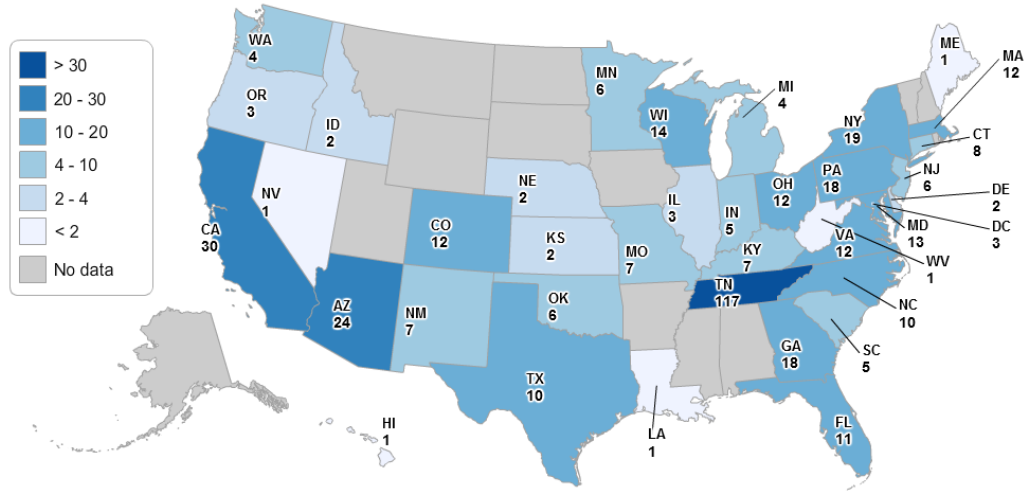
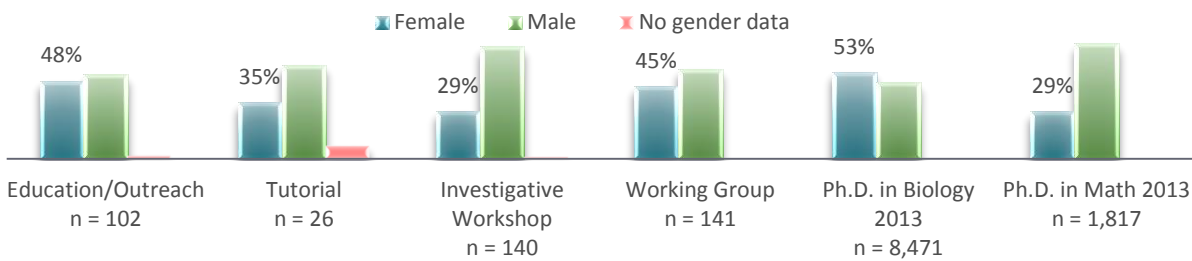


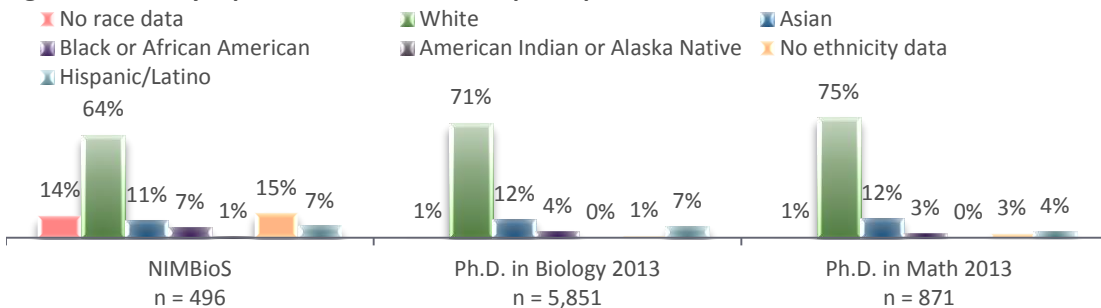
Figure 5. Gender composition of participants by event type



Overall minority representation³² during RP 7 was around 13%. Representation of various minority categories was near current trends for doctoral

recipients in the biological sciences, and greater than that in the 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 2013².

Figure 6. Minority representation of NIMBioS participants



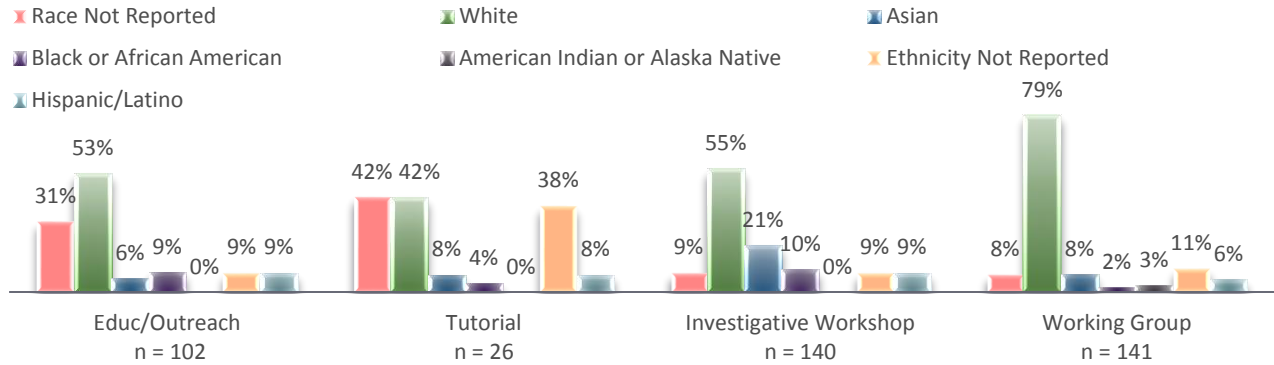
Minority representation varied among programs (Tutorials are considered part of Education and Outreach at NIMBioS, but are reported upon separately). Education and Outreach and Investigative Workshop activities showed greatest percentage of

² Data from the 2013 NSF Survey of Earned Doctorates, http://www.nsf.gov/statistics/sed/2012/data_table.cfm

³ For the purposes of this report, “underrepresented 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, 2013)

Hispanic/Latino participants (9%). 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 Workshop (10%) and Education/Outreach Events (9%), and Hispanic individuals were represented well in all events (**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

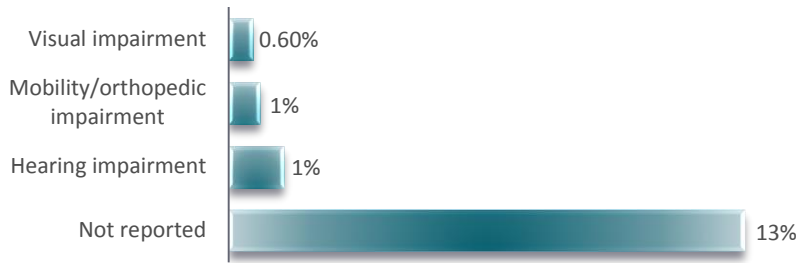
		Yr 1*	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr7	Overall
Participant diversity									
Gender	(Benchmark: approximately 30% female)								
	Working Groups	19%	22%	27%	34%	34%	36%	45%	31%
	Investigative Workshops	40%	40%	38%	39%	39%	43%	29%	38%
	All events	37%	42%	38%	39%	39%	44%	41%	40%
International	(Benchmark: approximately 10% outside USA)								
	Working Groups	20%	19%	19%	18%	24%	26%	18%	21%
	Investigative Workshops	10%	22%	21%	19%	5%	23%	16%	17%
	All events	7%	12%	14%	16%	14%	11%	16%	13%
URG									
	Working Groups	9%	10%	7%	8%	9%	9%	7%	8%
	Investigative Workshops	7%	10%	14%	14%	11%	12%	17%	12%
	All events	9%	11%	11%	13%	11%	13%	13%	12%
Local	(Benchmark: No more than 15% from UT/ORNL)								
	Working Groups	14%	15%	16%	18%	14%	9%	7%	13%
	Investigative Workshops	22%	23%	10%	7%	11%	4%	13%	13%
	All events	35%	20%	16%	13%	16%	5%	12%	17%
Organizer diversity									
Gender	(Benchmark: approximately 30% female)								
	Working Groups	11%	13%	16%	28%	27%	23%	28%	21%
	Investigative Workshops	25%	29%	38%	39%	0%	52%	44%	32%
	All events	23%	28%	27%	34%	30%	36%	33%	30%
Local	(Benchmark: No more than 25% UT Faculty/Staff)								
	Working Groups	28%	22%	20%	28%	21%	16%	6%	20%
	Investigative Workshops	75%	36%	12%	17%	0%	12%	22%	25%
	All events	57%	42%	33%	27%	21%	21%	18%	31%

*Year 1 includes activities from March-August 2009

** Year 7 includes activities from September 2014-March 2015

ABILITY DIVERSITY. Disclosure of disability status by participants to NIMBioS is optional. Around 2% overall indicated having some sort of disability during RP 7 (**Figure 8**).

Figure 8. Disability status of participants (n = 496)



INSTITUTIONAL AND DISCIPLINARY 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**).

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**).

The 196 participants indicating Biological/Biomedical Sciences as their primary field of study indicated 27 different areas of concentration within which they would classify their primary areas of research/expertise. The most commonly indicated area of concentration was ecology (24%), followed by neuroscience (15%), mathematical biology (13%) and evolutionary biology (11%) (**Figure 11**).

Figure 9. Employment status of participants (n = 496)

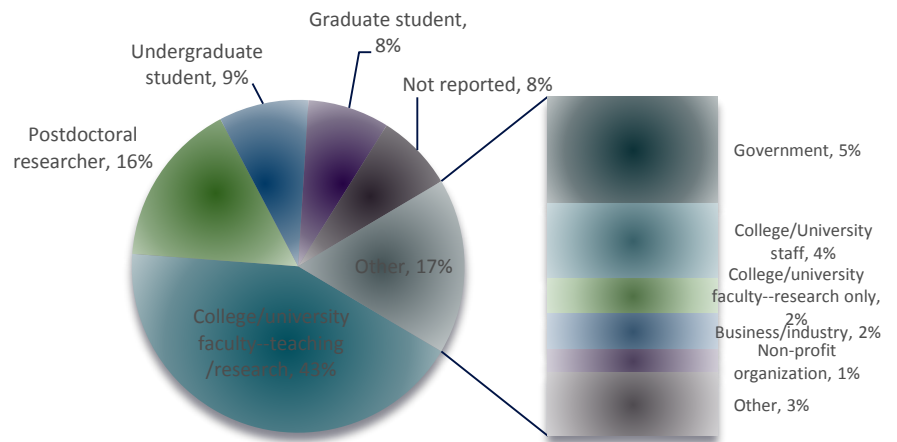


Figure 10. Primary, secondary, and tertiary discipline areas of participants

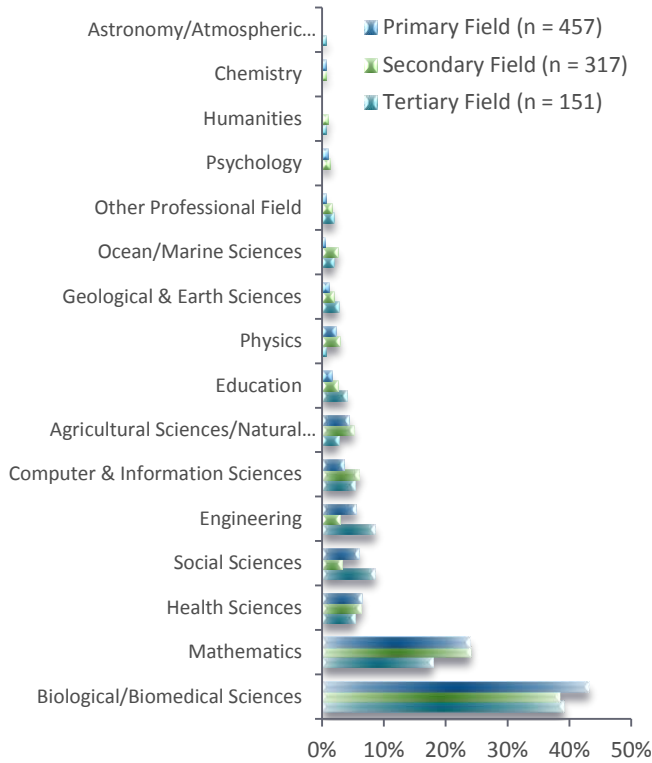
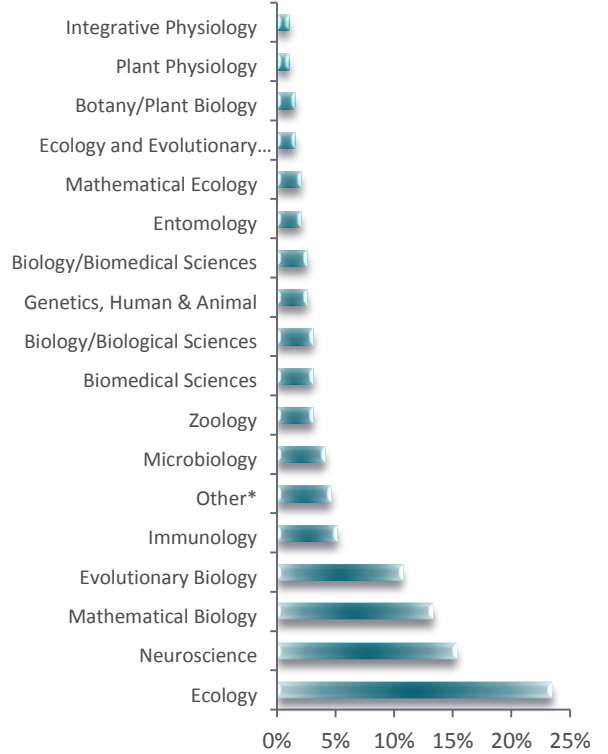


Figure 11. Participant expertise area concentrations within biological/biomedical sciences field of study (n = 196)



* Other concentrations having one participant each: Biotechnology, Molecular Biology, Physiology, Human & Animal, Biometrics & Biostatistics, Electrophysiology, Bioinformatics, Biochemistry, Biophysics, and Epidemiology

Participants during RP 7 represented 190 different institutions, including colleges and universities, government institutions, industry, non-profits, and high schools (Figure 12). Of the 151 universities represented, most were classified as comprehensive (having undergraduate and graduate programs) (Figure 13).

Figure 12. Types of institutions represented (n = 190)

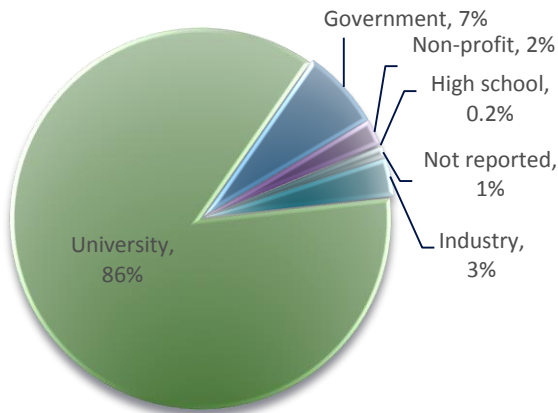
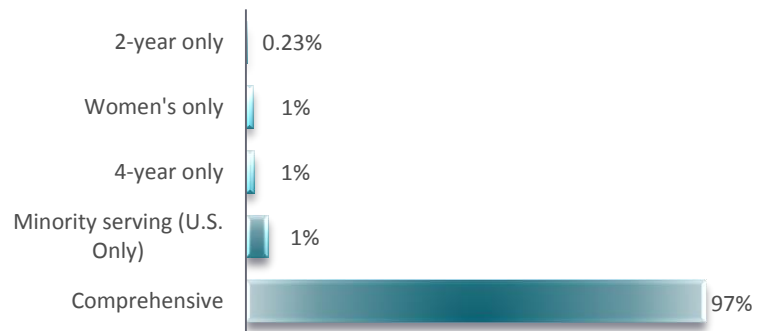


Figure 13. Characteristics of participants' universities (n = 151)



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, and Research Experiences for Undergraduates/Veterinary Students 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 7.

RESEARCH ACTIVITIES PROCESS EVALUATION 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.

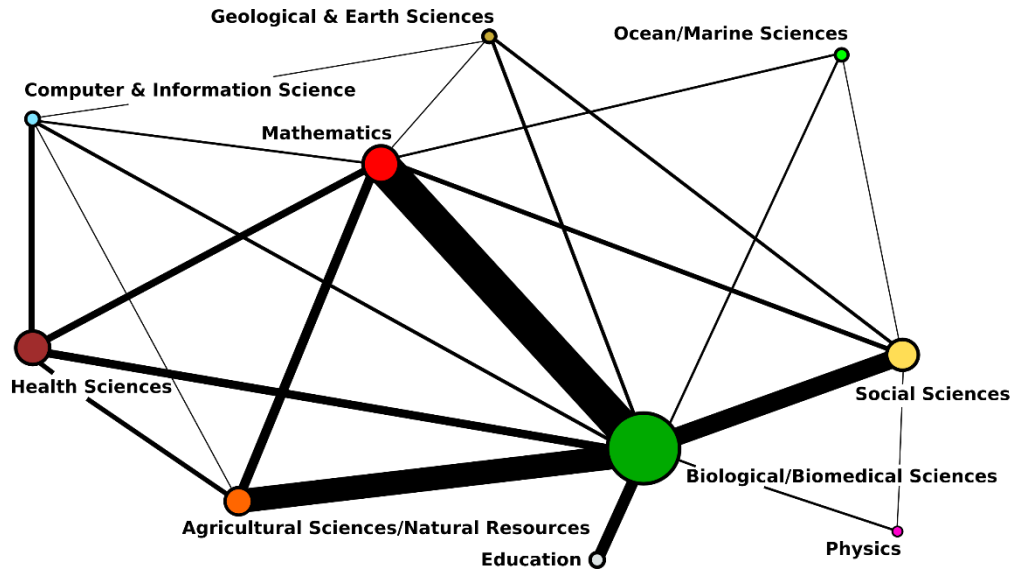
WORKING GROUPS. NIMBioS Working Groups are chosen to focus on major scientific questions at the interface between biology and mathematics that require insights from diverse researchers. The questions to be addressed may be either fundamental, applied or both, and may be focused around a particular biological 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, RP 7. During RP 7, NIMBioS hosted a total of 12 Working Group meetings, including the start of four new groups and the return of 8 established groups. A total of 141 participants from 77 institutions took part in the Working Groups. During RP 7, participants came together from 10 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 7. 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.

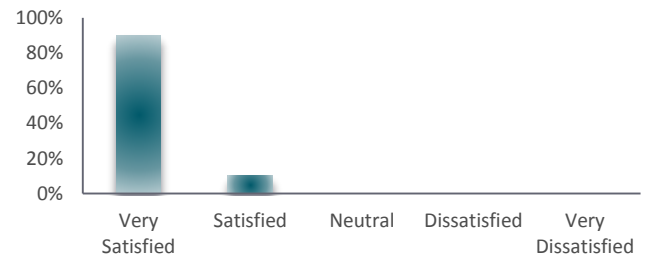
Figure 14. Working Group cross-disciplinary collaboration



ORGANIZER FEEDBACK

Beginning in November 2011, NIMBioS began collecting 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 7 organizers of beginning Working Groups.

Figure 15. Working Group organizer satisfaction with NIMBioS handling of event (n = 20)



Working Group organizer comments:

All of your help with the logistics of travel, food, and technology was extremely helpful and allowed us to focus on the content of the Working Group instead of small details.

NIMBioS does an outstanding job of organizing meetings. I've been at prior meetings organized by some NIMBioS personnel although not officially connected to NIMBioS, and I know someone who has organized a Workshop. I expected a first-rate operation, and that is what I got.

FIRST MEETINGS

During RP 7, NIMBioS hosted the first meetings of four Working Groups, with a total of 51 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 38 participants took part in the evaluation of the first meetings of their Working Groups. Eleven 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
Modeling Antimicrobial Resistance (AMR) Intervention	9/19-22/14	14
A DEB Model for Trees	10/14-17/14	11
Expanding Data Nuggets	1/7-9/15	12
Vector Movement and Disease	3/30-4/2/15	14

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

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

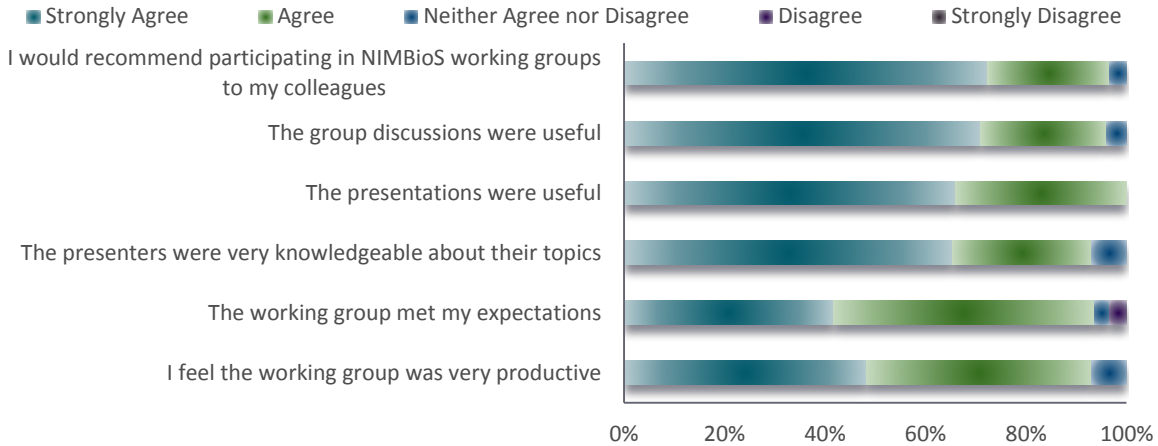


Figure 17. Participant responses to the following question--As a result of participating in this Working Group, I have a better understanding of:

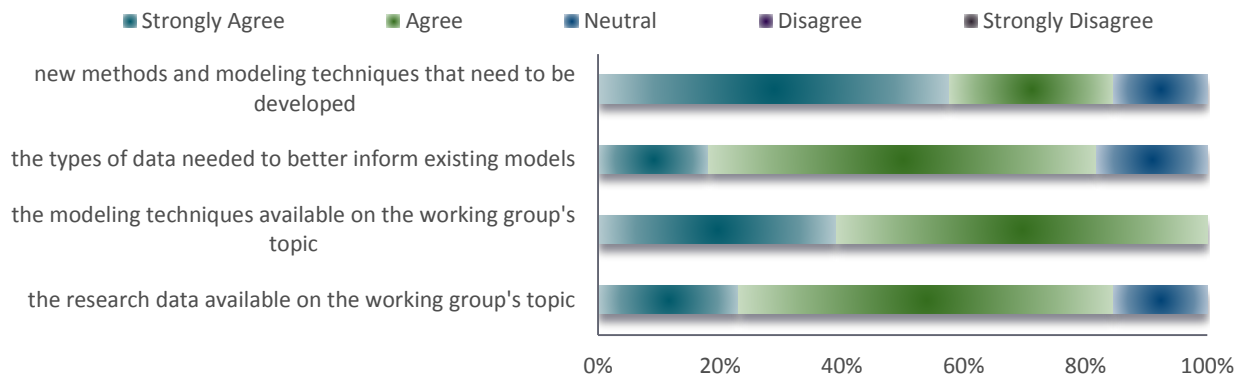
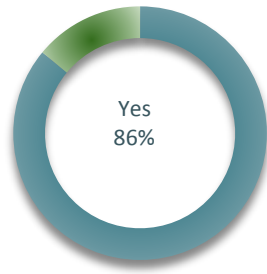


Figure 18. Participants who felt the exchange of ideas during the Working Group would influence their future research:



WORKING GROUP SECOND, THIRD, AND FOURTH MEETINGS

During the reporting period, NIMBioS hosted the second meetings of four Working Groups, with a total of 48 participants, and the third meeting of two Working Groups, with a total of 20 participants. Two groups held their fourth meetings with 22 participants (**Table 3**).

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

Title of Working Group	Dates	# Participants
Second Meetings		
Evolution of Sustainability	11/17-20/15	9
Habitat for Migratory Species	1/26-29/15	17
Evolution of Institutions	2/11-13/15	10
Modeling Antimicrobial Resistance (AMR) Intervention	2/23-25/15	12
Third Meetings		
Plant-Soil Feedback Theory	11/3-5/15	11
Nonautonomous Systems and Terrestrial Carbon Cycle	11/17-21/15	9
Fourth Meetings		
Hierarchy and Leadership	10/13-15/14	10
'Pretty Darn Good' Control: Extensions of Optimal Control for Ecological Systems	1/21-23/15	12

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. Some **participant comments from Working Group meetings 2-4**:

Excellent interactions. I anticipate that I will organize a subgroup to consider model applications to inform conservation action for migratory species

Excellent organization - despite the weather! I was very impressed by the NIMBioS getting our room set-up even though the University was closed.

It was a very productive meeting with clear linkages between the different projects and a clearly arising overarching vision that is the precondition for the future synthesis. The atmosphere was very open and inspiring. A couple of virtual Meetings is planed till the next physical meeting at NIMBioS. Excellent support by the NIMBioS staff.

NIMBioS is great chance for face-to-face collaborations and developing new ideas!

We were incredibly productive during our recent stay, and it was due in part to a very accommodating facility and people associated with it.

CONCLUDING WORKING GROUPS

NIMBioS received notification that three Working Groups had reached their conclusions (**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 35 participants responded to the final evaluation for their groups.

Table 4. Concluded Working Groups, RP 7

Title of Working Group	Dates	# Participants
Play, Evolution, and Sociality	Nov 2011-Nov 2014	19
Multiscale Modeling of the Life Cycle of <i>Toxoplasma gondii</i>	May 2011-July 2013	13
Hierarchy and Leadership	April 2013-Oct 2014	15

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

Figure 19. Evaluation of various aspects of Working Groups

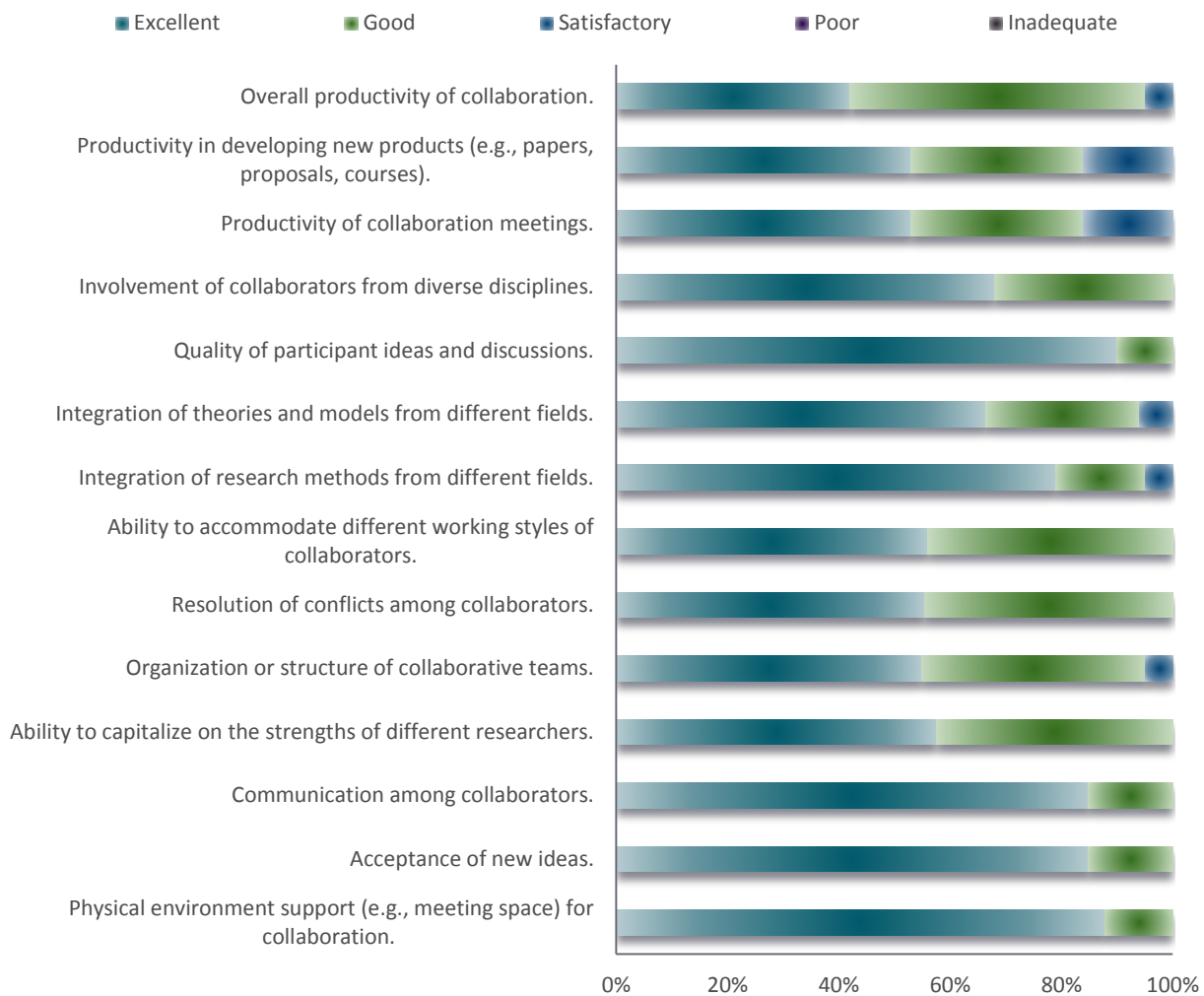
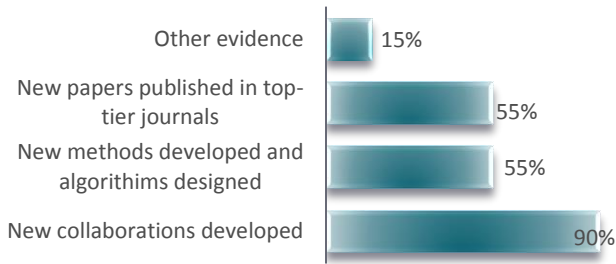


Figure 20. Evidence to support new insights and collaborations within the group



Concluded Working Group participant comments:

Organizational team was immaculate.

Overall, a fantastic experience.

Submitted proposal, manuscript in progress, and plans for future studies.

We have multiple paper pending publication.

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.

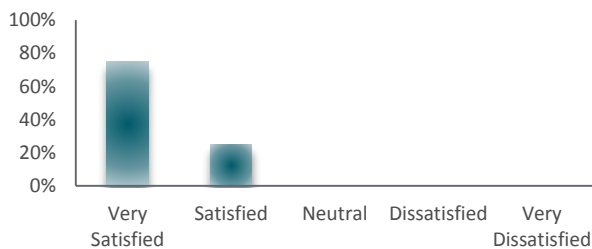
NIMBioS hosted four Investigative Workshops during RP 7 with a total of 140 participants (Table 5). Evaluation surveys were sent to all Workshop participants. A total of 119 participants took part in the evaluation of the Workshops.

Table 5. Investigative Workshops Hosted by NIMBioS

Title of Workshop	Dates	# Participants
Heart Rhythm Disorders	12/3-5/14	37
Lymphoid Cells in Acute Inflammation	1/15-16/15	38
Neurobiology of Expertise	3/11-13/15	27
Olfactory Modeling	3/2-4/15	38

HIGHLIGHTS OF WORKSHOP EVALUATION RESPONSES (FIGURES 21-23)

Figure 21. Workshop organizer satisfaction with NIMBioS handling of event (n = 8)



Investigative workshop organizer comments:

The NIMBioS staff was very attentive and helpful before, during, and after the workshop. Eric Carr, in particular, went above and beyond to help us make the technology work for our purposes. Also, the facilities and equipment were perfect for our event. Having the breakfasts and lunches catered in was a great way to save time and facilitate conversations.

The NIMBioS staff was very proactive and responsive to all organizer requests before and during the meeting. Great experience organizing the workshop.

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

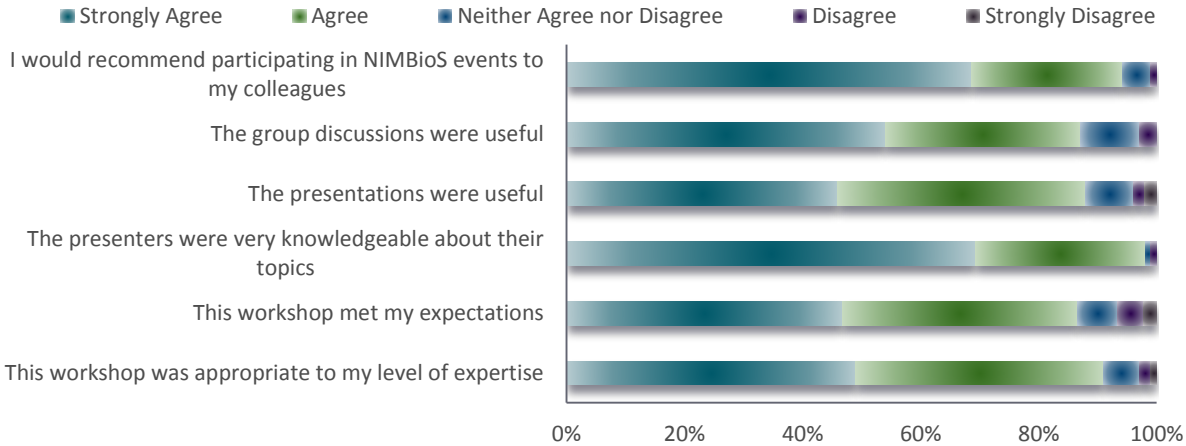
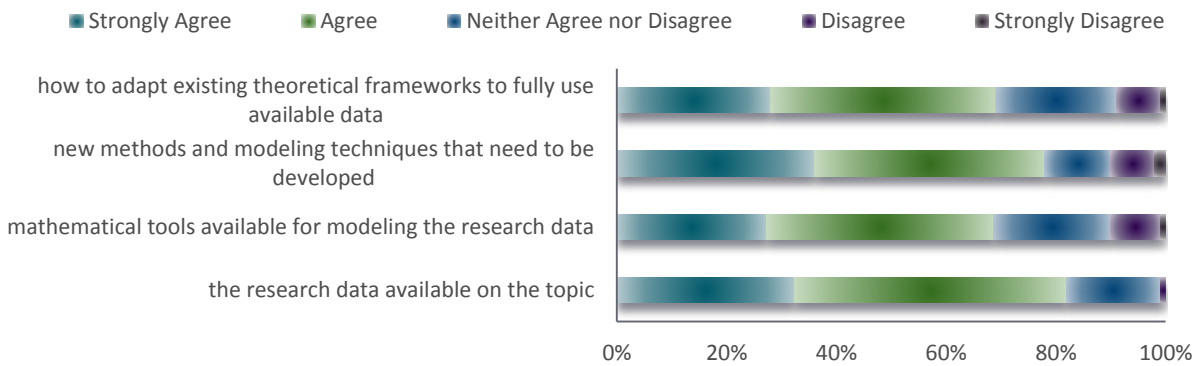


Figure 23. Participant responses to the following question-- As a result of participating in this Workshop, I have a better understanding of:



Investigative Workshop participant comments:

I had a useful time. The staff were great and NIMBioS is certainly worthy of further support. Strange how when the Government creates something useful it then abandons it. The free market does NOT apply to Science and Academe which are a public good. NIMBioS is a public good - I would hope NSF (of all people) recognize this.

It was a great experience participating in this workshop and I think that I have established contacts will be very helpful for my research and that of other participants in the foreseeable future. I have been very motivated to participate in future versions of these workshops of NIMBioS

Thank you for the opportunity to participate in the NIMBioS workshop. It was a stimulating scientific experience from which I will reap many benefits in the future. The topic The Neurobiology of Expertise is so broad, but the structure of the workshop allowed us to get focused and productive in an amazing short period of time. It is sometimes difficult to bring together scientists from such a diverse backgrounds, but at the end of the 2 and a half days, many of us developed concrete plans for future research. Special thanks to Chris and Jennifer Spar for making us feel so welcome.

Thanks for helping us make our workshop a huge success. It exceeded our expectations and the NIMBioS staff and facilities had a lot to do with that. Also, the location provided a 'neutral' environment and we feel that this played a big role in facilitating cross talk between and among disciplines and more open discussion that might not have happened in environments where there may be a perceived bias.

EDUCATION AND OUTREACH PROGRAM ACTIVITIES

TUTORIAL: USING R FOR HPC

The Using R for HPC Tutorial was a joint training supported by the University of Tennessee, NIMBioS, Extreme Science and Engineering Discovery Environment (XSEDE), and the National Institute for Computational Sciences (NICS). Organizers were Eric Carr (NIMBioS) and Drew Schmidt (XSEDE and NICS). This half-day (four hour) Tutorial, introduced participants to debugging, profiling and performance analysis, optimization, foreign language API's, and parallel programming with R. There was also a comprehensive hands-on component to reinforce topics introduced during the lecture portion. The Tutorial was live-streamed, as well as attended in person. A total of 24 participants (plus two organizers) attended the in-person training, while an additional 359 attended online. The evaluation survey was sent to all 385 participants and organizers, and 176 participants completed the survey.

HIGHLIGHTS OF TUTORIAL EVALUATION RESPONSES

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

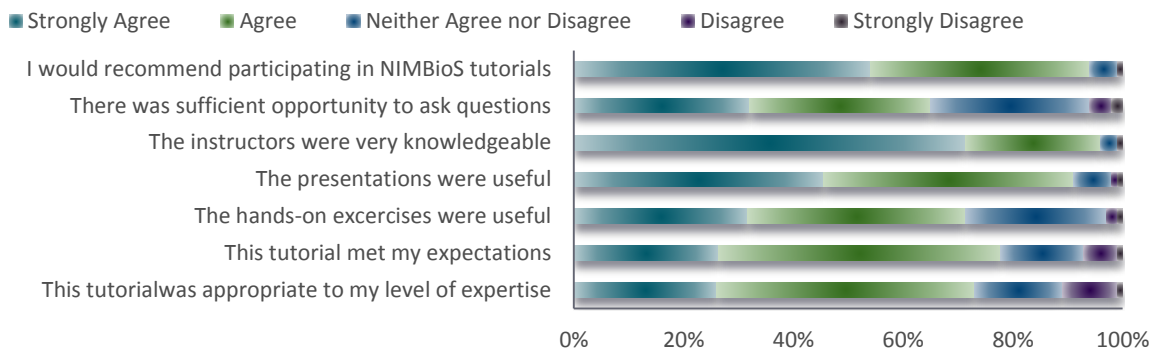
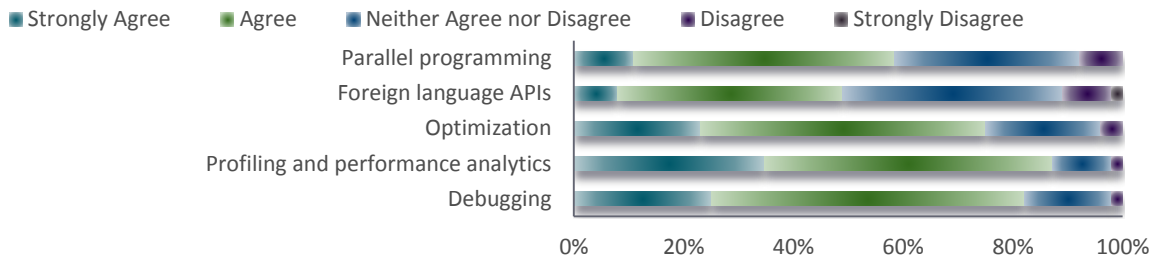


Figure 25. Participant responses to the following question-- As a result of participating in this Tutorial, I have a better understanding of:



Tutorial participant comments:

Had a great experience! Thought the lectures were the right lengths. Thought the spacing of the tutorial was great, with the mix of lectures and breaks. Really appreciated the breaks after each lecture to let me rest my poor brain.

I really appreciated that this was open to the public. I found it to be a very informative session and the speaker was fantastic.

Often the academic world does itself a great disservice when it strictly adheres to the philosophy of teaching to the exclusion of training. This was not the case in this tutorial; I greatly appreciated the content and the training approach.

Thank you! I appreciate the opportunity to participate in events like this remotely and consider it an important part of my professional development. I look forward to hearing about similar opportunities!

SUMMER RESEARCH EXPERIENCE

The NIMBioS *Summer Research Experience (SRE)* program took place on the University of Tennessee, Knoxville (UT) Knoxville campus June 9-August 1, 2014. Eighteen 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 six (RP 6), the SRE program for 2015 will not conclude until after the RP 7 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.

The six research projects for the 2014 program included:

- Prospects for the continued global Argentine ant supercolony
- Modeling transmission and control of bovine respiratory disease
- A dynamic systems approach to tracking the facial expressions and conscious experience of emotion
- Living on the edge: How location within a geographic range affects genetics and individual fitness
- Statistical techniques for predicting cardiac rhythm disorder
- Mathematical modeling of granuloma formation in Johne's Disease

Program organizers were Suzanne Lenhart (Dept. Mathematics/NIMBioS), and Kelly Sturner (NIMBioS). Matt Zefferman (Evolutionary social science, Ant supercolony), Keenan Mack (Evolution of cooperation, Ant supercolony), Cristina Lanzas (Veterinary Medicine, Bovine respiratory disease), Suzanne Lenhart (Mathematics, Bovine respiratory disease), Shi Chen (Veterinary Science, Bovine respiratory disease), Jeff Larsen (Social psychology, Facial expressions), Charles Collins (Mathematics, Facial expressions), Julia Earl (Ecosystem ecology, life history theory, conservation biology, Geo-fitness), Sean Hoban (Small population dynamics, Geo-fitness), Xiaopeng Zhao (Computational biology, disease modeling, Cardiac rhythm disorder), Heather Finotti (Mathematics, Cardiac rhythm disorder), Shigetoshi Eda (Wildlife health, Johne's disease), and Vitaly Ganusov (Theoretical immunology, Johne's disease).

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

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

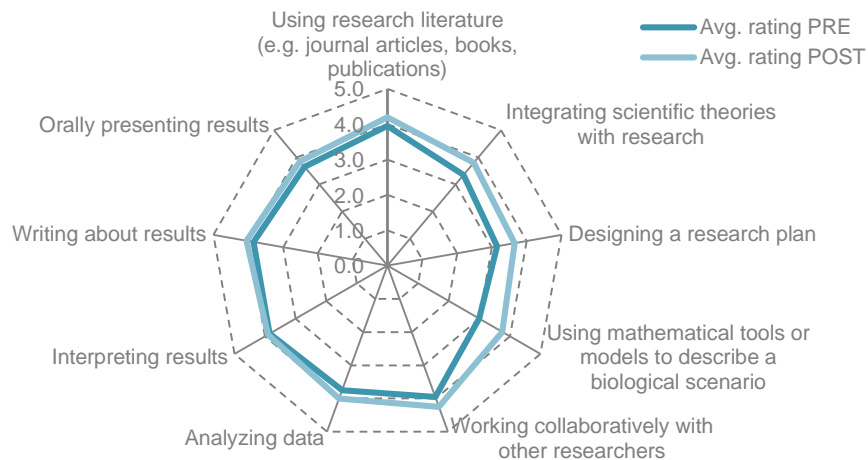


Figure 27. Participant pre- and post-program knowledge, response scale of 1 = extremely poor understanding to 5 = excellent understanding

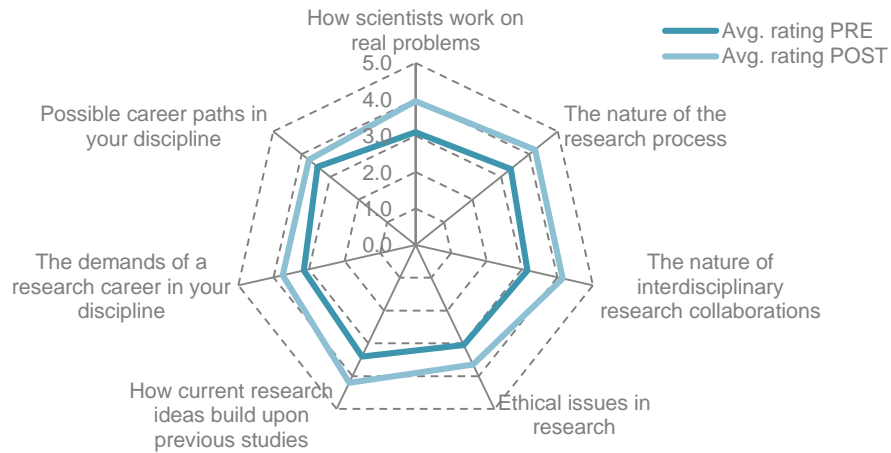
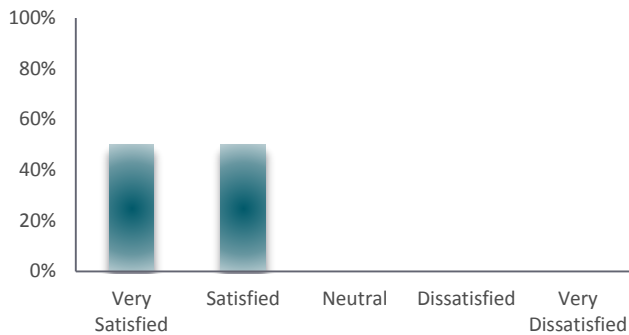


Figure 28. Overall satisfaction with the research experience



SRE participant comments:

I had an amazing experience and learned a lot. We will also be looking to get a publication out of this work so it is very exciting. The SRE was also nice because it didn't consume my entire summer!

I thought it was a great experience to branch out and see the world in different perspectives. Often times, majoring in one thing only makes you look at the way in a very specific, defined manner. However, the program really opened my eyes.

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

The NIMBioS sixth 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 1-2, 2014. 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.

More than 100 participants participated in the event. The sixth annual Undergraduate Research Conference 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 77 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

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

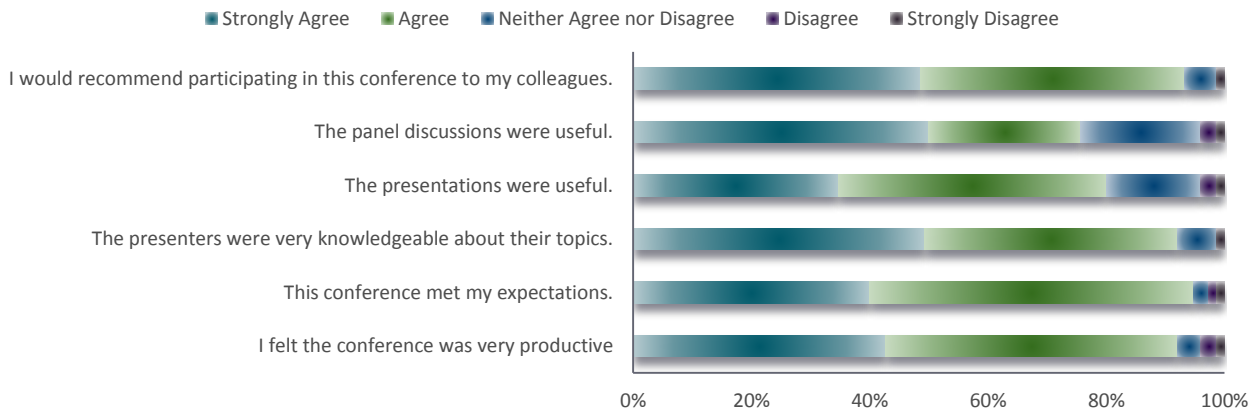
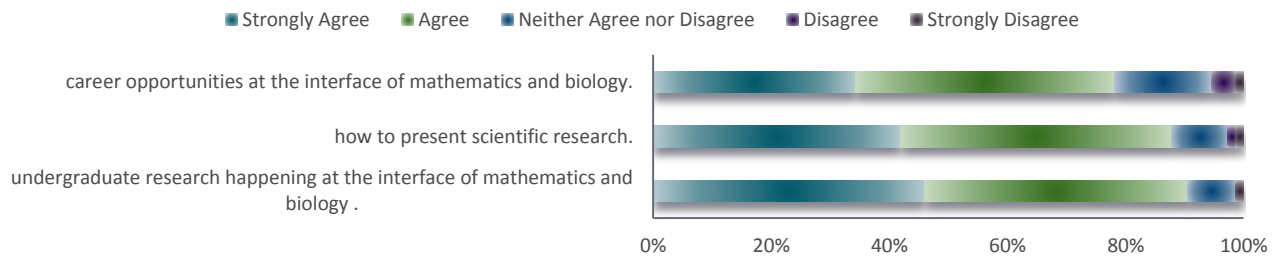


Figure 30. As a result of attending this conference, I have a better understanding of



URC participant comments:

I am so grateful I had the opportunity to attend the conference. It was enlightening, and would not have been financially possible for me without the support I received to come through NIMBioS

This conference impacted me in many ways and helped me learn and grow regarding research opportunities. I am honored to have been part of such event.

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 data bases, 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, 23 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

Figure 31. Postdoctoral fellow satisfaction with program mentors

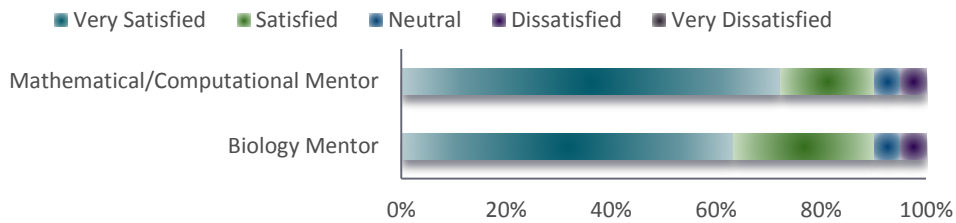


Figure 32. Postdoctoral fellow satisfaction with advice/assistance received from program mentors

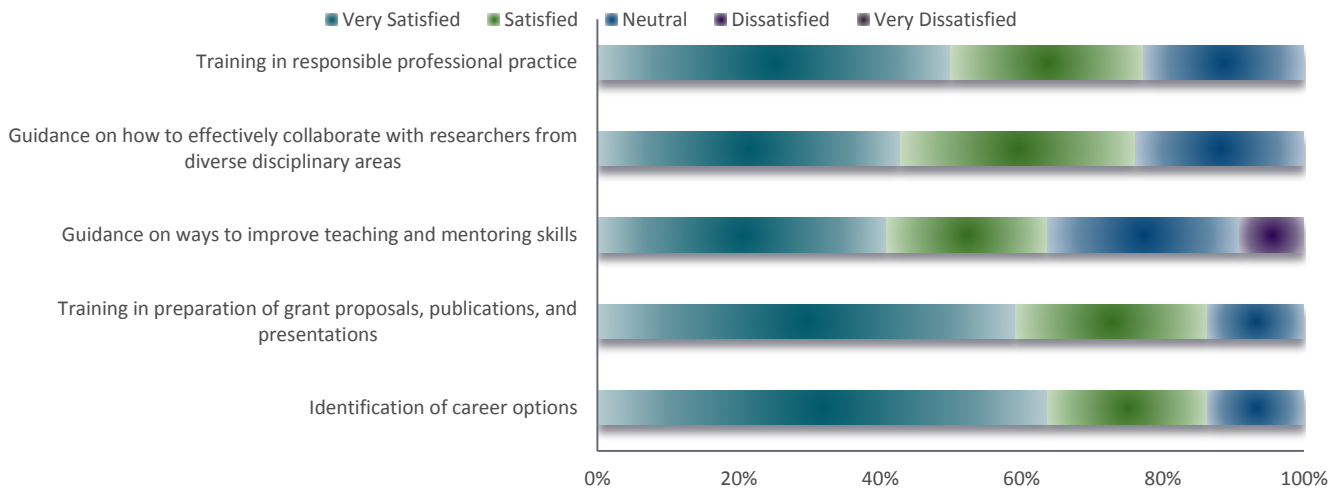


Figure 33. Postdoctoral fellow satisfaction with overall program experience



NIMBioS Postdoctoral Fellowship alumni comments:

If I had to do it all over again, I would be a NIMBioS postdoc again without hesitation.

I can't imagine a better post-doc experience. I will always feel very grateful for receiving the honor of being a part of NIMBioS.

This is probably the best postdoctoral experience I have had. I enjoyed working with colleagues as well as sharing the experience of my mentors in terms of career planning, job search and interview. One of the great things about NIMBioS postdoc experience is the opportunity to learn how to communicate your research to others, and having camera time talking about your research. Overall, I felt like NIMBioS was trying hard to improve the chances of its postdoc to get jobs and pursue their career. This is a great aspect the institute should consider prioritizing amid changes that may take place at the leadership level.

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.

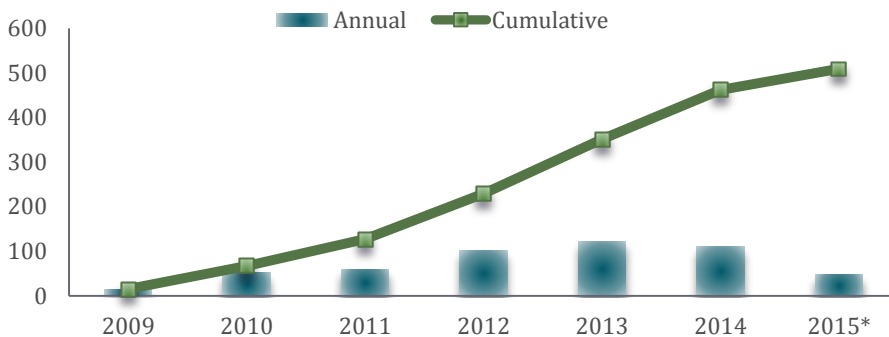
CONTEXT

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

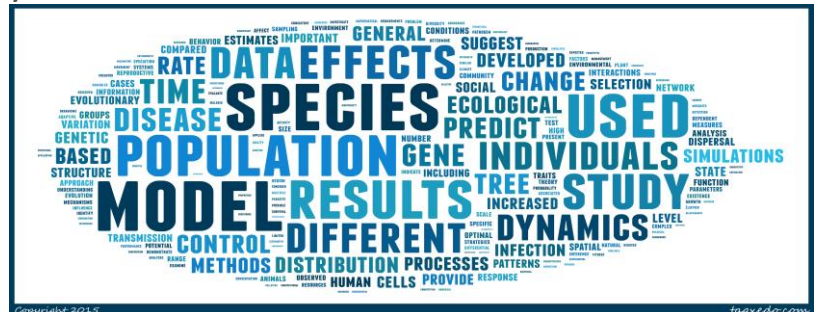
Activities at NIMBioS have led to 499 published journal articles on a range of subjects from 2009-April 2015 (Figures 34 and 35 and Table 6). An additional seven are in press at writing and 16 have been submitted for review. The articles cover research ranging across many areas of ecology, evolutionary biology, applied mathematics, and computational biology.

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



*2015 includes publications submitted by participants to NIMBioS through April, 2015

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



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 2015) and since NIMBioS' inception, sorted by journal 5-Year Impact Factor

Journal Title	5-Year Impact Factor *	# of NIMBioS Publications in Year 7 **	# of NIMBioS Publications Since Inception ***
Nature	42.35	1	3
Cell	35.02	-	1
Science	34.46	-	5
Trends in Ecology and Evolution	18.99	-	5
Ecology Letters	17.79	-	8
Systematic Biology	14.22	2	5
PLoS Biology	12.81	-	2
Nature Communications	11.02	2	2
Proceedings of the National Academy of Sciences	10.73	3	15
Current Biology	10.23	-	1
PLoS Genetics	8.90	-	2
Nucleic Acids Research	8.38	1	3
Phil Trans of the Royal Soc B-Biological Sciences	7.96	2	4
Molecular Ecology	6.54	3	7
Ecology	6.37	1	6
Proc of the Royal Soc B-Biological Sciences	5.81	3	9
PLoS Computational Biology	5.67	1	6
Evolution	5.47	5	15
Journal of Animal Ecology	5.44	1	3
The American Naturalist	5.20	4	11
Journal of the Royal Society Interface	4.88	2	5
PLoS One	4.02	6	26
Animal Behaviour	3.50	3	7
BMC Bioinformatics	3.49	1	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: $\text{cites in year } n \text{ to articles published in year } (n-1 + n-2) / \text{number of articles published in year } (n-1 + n-2)$.

** Number of publications in Year 7 includes all publications reported since compilation of the previous Annual Report (June 2014) through April 2015.

*** September 2008 – April 2015

NIMBioS publications come from a variety of activities, although Working Group participants tend to publish the largest portion of journal articles (29%), followed by NIMBioS Postdoctoral Fellows (21%) (Figure 36).

BIBLIOMETRIC INDICATORS

Of the 499 journal articles reported by NIMBioS participants, 438 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 1,210 researchers from 531 unique institutions spanning 49 countries. These articles have appeared in 196 different publications, many of which are considered to have high-impact in the academic community. These articles have been collectively cited 4,309 times, with an average of 9.82 cites per article, 612 citations per year, and an h-index of 30 (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 (3.65 citers/paper) and biology (15.65 citers/paper). Forty-four participants have authored five or more papers each as a result of NIMBioS affiliated collaborations.

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

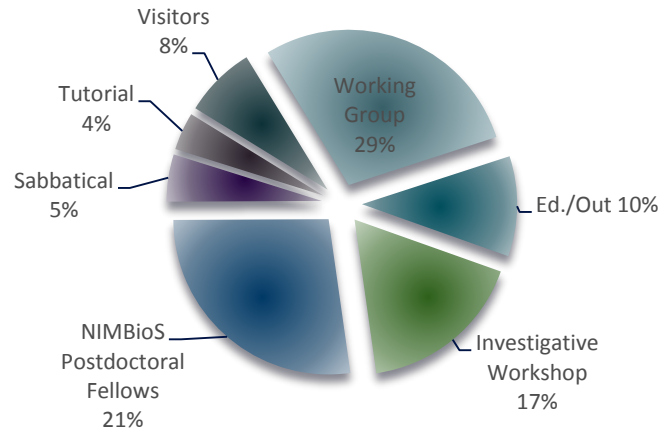
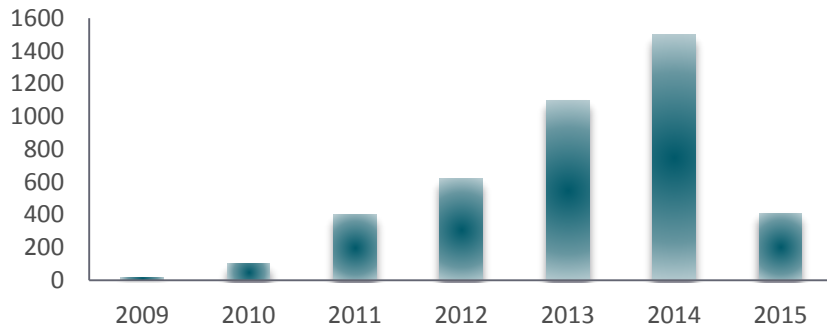


Figure 37. Citations per year for NIMBioS articles

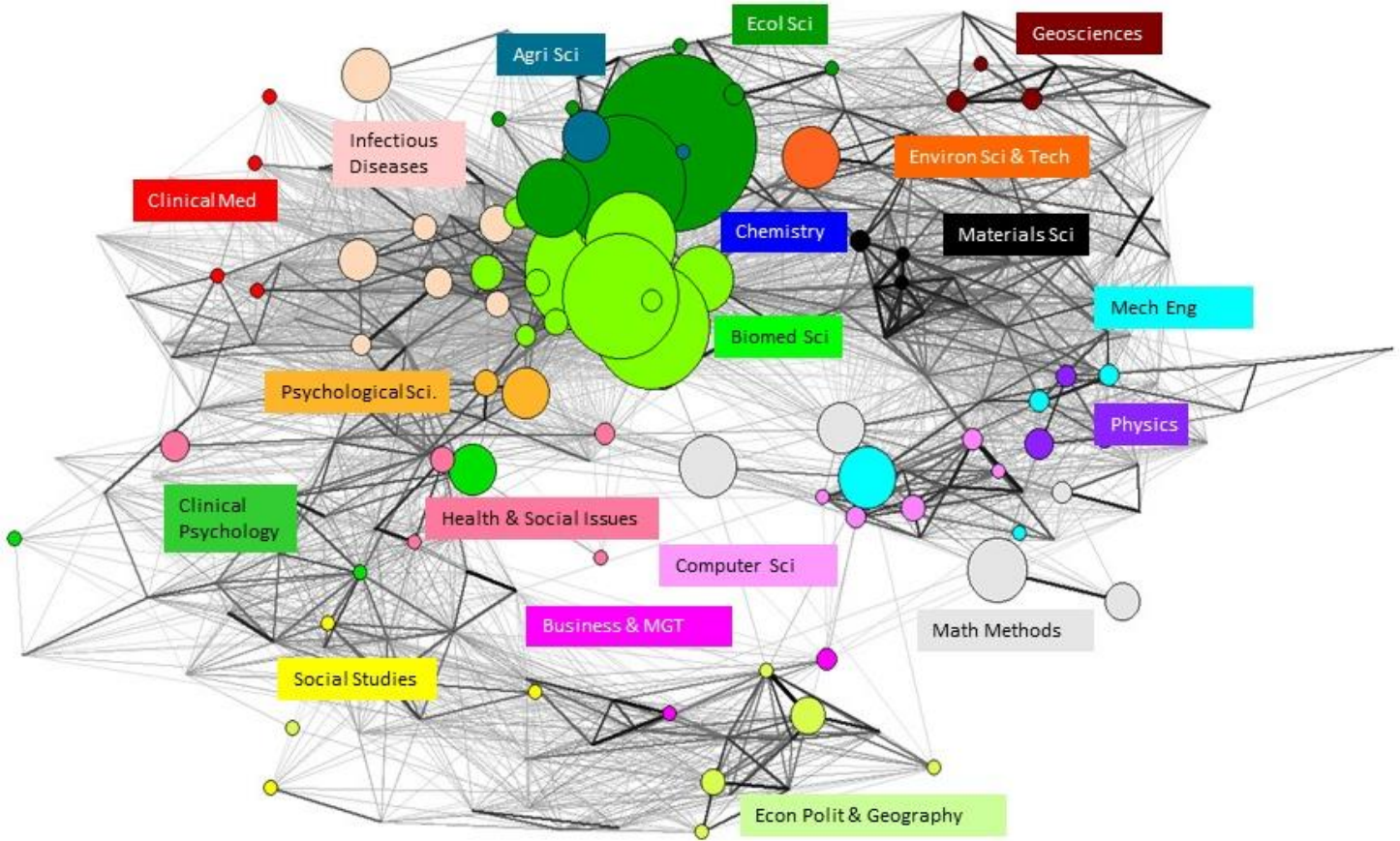


DISCIPLINARY SPAN OF PUBLICATIONS

The 438 published articles span 87 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 438 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 (126), followed by Evolutionary Biology (76), Multidisciplinary Sciences (64), Mathematical & Computational Biology (64), Biology (60), and Genetics & Heredity (39).

Figure 38. Web of Science Categories for 439 WoS journal articles to date



Method from Rafols, Porter and Leydesdorff (2009)

COLLABORATION

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 438 publications reported thus far, the average number of co-authors per paper is 4.2 (Figure 39).

Figure 39. Coauthorship frequency of NIMBioS publications

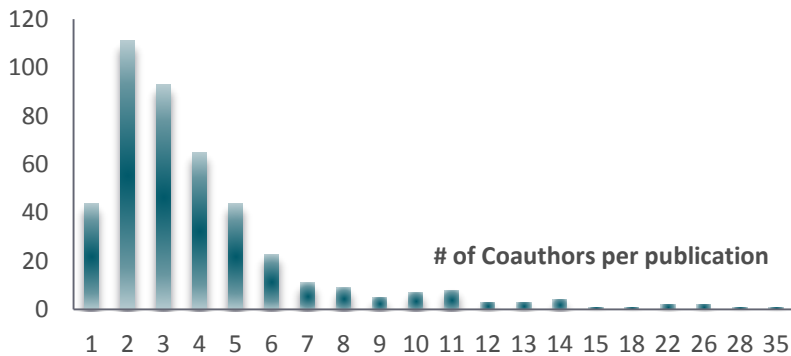
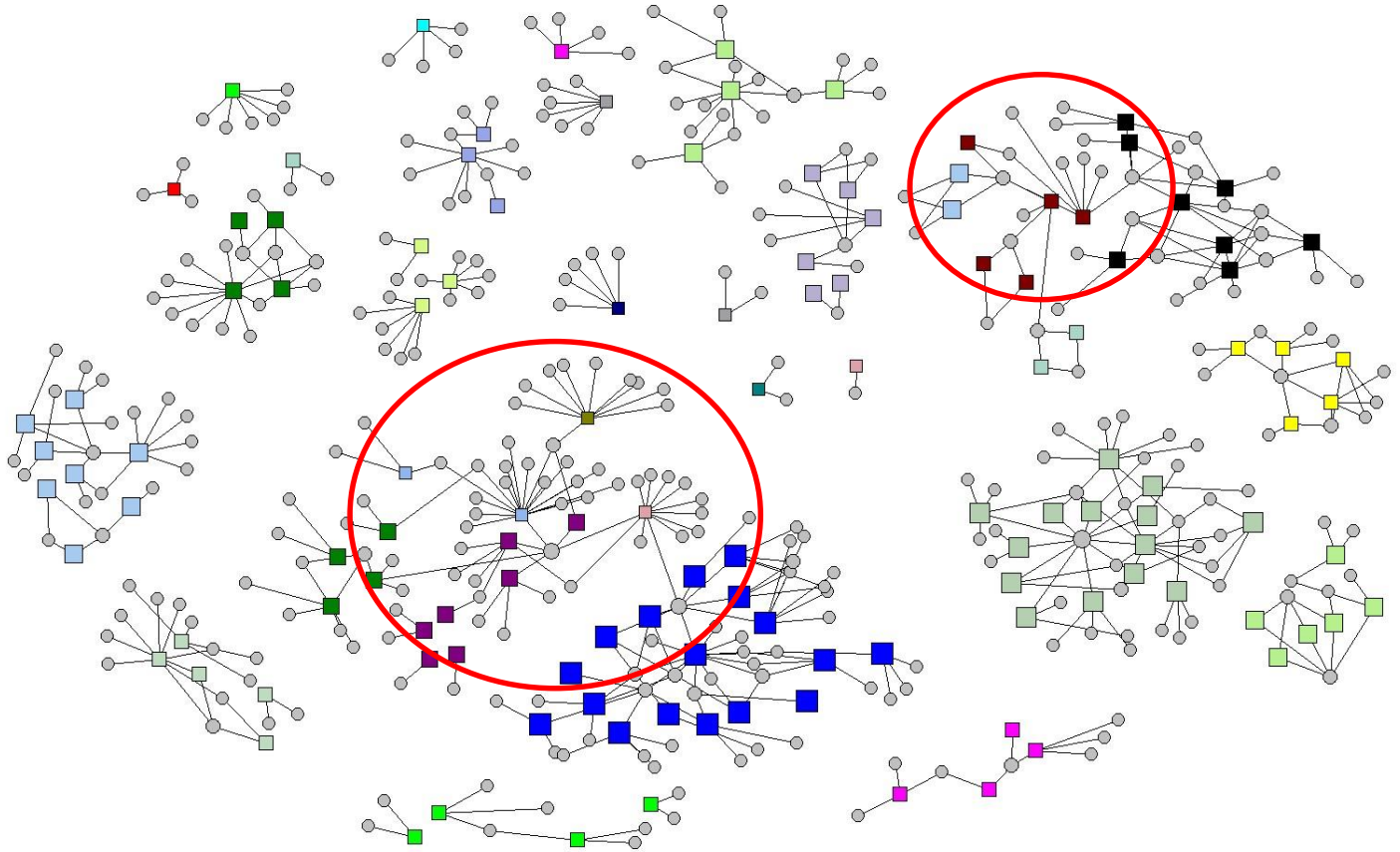


Figure 40 shows the paper-author network for Working Groups only. Twenty-four Working Groups have reported 124 publications related to their NIMBioS work. Grey circles represent authors and colored squares represent papers, colored by Working Group affiliation. Nodes are sized by numbers of publications for each group (squares) or a person’s total number of NIMBioS affiliated publications (circles). The Synthesizing and Predicting Infectious Disease (SPIDER) Working Group (large royal blue cluster, started in 2009), has been the most prolific group with 17 publications, followed by Population and Community Ecology Consequences of Intraspecific Niche Variation (large light green cluster, started 2009), with 14 publications. Most Working Groups do not co-author across groups, however, some members who participate in

multiple groups do author papers with members of two or more groups, as is the case with the two circled clusters in the figure. This cross-group authorship is becoming more prevalent as the institute matures.

Figure 40. Participant paper collaboration network for all Working Groups



NIMBioS also fosters international collaboration among researchers. While 49 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 1-10 countries represented per paper (Figure 41).

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.

Coauthors of NIMBioS publications through the current reporting period came from 531 unique institutions (Figure 42). The average number of institutions represented per paper was 3.0, with a range of 1-31 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 10 of the 531 institutions represented have published single-institution papers. The University of Tennessee is at the center of the graph.

Figure 41. International collaboration on NIMBioS publications

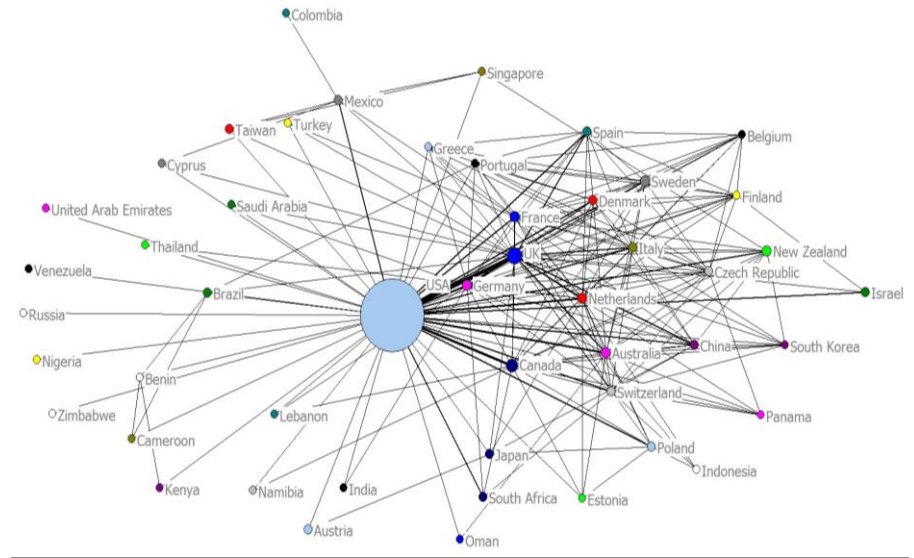
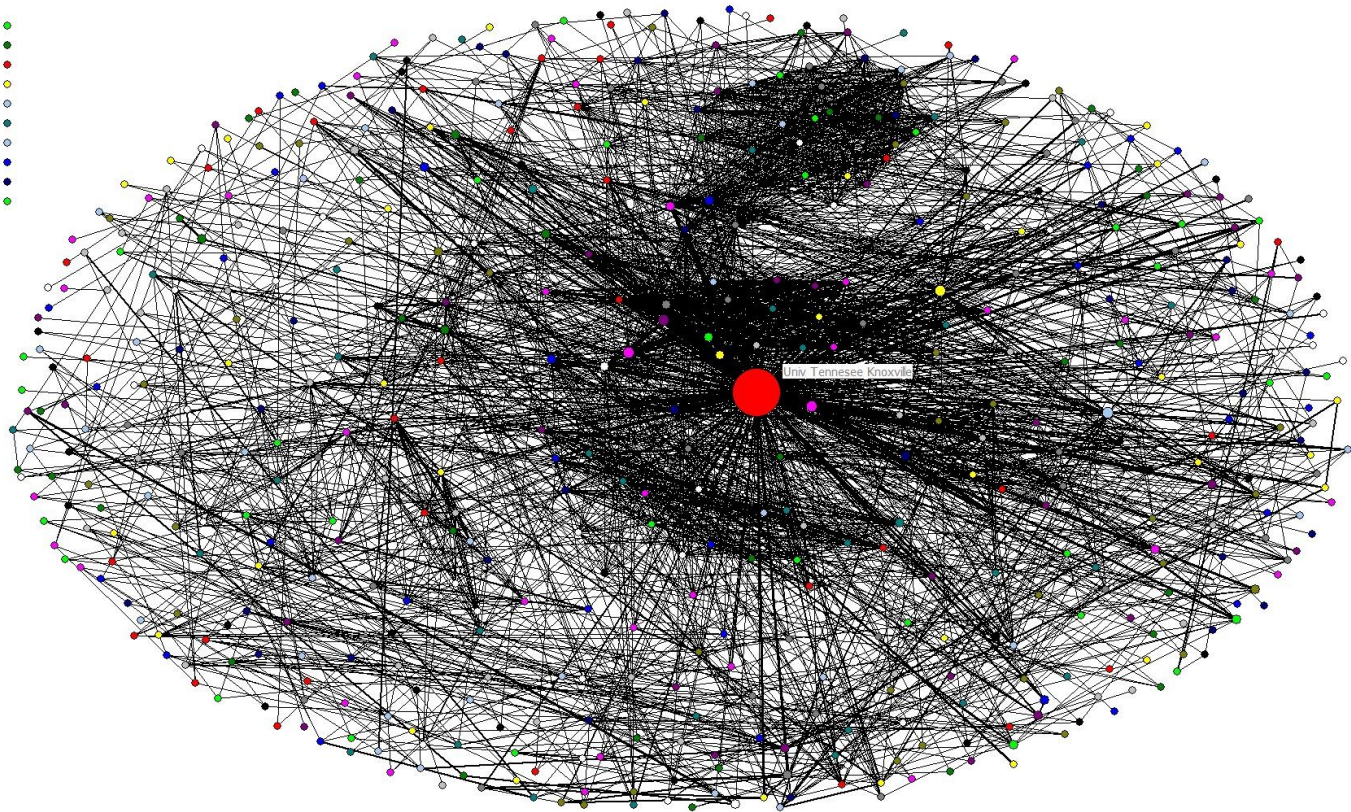


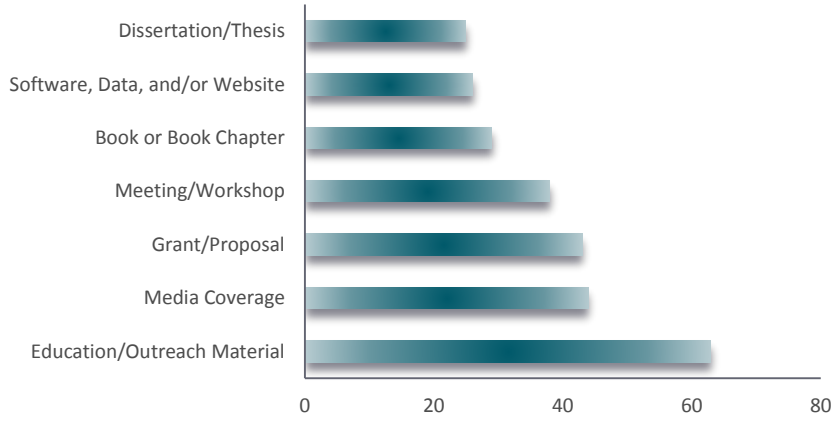
Figure 42. Cross-institutional collaboration of NIMBioS publications



OTHER SCHOLARLY PRODUCTS

In addition to journal publications, participants report other types of products that have resulted from their activities at NIMBioS. **Figure 43** summarizes these types of products for the seven-year period. In addition to the items listed in Figure 43, NIMBioS participants have reported 520 conference presentations related to NIMBioS affiliation.

Figure 43. Non-journal publication products arising from NIMBioS events



Addendum to NIMBioS Annual Report

Sep 1, 2014–Aug 31, 2015

Y7-3. Participant List for NIMBioS Events and Activities

PARTICIPANT LIST FOR NIMBIOS EVENTS AND ACTIVITIES

Advisory Board

NAME	PRIMARY FIELD OF STUDY	Start Date	End Date
BoA Meeting Oct. 2014		10/20/2014	10/21/2014
Camacho, Erika	Mathematics		
Jenkins, Kristin	Education		
Webb, Colleen	Biological/Biomedical Sciences		
Popovic, Lea	Mathematics		
Weitz, Joshua	Biological/Biomedical Sciences		
Brosnan, Sarah	Biological/Biomedical Sciences		
Washington, Talitha	Mathematics		
Velasco-Hernandez, Jorge	Biological/Biomedical Sciences		
Bourouiba, Lydia	Mathematics		
Jackson, Julius	Biological/Biomedical Sciences		
Mejia, Raymond	Other Professional Field		
Schlick, Tamar	Mathematics		
Day, Troy	Mathematics		
Robeva, Raina	Mathematics		
Kubatko, Laura	Mathematics		
Liebhold, Andrew (Sandy)	Biological/Biomedical Sciences		
Richerson, Peter (Pete)	Social Sciences		
Amarasekare, Priyanga	Biological/Biomedical Sciences		
Jonsson, Colleen	Biological/Biomedical Sciences		
Munoz-Zanzi, Claudia	Health Sciences		
Zhang, Nancy	Mathematics		
Fenichel, Eli	Agricultural Sciences/Natural Resources		
Wu, Jianhong	Mathematics		
BoA Virtual Meeting January 2015		1/20/2015	1/20/2015
Camacho, Erika	Mathematics		
Jenkins, Kristin	Education		
Popovic, Lea	Mathematics		
Uyenoyama, Marcy	Biological/Biomedical Sciences		
Weitz, Joshua	Biological/Biomedical Sciences		

Washington, Talitha	Mathematics
Velasco-Hernandez, Jorge	Biological/Biomedical Sciences
Bourouiba, Lydia	Mathematics
Jackson, Julius	Biological/Biomedical Sciences
Mejia, Raymond	Other Professional Field
Day, Troy	Mathematics
Robeva, Raina	Mathematics
Kubatko, Laura	Mathematics
Liebhold, Andrew (Sandy)	Biological/Biomedical Sciences
Richerson, Peter (Pete)	Social Sciences
Jonsson, Colleen	Biological/Biomedical Sciences
Munoz-Zanzi, Claudia	Health Sciences
Armsworth, Paul	Biological/Biomedical Sciences
Brothers, Ernest	Chemistry
Buchan, Alison	Biological/Biomedical Sciences
Gavrilets, Sergey	Biological/Biomedical Sciences
Lenhart, Suzanne	Mathematics
Welsh, Chris	Agricultural Sciences/Natural Resources
Fenichel, Eli	Agricultural Sciences/Natural Resources
Wu, Jianhong	Mathematics

BoA Virtual Meeting April 2015

4/6/2015 4/6/2015

Jenkins, Kristin	Education
Uyenoyama, Marcy	Biological/Biomedical Sciences
Washington, Talitha	Mathematics
Velasco-Hernandez, Jorge	Biological/Biomedical Sciences
Jackson, Julius	Biological/Biomedical Sciences
Mejia, Raymond	Other Professional Field
Day, Troy	Mathematics
Robeva, Raina	Mathematics
Liebhold, Andrew (Sandy)	Biological/Biomedical Sciences
Richerson, Peter (Pete)	Social Sciences
Jonsson, Colleen	Biological/Biomedical Sciences
Munoz-Zanzi, Claudia	Health Sciences
Armsworth, Paul	Biological/Biomedical Sciences
Buchan, Alison	Biological/Biomedical Sciences
Gavrilets, Sergey	Biological/Biomedical Sciences

Lenhart, Suzanne	Mathematics
Fenichel, Eli	Agricultural Sciences/Natural Resources
Wu, Jianhong	Mathematics

Education/Outreach

NAME	PRIMARY FIELD OF STUDY	Start Date	End Date
Graduate Research Assistant 2014		8/1/2014	4/30/2015
Bintz, Jason	Mathematics		
Dumoulin, Christine	Biological/Biomedical Sciences		
Levy, Benjamin (Ben)	Mathematics		
Martin, John	Computer & Information Sciences		
Milt, Austin	Biological/Biomedical Sciences		
NIMBioS Seminar Series			
Hobson, Elizabeth	Biological/Biomedical Sciences	9/9/2014	9/9/2014
Tanaka, Katsuya	Agricultural Sciences/Natural Resources	9/11/2014	9/11/2014
Peace, Angela (Angie)	Mathematics	9/23/2014	9/23/2014
Smouse, Peter	Agricultural Sciences/Natural Resources	10/7/2014	10/7/2014
Kawano, Sandy	Biological/Biomedical Sciences	10/21/2014	10/21/2014
Ferguson, Jake	Biological/Biomedical Sciences	11/4/2014	11/4/2014
Kokko, Hanna	Biological/Biomedical Sciences	11/11/2014	11/11/2014
Boyd, Robert	Social Sciences	11/18/2014	11/18/2014
Abel, Steven	Engineering	11/25/2014	11/25/2014
O'Regan, Suzanne	Mathematics	1/27/2015	1/27/2015
Krueger-Hadfield, Stacy	Biological/Biomedical Sciences	2/10/2015	2/10/2015
Lynch, Michael	Biological/Biomedical Sciences	2/10/2015	2/10/2015
Ramirez, Julio	Biological/Biomedical Sciences	2/25/2015	2/25/2015
Excoffier, Laurent	Biological/Biomedical Sciences	3/10/2015	3/10/2015
Salau, Kehinde	Mathematics	3/25/2015	3/25/2015
Zhao, Xiaopeng	Engineering	3/31/2015	3/31/2015
Farrior, Caroline	Biological/Biomedical Sciences	4/7/2015	4/7/2015
Mats Gyllenberg	Mathematics/Statistics	4/21/2015	4/21/2015
Postdoctoral Fellow			
Beaulieu, Jeremy	Biological/Biomedical Sciences	9/4/2012	2/1/2015

Ilany, Amiyaal	Biological/Biomedical Sciences	10/8/2012	1/7/2015
Aguilar, Clemente	Biological/Biomedical Sciences	7/8/2013	11/14/2014
Matzke, Nicholas (Nick)	Biological/Biomedical Sciences	9/9/2013	
Zefferman, Matthew (Matt)	Social Sciences	9/23/2013	
Hoban, Sean	Biological/Biomedical Sciences	9/30/2013	
Hobson, Elizabeth	Biological/Biomedical Sciences	6/2/2014	
Peace, Angela (Angie)	Mathematics	7/28/2014	
Kawano, Sandy	Biological/Biomedical Sciences	7/28/2014	
Ferguson, Jake	Biological/Biomedical Sciences	8/11/2014	
Farrior, Caroline	Biological/Biomedical Sciences	8/25/2014	
Sgouralis, Ioannis (John)	Mathematics	8/29/2014	
O'Regan, Suzanne	Mathematics	1/5/2015	

Undergraduate Research Conference (URC) 2014

11/1/2014 11/2/2014

Kelley, Michael	Mathematics
Hall, Elisha	Mathematics
Kuwano, Dodji	Not reported
Bean, Brennan	Mathematics
White, Alexander	Mathematics
Amirfaiz, Amir	Not reported
Blanton, Hugh	Not reported
Cintron-Arias, Ariel	Biological/Biomedical Sciences
Elgazzar, Rana	Not reported
Ignace, Caleb	Not reported
Lewis, David	Not reported
Martin, Benjamin	Not reported
Shaffer, Cassidy	Not reported
Anyaeche, Vivian	Biological/Biomedical Sciences
Nelms, Brian	Biological/Biomedical Sciences
Onabolu, Oreoluwa	Biological/Biomedical Sciences
Williams, Brandon	Not reported
Yagboyaju, Sultan	Not reported
DiDiego, John	Not reported
Martinez, Juita	Biological/Biomedical Sciences
Kelley, Victoria	Mathematics
Sipes, Katie	Biological/Biomedical Sciences
Brillhart, Wesley	Not reported

Burchfield, Shelbie	Not reported
Frye, Rebekah	Not reported
Swallow, Elizabeth	Not reported
Vaughan, Laura	Biological/Biomedical Sciences
Widner, Brooke	Not reported
Abieva, Linera	Not reported
Romadan, Marina	Not reported
Daniels, Henry	Not reported
Hagenbarth, Rachael	Chemistry
Merrick, Sierra	Not reported
Miller, Kasey	Biological/Biomedical Sciences
Rivers, Jasmine	Mathematics
Torres, Jose	Mathematics
Magruder, Daniel Sumner	Mathematics
Maki, Kara	Mathematics
Mooney, John	Mathematics
Cruickshank, Zhane	Biological/Biomedical Sciences
Kirkland, Maya	Not reported
Scott, Keyana	Not reported
Bufford, Kendrea	Mathematics
Maxwell, Leora	Engineering
Tien, Joseph	Mathematics
Kotthoff, Ian	Biological/Biomedical Sciences
Mao, Kailong	Biological/Biomedical Sciences
Wikle, Nathan	Mathematics
Lynch, Sabrina	Engineering
Cahill, Laura	Biological/Biomedical Sciences
Freligh, Andre	Biological/Biomedical Sciences
Sausa, Ross	Biological/Biomedical Sciences
Lewis, Thomas	Mathematics
Grooms, Jennifer	Not reported
Guth, Benjamin	Mathematics
Lenhart, Suzanne	Mathematics
Smith, Jeremy	Biological/Biomedical Sciences
Sturner, Kelly	Agricultural Sciences/Natural Resources
Cox, Brittney	Not reported
DeBellevue, Michael	Mathematics

Nguyen, Christy	Mathematics
Oyediran, Oladipo	Mathematics
Pang, Zengxing	Not reported
Chapina, Rosaura	Not reported
Barton, George	Mathematics
Berges, John	Ocean/Marine Sciences
Bersie, Lauren	Not reported
Bury, Alexis	Biological/Biomedical Sciences
Lauko, Istvan	Mathematics
Neubauer, Kimberlee	Not reported
Pederson, Joseph	Biological/Biomedical Sciences
Pickett, McKenzie	Biological/Biomedical Sciences
Schmidt, Ally	Not reported
Steiz, Chelsea	Not reported
Olivos, Anthony	Mathematics
Meyers, John	Computer & Information Sciences
Price, Kathryn	Biological/Biomedical Sciences
Vernon, Zoe	Mathematics

Summer Research Experience 2015

6/8/2015 7/31/2015

Bedell, Mariel
Dantzer, Ashley
Gauli, Ashish
Hujoel, Margaux
Johnson, Talon
Khanal, Januka
Lin, Yilin
Mummah, Riley
Parkman, Virginia
Rohly, Michael
Roman-Melendez, Emmie
Sashidhar, Diya
Sirek, Nick
Wei, Jinchuan
Wikle, Nathan
Wild, Ayana
Yan, Ryan

Tutorials

NAME	PRIMARY FIELD OF STUDY	Start Date	End Date
Using R for HPC TU		2/27/2015	2/27/2015
Madeleine Beatty	Business Analytics		
Kathleen Brannan-Donnelly	Not reported		
Liu Cao	Not reported		
Eric Carr	Geological & Earth Sciences		
Huan Chen	Not reported		
Blair Christian	Mathematics		
Chanda Drennen	Not reported		
Caroline Farrior	Biological/Biomedical Sciences		
Sean Hoban	Biological/Biomedical Sciences		
Sandy Kawano	Biological/Biomedical Sciences		
Thomas Lane	Not reported		
Irma Lima Rojas	Not reported		
Ayan Malakar	Other Professional Field		
David Mercer	Not reported		
Bob Muenchen	Mathematics		
Alex Pawlowski	Other Professional Field		
Angela (Angie) Peace	Mathematics		
Eduardo Ponce	Computer & Information Sciences		
Joshua Price	Not reported		
Ana Richters	Other Professional Field		
Andrea Rocha	Biological/Biomedical Sciences		
Drew Schmidt	Computer & Information Sciences		
Ken Sublett	Computer & Information Sciences		
Nathan Sutton	Biological/Biomedical Sciences		
Mario Vela	Engineering		
Matthew (Matt) Zefferman	Social Sciences		
Current Issues in Statistical Ecology TU		4/15/2015	4/17/2015
Adu-Oppong, Boahemaa	Biological/Biomedical Sciences		
Aoki, Carissa	Biological/Biomedical Sciences		
Araya-Salas, Marcelo	Not reported		
Barner, Allison	Biological/Biomedical Sciences		
Beckage, Brian	Biological/Biomedical Sciences		

Bonilla, Nelson	Biological/Biomedical Sciences
Bravo, Catherine	Biological/Biomedical Sciences
Buelow, Heather	Biological/Biomedical Sciences
Calle, Leonardo	Biological/Biomedical Sciences
Castillo-Chavez, Carlos	Mathematics
Castro Escobar, Betsabe	Social Sciences
Cruz-Marrero, Wilmelie	Ocean/Marine Sciences
Davis, Ancilleno	Ocean/Marine Sciences
Dean, Charmaine	Mathematics
Fagundo, Raquel	Biological/Biomedical Sciences
Fischer, Justin	Biological/Biomedical Sciences
Granados, Monica	Biological/Biomedical Sciences
Gross, Louis	Biological/Biomedical Sciences
Guo, Jessica	Biological/Biomedical Sciences
Guzman-Colon, Diana	Agricultural Sciences/Natural Resources
Harris, Erica	Biological/Biomedical Sciences
Heim, Kurt	Biological/Biomedical Sciences
Hille Ris Lambers, Janneke	Biological/Biomedical Sciences
Hogan, Aaron	Biological/Biomedical Sciences
Hurst, Zachary	Agricultural Sciences/Natural Resources
Johnston, Miriam	Biological/Biomedical Sciences
Joppa, Lucas	Agricultural Sciences/Natural Resources
Joseph, Carrie	Agricultural Sciences/Natural Resources
Kelley, Rebecca	Biological/Biomedical Sciences
Ketz, Alison	Biological/Biomedical Sciences
Krumbeck, Janina	Biological/Biomedical Sciences
Lenhart, Suzanne	Mathematics
Levine, Carrie	Biological/Biomedical Sciences
Luo, Jessica	Ocean/Marine Sciences
Marion, Zachary	Biological/Biomedical Sciences
Meza-Lopez, Maria	Biological/Biomedical Sciences

Mourad, Teresa	Education
Munoz, David	Agricultural Sciences/Natural Resources
Nuanez, Michelle	Biological/Biomedical Sciences
Ogle, Kiona	Biological/Biomedical Sciences
Poudel, Ravin	Agricultural Sciences/Natural Resources
Ramos, Jorge	Biological/Biomedical Sciences
Recart Gonzalez, Wilnelia	Biological/Biomedical Sciences
Roopsind, Anand	Agricultural Sciences/Natural Resources
Rubenstein, Madeleine	Biological/Biomedical Sciences
Schultz, Emily	Biological/Biomedical Sciences
Smith Vidaurre, Grace	Biological/Biomedical Sciences
Tapia, Javier	Mathematics
Whitaker, Briana	Biological/Biomedical Sciences
Schmidt, Drew	Computer & Information Sciences

Working Groups

NAME	PRIMARY FIELD OF STUDY	Start Date	End Date
Modeling Antimicrobial Resistance (AMR) Intervention WG M1		9/19/2014	9/22/2014
Karp, Beth	Health Sciences		
Spicknall, Ian	Health Sciences		
Grohn, Yrjo	Health Sciences		
Li, Min	Agricultural Sciences/Natural Resources		
Volkova, Victoriya	Health Sciences		
Pullum, Laura	Computer & Information Sciences		
Van Boeckel, Thomas	Health Sciences		
Carson, Carolee	Health Sciences		
Bjork, Kathe	Health Sciences		
Lewis, Craig	Health Sciences		
White, David	Biological/Biomedical Sciences		
Ponciano Castellanos, Jose	Mathematics		
Hungerford, Laura	Health Sciences		
Lanzas, Cristina	Health Sciences		

Hierarchy and Leadership WG M4**10/13/2014 10/15/2014**

Pusey, Anne	Biological/Biomedical Sciences
Smith, Jennifer	Biological/Biomedical Sciences
Nettle, Daniel	Biological/Biomedical Sciences
Hooper, Paul	Social Sciences
Hauert, Christoph	Physics
Borgerhoff Mulder, Monique	Social Sciences
Zefferman, Matthew (Matt)	Social Sciences
Perry, Susan	Social Sciences
El Mouden, Claire	Biological/Biomedical Sciences
Gavrilets, Sergey	Biological/Biomedical Sciences
Smith, Eric	Social Sciences

A DEB Model for Trees WG M1**10/14/2014 10/17/2014**

Peace, Angela (Angie)	Mathematics
Zimmer, Elke	Biological/Biomedical Sciences Agricultural Sciences/Natural Resources
Couvreur, Valentin	
Bartlett, Megan	Biological/Biomedical Sciences
Sack, Lawren	Biological/Biomedical Sciences
Muller, Erik	Biological/Biomedical Sciences
Nisbet, Roger	Biological/Biomedical Sciences
Ledder, Glenn	Mathematics
Russo, Sabrina	Biological/Biomedical Sciences
Farrior, Caroline	Biological/Biomedical Sciences
Way, Danielle	Biological/Biomedical Sciences

Plant-Soil Feedback Theory WG M3**11/3/2014 11/5/2014**

Abbott, Karen	Biological/Biomedical Sciences
Bauer, Jonathan	Biological/Biomedical Sciences
Bever, James (Jim)	Biological/Biomedical Sciences
Comita, Liza	Biological/Biomedical Sciences
Suding, Katherine	Biological/Biomedical Sciences
Crawford, Kerri	Biological/Biomedical Sciences
Mack, Keenan	Biological/Biomedical Sciences
Jiang, Jiang	Biological/Biomedical Sciences
Baudena, Mara	Biological/Biomedical Sciences

Eppinga, Maarten	Agricultural Sciences/Natural Resources
Mangan, Scott	Biological/Biomedical Sciences
Johnson, Daniel (Dan)	Biological/Biomedical Sciences

Evolution of Sustainability WG M2

11/17/2014 11/20/2014

Baggio, Jacopo	Social Sciences
Janssen, Marco	Social Sciences
Frank, Karin	Biological/Biomedical Sciences
Smaldino, Paul	Biological/Biomedical Sciences
Moya, Cristina	Social Sciences
Hillis, Vicken	Biological/Biomedical Sciences
Zefferman, Matthew (Matt)	Social Sciences
Waring, Timothy	Geological & Earth Sciences
Panchanathan, Karthik	Social Sciences

Nonautonomous Systems and Terrestrial Carbon Cycle WG M3

11/17/2014 11/21/2014

Wang, Ying-Ping	Geological & Earth Sciences
Rasmussen, Matthew (Matt)	Computer & Information Sciences
Smith, Matthew	Biological/Biomedical Sciences
Hastings, Alan	Mathematics
Luo, Yiqi	Biological/Biomedical Sciences
Todd-Brown, Katherine (Kathe)	Geological & Earth Sciences
Wang, Ying	Mathematics
Jiang, Jiang	Biological/Biomedical Sciences
Chen-Charpentier, Benito	Mathematics

Expanding Data Nuggets WG M1

1/7/2015 1/9/2015

Stuhlsatz, Molly	Education
Jenkins, Kristin	Education
Cintron-Arias, Ariel	Biological/Biomedical Sciences
Strode, Paul	Biological/Biomedical Sciences
Mayes, Robert	Education
Kjelvik, Melissa	Biological/Biomedical Sciences
Mead, Louise	Education
Schultheis, Elizabeth	Biological/Biomedical Sciences
Wojdak, Jeremy	Biological/Biomedical Sciences
Hartley, Laurel	Biological/Biomedical Sciences

Morris, Julie	Biological/Biomedical Sciences
Uno, Gordon	Biological/Biomedical Sciences

'Pretty Darn Good' Control: Extensions of Optimal Control for Ecological Systems WG M4

1/21/2015 1/23/2015

Chades, Iadine	Biological/Biomedical Sciences
Toews, Carl	Mathematics
Karnauskas, Mandy	Biological/Biomedical Sciences
Ryan, Daniel (Dan)	Mathematics
Boettiger, Carl	Biological/Biomedical Sciences
Hastings, Alan	Mathematics
Sanchirico, James (Jim)	Social Sciences
Donahue, Megan	Biological/Biomedical Sciences
Bode, Michael	Mathematics
Paris, Claire	Ocean/Marine Sciences
Armsworth, Paul	Biological/Biomedical Sciences
LaRiviere, Jacob	Social Sciences

Habitat for Migratory Species WG M2

1/26/2015 1/29/2015

Federico, Paula	Mathematics
Nicol, Sam	Agricultural Sciences/Natural Resources
Earl, Julia	Biological/Biomedical Sciences
Mattsson, Brady	Agricultural Sciences/Natural Resources
Long, Kevin	Mathematics
Diffendorfer, James (Jay)	Not reported
Erickson, Richard	Agricultural Sciences/Natural Resources
Runge, Michael	Agricultural Sciences/Natural Resources
Semmens, Darius	Agricultural Sciences/Natural Resources
Thogmartin, Wayne	Agricultural Sciences/Natural Resources
Lopez Hoffman, Laura	Agricultural Sciences/Natural Resources
Wiederholt, Ruscena	Biological/Biomedical Sciences
Fryxell, John	Biological/Biomedical Sciences
Norris, Ryan	Biological/Biomedical Sciences
Bieri, Joanna	Mathematics

Krauel, Jennifer Biological/Biomedical Sciences
McCracken, Gary Biological/Biomedical Sciences

Evolution of Institutions WG M2

2/11/2015 2/13/2015

Anderies, John Social Sciences
Golman, Russell Social Sciences
Meza Woolley, Olivia Mathematics
Robinson, Amanda Social Sciences
Richerson, Peter (Pete) Social Sciences
Zefferman, Matthew (Matt) Social Sciences
Turchin, Peter Social Sciences
Bednar, Jenna Social Sciences
Gavrilets, Sergey Biological/Biomedical Sciences
Roemer, John Social Sciences

Modeling Antimicrobial Resistance (AMR) Intervention WG M2

2/23/2015 2/25/2015

Karp, Beth Health Sciences
Spicknall, Ian Health Sciences
Grohn, Yrjo Health Sciences
Stanhope, Michael Biological/Biomedical Sciences
Volkova, Victoriya Health Sciences
Pullum, Laura Computer & Information Sciences
Van Boeckel, Thomas Health Sciences
Carson, Carolee Health Sciences
Bjork, Kathe Health Sciences
Lewis, Craig Health Sciences
Ruan, Shigui Mathematics
Lanzas, Cristina Health Sciences

Vector Movement and Disease WG M1

3/30/2015 4/2/2015

Kuang, Yang Mathematics
Peace, Angela (Angie) Mathematics
Li, Jing Mathematics
Cintron-Arias, Ariel Biological/Biomedical Sciences
Legg, James Biological/Biomedical Sciences

Pattemore, David	Biological/Biomedical Sciences
Sharon, Rakefet	Agricultural Sciences/Natural Resources
Medlock, Jan	Health Sciences
Lee, Jo Ann	Mathematics
Bosque-Perez, Nilsa	Biological/Biomedical Sciences
Shaw, Allison	Biological/Biomedical Sciences
Finke, Deborah	Biological/Biomedical Sciences
Lenhart, Suzanne	Mathematics
Lewis, Chelsea	Mathematics
Crowder, David	Biological/Biomedical Sciences

Leptospirosis Modeling M1

4/8/2015 4/10/2015

Convertino, Matteo	Engineering
de la Pena-Moctezuma, Alejandro	Health Sciences
Feng, Zhilan	Mathematics
Gompper, Matthew	Biological/Biomedical Sciences
Hartskeerl, Rudolf (Rudy)	Biological/Biomedical Sciences
Herbreteau, Vincent	Health Sciences
Lenhart, Suzanne	Mathematics
Munoz-Zanzi, Claudia	Health Sciences
O'Regan, Suzanne	Mathematics
Previtali, Andrea	Biological/Biomedical Sciences
Schneider, Maria Cristina	Health Sciences
Velasco-Hernandez, Jorge	Biological/Biomedical Sciences

Climate Proxies M1

4/20/2015 4/24/2015

Bush, Mark	Biological/Biomedical Sciences
Correa-Metrio, Alex	Geological & Earth Sciences
Enquist, Brian	Biological/Biomedical Sciences

Hwang, Grace	Biological/Biomedical Sciences
McMichael, Crystal	Biological/Biomedical Sciences
Silman, Miles	Biological/Biomedical Sciences
Unal, Arzu	Mathematics
van Woesik, Robert	Ocean/Marine Sciences
Wright, Joe	Biological/Biomedical Sciences

Evolution of Institutions M2

5/6/2015 5/9/2015

Anderies, Marty
Aoki, Masahiko
Bednar, Jenna
Gavrilets, Sergey
Golman, Russell
Mathew, Sarah
Meza, Olivia Woolley
Richerson, Pete
Robinson, Amanda
Zefferman, Matt

Dispersal Biogeography M1

5/11/2015 5/14/2015

Amarasekare, Priyanga
Bolker, Ben
Bullock, James
Crone, Elizabeth
Dambros, Cristian
Graham, Catherine
Lawing, Michelle
Lewis, Mark
Machac, Antonin
Petrovskii, Sergei
Shea, Katriona
Teller, Brittany

Biotic Interactions M4

5/11/2015 5/15/2015

Araujo, Miguel
Blanchet, Guillaume
Godsoe, Will
Gravel, Dominique
Holt, Robert
Jager, Yetta
Jankowski, Jill
King, Tony
Norberg, Anna
Ovaskainen, Otso

Plant-Soil Feedback Theory M4

5/26/2015 5/29/2015

Abbott, Karen
Bauer, Jonathan
Bever, Jim
Comita, Liza
Crawford, Kerri
Eppinga, Maarten
Jiang, Jiang
Johnson, Dan
Mack, Keenan
Mangan, Scott
Strand, Allan
Suding, Katharine
Umbanhowar, James
Yakubu, Abdul-Aziz

Climate Change and Vector-borne Diseases M3

6/1/2015 6/3/2015

Agusto, Fola
Ashfaq, Moet
Fefferman, Nina
Gumel, Abba
Lenhart, Suzanne
Mickens, Ronald
Naumova, Elena

Parham, Paul
Ostfeld, Richard
Ready, Paul
Thomas, Matthew
Velasco-Hernandez, Jorge
Zhu, Huaiping

Computational Landscape Genomics M2

6/3/2015 6/6/2015

Antolin, Michael
Bradburd, Gideon
DeGiorgio, Mike
Hancock, Angela
Hoban, Sean
Huerta-Sanchez, Emilia
Kelley, Joanna
Lowry, David
Mitchell-Olds, Tom
Poss, Mary
Reed, Laura
Storfer, Andrew
Whitlock, Mike

Ecological Network Dynamics M1

6/10/2015 6/12/2015

de Aguiar, Marcus
Burkle, Laura
Díaz Castelazo, Cecilia
Fortin, Marie-Josée
Gravel, Dominique
Gross, Thilo
Hembry, David
Mueller, Ulrich
Newman, Erica
O'Donnell, Jimmy
Olesen, Jens
Pires, Mathias
Poisot, Timothée
Yeakel, Justin

A DEB Model for Trees M2

6/15/2015 6/19/2015

Bartlett, Megan
Couvreur, Valentin
Farrior, Caroline
Hopmans, Jan
Ledder, Glenn
Muller, Erik
Nisbet, Roger
Peace, Angie
Russo, Sabrina
Sack, Lawren
Sterck, Frank
Way, Danielle
Zimmer, Elke

Habitat for Migratory Species M3

7/20/2015 7/23/2015

Bieri, Joanna
Diffendorfer, Jay
Earl, Julia
Erickson, Richard
Federico, Paula
Fryxell, John
Long, Kevin
López-Hoffman, Laura
Mattsson, Brady
McCracken, Gary
Nicol, Sam
Norris, Ryan
Runge, Mike
Sample, Christine
Semmens, Darius
Thogmartin, Wayne
Wiederholt, Ruscena

Nonautonomous Systems and Terrestrial Carbon Cycle M4

7/27/2015 7/31/2015

Agusto, Folashade

Chen, Benito
Hastings, Alan
Hoffman, Forrest
Jiang, Jiang
Luo, Yiqi
Medlyn, Belinda
Rasmussen, Martin
Smith, Matthew
Todd-Brown, Kathe
Wang, Ying Ping
Wang, Ying

Investigative Workshop

NAME	PRIMARY FIELD OF STUDY	Start Date	End Date
Heart Rhythm Disorders WS		12/3/2014	12/5/2014
Lin, Yun	Other Professional Field		
Fraguela Collar, Andres	Mathematics		
Lemuz, Rafael	Computer & Information Sciences		
Meo, Marianna	Engineering		
Shiferaw, Yohannes	Physics		
Christini, David	Biological/Biomedical Sciences		
Krogh-Madsen, Trine	Biological/Biomedical Sciences		
Hubbard, Marjorie	Engineering		
Fenton, Flavio	Physics		
Grigoriev, Roman	Physics		
Ji, Yanyan	Physics		
Gao, Jianbo	Computer & Information Sciences		
Potse, Mark	Physics		
Solhjoo, Soroosh	Engineering		
Sinkala, Zachariah	Mathematics		
Karma, Alain	Physics		
Cherry, Elizabeth	Mathematics		
Munoz, Laura	Mathematics		
Otani, Niels	Mathematics		
Seshan, Sridhar	Physics		
Garzon, Alejandro	Biological/Biomedical Sciences		
Zlochiver, Sharon	Biological/Biomedical Sciences		
Onal, Birce	Engineering		
Alencar Filho, Aristoteles	Health Sciences		
Uzor, Blessing	Mathematics		
Patwardhan, Abhijit	Engineering		
Coulibaly, Zana	Mathematics		
Kulkarni, Kanchan	Biological/Biomedical Sciences		
Talkachova, Alena	Engineering		
Cain, John	Mathematics		
Alexiades, Vasilios	Mathematics		
Newby, Steven	Biological/Biomedical Sciences		
Zhao, Xiaopeng	Engineering		

Wang, Xueying	Mathematics
Xia, Ling	Biological/Biomedical Sciences
Sullivan, Adam	Engineering
Szymkiewicz, Steven	Biological/Biomedical Sciences

Lymphoid Cells in Acute Inflammation WS

1/15/2015

1/16/2015

Wentz, Jacqueline	Engineering Biological/Biomedical Sciences
Kepler, Thomas	Biological/Biomedical Sciences
Barba, Cindy	Biological/Biomedical Sciences
Park, Christa	Not reported Biological/Biomedical Sciences
Cintron-Arias, Ariel	Mathematics
Joyner, Michele	Mathematics
Li, Qingxia	Biological/Biomedical Sciences
Lederer, James	Mathematics
Washington, Talitha	Computer & Information Sciences
Bartels, John	Mathematics
Arciero, Julia	Mathematics
Mummert, Anna	Engineering
Chakraborty, Arup	Not reported
Johnson, Mike	Mathematics
McGee, Reginald	Not reported
Androulakikis, Ioannis	Mathematics
Nanda, Seema	Biological/Biomedical Sciences
Das, Jayajit	Biological/Biomedical Sciences
Hong, Tian	Engineering
Wu, Tie Bo	Biological/Biomedical Sciences
An, Gary	Mathematics
McKinley, Scott	Biological/Biomedical Sciences
Becker, Daniel	Biological/Biomedical Sciences
Cannon, Judy	Computer & Information Sciences
Moses, Melanie	Health Sciences
Xie, Xiaoyue	

Abboud, Andrew	Biological/Biomedical Sciences
Billiar, Timothy	Health Sciences
Darwiche, Sophie	Health Sciences
Namas, Rami	Biological/Biomedical Sciences
Ramadan, Mostafa	Biological/Biomedical Sciences
Vodovotz, Yoram	Biological/Biomedical Sciences
Zamora, Ruben	Biological/Biomedical Sciences
Abel, Steven	Engineering
Caldwell, James (Marc)	Health Sciences
Day, Judy	Mathematics
Fry, Michael	Health Sciences
Kania, Stephen	Biological/Biomedical Sciences
Mlynarczyk, Paul	Not reported
Pantha, Buddhi	Mathematics
Segal, Rebecca	Mathematics
Bassaganya-Riera, Josep	Biological/Biomedical Sciences
Li, Liwu	Biological/Biomedical Sciences
Schugart, Richard	Mathematics

Olfactory Modeling WS

3/2/2015

3/4/2015

Birgiolas, Justas	Other Professional Field
Crook, Sharon	Biological/Biomedical Sciences
Gerkin, Richard	Biological/Biomedical Sciences
Sinakevitch, Irina	Biological/Biomedical Sciences
Burton, Shawn	Engineering
Yeh, Chung-Heng	Engineering
Cleland, Thomas	Biological/Biomedical Sciences
Linster, Christiane	Biological/Biomedical Sciences
Doloc-Mihu, Anca	Computer & Information Sciences
Gunay, Cengiz	Computer & Information Sciences

Simoes de Souza, Fabio	Biological/Biomedical Sciences
Migliore, Michele	Biological/Biomedical Sciences
Rinberg, Dmitry	Biological/Biomedical Sciences
Park, Choongseok	Mathematics
Belli, Hayley	Mathematics
Padmanabhan, Krishnan	Biological/Biomedical Sciences
Smith, Brian	Biological/Biomedical Sciences
Bazhenov, Maxim	Biological/Biomedical Sciences
Chen, Jen-Yung	Computer & Information Sciences
Glenn-Hall, Tiffany	Biological/Biomedical Sciences
Huerta, Ramon	Biological/Biomedical Sciences
Bower, James	Biological/Biomedical Sciences
Kay, Leslie	Biological/Biomedical Sciences
Osinski, Boleslaw	Physics
Restrepo, Diego	Biological/Biomedical Sciences
O'Connor, Simon	Biological/Biomedical Sciences
Steuber, Volker	Biological/Biomedical Sciences
Madany, Amir	Computer & Information Sciences
Metzner, Christoph	Biological/Biomedical Sciences
Oswald, Anne-Marie	Biological/Biomedical Sciences
Nowotny, Thomas	Physics
Schmuker, Michael	Chemistry
Adebali, Ogun	Biological/Biomedical Sciences
Burghardt, Gordon	Biological/Biomedical Sciences
Hollis, Francine	Agricultural Sciences/Natural Resources
Sgouralis, Ioannis (John)	Mathematics
Sgouralis, Ioannis (John)	Mathematics

Shepherd, Gordon
Biological/Biomedical
Sciences

Neurobiology of Expertise WS

3/11/2015

3/13/2015

Appelbaum, Lawrence (Greg) Psychology
Ericsson, Karl (Anders) Psychology
Haufler, Amy Biological/Biomedical
Sciences
Cho, Eungchun Mathematics
Ba, Demba Engineering
Smith, Anne Biological/Biomedical
Sciences
Cisneros, Pedro Engineering
Yoo, Herb Engineering
Macknik, Stephen Biological/Biomedical
Sciences
Sherwin, Jason Biological/Biomedical
Sciences
Ouyang, Zhengqing Biological/Biomedical
Sciences
Miller, Robyn Biological/Biomedical
Sciences
Franaszczuk, Piotr Biological/Biomedical
Sciences
Gregory, Frederick Biological/Biomedical
Sciences
Pasour, Virginia Mathematics
Grafton, Scott Biological/Biomedical
Sciences
Hancock, Peter Psychology
Zhang, Yuping Mathematics
Buss, Aaron Psychology
Hobson, Elizabeth Biological/Biomedical
Sciences
Maroulas, Vasileios Mathematics
McFarlane, Nicole Engineering
Nguyen, An Mathematics
Zhao, Xiaopeng Engineering
Huang, Yufei Biological/Biomedical
Sciences
Hagen, Simen Biological/Biomedical
Sciences
Tanaka, James Biological/Biomedical
Sciences

Information and Entropy

4/8/2015

4/10/2015

Baez, John	Mathematics
Brasselet, Romain	Biological/Biomedical Sciences
Brinck, Katharina	Biological/Biomedical Sciences
Cobbold, Christina	Mathematics
Day, Troy	Mathematics
de Vries, Charlotte	Biological/Biomedical Sciences
Deris, John Barrett	Physics
Dewar, Roderick	Biological/Biomedical Sciences
Donaldson-Matasci, Matina	Biological/Biomedical Sciences
Ellison, Christopher	Physics
Freer, Cameron	Mathematics
Fritz, Tobias	Mathematics
Fryer, Dashiell	Mathematics
Gilchrist, Michael	Biological/Biomedical Sciences
Gopalkrishnan, Manoj	Computer & Information Sciences
Harper, Marc	Mathematics
Harte, John	Biological/Biomedical Sciences
Hines, Ellen	Ocean/Marine Sciences
Hobson, Elizabeth	Biological/Biomedical Sciences
Jungck, John R	Biological/Biomedical Sciences
Lee, Christopher (Chris)	Computer & Information Sciences
Leinster, Thomas (Tom)	Mathematics
Leite, Maria	Mathematics
Lezon, Timothy	Biological/Biomedical Sciences
Mei, Yajun	Mathematics
Molzon, Robert	Mathematics
Murrugarra, David	Mathematics
Ortiz Mancera, Maria	Mathematics
Ostling, Annette	Biological/Biomedical Sciences

Phong, Connie	Biological/Biomedical Sciences
Pollard, Blake	Physics
Reeve, Richard	Health Sciences
Shaw, Robert	Physics
Smerlak, Matteo	Physics
Still, Susanne	Not reported
Wolpert, David	Physics
Zefferman, Matthew	Social Sciences

Malaria-Leishmania Co-infection

5/26/2015 5/28/2015

Adebimpe, Olukayode
 Aguiar, Maira
 Agosto, Folashade
 Akudibillah, Gordon
 Ali Siddiqui, Niyamat
 Banerjee, Malay
 Boete, Christophe
 Brown, Zachary
 Caja Rivera, Rocío Marilyn
 Castillo-Chavez, Carlos
 Chaturvedi, Ojaswita
 Chaves Sanabria, Luis Fernando
 Chitnis, Nakul
 Das, Pradeep
 El Mojtaba, Ibrahim
 Golnar, Andrew
 Goncalves, Maria Jacirema
 Hammett, Michelle
 Kribs-Zaleta, Christopher
 Lanz, Aprillya
 Li, Qingxia
 Lubuma, Jean
 Medlock, Jan
 Mubayi, Anuj
 Muturi, Ephantus J.
 Osei, Bonsu

Pandey, Abhishek
Peace, Angie
Prosper, Olivia
Rios-Sotelo, Gabriela
Sattenspiel, Lisa
Seidman, Thomas
Siewe, Nourridine
Srinivasa Rao, Arni S. R.
van den Bogaart, Erika
Vogt Geisse, Katia
Xue, Ling
Yakubu, Abdul-Aziz
Yukich, Joshua

**A Research Collaboration Workshop for Women in
Mathematical Biology**

6/22/2015

6/25/2015

Asih, Tri Sri Noor
Booth, Victoria
Bourouiba, Lydia
Chuang, Angela
Ciocanel, Veronica
Edwards, Aurélie
Genereux, Diane
Ferguson, Paige
Fleming-Davies, Arietta
Hastings Hagenaur, Megan
Hota, Sanjukta
Jabbari, Sara
Kile, Jennifer
Lanzas, Cristina
Layton, Anita
Lenhart, Suzanne
Miller, Laura
Panayotova, Iordanka
Piltz, Sofia
Robertson, Suzanne
Scott, Caitlin
Sheldon, Kimberly

Stepien, Tracy
Theriot, Casey
Toporikova, Natalia
Zhao, Longhua

Many-cell System Modeling

7/7/2015

7/9/2015

Aguilar, Boris
Byrne, Helen
Flann, Nicholas
Glazier, James
Hartley, Matthew
Hawkins-Daarud, Andrea
Hoehme, Stefan
Jacobs, Josh
Kahan, Simon
Kang, Seunghwa
Macklin, Paul
Mumenthaler, Shannon
Poleszczuk, Jan
Rockne, Russell
Shmulevich, Ilya
Shou, Wenying
Sottoriva, Andrea
Suetterlin, Thomas
Swat, Maciej
Tasseff, Ryan
Voß-Böhme, Anja

Addendum to NIMBioS Annual Report

Sep 1, 2014–Aug 31, 2015

Y7-4. Description of Activities

DESCRIPTION OF MAJOR ACTIVITIES SEPTEMBER 1, 2014 – AUGUST 31, 2015

During September 1, 2014 through August 31, 2015 reporting period, NIMBioS hosted (or will host this summer) 24 meetings of 18 different Working Groups, nine Investigative Workshops, and four Tutorials. There are projected to be more than 830 participants in NIMBioS-hosted activities during this period with 14 Postdoctoral Fellows in residence, 40 Short-term Visitors, and one visiting Graduate Student Fellow.

Demographics data on all participants are available for events from September 1, 2014 through March 31, 2015 and are presented in detail in the NIMBioS Evaluation Report (see section Y7-2 of the attached addendum to this Annual Report) and summarized below. There were 496 participants through March 31, 2015 from 24 countries and 39 U.S. states as well as the District of Columbia representing 190 different institutions. International participants amounted to 19% of all participants. Most participants were college or university faculty (49%), but post-doctoral researchers (18%), undergraduates (11%), and graduate students (9%) accounted for a significant fraction of participants. Across all events female representation was 41%, 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, 2014 through March 31, 2015 were from 22 different institutions and collaborated with NIMBioS post-doctoral and sabbatical fellows, faculty from five University of Tennessee departments, and seven researchers external to NIMBioS/Univ. Tennessee.

Below is a short description of each of the Working Groups, Investigative Workshops, and Tutorials held September 1, 2014 – August 31, 2015 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 Y7-3 of this addendum.

WORKING GROUPS

Working group: Nonautonomous linear system of the terrestrial carbon cycle: Mathematical and ecological properties and their uses in guiding carbon research

http://www.nimbios.org/workinggroups/WG_ccycle

Organizers: Yiqi Luo (Dept. of Microbiology and Plant Biology, University of Oklahoma) and Maria Leite (Dept. of Mathematics and Statistics, University of Toledo)

This working group examines theoretical properties of the nonautonomous linear system of the terrestrial carbon cycle and explores uses of those properties to guide observational, experimental, and modeling research. This group also has the potential to make seminal contributions to establish theoretical ecosystem ecology as a subdiscipline in ecology.

Meeting dates: November 17-21, 2014; July 27-31, 2015

Working group: Estimating area-specific contributions to the population dynamics of 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), 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 will consider 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: January 26-29, 2015; July 20-23, 2015

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 plans to develop 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. Our 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: October 14-17, 2014; June 15-19, 2015

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: June 10-12, 2015

Working group: Addressing the computational challenges in 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 will address this challenge by advancing analytical and computational methods with an interdisciplinary collaboration of experts in genomics, statistics, mathematics, bioinformatics and population genetics.

Meeting dates: June 3-6, 2015

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 will be 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: June 1-3, 2015

Working group: When are biotic interactions necessary to model species distributions?

http://www.nimbios.org/workinggroups/WG_biotic_interactions

Organizers: William Godsoe (School of Biological Sciences, Univ. of Canterbury, Christchurch, New Zealand) and Robert D. Holt (Univ. of Florida, Gainesville)

This working group seeks to formally link ecological theory on species interactions to empirical species' distribution models as a strong understanding of distributions is essential to making predictions about the distribution of biodiversity and biosecurity threats. It is investigating the relative importance of species interactions and the abiotic environment at large spatial scales,

determining whether omitting some species interactions (e.g. predation) produces poorer inferences than omitting other interactions (e.g. competition), and identifying the conditions under which the effects of species interactions must be separated from dispersal and population stochasticity.

Meeting dates: May 11-15, 2015

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: May 11-14, 2015

Working group: Evolutionary origins of complex institutions

http://www.nimbios.org/workinggroups/WG_inst

Organizers: Peter J. Richerson (Environmental Science and Policy, Univ. of California, Davis), Jenna Bednar (Political Science, Univ. of Michigan, Ann Arbor), and Peter Turchin (Ecology and Evolutionary Biology, Mathematics, Univ. of Connecticut, Storrs)

A persistent puzzle in evolutionary biology is explaining why humans cooperate with much larger groups of non-kin than other animals. This working group seeks to develop mathematical and computational tools for understanding the evolutionary transition from relatively small-scale societies to large-scale institutional organizations, such as complex chiefdoms, empires, and nation states. Since this research exists where the current "bottom-up" approach of evolutionary biology and anthropology intersects the "top-down" approach of political science and economics, this working group incorporates mathematically and evolutionarily-oriented researchers from these disciplines as well as mathematical and computational modelers.

Meeting dates: February 11-13, 2015; May 6-9, 2015

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 will take 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 we 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 of the working group will be useful to a suite of academic disciplines, particularly

climate modelers, biogeographers, ecologists, evolutionary biologists, archaeologists, and anthropologists.

Meeting dates: April 20-24, 2015

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 will use 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 will develop new approaches to gain insight into the processes influencing the ecology and epidemiology of leptospirosis in complex natural systems. Mathematical models will be 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: April 8-10, 2015

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. Our approach combines existing modeling techniques from the broader animal movement literature with mathematical models for vector-borne pathogen transmission.

Meeting dates: March 30 - April 2, 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) 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 will identify 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 will identify strategic methods for data collection, analysis and synthesis to address research and regulatory questions and to allocate limited resources efficiently.

Meeting dates: September 19-22, 2014; February 23-25, 2015

Working Group: 'Pretty Darn Good' Control: Extensions of Optimal Control for Ecological Systems

http://nimbios.org/workinggroups/WG_PDG

Organizers: Megan Donahue, Hawaii Inst. of Marine Biology, Univ. of Hawaii, Kaneohe; Carl Toews, Dept. of Mathematics, Duquesne Univ., Pittsburgh, PA; Alan Hastings, Dept. of Environmental Science and Policy, Univ. of California, Davis; Paul Armsworth, Dept. of Ecology and Evolutionary Biology, Univ. of Tennessee, Knoxville

This group focuses on three practical concerns that complicate straightforward applications of optimal control: model uncertainty, objective uncertainty, and control constraints. Using a problem-based approach, the group considers examples in fisheries management, marine spatial planning, life-history evolution, and ecosystem dynamics, but the techniques being developed apply to biological systems much more broadly.

Meeting date: January 21-23, 2015

Working group: Expanding Data Nuggets

http://www.nimbios.org/workinggroups/WG_datanuggets

Organizers: Melissa Kjellvik (Zoology & EEBB, Michigan State Univ.), Elizabeth Schultheis (Plant Biology & EEBB, Michigan State Univ.) and Julie Morris (Biological Sciences, Univ. of Denver)

Data Nuggets (<http://datanuggets.org>) are worksheets designed to give students practice interpreting quantitative information and making claims based on evidence. The standard format of each Nugget provides a brief background to a researcher and their study system, along with a small, manageable dataset. This Working Group will serve as a mechanism to bring NIMBioS resources and leaders in science education research and reform together in an effort to develop a national resource focused on integrating mathematics and science, particularly in the fields of ecology and evolutionary biology.

Meeting date: January 7-9, 2015

Working group: A cultural evolutionary approach to social-ecological systems change

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 Safarzyńska (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 of this working group 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 will develop 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: November 17-20, 2014

Working group: Theory of plant-soil feedback: phenomenological, mechanistic and spatial models

Organizers: James Bever (Biology, Indiana Univ., Bloomington) and Maarten Eppinga (Environmental Science, Copernicus Institute, Utrecht Univ., The Netherlands)

http://www.nimbios.org/workinggroups/WG_plantsoilfb

The framework of plant-soil community feedback has been successful at integrating the effects of soil microbes into plant-plant interactions. A major strength of this framework is that its theoretical predictions are closely connected with the setup of experiments, enabling a direct assessment of how plant-soil interactions scale up to a net feedback effect at the plant community level. However, observations from real ecosystems show that positive and negative plant-soil feedbacks may act concurrently, but current theory has yet to incorporate simultaneous negative and positive feedbacks and their consequences for plant community structure within a spatio-temporal mosaic. The goals of this group are 1) to extend current spatial and mean-field models of plant-soil feedback to more fully incorporate both positive and negative feedbacks between soil micro-organisms and individual plant species and the consequences of these interactions for plant community structure and change over time; and 2) to parameterize and test these models with existing data sets on plant-soil feedback and community structure.

Meeting dates: November 3-5, 2014

Working group: Emergence of hierarchy and leadership in mammalian societies

http://www.nimbios.org/workinggroups/WG_leadership

Organizers: Eric Alden Smith (Dept. of Anthropology, Univ. of Washington), Claire El Mouden (Dept. of Zoology, Univ. of Oxford), and Sergey Gavrilets (Depts. of Ecology & Evolutionary Biology and Mathematics, Univ. of Tennessee)

The goal of the working group is to analyze factors favoring the emergence of leadership and hierarchies (and resultant inequality in power, resources, and reproductive outcomes) across a range of animal species and humans. Of particular interest to the working group is the transition from systems where differences in power are based on individual characteristics or kin-based alliances to ones with hierarchical structures and clear leadership roles that extend beyond dyadic dominance relations and kinship ties. The working group effort will involve a combination of advanced modeling (based on game-theoretic, population genetics, behavioral ecology, and agent-based models) and empirical synthesis. The aim of the working group is to produce a series of high-impact collaborative research papers that would be of interest to researchers in multiple disciplines.

Meeting dates: October 13-15, 2014

INVESTIGATIVE WORKSHOPS

Investigative workshop: Many-cell System Modeling

http://www.nimbios.org/workshops/WS_manycell

Organizers: Simon Kahan (Computer Science and Engineering, Univ. of Washington; Northwest Inst. for Advanced Computing), Nicholas S. Flann (Computer Science, Utah State Univ., Logan), Andrea Hawkins-Daarud (Swanson Lab, Feinberg School of Medicine, Northwestern Univ.), Russell Rockne (Neurological Surgery, Swanson Lab, Feinberg School of Medicine, Northwestern Univ.) and Ryan Tasseff (Institute for Systems Biology, Seattle, WA)

Knowledge about cell-cell and cell-environment interactions is rapidly accumulating. Given clearly stated rules and empirical data, mathematicians formulate models for living systems expressed as equations. Computational scientists then perform simulations solving these equations to predict collective behavior over time. When billions of cells must be simulated to reproduce emergent behaviors, computational challenges can become overwhelming. This workshop will bring together modelers, computer scientists and scientific computing experts to discuss state of the art modeling and simulation of many-cell living systems. Participants will learn from shared experiences, match methodologies to modeling problems, and match skills to modeling challenges. Workshop results and the new relationships formed will serve as a

foundation for future work in addressing the challenges of moving from small-scale multicellular models to modeling whole organisms and communities.

Meeting dates: July 7-9, 2015

Investigative workshop: Malaria-Leishmania Co-Infection

http://www.nimbios.org/workshops/WS_coinfection

Organizers: AnujMubayi (Mathematical Computational Modeling Science Center and School of Mathematical and Natural Sciences, Arizona State Univ.), FolashadeAgusto (Mathematics & Statistics, Austin Peay State Univ., Clarksville, TN), Christopher Kribs-Zaleta (Mathematics, Univ. of Texas, Arlington), Ephantus J. Muturi (Medical Entomology Program, Illinois Natural History Survey, Univ. of Illinois, Urbana-Champaign) and Niyamat Ali Siddiqui (Epidemiology and Biostatistics, Dept. of Health Research, Ministry of Health & Family Welfare, Patna-India) Disease-prevention, outbreak-control and health promotion are key functions of public health. Lacking on these fronts within the health system is the major concern for developing countries of controlling infectious diseases. Mathematical and statistical modeling has become an essential tool for the development of control strategies and for the evaluation of mechanisms driving disease dynamics. The focus of this workshop is to identify challenges for the control of malaria-leishmaniasis co-infections in South Asian and the African continent. The workshop will also model the complexity involved in the propagation of these co-infections in resource limited regions. The types of data needed to analyze co-infection models and associated uncertainty will be assessed.

Meeting dates: May 26-28, 2015

Investigative workshop: Information and Entropy in Biological Systems

http://www.nimbios.org/workshops/WS_entropy

Organizers: John Baez (Mathematics, Univ. of California, Riverside), Marc Harper (Educational and biotechnology consultant) and John Harte (Environmental Science, Policy and Management, Univ. of California, Berkeley)

The aim of this investigative workshop is to synthesize different ways of applying these concepts to help systematize and unify work in biological systems. Investigators will 1) study the validity of the principle of Maximum Entropy Production (MEP), 2) familiarize all the participants with applications to ecology of the MaxEnt method, 3) clarify relations between known characterizations of entropy, the use of entropy as a measure of biodiversity, and the use of MaxEnt methods in ecology, 4) develop the concept of evolutionary games as "learning" processes in which information is gained over time, and 5) study the interplay between information theory and the thermodynamics of individual cells and organelles.

Meeting dates: April 8-10, 2015

Investigative workshop: Olfactory Modeling

http://www.nimbios.org/workshops/WS_olfaction

Organizers: Sharon Crook (School of Mathematical and Statistical Sciences & School of Life Sciences, Arizona State Univ., Tempe) and Brian Smith (School of Life Sciences, Arizona State Univ., Tempe)

Recent technological advances have led to a wealth of information about how olfactory coding takes place in the mammalian nervous system, where experimental approaches range from large-scale measurement of neural activity during behavior to manipulation of activity via optogenetics. Our workshop goal was to review the current state of the mathematical approaches and tools for modeling olfaction. We also identified tasks for future development that will maximize the impact of individual projects, and defined areas of mutual interest and establish collaborations for large-scale modeling of this system, with a focus on incorporating realistic biophysical mechanisms for learning and memory.

Meeting dates: March 2-4, 2015

Investigative workshop: Neurobiology of Expertise

http://www.nimbios.org/workshops/WS_expertise

Organizers: Frederick Gregory (Neurophysiology of Cognition, U.S. Army Research Office) and Virginia Pasour (Biomathematics, U.S. Army Research Office)

This investigative workshop aims to synthesize these and other state of the art applications of mathematics in order to systematize and unify multidisciplinary and multiscale work on expert human performance. The workshop will bring together researchers from multiple disciplines in order to better understand the existing mathematical challenges and explore new directions in modeling genomic to behavioral signatures of performance in humans and animal models for perceptual, motor and analytical expertise domains. Workshop goals are to identify challenges and frontiers in mechanistic modeling, prediction, signal processing and machine learning as well as novel neurotechnologies for data acquisition in order to facilitate uncovering the underlying neural mechanisms of expertise. This investigative workshop will bring together top researchers from diverse fields to share insights and methods and address long-standing and emerging conceptual problems.

Meeting dates: March 11-13, 2015

Investigative workshop: Lymphoid Cells in Acute Inflammation

http://www.nimbios.org/workshops/WS_lymphoid

Organizers: Judy Day (Mathematics, Electrical Engineering & Computer Science, Univ. of Tennessee) and Yoram Vodovotz (Director, Center for Inflammation & Regenerative Modeling, Univ. of Pittsburgh)

The Acute Inflammatory Response (AIR) to infection or traumatic injury has largely been characterized by the actions of complement, immune cells such as macrophages and neutrophils, and the inflammatory mediators they produce. This workshop aims to survey and organize what is currently known about the role of lymphoid cells and their mediators in the AIR, how the role of lymphoid cells may differ in acute inflammation due to infection versus traumatic injury, and efforts at computational modeling of the AIR. Implicit in this aim is the goal of determining what relevant experimental datasets are available and how best to use them for the modeling efforts.

Meeting dates: January 15-16, 2015

Investigative workshop: Heart Rhythm Disorders

http://www.nimbios.org/workshops/WS_cardiac

Organizers: Alena Talkachova (Biomedical Engineering, Univ. of Minnesota), John Wesley Cain (Mathematics and Computer Science, Univ. of Richmond, Virginia) and Xiaopeng Zhao (Mechanical, Aerospace, and Biomedical Engineering, Univ. of Tennessee, Knoxville)

Cardiovascular diseases, which are often associated with heart rhythm disorders, are the leading cause of death in the Western world. A complete understanding of heart rhythm disorders requires a complex system-level approach that incorporates the interaction between electrical, chemical, and mechanical activities of the heart on a variety of biological scales. The goal of this workshop is to unite researchers from different disciplines – clinicians, mathematicians, physicists, biomedical engineers, and industrial practitioners – in order to better understand the existing mathematical challenges and to explore new directions in modeling of cardiovascular dynamics. As a result of the workshop, we will identify challenges and frontiers in mathematical modeling, statistics and prediction, dynamics and control, stability analysis, as well as data acquisition and analysis for heart rhythm related diseases.

SHORT-TERM VISITORS

Katsuya Tanaka (Economics, Shiga Univ.) visited NIMBioS to collaborate with Paul Armsworth to develop a mathematical model for determining a cost-effective payment system for forest carbon sequestration. (September 7-16, 2014)

Dan Warren (Biology, Macquarie Univ.) visited NIMBioS to collaborate with Nick Matzke on a project to develop an R package for integrating evolutionary history into niche and distribution modeling. (September 7-17, 2014)

Peter Smouse (Ecology, Rutgers Univ.) visited with NIMBioS postdoctoral fellows and gave a seminar as a NIMBioS Postdoctoral Fellow Invited Distinguished Visitor. (October 5-8, 2014)

Gregers Jungersen (Technical Univ. of Denmark) and Lovisa Sunesson (Technical Univ. of Denmark) met with various individuals, including Shigetoshi Eda (far left) as a part of a self-supported visit to discuss the creation of an educational program at DTU for quantitative biology and disease modeling. (October 13-14, 2014)

Miles Davenport (Centre for Vascular Research, Univ. New South Wales) visited NIMBioS to collaborate with Michael Gilchrist (left) and Vitaly Ganusov (right) to discuss research on modeling immune responses and present a seminar on modeling malaria dynamics. (November 7, 2014)

Jane White (Mathematical Sciences, Univ. of Bath) visited NIMBioS to collaborate with Suzanne Lenhart on a project to develop a generic deterministic model for infectious disease spread in a heterogeneous population where infection may be asymptomatic. The models will be parameterized using information on swine flu and Chlamydia. (November 10-18, 2014)

Hanna Kokko (Institute of Evolutionary Biology and Environmental Studies, Univ. of Zurich) visited with NIMBioS postdoctoral fellows and gave a seminar as a NIMBioS Postdoctoral Fellow Invited Distinguished Visitor. (November 10-12, 2014)

Robert Boyd (Biological Anthropology, Arizona State Univ.) visited with NIMBioS postdoctoral fellows and gave a seminar as a NIMBioS Postdoctoral Fellow Invited Distinguished Visitor. (November 18, 2014)

Laura Huenneke (Office of the Provost, Northern Arizona Univ.) visited with NIMBioS postdocs and other researchers to discuss science and career paths. (December 1, 2014)

Birce Onal (Biomedical Engineering, Ohio State Univ.); Zana Coulibaly (Math & Statistics, Univ. Maryland-Baltimore Co); Alexandros Gelastopoulos (Math, Boston Univ.) visited NIMBioS to collaborate on a project begun with Xiaopeng Zhou at the 2014 CAMBAM-MBI-NIMBioS summer program on rhythms and oscillations. (December 6-11, 2014)

Julia Earl (Natural Resources Ecology & Management, Oklahoma State Univ.); Paula Federico (Mathematics, Computer Science and Physics, Capital Univ., Columbus, Ohio); Ryan Norris (Integrative Biology, Univ. of Guelph); Christine Sample (Mathematics, Emmanuel College); and Ruscena Wiederholt (Natural Resources, Univ. of Arizona) visited NIMBioS to investigate a habitat contribution metric through network analysis with the help of a network mathematician. (January, 23-25, 2015)

Kamuela Yong (Mathematics & Statistical Sciences, Arizona State Univ.) visited NIMBioS to meet with NIMBioS postdoctoral fellows, Suzanne Lenhart and Paul Armsworth to discuss common interests in ecological and epidemiological models. (January 29-30, 2015).

Laura Salla (Geosciences and Geography, Univ. Helsinki) visited NIMBioS to collaborate with Nick Matzke to incorporate phylogenetic supertrees, the NOW Database, and biogeographic modeling to investigate the biogeographic history of Neogene mammals in changing environments. (February 7-17, 2015)

Michael Lynch (Biology, Indiana Univ. Bloomington) visited with NIMBioS postdoctoral fellows and gave a seminar as a NIMBioS Postdoctoral Fellow Invited Distinguished Visitor. (Feb 8-10, 2015)

Stacy Krueger-Hadfield (Grice Marine Lab, College of Charleston) visited NIMBioS to collaborate with Sean Hoban on a project to develop population and genomic sampling strategies for invasive red seaweed. (Feb 9-13, 2015)

Alan de Queiroz (Univ. of Nevada, Reno) visited NIMBioS to collaborate with Nick Matzke and others to devise more advanced parametric models of dispersal in historical biogeography. He is also the keynote speaker for UT's Darwin Day. (February 10-13, 2015)

Laurent Excoffier (Population Genetics CPMG Lab, Institute of Ecology and Evolution, Univ. of Bern) visited with NIMBioS postdoctoral fellows, including Jake Ferguson and gave a seminar as a NIMBioS Postdoctoral Fellow Invited Distinguished Visitor. (March 9-10, 2015)

Kehinde R. Salau (Alliance Postdoctoral Research Fellow, Mathematics, Univ. of Arizona) visited NIMBioS to give a seminar and meet with NIMBioS researchers to explore potential collaborations. (March 24-26, 2015)

Gwen Iacona (ARC Center of Excellence for Environmental Decisions) collaborated on a project with Paul Armsworth to extend a game theoretic model to include contracting mechanisms developed while a NIMBioS GRA. (March 27-April 11)

Mats Gyllenberg (Mathematics and Statistics, Centre of Excellence in Analysis and Dynamics, Univ. of Helsinki) gave a seminar and visited with researchers (April 19-22, 2015)

Fabiola Soto-Trejo (Biological Sciences, Universidad Nacional Autonoma de Mexico) collaborated on a project with Nick Matzke, Katie Massana and Ed Schilling to investigate the probabilistic inference of the biogeographic history of *Brickellia* (Asteraceae, Eupatorieae) (April 7-25, 2015)

Alexey Surnov (Dresden Univ. of Technology) collaborated with Vitaly Ganusov on a project to develop models of how stochastic perturbations of proliferative capacities of two lymphocyte populations affect competition for nutrients or for stimulators. (April 22-25, 2015)

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, Junior Science and Humanities Symposium, SRE Program), 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, 2014 and August 31, 2015.

2015 Summer Research Experience (SRE) for Undergraduates and Teachers Program

Fifteen undergraduates and two high school teachers are participating in the 2015 NIMBioS Summer Research Experience (SRE) for undergraduates and teachers. 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) Modeling the distribution of fluid pressure in the kidney (2) Development of mathematical models of Mycobacterium tuberculosis in mice (3) Canine distemper modeling (4) Exploring stressors in the host-pathogen interaction: Can a host use self-harming defenses to adequately protect itself? (5) Ships, ports, invasions and math: Invasive species movements through global shipping routes. (Dates: June-July, 2015)

Minority-Serving Institution Partner Visits

Visits were arranged for NIMBioS researchers, leadership and staff to visit our minority-serving institution partners: Fisk University (A. Peace, April 2015), Howard University (J. Ferguson, November 2014; N. Matzke, February 2015), Tennessee State University (J. Ferguson, April 2015) and University of Texas-El Paso (S. Kawano, September 2014; S. Lenhart, February 2015). S. Lenhart visited Fisk University for discussion of curriculum and course issues in June 2015.

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 2015 meeting in San Antonio, TX, 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 about our SRE program in a session on mentoring undergraduates in research experiences.

Great Smoky Mountains National Park (GSMNP) Outreach

NIMBioS led quantitative biology sessions for the Girls in Science weeks (2 events) at Tremont. (Dates: June and July 2015).

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 sixth 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 100 undergraduates and faculty from academic institutions across North America were in attendance. There were over 50 undergraduate research talks and posters. (Date: November 2014)

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 2014 and Spring 2015)

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.

Publicity

UTK's Carnegie Community Engagement Classification was kicked off February 6 with the Biology in a Box Project being the first Outreach program highlighted.

Production

Production activity has focused on revision and developing the necessary materials to accompany the exercises in Unit 11 Biomechanics. We are now in production of this unit with materials purchased to cover ten copies thus far. The materials cost for this unit are \$843/ box.

Exercise series 1-5 of Unit 11 are up on the web page with the following NEW exercises added to the Unit and on the webpage:

Exercise 1: Introduction to Biomimetics / Borrowing Designs from Nature

Exercise 3: Jaws are Levers

Exercise 3a. The Lever: A Simple Machine to Lift or Move Objects

Exercise 3a1. Structure and Function of the Class 1 Lever

Exercise 3a2. Levers We Use Everyday

Exercise 3b. The Vertebrate Jaw

Exercise 3b1. Mouth Shape & Size Predicts Feeding Habits in Fish.35

Part I. Think-Pair-Share: Examining Fish Mouth Morphology

Part II. Class Observation and Discussion: Fish Feeding in Action!

Part III. The Mechanics of Fish Feeding

Exercise 3b2. Bird Beaks (Bills) as Simple Machines: From Feeding Niches to Individual Fitness

Pliers & Finch Fitness: Natural Selection

Supersolver Questions

Exercise 5 Similar Things to Wings: Drag

Exercise 5b. Exploring Dispersal in Nature

Exercise 5b1. Maple Samaras

Exercise 5b2 Gliding Mammals

Exercise series 6 Acoustics (the final exercise series in the Biomechanics Unit) is near completion with the addition of several new exercises in addition to the revision of original exercises. The new exercise thus far include:

Exercise 6a1a. Courtship Signaling

Exercise 6a1b1. Animal Sound Production Quiz

Box Set Exchanges/Refurbishes

September 2014: DeKalb County

Box Set Loans and Demonstrations

November 2014: Lisa LaForest demonstrated Unit 2 (Skulls and Teeth) materials for Outdoor Classroom / ProjectGRAD students at Lonsdale Elementary (after-school program)

December 2014: Lisa LaForest demonstrated Unit 7 (Tracks and Poop) materials for Outdoor Classroom / ProjectGRAD students at Lonsdale Elementary (after-school program)

March 2015: Demonstration of various unit materials (6, 7, 10, & 11) at AL Lotts Elementary School's Science Night for students, parents, and teachers; Lisa LaForest, Daniel Rose, and Melissa Horning

Undergraduate Interns Trained (VolsTeach/Noyce Educational Assistants)

Fall 2014: Daniel Rose, Melissa Horning, and Natasha Sellers

Spring 2015: Daniel Rose, Melissa Horning, and Natasha Sellers

Formal assessment continues on two Biology in a Box exercise groups:

Black Box Experiment series and Snack Slap game series.

1. The Black Box Experiment series (NSTA publication planned) offers students from elementary to college grade levels an in-depth understanding of how science works as well as a review of and practice with the mathematical concept of probability. This experiment has been evaluated in elementary, middle school, high school and college classrooms. A STEM teacher preparation class participated in formal assessment of this unit (spring 2015) and three introductory biology for majors classes, in the fall of 2014. Initial data reduction has been completed. Elementary and a middle school class tested the Snack Slap game series exercises during this recording period.

2. Under Slap Snack Alarm and Mimic card games, students gain experience with the concept of individual fitness and natural selection. Four classrooms participated in the evaluation of the exercise this past year and publication is planned for NABT).

3. Riechert also authored a book chapter on the project's new **Biomechanics Unit** in Cary Sneider's 2015 edited book entitled "High School Engineering Curricula Ready –To-Go, Corwin Press. The chapter is titled "**Learning STEM through Inquiry Involving Nature's Designs Applied to Technology.**"

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 Los Angeles, CA, October 15-16, 2014. 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 C. Aguilar to speak about NIMBioS and his research, and S. Lenhart presented about opportunities at NIMBioS. Also, NIMBioS co-sponsored ecology and evolutionary biology events at SACNAS organized by NESCent, and postdoc A. Peace also presented in an ecology-themed symposium with researchers from NESCent and NCEAS. (Date: October 2014)

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. K. Sturner and S. Lenhart volunteered, helped find additional volunteers and led math activities at this event. The workshop was hosted at NIMBioS. (Date: November, 2014)

STEM Education Seminar Series

NIMBioS co-organizes a monthly seminar on issues in teaching STEM (science, technology, engineering and mathematics) with VolsTeach. The fourth round of seminars was hosted at the UT Center for Enhancing Education in Mathematics and Sciences, and centered on the theme of teaching math and science at schools serving economically distressed communities. (Dates: March-April, 2015)

Teaching Workshops

K. Sturner presented an activity on Quantifying Biodiversity to teachers from across the state at the Tennessee Environmental Education Conference at the Great Smoky Mountains Institute at Tremont (September, 2014)

K. Sturner, representing NIMBioS, served on the organizing committee and helped to organize a session "Lactose Intolerance & Evolution - Lab and Lesson on Human Culture as Selection Pressure (Sponsored by Darwin Day at the University of Tennessee)" workshop at the annual Tennessee Science Teachers Association (TSTA) conference in Murfreesboro, TN. The session highlighted several useful activities for teaching evolution and the nature of science and was presented by W. Hoskins (UTK graduate student) and high school biology teacher M. Knapp. Teachers attended from across the state. (Date: November, 2014)

S. Lenhart, K. Sturner and V. Parkman all presented activities showing real world applications of mathematics concepts for the teacher professional development workshop Math Counts in rural Campbell County, TN. Approximately 75 K-8 teachers were in attendance. (June, 2015)

Southern Appalachian Science & Engineering Fair

NIMBioS was a 2015 sponsor of the fair. K. Sturner, J. Bintz and V. Parkman served as judges for several awards: a special NIMBioS award (the NIMBioS Prize for Research at the Interface of Mathematics and Biology; Junior and Senior level division prizes were awarded), the Association for Women in Science and the Mu Alpha Theta prizes. (Date: March, 2015)

University of Tennessee Pro2Serve Math Contest

Annual contest of individual and team competitions to promote interest in mathematics among Tennessee high school students, to encourage them toward careers in mathematics, science, and engineering, and to recognize their mathematical prowess by awarding scholarships, trophies, plaques, and certificates. K. Sturner and S. Lenhart presented NIMBioS education & outreach and a probability activity to teachers from across the state at this conference (Date: November 2014)

Adventures in STEM Camp

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 2015)

NIMBioS/XSEDE/NICS Tutorial: Using R for HPC

Tutorial objectives: By some measures, R is the most popular software package for the analysis of data. But R has a reputation for being sluggish and inappropriate for large datasets. However, much of R's problems with performance and scalability are due to bad practices of individual programmers rather than being inherent limitations of R itself.

This half-day (four hour) tutorial, introduced participants to debugging, profiling and performance analysis, optimization, foreign language API's, and parallel programming with R. There was also a comprehensive hands-on component to reinforce topics introduced during the lecture portion.

The tutorial was ideally suited for those already working with R, as well as service providers who are serving R customers. The content was appropriate for any students, researchers, or staff who were working with R and interested in performance. The tutorial was a joint training between the University of Tennessee, NIMBioS, XSEDE, and NICS. (Date: February 2015)

NIMBioS Graduate Workshop: Current Issues in Statistical Ecology

For graduate students in ecology-related fields or statistics with an interest in ecological applications, this workshop gave participants the opportunity to learn about the latest trends in statistical ecology. There were opportunities to build skills in new statistical tools useful for ecology and to work on applying tools to participants' research questions. The program also featured panel discussions about career opportunities, the job search, and surviving graduate school/writing the dissertation.

Participants were encouraged to bring data sets associated with their research to be explored under the guidance of workshop leaders.

This workshop was co-organized by the Ecological Society of America SEEDS program and SAMSI (Statistical and Applied Mathematical Sciences Institute). Alumni of the SEEDS program received priority consideration to attend, and all participants were invited to join the SEEDS network. (Date: April, 2015)

A Research Collaboration Workshop for Women in Mathematical Biology

This collaborative workshop aimed to help build a strong collaboration network of women working on problems in mathematical biology by facilitating the formation of new collaborative research groups and encouraging them to continue to work together after the workshop. The format of this workshop was designed to maximize the opportunities to collaborate.

There were four teams. Each team was led by two senior women researchers working collaboratively on a problem. Team members were chosen from applicants and consisted of junior researchers from both mathematics and biology. Team members expressed their project preference in their application, each team worked intensely and presented their findings at the end of the workshop, and each team was expected to continue their research and obtain results for a joint publication.

The format of this workshop followed that of the highly successful WhAM! Research Collaboration Workshop for Women in Applied Mathematics held at the Institute for Mathematics and its Applications (IMA) in September 2013. The workshop structure, with leaders, projects and working groups planned in advance, was intended to be bi-directional: senior women met, mentored, and collaborated with the brightest young women in their field on a part of their research agenda of their choosing, and junior women (tenure track faculty, post-docs and advanced graduate students) developed their network of colleagues and supporters and encountered important new research areas to work in, thereby improving their chances for successful research careers.

Projects:

- **Aerodynamics of spider ballooning** - Leaders: Laura Miller (Biology, Univ. of North Carolina); Lydia Bourouiba, Institute for Medical Engineering and Science and Dept. of Environmental Engineering, MIT
- **Sleep, circadian rhythms and pain** - Leaders: Victoria Booth (Mathematics and Anesthesiology, Univ. of Michigan); Megan Hastings Hagenauer (Molecular and Behavioral Neuroscience Institute, Univ. of Michigan)
- **Blood flow autoregulation in the kidney** - Leaders: Anita Layton (Mathematics, Duke Univ.); Aurélie Edwards (CNRS, Paris)
- **Modeling the effects of antimicrobial therapy on gut microbiota and *Clostridium difficile*** - Leaders: Suzanne Lenhart (Mathematics, Univ. of Tennessee); Cristina Lanzas (Epidemiology, North Carolina State University)

(Date: June, 2015)

NIMBioS/Bioquest Curriculum Workshop (Tutorial): Biology by Numbers: Bringing Math to the High School Biology Classroom

This tutorial was for high school biology teachers focused on getting comfortable with the quantitative side of biology. The program featured hands-on experience with inquiry activities that use real data, tools for graphing, modeling, and much more. The University of Tennessee's popular Biology in a Box supplied some of the activities integrating math and science. Teachers worked collaboratively to add or enrich the quantitative aspects of their favorite biology labs.

This tutorial was led by the BioQUEST Curriculum Consortium, a 25-year biology education reform community that focuses on helping faculty develop and implement innovative curricula. (Date: July, 2015)

NIMBioS Tutorial: Evolutionary Quantitative Genetics

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, 2015)

School Visits & Field Trips

Bearden High School – 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. S. Lenhart wrote an article for the Association for Women in Mathematics about some of these high school activities (January 2015).

University Visits – During the reporting dates, S. Lenhart gave seminars about NIMBioS opportunities to student groups at East Tennessee State University, Clemson University, University of Kentucky, University of Nebraska, Kennesaw State University, the University of California – Irvine, University of Tennessee – Chattanooga, University of North Carolina – Greensboro, and also the South African Mathematical Sciences Association Conference (November 2014).

S. Lenhart and K. Sturner helped to organize one visit to Pond Gap Elementary School by graduate students in the Program for Equity and Excellence in Research.

S. Lenhart served as a judge at the St. Joseph School Science Fair (January 2015).

NIMBioS helped organize and host a field trip by 7th graders from Greenback School in Loudon County, TN, which brought 60 students and three teachers for a day learning about biodiversity

and computer image analysis, touring the university library, and building windmills and doing engineering lab tours at CURENT, an engineering center across campus. (November, 2014)

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 two of the schools during this reporting period (Oct 17, 2014 Blount County Homeschool group at Ijams Nature Center; ~75 students; May 15, 2015 – Sevierville Primary School, ~100 students).

UT Library Display

K. Sturner, S. Lenhart and V. Parkman prepared a display about undergraduate research, NIMBioS and the SRE program for display in the University of Tennessee library (January 2015).

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 was “Non-linear Dynamics in Biological Systems”. This graduate workshop had instructors from across North America whose research expertise on the topic. Workshop description: “Quantitative bioscience is the application of mathematics, physics and numerical computations to all spheres of biology. It provides a common currency to the understanding of life at the microscopic and macroscopic level, from single molecules to complex ecosystems. It underlies the development of personalized biomedical devices, optimized drug delivery to patients and the prediction of ecosystem health in changing environments. While these challenges are typically addressed within each research area, the required quantitative (mathematical, physical and computational) tools are shared across all areas. The rich stream of experimental data has made it possible for bioscientists to build testable and predictive models that are based on sound data. It is these models, accompanied by statistical and computational approaches that have provided a platform for experimentalists to understand the dynamics of their respective biological systems and to guide new experiments. As a result, the field of mathematical and computational modeling has been felt strongly across the biological sciences, including neuroscience, cancer biology, immunology, epidemiology, ecology, and evolutionary biology.

In this summer school, we aim to provide a new generation of trainees with the opportunity to learn more about the basics of this field and give them an overview of the latest advancements made in quantitative biosciences.” Researchers from the mathematical and biological sciences were featured speakers. S. Lenhart and A. Buchan worked the participant selection process and NIMBioS helped provide travel support for four participants. (Date: June, 2015)

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. TNSCORE and CURENT NSF engineering centers are the other co-hosts. NIMBioS SRE students presented. (Date: July, 2015)

Addendum to NIMBioS Annual Report

Sep 1, 2014–Aug 31, 2015

Y7-5. Additional Products

Featured Articles

Websites

Media Coverage

Additional products (featured articles, websites, media coverage)

Feature Articles

(Missing from previous year's Annual Report)

July 9, 2014. Study predicts ranavirus as potential new culprit in amphibian extinctions

July 30, 2014. Saving seeds the right way can save the world's plants

August 19, 2014. New textbook introduces undergraduates to mathematics for the life sciences

August 20, 2014. The ABCs of animal speech: Not so random after all

(Sept. 1, 2014 – March 31, 2015)

September 9, 2014. Meet Education & Outreach intern Virginia Parkman

September 17, 2014. Being social: Learning from the behavior of birds new study elucidates the social world of parrots

September 30, 2014. Tennessee environmental educators connect biodiversity & probability

September 30, 2014. Research confirms controversial Darwin theory of "jump dispersal"

October 15, 2014. National institute specializing in mathematical and biological synthesis names new director

October 27, 2014. Building new connections at SACNAS 2014

October 29, 2014. NIMBioS fall hike: Grotto Falls and Brushy Mountain

October 31, 2014. Postdoc shares latest research with national seed bank

November 6, 2014. The bat cave at NIMBioS

November 4, 2014. Math for cholera, drug discovery, environment & more at 2014

November 11, 2014. Two days of STEM fun: Over 100 middle school students, teachers & parents visit NIMBioS

November 13, 2014. Evolution featured at Tennessee teacher conference

November 26, 2014. Prehistoric conflict hastened human brain's capacity for collaboration, study says

January 21, 2015. NIMBioS hits 5,000 mark

January 22, 2015. Study projects unprecedented loss of corals in great barrier reef due to warming

February 13, 2015. Peace of cake: NIMBioS postdoc revealed as top baker

March 10, 2015. Bat Monitoring Working Group receives 'Wings Across the Americas' award

March 31, 2015, Q&A with Suzanne O'Regan

Websites

Title: The NIMBioS Website

URL: www.nimbios.org

Short Description of the Website: For the three-month period ending April 1, 2015, unique visitors increased 15%, site visits increased 16%, and pageviews increased 11% compared to the previous year. For both periods, 62% of visitors were new, 38% returning.

Title: NIMBioS Investigative Workshop: Insect Pest Resistance Evolution

URL: <http://nimbios.org/wordpress-training/insectpest/>

Short Description of the Website:

The site is a WordPress blog for the NIMBioS Investigative Workshop: Insect Pest Resistance Evolution, which was held Nov. 14-15, 2013. The site was designed to facilitate group communication and information sharing before, during and after the workshop.

Title: NIMBioS Investigative Workshop: Animal Social Networks

URL: <http://nimbios.org/wordpress-training/animalsocialnet/>

Short Description of the Website:

The site is a WordPress blog for the NIMBioS Investigative Workshop: Animal Social Networks, which was held March 6-8, 2014. The site was designed to facilitate group communication and information sharing before, during and after the workshop.

Title: NIMBioS Investigative Workshop: Vectored Plant Viruses

URL: <http://nimbios.org/wordpress-training/plantviruses/>

Short Description of the Website:

The site is a WordPress blog for the NIMBioS Investigative Workshop: Vectored Plant Viruses, which was held March 17-19, 2014. The site was designed to facilitate group communication and information sharing before, during and after the workshop.

Title: NIMBioS Investigative Workshop: Interface Disease Models

URL: <http://nimbios.org/wordpress-training/interface/>

Short Description of the Website:

The site is a WordPress blog for the NIMBioS Investigative Workshop: Interface Disease Models, which was held March 11-13, 2014. The site was designed to facilitate group communication and information sharing before, during and after the workshop.

Title: NIMBioS Tutorial: Computing in the Cloud

URL: <http://nimbios.org/wordpress-training/cloud/>

Short Description of the Website:

The site is a WordPress blog for the NIMBioS Tutorial: Computing in the Cloud, which was held April 6-8, 2014. The site was designed to facilitate group communication and information sharing before, during and after the tutorial.

Title: NIMBioS Investigative Workshop: Modeling Contamination of Fresh Produce

URL: <http://nimbios.org/wordpress-training/produce/>

Short Description of the Website:

The site is a WordPress blog for the NIMBioS Investigative Workshop: Modeling Contamination of Fresh Produce, which was held April 24-25, 2014. The site was designed to facilitate group communication and information sharing before, during and after the workshop.

Title: NIMBioS Investigative Workshop: Predictive Models for ERA

URL: <http://nimbios.org/wordpress-training/era/>

Short Description of the Website:

The site is a WordPress blog for the NIMBioS Investigative Workshop: Predictive Models for ERA, which was held April 28-30, 2014. The site was designed to facilitate group communication and information sharing before, during and after the workshop.

Title: NIMBioS Tutorial: Parameter Estimation for Dynamic Biological Models

URL: <http://nimbios.org/wordpress-training/parameter/>

Short Description of the Website:

The site is a WordPress blog for the NIMBioS Tutorial: Parameter Estimation for Dynamic Biological Models, which was held May 19-21, 2014. The site was designed to facilitate group communication and information sharing before, during and after the tutorial.

Title: NIMBioS Investigative Workshop: Leptospirosis Modeling

URL: <http://nimbios.org/wordpress-training/leptospirosis/>

Short Description of the Website:

The site is a WordPress blog for the NIMBioS Investigative Workshop: Leptospirosis Modeling, to be held June 3-5, 2014. The site was designed to facilitate group communication and information sharing before, during and after the workshop.

Title: NIMBioS Tutorial: Algebraic and Discrete Biological Models for the Undergraduate Classroom

URL: <http://nimbios.org/wordpress-training/mathbio/>

Short Description of the Website:

The site is a WordPress blog for the NIMBioS Tutorial: Algebraic and Discrete Biological Models for the Undergraduate Classroom, which will be held June 18-21, 2014. The site was designed to facilitate group communication and information sharing before, during and after the tutorial.

Title: NIMBioS Twitter

URL: <https://twitter.com/nimbios>

Short Description of the Website:

The NIMBioS Twitter account is an interactive social media site with 1,603 followers and 1,603 tweets (as of May 15, 2014) that feature 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 with 689 “likes” and posts that feature 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 photos from various NIMBioS activities and events, both formal and informal.

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 Annual Report, April 1, 2014-August 31, 2015)

4/2/14, Wanted: UT's NIMBioS needs scientists and science lovers to analyze howls, Tennessee Today, <http://tntoday.utk.edu/2014/04/02/wanted-uts-nimbios-scientists-science-lovers-analyze-howls/>

4/7/14, Sing a song of science literacy, FrogHeart Blog, <http://www.frogheart.ca/?p=12987>

4/7/14, UT conference to look at how women in STEM can thrive in industry, academia, Tennessee Today, <http://tntoday.utk.edu/2014/04/07/women-in-stem-conference/>

4/7/14, UT to help science-oriented women professionals at workshop, Knox News Sentinel, <http://www.knoxnews.com/news/2014/apr/07/ut-to-help-science-oriented-women-professionals/?partner=RSS>

4/7/14, UT conference to look at how women in STEM can thrive, Oak Ridger, <http://www.oakridger.com/article/20140407/News/140409830>

5/1/14, Outreach, global awareness recognized at annual honors banquet, Tennessee Today, <http://tntoday.utk.edu/2014/05/01/academic-outreach-global-honors-banquet/>

5/5/14, Researchers receive top honors for ecology paper, Phys.org, <http://phys.org/news/2014-05-honors-ecology-paper.html>

5/7/14, Nick Matzke: Reconstructing Species Migrations Across Time, Live Science, <http://www.livescience.com/45409-species-migrations-across-history-nick-matzke-nsf-sl.html>

5/29/14, Doing the math, Quest, <http://quest.utk.edu/2014/doing-the-math/>

6/9/14, Using math to understand the puzzle of humanity, LiveScience, <http://www.livescience.com/46191-human-culture-society-influences-matthew-zefferman-nsf-sl.html>

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Addendum to NIMBioS Annual Report

Sep 1, 2014–Aug 31, 2015

**Y7-6. 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.

Table 1 includes NIMBioS data from the previous reporting period (9/1/2013-8/31/2014) as well as data through March 31st, 2015 for the current reporting period. The NIMBioS Annual Report is submitted before 8/31/2015, the end of the reporting period, so data for the current reporting period only include the period from 9/1/2014-3/31/2015; they do not include projections for activities occurring between 4/1/2015-8/31/2015. Subsequent annual reports will include updated values for each previous reporting period.

Table 1. Number of participating institutions, partners, and participants at NIMBioS

Area	Reporting period 9/1/2013-8/31/2014	Reporting period 9/1/2014-3/31/2015 ^a
Academic institutions	230	152
Partners	28 ^b	38 ^c
Total participants	1123 (922 indiv.)	496 (422 indiv.)

^a Numbers reported here only include the period from 9/1/2014-3/31/2015; they do not include projections for activities occurring between 4/1/2015-8/31/2015.

^b 10 business/industry, 9 federal, 8 non-profit, 1 state

^c 14 business/industry, 14 federal, 9 non-profit, 1 high school