



2018 Annual Report

National Institute for Mathematical and Biological Synthesis

Reporting Period September 2017 – August 2018

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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 to assist in the development of a cadre of researchers who are capable of conceiving and engaging in creative and collaborative connections across disciplines to address fundamental and applied biological questions. NIMBioS is structured to efficiently use NSF funding: 1) to address key biological questions by facilitating the assembly and productive collaboration of interdisciplinary teams; and 2) to foster development of the critical and essential human capacity to deal with the complexities of the multi-scale systems that characterize modern biology.

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

Human capacity building goals are fostered through: direct mentoring of new researchers (including

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

The questions addressed by NIMBioS span all of biology, impacting both basic and applied science. Hence, the impacts are wide-ranging from those arising due to the application of specific models to particular challenges, such as controlling zoonotic disease spread, to fundamental questions about human origins, biosphere functioning, and the emergence of biological patterns at diverse scales. An objective is for NIMBioS to provide the effective infrastructure so that it serves as 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.

This reporting period is the tenth year for NIMBioS, and as the NSF funding for Year 10 of the cooperative agreement supporting NIMBioS was reduced relative to earlier years of the project, the number of activities and participants is fewer than previous years. As the cooperative agreement that supports NIMBioS ends, another major goal is to create an effective plan that allows for the sustainability of efforts at NIMBioS to continue to contribute to the major scientific and educational goals noted above. This plan includes developing affiliated centers that expand some of the ongoing efforts at NIMBioS, particularly in evaluation of STEM education and collaborative team research, in analysis of complex spatial data, in modeling of complex biological systems and in development and analysis of models for complex social systems.

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

Major Activities: During the September 1, 2017 through August 31, 2018 reporting period, NIMBioS hosted eleven meetings of ten different Working Groups, two Investigative Workshops, two Tutorials, monthly XSEDE HPC workshops, five INCLUDES webinars, and many Outreach and Education activities. There are projected to be more than 400 participants in NIMBioS-hosted activities during this period with seven Postdoctoral Fellows in residence, 21 Short-term Visitors, one Visiting Scholar and one Visiting Graduate Student Fellow.

The Working Groups that met during this period were: Modeling Molecules-to-Organisms (September 2017), Modeling Organisms-to-Ecosystems (September 2017), Models of Produce Contamination (September 2017), Long Transients and Ecological Forecasting (October 2017), Conservation Hierarchies (November 2017, May 2018), Prediction and Control of Cardiac Alternans (December 2017), Multiscale Vectored Plant Viruses (December 2017), Ecosystem Federalism (January 2018), Learning in Networks (February 2018), and Improving Quantitative Biology Skills at Community Colleges (April 2018). This does not include a meeting of a joint Working Group supported by NIMBioS and SESYNC on Integrating Human Risk Perception of Global

Climate Change into Dynamic Earth System Models which met at SESYNC (May 2018).

The Investigative Workshops were: Stoichiometric Ecotoxicology (January 2018) and Bio-acoustic Structure (June 2018). Tutorials included Applications of Spatial Data: Ecological Niche Modeling (May 2018) and The Search for Selection (June 2018).

Demographic data on all participants are available for events from September 1, 2017 through June 30, 2018 and are presented in detail in the NIMBioS Evaluation Report (see Section Y10-2 of the attached addendum to this Annual Report) and summarized below. There were 408 participants through June 30, 2018, from 15 countries and 40 U.S. states as well as the District of Columbia representing 181 different institutions. International participants amounted to 10% of all participants. Most participants were college or university faculty (46%), but undergraduates (13%), post-doctoral researchers (13%), and graduate students (8%) accounted for a significant fraction of participants. Across all events female representation was 48%. Overall minority representation across NIMBioS events was 12%, which falls within ranges for doctoral recipients in the biological and mathematical sciences.

Twenty-one short-term visitors from September 1, 2017 through August 31, 2018 represented 20 different institutions and collaborated with NIMBioS post-doctoral fellows and faculty from five University of Tennessee departments.

Additional meetings held at NIMBioS during this period included the UT-NIMBioS STEM Alliance Workshop (November 2017), the SECSC Working Group on Research Needs for Conservation Policy and Resource Management (December 2017), and the DySoc Critical Workshop on Modeling Complex Systems in Archaeology (June 2018). As we move to sustainment of key programs beyond NSF support, we will continue to reach out to potential collaborators to host tutorials, workshops, and working groups as this is an effective approach to maintaining scientific activities.

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 in October of this reporting period to evaluate requests for Working Groups and Investigative Workshops of which two were approved. 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 and Adventures in STEM Camp (Science, Technology, Engineering, and

Mathematics) are examples of efforts to reach out to K-12 students and encourage their interest in math and the sciences. The Summer Research Experience (SRE) for undergraduates and teachers help participants gain the skills and make the connections between mathematics and biology that are a core component of the NIMBioS mission.

NIMBioS hosted a Summer Research Experience for undergraduates program, which included 15 undergraduates in math and biology fields from 11 different institutions. The students engaged in team research projects in one of five different topics: Ecological Niche Modeling and Risk Assessment of Thousand Cankers Disease, Mosquito Population Response to Environmental Variables, Modeling the Management of Feral Cats with Economic Impacts, Spatial Interactions between Hunting and Plant Gathering in Tropical Forests, or Using Phylogenetics to Understand Cancer Tumors. The goal of this program is to further enhance the students' abilities to independently and as part of a team develop quantitative approaches to answer biological questions. An indicator of the success of the NIMBioS SRE program is the progression of many former participants into doctoral programs in STEM fields.

In fall 2017, NIMBioS hosted its Ninth Annual Undergraduate Research Conference at the Interface of Math and Biology, which included more than 60 undergraduate research talks and posters and was attended by more than 100 students and faculty from academic institutions across North America.

Graduate students have been regular participants in many NIMBioS research activities, particularly workshops, tutorials, and short-term visits. NIMBioS supported four University of Tennessee graduate students to carry out research in collaboration with NIMBioS post-docs and researchers and to provide assistance with specific programs. Our Visiting Graduate Fellow program allows graduate students from outside the University of Tennessee to come for longer visits to collaborate with NIMBioS post-docs and University of Tennessee faculty. Tiago Yuzo Miyaoki, was a NIMBioS Visiting Graduate Fellow with support from Brazil and worked with S. Lenhart on applying control techniques to Zika models. (May – December 2017)

Postdoctoral 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. There were seven Postdoctoral Fellows in residence for at least part of this reporting period. An objective of NIMBioS is to enhance career opportunities for current and former Postdoctoral Fellows, and career development seminars and workshops are held regularly. As of July 2018, two of the NIMBioS Postdocs in residence this year moved on to new positions, one to a faculty position and one to another postdoctoral position at another university.

Significant Results: NIMBioS relies upon participants to self-report products that were derived from their participation in NIMBioS activities. There were a total of 342 products reported from the time of preparation of the September 2016 - August 2017 annual report (April 30, 2017) through July 25, 2018, including 184 journal articles, 10 book chapters, 3 books, 89 conference papers and presentations, 6 software/netware/data and research materials, 16 grant requests, 8 educational

aids or curricula, 5 meetings, workshops or symposiums, and 21 other products or publications. 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 Y10-5 of the Addendum to this annual report.

Since inception NIMBioS-supported activities have resulted in publications in a broad range of topics as designated by ISI Web of Science categories. The most common subject category has been Ecology, followed by Evolutionary Biology, Biology, Mathematical & Computational Biology, Multidisciplinary Sciences, and Genetics & Heredity.

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, Cell, Science, Nature Climate Change, Trends in Ecology and Evolution, Ecology Letters, Systematic Biology, PLoS Biology, Nature Communications, and Proceedings of the National Academy of Sciences, among others. Table 1 (see supporting tables at the end of this section) provides details on NIMBioS-derived publications in certain high-impact journals during this reporting period and since inception.

Figure 1 (see supporting figures at the end of this section) illustrates the diversity of scientific topics covered by working groups and workshops hosted by NIMBioS between September 1, 2017 and June 30, 2018 (more information on interpretation of this figure is available in the NIMBioS Evaluation Report, Section Y10-2 of the addendum to this annual report - see Figure 43 and associated text in Section Y10-2).

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 (see supporting figures at the end of 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 and mathematical sciences, there are a number of participants from the social sciences, marine sciences, health sciences, education, engineering, and others. As the width of the connecting line segments in this graphic illustrates, these NIMBioS Working Groups have generated a number of connections between individuals from diverse fields.

The National Institute for STEM Evaluation and Research (NISER) was founded in 2016 and operates as a Center within NIMBioS. NISER continues to make significant progress as a leading national resource for evaluation expertise. In particular, the Center has built a national reputation in areas that have generally been ignored or poorly handled in many large-scale research and education projects. NISER has essentially become the go-to group for high quality program evaluation for major NSF projects. For example, it is the external evaluator for the largest NSF-funded education project in biology.

Accomplishments to date include:

Collaborations were established on more than 80 grant proposals with fourteen awards, including two major University of Tennessee STEM education projects (NIH funded PEER and PIPES projects). Additionally, NISER is evaluating STEM education projects at Harvard University arising from their MRSEC. NISER's total external funding secured to date is around \$1.5M.

During 2018, NISER developed and delivered five NSF INCLUDES-sponsored evaluation-focused webinars, including: Evaluation Strategies for Measuring the Broader Impacts (BI) of NSF INCLUDES Projects (June 7, 2018—74 registrants, 33 attendees), Qualitative Data in Culturally Rich Evaluations of NSF INCLUDES Projects (May 3, 2018—97 registrants, 53 attendees), Engaging Diverse Populations in Evaluations of NSF INCLUDES Projects (April 5, 2018—57 registrants, 36 attendees), Program Models as a Tool for Scaling up NSF INCLUDES Projects (March 1, 2018—48 registrants, 25 attendees), and Evaluating Social Media Impact in NSF INCLUDES Projects (February 1, 2018—101 registrants, 65 attendees). All materials from these webinars were posted on the NIMBioS website.

Four research projects are underway: one in collaboration with investigators from the NSF-funded Quantitative Biology Education and Synthesis (QUBES) project on the roadblocks and incentives of biology faculty to contribute to and use open educational resource; one study looking at 35 completed working groups with 458 participants using HLM to examine the group and individual level diversity factors that may influence productivity; one study with the NIH-funded Possibilities in Post-Secondary Education in Science (PiPES) project that examines the usefulness of undergraduate and graduate student journaling when implementing STEM-based K-12 in-school interventions; and one NSF-funded project to develop and validate the Biology Calculus Concept Inventory, which will be broadly disseminated as an assessment instrument for life sciences students taking calculus.

NIMBioS' **Spatial Analysis Laboratory** (SAL) has become a resource for Knoxville-area faculty and institutions to have access to drone, remote sensing and LIDAR technology, along with associated analysis capabilities. SAL is being considered as a UTK Core Facility. SAL is actively seeking users for its facilities, but as it only recently became operational, its revenue stream is still developing. The drone technology and analysis capabilities it has available are expected to be of benefit to many different faculty and projects in the UT Knoxville area, but are also available to external researchers.

The **Center for the Dynamics of Social Complexity** (DySoC) has arisen through the long-term efforts of Dr. S. Gavrilets, NIMBioS Associate Director for Scientific Activities, to build at UTK a collaborative program at the leading edge of research in quantitative evolutionary aspects of human social systems. Established in 2018, it has great potential to sustain UTK efforts to build a world-leading program that is capable of attracting significant external funding. NIMBioS is the natural base for building DySoC due to the long history of NIMBioS support for research activities at the core of DySoC objectives in using mathematical and computational methods to address interdisciplinary challenges in human social systems. Proposals to two major novel sources of

funding to support DySoC activities are in progress.

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

NIMBioS carries out extensive training and professional development activities. We provide some highlights here, but see the detailed listing of activities during this reporting period in Section Y10-4 of the Annual Report Addendum.

Postdoctoral Fellows

Postdoctoral 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. There were seven Postdoctoral Fellows in residence for at least part of this reporting period. An objective of NIMBioS is to enhance career opportunities for current and former Postdoctoral Fellows, and career development seminars and workshops are held regularly. As of July 2018, two of the seven NIMBioS Postdocs in residence this year moved on to new positions, one to a faculty position and one to another Postdoctoral position at another university.

NIMBioS provides a Postdoctoral Professional Development Seminar series for the Fellows during the academic year and gives the Fellows additional opportunities to explore and discuss shared professional development issues with faculty and staff from around the University. Often the ratio of Fellow to faculty in these discussions will be between 2:1 and 3:1 enabling a rich discussion environment in which the Fellows can explore questions and ideas they have. Topics for the series are typically suggested by the Fellows themselves. The most frequently requested topics concern aspects of the job application and interview process. Teams of Fellows and their mentors are involved in the design of some of these professional development sessions. Several Fellows initiated a program for mentoring female postdocs in science as well as participated in departmental discussions about challenges to diversity in science. New postdocs 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. Postdoctoral Fellows are informed of other opportunities (e.g., workshops, short-courses, web sites and other information relevant to professional development) occurring on campus and elsewhere. All Postdoctoral Fellows are asked to complete online profiles that require them to succinctly describe their work. Postdoctoral Fellows are provided with a travel allowance to promote their development as scientists and for career development. Presentations by Fellows are included with Other Products in the Products section of this report.

Annual reviews of Postdoctoral Fellows focus on professional and scientific development. Manuscript submission is an expected goal for all Fellows; 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.

Graduate Students

During AY18-19, NIMBioS supported four UTK graduate student research fellowships using internal UTK funds. Two male and two female students are pursuing degrees in Chemical Engineering, Ecology and Evolutionary Biology, and Math. They were granted research awards based on an internal annual competitive application process. They performed research in the areas of computational methods to investigate interactions of a T cell with an antigen-presenting cell; mathematical and computational methods to infer protein properties and their evolution; optimal control of difference equations to describe populations and examine the effects of processes such as harvesting or dispersal on individual or coupled populations; and mathematical modeling to better understand and predict costs associated with protected areas and spatial optimization approaches to inform reserve design and selection.

Collectively, they presented at five national conferences and have two (D Burton and C Landerer) published

manuscripts and one (R. Pullen) under review. R. Pullen and C. Landerer plan to defend their Ph.D.s in Fall 2018, while D. Le Bouille is targeting later in AY 18-19 and D. Burton continues as a doctoral student. All participated in NIMBioS-related K-12 outreach activities and provided support for NIMBioS events. Three additional UTK graduate students worked on projects related to the National Institute for STEM Evaluation and Research (NISER).

NIMBioS hosted T.Miyaoki (Applied Mathematics, University of Campinas, Brazil), a self-supported Visiting Graduate Fellow collaborating on a project with NIMBioS postdoc N.Siewe and NIMBioS Associate Director for Education & Outreach S. Lenhart on applying control techniques to Zika models. Miyaoki conducted research at NIMBioS from May-December 2017. Three additional graduate students (A. Fieldler, S. Drohan, and S. Carrignon) were short-term visitors at NIMBioS.

Our tutorials provide training on specific research tools for all groups but are important for graduate student professional development. Tutorials on Applications of Spatial Data and on Search for Selection provided opportunities for graduate students to learn techniques for working with and analyzing spatial data and for identifying whether features may have been shaped by selection.

Undergraduates

Our Summer Research Experiences for Undergraduates program provided training in research procedures, mathematical modeling, R and MATLAB programming, and poster and oral presentations, as well as opportunities to explain their research to various media outlets. In this program, our professional development activities included sessions on career opportunities, graduate school applications, and learning to work in teams (including the use of self-assessments). Our Undergraduate Research Conference at the Interface of Biology and Mathematics (November 2017) 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 new initiative involving STEM undergraduates with disabilities provided activities to build a community and to provide career advice and skills for being successful in obtaining their degrees. This program is partially funded through a subcontract through the NSF INCLUDES program: Southeast Alliance for Persons with Disabilities in STEM centered at Auburn University. We also hosted a workshop on Transitions for STEM Students with Disabilities at NIMBioS on Nov. 28, 2017.

Sustainability

The Search for Selection tutorial in June 2018 was oversubscribed, and we plan to offer that tutorial again next year. Many of the participants in 2018 paid most of their expenses, and we expect this again next year. We are also planning to pursue funding through grants and other government or industrial sources to support additional tutorials.

An NSF proposal to obtain additional funding for our undergraduate conference was successful in 2017, and we have submitted a similar proposal for our 2018 conference. Proposals for funding to extend the NIMBioS undergraduate summer research program will also be submitted.

We will seek follow-up funding for our NSF EAGER grant to formulate a BioCalculus Concept Inventory with biological applications. Further work needs to be done to evaluate this inventory as a tool to assess quantitative concept learning goals in the context of life science data examples and models. L. Gross, P. Bishop, and S. Lenhart are involved in this project.

*** 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 June 2018, the website contained 1,244 pages and 2,079 pdf documents. Table 2 and Figure 3 (appended to end of this section) illustrate trends in the number of site visits over the current reporting period and over the full range of NIMBioS operation. The purpose of the website is to provide information about research at the interface of mathematics and biology and attract potential scientists/researchers to participate in the work of NIMBioS while also providing scientific information to a generalized audience. The audience for nimbios.org is multifaceted with a wide range of needs and interests, primarily consisting of scientists from academic institutions, state and federal government agencies and non-governmental organizations. Viewers searching online for information about science-related topics visit NIMBioS pages where they can view videos on science topics, read feature stories about science and scientists, interact using social media tools including sharing posts or leaving comments on the NIMBioS blog. The website provides up-to-date and accurate information about the wide range of topics addressed by NIMBioS groups and researchers, while familiarizing viewers with the NIMBioS mission and activities. It also provides a comprehensive listing of research results via NIMBioS “products,” including publications, presentations, proposals, scientific meetings generated by NIMBioS activities, educational products, and data and software. The site is updated with new content on a daily basis.

Another key channel for disseminating information to NIMBioS communities of interest is the bi-monthly newsletter called “NIMBioS News.” The newsletter includes science stories, education and outreach-related features, links to videos from the library of NIMBioS-produced videos, future educational and research opportunities, and selected recent publications. As of July 2018, there were more than 8,300 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 500 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, which has more than 1,000 subscribers, and are also featured on the NIMBioS website.

NIMBioS 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. Viewer discussion is promoted via Twitter hashtags.

NIMBioS maintains a subscription account with EurekAlert!, an online, global news service which reaches thousands of journalists. NIMBioS press releases are disseminated via EurekAlert! as well as via its private list of media contacts. The press releases are written for a non-specialized audience interested in science topics. NIMBioS also collaborates with the media office at the University of Tennessee, Knoxville, as well as the press offices of visiting scientists’ institutions, in order to increase dissemination of research results via press releases. Addendum Y 10-5 includes a full listing of media coverage of NIMBioS during this reporting period.

Press releases derived from NIMBioS activities have led to news coverage in local, regional, national and international press including Science, Nature, The New York Times, the Los Angeles Times, National Public Radio, CNN, and many other outlets.

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

individuals using these websites.

In addition, NIMBioS gives workshop and tutorial organizers the option to have NIMBioS create and maintain a WordPress site for each workshop and tutorial. The site facilitates group communication and information sharing for the workshop/tutorial, and is accessible for informational purposes to individuals not participating in the workshop. NIMBioS currently maintains 41 of these WordPress sites.

Finally, aside from NIMBioS' multimedia channels and communication activities, NIMBioS undertakes numerous outreach activities via the NIMBioS Education and Outreach office. These include presentations and exhibits about our activities at professional meetings, such as the Joint Mathematics Meeting, the Society for the Advancement of Chicanos and Native Americans in Science, and the National Science Teacher's Association. It also includes outreach to the general public, such as the presentation of a special NIMBioS math and biology award at the regional science fair and coordinating activities for the Sharing Adventures in Science and Engineering (SHADES) event. For a complete listing of all of our outreach activities during the reporting period see the Addendum Y10-4.

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

In the no-cost extension year of support from NSF, NIMBioS will continue to promote and implement its vision and mission to; (1) Foster new collaborative efforts to investigate fundamental and applied questions arising in biology using appropriate mathematical and computational methods; (2) Enhance the essential human capacity to analyze complex biological questions and develop necessary new mathematics; and (3) Encourage broader public appreciation of the unity of science and mathematics. In addition to continuation of ongoing activities, several new components are being developed to enhance NIMBioS' mission, including expansion of the National Institute for STEM Evaluation and Research (NISER), ramp up of the Spatial Analysis Laboratory (SAL), further development of the Center for the Dynamics of Social Complexity (DySoc), and beginning the Mathematical Modeling Consulting Center (MMCC).

Workshops, Working Groups, and Tutorials. An important part of the effort to foster new collaborative activities is supporting and hosting community-driven workshops and working groups. Three workshops and a tutorial are already scheduled, and nine current Working Groups are expected to hold one or more meetings. Maintaining these types of activities is part of NIMBioS' core, and one means of maintaining them is encouraging and facilitating inclusion of NIMBioS-hosted workshops, tutorials, and working groups in grant submissions. As discussed in the various sections of the annual report, these efforts are at various stages of development, but we have developed websites and application processes and will continue advertising these opportunities as they arise. A number of grant proposals that include support for activities at NIMBioS have been submitted to date; and we anticipate several of these will support activities here within the next year.

Postdoctoral Fellows. NIMBioS will continue to enhance the human capacity in all of our programs. We have made a concerted effort to encourage faculty to submit grants through NIMBioS that include Postdoctoral support, and we anticipate having four new Postdoctoral Fellows during the no-cost extension year supported wholly or in part by other grants. Research areas for these Fellows will include Mathematical Modeling of Epidemiology and Evolutionary Game Theory, Mathematical Modeling of Biological Systems, Species Distribution Modeling and Conservation, and Spatial Biology.

Spatial Analysis Laboratory (SAL). M. Papes leads the development of the Spatial Analysis Laboratory as a recharge center that will be available to the Postdoctoral Fellows and serve as a local, regional and national resource. We have worked collaboratively with EEB, the Department of Geography, and the Office of Research to equip the lab with a terrestrial LIDAR unit and a drone for surveillance. The lab provides the ability to accumulate large, spatially explicit datasets (big data) and the development of new technologies (e.g. Unmanned Aerial Systems) and thereby expand the scope of analyses and bridging across disciplines. M. Papes and E. Carr have begun coalescing a community of scholars to disseminate information and bridge funding opportunities, through

partnerships with stakeholders. The role of SAL will be pivotal in providing the infrastructure and talent to solve problems that require broad geographic extent, long-term data and collaborations between researchers from various disciplines and stakeholders. The convergence of ideas, tools, and technologies from various fields has been identified by NSF as one of the 10 Big Ideas for the coming decades. Convergent research is possible through collaborations of universities with state and federal agencies, industry, and private foundations. SAL will seek to foster these partnerships

National Institute for STEM Evaluation and Research (NISER). P. Bishop is directing this Center, which was founded in 2016 and ties directly to NIMBioS' mission in STEM education and research. NISER provides experience in systems-level evaluation, a deep understanding of interdisciplinary team science, a professional collaborative approach to program evaluation and research, and the ability to untangle the complexity of large-scale STEM programs. The Center employs two full-time staff members and several part-time assistants. During the next reporting period, we expect to take further steps to enhance the capabilities and growth of NISER.

Center for the Dynamics of Social Complexity (DySoC). A number of NIMBioS-supported activities focusing on transferring methods and insights from mathematical and computational biology to social sciences have resulted in the momentum to establish a new Center that would unite researchers interested in combining system thinking, modeling tools, and big data to develop testable predictions and research into a variety of topics related to human social behavior, such as cooperation, conflict, cultural evolution and dynamics, mass behavior and psychology, and human origins. The Center for the Dynamics of Social Complexity (DySoC; dysoc.org) started in January of 2018. Researchers at the Center also focus on emergence and evolution of human societies, impacts of social structure on disease transmission, social norms, and societal response to shocks. The Center currently has 16 members from 10 different departments (Anthropology, Child and Family Studies, Classics, Ecology and Evolutionary Biology, Mathematics, Mechanical, Aerospace and Biomedical Engineering, Physics, Political Science, Psychology). The Center's Director is Sergey Gavrilets, who is the Associate Director for Scientific Activities at NIMBioS. The Center has started a seminar series, a monthly newsletter, and a series of joint lab meetings.

With NIMBioS' support, the Center is organizing three meetings to be held at NIMBioS: a workshop on "Extending the Theory of Sustainability" (December 2018), a working group on "Human Origins 2021" (February 2018), and a workshop on "Social norms: emergence, persistence, and effects" (April 2018).

The Center has partnered with the newly established Cultural Evolution Society (President P. J. Richerson) in submitting a grant proposal to the John Templeton Foundation and with the Evolution Institute (President D. S. Wilson) in submitting a grant proposal to the Kauffman Foundation. The Center has also collaborated with several external researchers in submitting grant proposals to the Department of Defense. There are plans for seeking additional funding by different groups of DySoC-associated faculty and jointly with external collaborators.

Mathematical Modeling Consulting Center (MMCC). The MMCC is a planned consulting center to operate within NIMBioS. It would take its inspiration from existing statistical consulting centers thriving at other universities and expand the research capabilities of researchers who need modeling expertise as opposed to statistical expertise. Researchers would come to the Center and be paired with modelers to discuss models and modeling approaches that could aid their research. The consulting center would potentially tie a community of postdoctoral fellows together, provide them mentorship opportunities, and enhance outreach and training experiences. N. Fefferman has joined the NIMBioS Leadership Team and will direct the next stages of development for the MMCC.

Supporting Figures and Tables

Figure 1. Diversity of topic areas for working groups and investigative workshops

Figure 2. Cross-disciplinary collaborations in NIMBioS working groups

Table 1. Listing of high-impact journal articles reported

Table 2 and Figure 3. Number of nimbios.org website visits and visitors

Figure 1. Diversity of subject areas represented in NIMBioS Working Group (WG) meetings and Investigative Workshops (WS) during the period from September 1, 2017 through June 30, 2018.

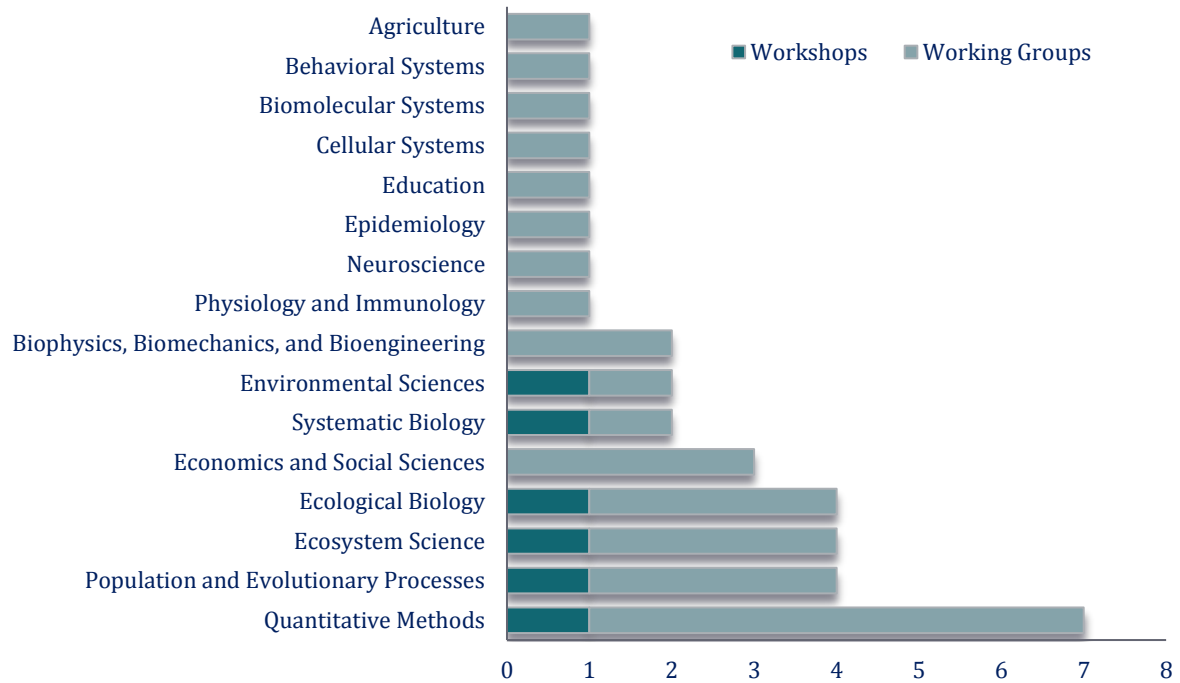


Figure 2. Cross-disciplinary connections fostered among Working Group members through the meetings hosted at NIMBioS from September 1, 2017 through June 30, 2018. Node radius is representative of the log scaled number of participants in each field of study. Line size is representative of the number of times researchers from each field were brought together to collaborate and problem-solve at NIMBioS.

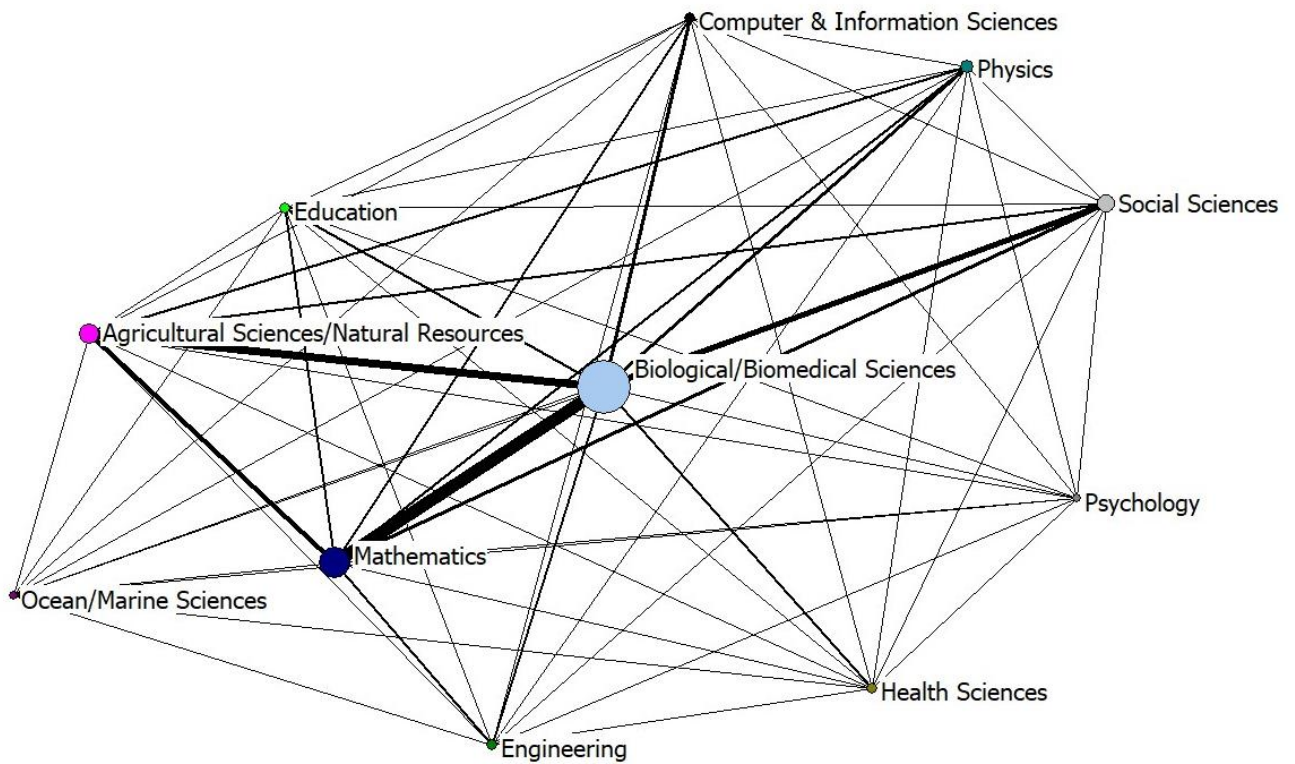


Table 1. Number of NIMBioS articles published in a selection of high-impact journals during the current reporting period (through June 2018) and since NIMBioS' inception, sorted by journal 5-Year Impact Factor

Journal Title	5-Year Impact Factor *	# of NIMBioS Publications in Year 10 **	# of NIMBioS Publications Since Inception ***
Nature	43.77	0	4
Cell	34.10	0	1
Science	38.06	2	10
Nature Climate Change	22.36	1	1
Trends in Ecology and Evolution	18.35	2	9
Ecology Letters	13.33	2	13
Systematic Biology	13.67	3	10
PLoS Biology	10.21	0	3
Nature Communications	13.09	1	3
Proceedings of the National Academy of Sciences	10.41	3	22
Current Biology	9.70	0	1
PLoS Genetics	7.06	0	2
Nucleic Acids Research	9.34	0	3
Phil Trans of the Royal Soc B-Biological Sciences	6.92	1	8
Molecular Ecology	6.64	1	12
Ecology	5.77	6	13
Proc of the Royal Soc B-Biological Sciences	5.42	1	13
PLoS Computational Biology	5.04	3	11
Evolution	4.56	1	18
Journal of Animal Ecology	5.06	3	7
American Naturalist	4.38	4	17
Journal of the Royal Society Interface	4.13	0	5
PLoS One	3.39	5	41
Animal Behaviour	3.28	2	11
BMC Bioinformatics	3.45	0	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 10 includes all publications reported since compilation of the previous Annual Report (April 2017) through June 2018.

*** September 2008 – June 2018

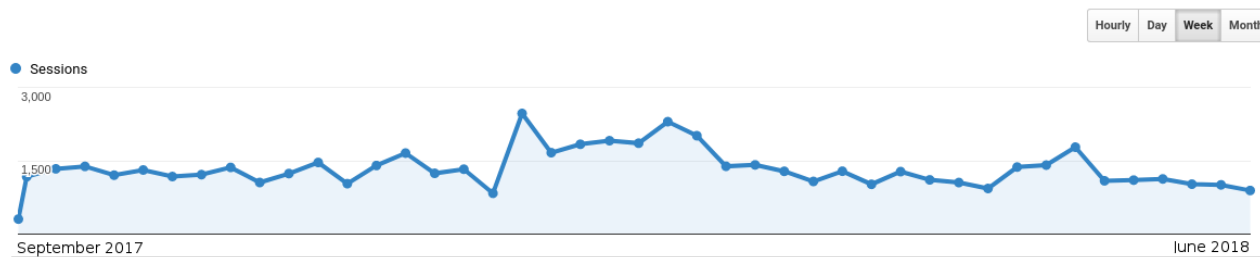
This supporting file contains Table 2 and Figure 3, which show overall trends of *nimbios.org* website visits and unique visitors through the reporting periods (site use data from Google Analytics).

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

Reporting year	Unique visitors	Visits
Sep 1, 2008 - Aug 31, 2009	9259	19951
Sep 1, 2009 - Aug 31, 2010	21278	41700
Sep 1, 2010 - Aug 31, 2011	33449	65208
Sep 1, 2011 - Aug 31, 2012	45084	88398
Sep 1, 2012 - Aug 31, 2013	74123	116473
Sep 1, 2013 - Aug 31, 2014	73906	116331
Sep 1, 2014 - Aug 31, 2015	78604	125992
Sep 1, 2015 – Aug 31, 2016	63800	99723
Sep 1, 2016 – Aug 31, 2017	50498	84553
Sep 1, 2017 - Jun 30, 2018*	37391	58421

*Partial year

(a)



(b)

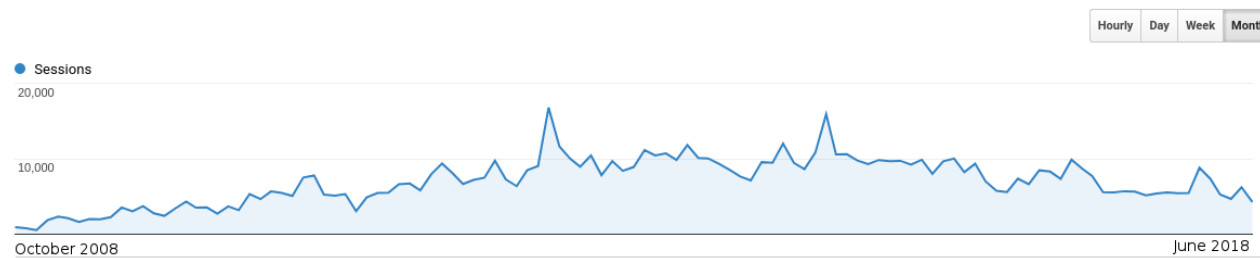


Figure 3. Number of *nimbios.org* website visits for (a) the 2018 reporting year (weekly, September 1, 2017 through June 30, 2018) and (b) monthly for the period October 1, 2008 through June 30, 2018. These figures show the impact of significant products on the number of website visits and document overall trends in visits since the inception of NIMBioS (site use data from Google Analytics).

Products

Books

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Inventions

Journals or Juried Conference Papers

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Wiederholt R, Mattsson BJ, Thogmartin WE, Runge MC, Diffendorfer JE, Erickson RA, Federico P, Lopez-Hoffman L, Fryxell JM, Norris DR, Sample C (2017). Estimating the per-capita contribution of habitats and pathways in a migratory network: a modelling approach. *Ecography*. 41 (5), 815. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1111/ecog.02718

Wiessner P (2016). The Rift between Science and Humanism What's Data Got to Do with It?. *Current Anthropology*. 57 (S13), S154. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer

Reviewed = Yes ; DOI: 10.1086/686017

Xu Z, Valdes C, Clarke J (2018). Existing and Potential Statistical and Computational Approaches for the Analysis of 3D CT Images of Plant Roots. *Agronomy*. 8 (5), 71. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.3390/agronomy8050071

Yuan Z, Zhou W, Chen X, Poyarkov NA, Chen H, Jang-Liaw N, Chou W, Matzke NJ, Iizuka K, Min M, Kuzmin SL, Zhang Y, Cannatella DC, Hillis DM, Che J (2016). Spatiotemporal Diversification of the True Frogs (Genus *Rana*): A Historical Framework for a Widely Studied Group of Model Organisms. *Systematic Biology*. 65 (5), 824. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1093/sysbio/syw055

Zawack K, Li M, Booth JG, Love W, Lanzas C, Grohn YT (2016). Monitoring Antimicrobial Resistance in the Food Supply Chain and Its Implications for FDA Policy Initiatives. *Antimicrobial Agents and Chemotherapy*. 60 (9), 5302. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1128/AAC.00688-16

Zefferman MR (2017). Cultural multilevel selection suggests neither large or small cooperative agreements are likely to solve climate change without changing the game. *Sustainability Science*. 13 (1), 109. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1007/s1162

Zlochiver S, Johnson C, Tolkacheva EG (2017). Constant DI Pacing Suppresses Cardiac Alternans Formation in Numerical Cable Models. *Chaos*. 27 (9), 0933903. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1063/1.4999355

Licenses

Other Conference Presentations / Papers

Forbes VE, Salice C (2017). *A framework for predicting impacts on ecosystem services from (sub)organismal responses to chemicals*. Ecological Society of America Conference. Portland, Oregon, United States. Status = PUBLISHED; Acknowledgment of Federal Support = Yes

Salice C, Forbes VE, Galic N (2017). *A systems modeling framework to link organism-level effects of chemical stressors to effects on ecosystem services*. Society of Environmental Toxicology and Chemistry. Minneapolis, Minnesota, United States. Status = PUBLISHED; Acknowledgment of Federal Support = Yes

Cavender-Bares J (2016). *Biodiversity in the Anthropocene: global detection, evolutionary legacies and stewardship*. Conference on Change and Biodiversity: Integrating Mechanisms of Interactions, Feedbacks and Scale. Monte Verita, Ascona, Switzerland. Status = PUBLISHED; Acknowledgment of Federal Support = Yes

Post BK, Riechert SE (2009). *Bridging the gap: Biology and engineering in the High School Curriculum*. ASEE SE Conference. Marietta, Georgia, United States. Status = PUBLISHED; Acknowledgment of Federal Support = Yes

Flanagan S (2017). *Challenges and advantages of the use of RAD-seq in the study of evolution (El Paso, TX)*. University of Texas-El Paso Bioinformatics Colloquium. El Paso, Texas, United State. Status = PUBLISHED; Acknowledgment of Federal Support = Yes

Nisbet RM, Murphy CA (2017). *Challenges in incorporating sub-organismal processes represented by quantitative AOPs into dynamic energy budgets models*. Society for Environmental Toxicology and Chemistry North America, 38th Annual Meeting. Minneapolis, Minnesota, United States. Status = PUBLISHED; Acknowledgment of Federal Support = Yes

Brozek O, Glomski M (2017). *Conditions for endemicity in a compartmental model with deceased-infectious class*.

Joint Meetings of the AMS and MAA. Atlanta, Georgia, United States. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Muller EB (2017). *Demand driven reserve allocation: can the reproductive buffer modulate kappa?*. 5th International Dynamic Energy Budget Symposium. Tromsø, Nord-Troms, Norway. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Downing R, Clark BJ, Nacci DE, Champlin D, Bosker T, Watanabe KH, Nishimura J (2016). *Development of a Mathematical Model for Fecundity in Mummichog (Fundulus heteroclitus)*. SETAC North America 37th Annual Meeting. Orlando, Florida, United States. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Muller EB (2017). *Dynamic Energy Budget models for production in holometabolous insects*. Université François-Rabelais. Tours, Centre-Val de Loire, France. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Cavender-Bares J (2017). *Ecosystem Services of Trees and Tree Diversity: Implications for Managing Planet Earth in the Anthropocene*. 6th Global Botanic Gardens Congress. Geneva, Switzerland. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Forbes VE, Bruins R, von Stackelberg K (2017). *Ecosystem services as a basis for ecological risk assessment of chemical*. Society of Environmental Toxicology and Chemistry. Minneapolis, Minnesota, United States. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Muller EB (2016). *Emerging issues in marine environmental toxicology: Effects, uptake and transfer mechanisms of contaminants in the lower marine food web*. Norwegian University of Science and Technology. Trondheim, Trøndelag, Norway. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Cavender-Bares J (2016). *Evolutionary Legacy Effects on Ecosystems: Implications for managing Planet Earth in the Anthropocene*. 101st Ecological Society of America Meeting. Ft. Lauderdale, Florida, United States. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Mayes R (2016). *Expert quantitative reasoning consultant for NABT Workshop*. National Association of Biology Teachers. Denver, Colorado, United States. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Smith-Ramesh LM (2017). *Food web properties and the causes and consequences of species invasions*. American Mathematical Society Central Sectional Meeting. Bloomington, Indiana, United States. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Gerkin RC, Keller A, Mainland J, Ihara Y, Vosshall L, Meyer P (2016). *From Shape to Smell: Predicting odor descriptors for single molecules*. Society for Neuroscience. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Burton D (2017). *Harvest timing in difference equations (Tanzania)*. Southern African Mathematical Sciences Association Annual Meetings. Arusha, Tanzania. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Burton D (2017). *Harvest timing in difference equations (U.S.)*. Southeastern-Atlantic Regional Conference on Differential Equations. Kennesaw, Georgia, United States. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Lika K, Murphy CA, Muller EB, Nacci D, Nisbet RM, Remien CH, Schultz IR, Watanabe KH (2017). *Hormone driven energy allocation for egg loading added to a dynamic energy budget model to predict the effects of endocrine disruption*. Society for Environmental Toxicology and Chemistry North America, 38th Annual Meeting. Minneapolis, Minnesota, United States. Status = PUBLISHED; Acknowledgement of Federal Support =

Yes

Archer E (2014). *In Silico Reverse Engineering of Human Energy Physiology using Agent-Based Modeling*. ObesityWeek™ at The Obesity Society (TOS) and the American Society for Metabolic & Bariatric Surgery (ASMBS) annual meeting. Boston, Massachusetts, United States. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Murphy CA, Nisbet RM (2018). *Incorporating Sub-Organismal Processes that Occur at the Molecular and Cellular Level to Dynamic Energy Budgets to Determine Whole Organism Responses*. SETAC Focus Topic Meeting: High Throughput Screening and Environmental Risk Assessment. Durham, North Carolina, United States. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Landerer C, Beaulieu J, O'Meara B, Gilchrist MA (2017). *Inference of Amino Acid functionality from DNA sequences using a novel phylogenetics approach*. Society for Molecular Biology and Evolution. Austin, Texas, United States. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Lacasse K, Beckage B, Gross L, Carr E, Metcalf S, Winter J, Howe P, Fefferman N, Zia A, Kinzig A, Franck T (2017). *Integrating human risk perception and behavior into a climate model*. Convention of the Society for the Psychological Study of Social Issues. Albuquerque, New Mexico, United States. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Lacasse et al (2017). *Integrating human risk perception and behavior into a climate model*. Convention of the Society for the Psychological Study of Social Issues. Santa Fe, New Mexico, United States. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Uzelac I (2017). *Level-set Method for Robust Analysis of Optical Mapping Recordings of Fibrillation*. Computing in Cardiology. Rennes, France. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Muller EB (2016). *Linking Adverse Outcome Pathway Analyses to Dynamic Energy Budgets: A Case Study with Endocrine Disruptors and Fish*. SETAC North America 37th annual meeting. Orlando, Florida, United States. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Cavender-Bares J, Meireles JE (2016). *Linking leaf spectra to phylogenies*. Ecological Society of America meeting. Ft. Lauderdale, Florida, United States. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Lacasse et al (2018). *Linking models of human behavior and climate alters projected climate change*. Preconference of the Society for Personality and Social Psychology Convention. Atlanta, Georgia, United States. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Cavender-Bares J (2016). *Linking remotely sensed optical diversity to functional and phylogenetic diversity*. Lunch seminar, Department of Environmental Biology, National Science Foundation. National Science Foundation. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Cavender-Bares J, Gamon J, Townsend P, Hobbie SE, Madritch M, Lindroth R, Montgomery R, Zygielbaum A (2016). *Linking remotely sensed optical diversity to genetic, phylogenetic and functional diversity to predict ecosystem processes*. 2016 NASA Biodiversity and Ecological Forecasting Team Meeting. Washington, D.C., United States. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Nisbet RM, Murphy CA (2017). *Linking the Adverse Outcome Pathway to Dynamic Energy Budgets: A conceptual model and two case studies*. Society for Environmental Toxicology and Chemistry Europe. Brussels, Belgium. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Murphy CA, Nisbet RM, Antczak P, Gergs A, Lika K, Mathews TJ, Muller EB, Nacci D, Peace A, Remien C, Schutlz I, Vinas N, Watanabe K (2016). *Linking the adverse outcome pathway to dynamic energy budgets: a conceptual model*. Society for Environmental Toxicology and Chemistry North America, 37th Annual Meeting. Orlando, Florida, United States. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Jenkins KP, LaMar MD, Donovan S, Eaton C (2017). *Making Meaning Through Modeling*. QUBES/BioQUEST Summer Workshop. East Lansing, Michigan, United States. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Jenkins KP, LaMar MD, Donovan S (2017). *Making the Most of Modeling*. National Association of Biology Teachers. St. Louis, Missouri, United States. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Flanagan SP (2017). *Mate quality and timing of reproduction affects sexual selection in a sex-role-reversed pipefish (Knoxville, TN)*. Women in STEM Symposium. Knoxville, Tennessee, United States. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Accolla C, Forbes VE (2017). *Mechanistic modeling of chemical stressors: Impacts of estrogen (EE2) on the greenback cutthroat trout*. Society of Environmental Toxicology and Chemistry. Minneapolis, Minnesota, United States. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Smith-Ramesh LM (2017). *Native predators and invasive plants interact to alter the role of plant-soil feedback as an invasion driver*. Ecological Society of America 102nd Annual Meeting. Portland, Oregon, United States. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Murphy C, Nisbet R (2017). *New Approaches to Ecological Risk Assessment - Bridging Adverse Outcome Pathways to Dynamic Energy Budget Models*. Society for Environmental Toxicology and Chemistry Annual Meeting. Minneapolis, Minnesota, United States. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Jeger MJ, Hamelin FM, Allen LJ (2017). *Plant virus transmission pathways: the evolution of virulence and mutualism*. British Applied Mathematics Colloquium. Surrey, England, United Kingdom. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Flanagan SP (2017). *Population genomics illuminates the role of selection in the evolution of pipefish (Christchurch, New Zealand)*. University of Canterbury Seminar Series. Christchurch, New Zealand. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Flanagan SP (2017). *Population genomics illuminates the role of selection in the evolution of pipefish (Norman, OK)*. University of Oklahoma Seminar Series. Norman, Oklahoma, United States. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Flanagan SP (2017). *Population genomics illuminates the role of selection in the evolution of pipefish (Pittsburgh, PA)*. University of Pittsburgh Seminar Series. Pittsburgh, Pennsylvania, United States. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Flanagan SP (2017). *Population genomics illuminates the role of selection in the evolution of pipefish (Portland, OR)*. Evolution 2017. Portland, Oregon, United States. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Flanagan SP (2017). *Population genomics illuminates the role of selection in the evolution of pipefish (Tampa, FL)*. SyngBio2017. University of Tampa, Tampa, Florida, United States. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Forbes VE, Railsback S, Accolla C, Birnir B, Bruins RJF, Ducrot V, Galic N, Garber K, Harvey BC, Jager H, Kanarek A, Pastorok R, Rebarber R, Thorbek P, Salice CJ (2017). *Predicting impacts of an endocrine disruptor on ecosystem services provided by fish populations*. Society of Environmental Toxicology and Chemistry. Minneapolis, Minnesota, United States. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Mayes R (2017). *Quantitative Reasoning in Undergraduate Biology*. HHMI Advancing Science Students Mastery of Quantitative Skills. Chevy Chase, Maryland, United States. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Mayes R (2015). *Quantitative Reasoning: Interdisciplinary STEM 21st Century Reasoning Modality*. HHMI Quantitative Biology Conference. Claremont, California, United States. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Murphy CA, Nisbet RM (2017). *Relating sub-organismal processes that occur at the molecular and cellular level to dynamic energy budgets*. Fifth International Symposium on Dynamic Energy Budget Theory. Tromso, Norway. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Mayes R (2016). *Research on Impact of Undergraduate Biology Courses on Student Modeling Ability*. HHMI Quantitative Biology/BioQuest/QUBES Conference. NCSU, Raleigh, North Carolina, United States. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Newman EA (2017). *Revealing biases in the sampling of large-scale ecological networks*. International Association for Landscape Ecology. Baltimore, Maryland, United States. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Archer E (2014). *Reverse Engineering of Human Energy Metabolism and Lipogenic Postprandial Nutrient Partitioning using Agent-Based Modeling*. Alabama Modeling and Simulation Conference. Huntsville, Alabama, United States. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Jenkins KP, Callender H (2017). *Scientific Thinking With Models and Data*. Society for the Study of Evolution. Portland, Oregon, United States. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Mayes R (2016). *Session: Teaching of Modeling - Quantitative Reasoning and Modeling in the Sciences*. BEER National Conference. Charleston, South Carolina, United States. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Jungck J (2017). *Slide Rules to Calculators to Laptop Computers to Tablets: A Metaphor for Four Generations of Change in Mathematical Biology Education*. Society for Mathematical Biology annual meeting. Salt Lake City, Utah, United States. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Russo SE, Ledder G, Couvreur V, Manzoni S, Way D (2017). *Stem Hydraulics Model for Tall Trees I: A Working Group Meeting at UNL*. A Working Group Meeting at UNL. Lincoln, Nebraska, United States. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Russo SE, Ledder G, Couvreur V (2018). *Stem Hydraulics Model for Tall Trees II: A Working Group Meeting at UNL*. A Working Group Meeting at UNL. Lincoln, Nebraska, United States. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Hamelin, F. M., Hilker, F. M., Sun, T. A., Jeger, M. J., Hajimorad, M. R., Allen, L. J., & Prendeville, H. R. (2017). *The evolution of parasitic and mutualistic plant-virus symbioses through transmission-virulence trade-offs*. International conference on Mathematical Methods and Models in Biosciences (Biomath 2017). Skukuza, Mpumalanga, South Africa. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Flanagan S (2017). *The role of selection in the evolution of pipefish: insights from population genomics* (Charleston, SC). College of Charleston Biology Department Seminar Series. Charleston, South Carolina, United States. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Flanagan SP (2017). *The role of selection in the evolution of pipefish: insights from population genomics* (College Park, MD). Horn Point Seminar Series. College Park, Maryland, United States. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Gaggiotti OE (2017). *Understanding associations between species and genetic diversity requires the use of consistent measures of biodiversity across levels of organisation*. Symposium "Conservation of Adaptive Potential and Functional Diversity". Durham University, Durham, United Kingdom. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Adams A, Dougherty O, Murphy Q (2017). *Within-host Mathematical Models for Orthohantavirus Infections*. NIMBioS Undergraduate Research Conference at the Interface of Mathematics and Biology. Knoxville, Tennessee, United States. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

de Aguiar MAM, Hembry D, Kraenkel R, Newman E, O'Donnell JL, Guimaraes PR (2018). *Workshop on Spatial and Temporal Dynamics of Ecological Networks*. International Centre for Theoretical Physics-South American Institute for Fundamental Research. Sao Paulo, Brazil. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Other Products

Audio or Video Products.

Album: The Infomatic EP

Artist: Brinkman B

Publication Year: 2012

URL: <http://music.bababrinkman.com/album/the-infomatic-ep>

Notes: Hip-hop album

Audio or Video Products.

Type: Podcast

Title: The psychology of wrecking or saving the planet

Description: Radio Ecoshock

Date: 21 January 2018

URL: <http://www.radio4all.net/index.php/series/Radio+Ecoshock+Show>

Software or Netware.

Title: spectrolab: Class and Methods for Hyperspectral Data. R package version 0.0.2

Authors: Meireles J, Schweiger A, Cavender-Bares J

Publication Year: 2017

URL: <https://github.com/annakat/spectrolab>

We developed a new open source R package, spectrolab, that implements input/output of spectral data for many common field spectrometers as well as various processing and visualization methods. Among other things, spectrolab can perform spectral smoothing, vector normalization, ancillary information integration (such as chemistry data), and static and interactive plotting. Most importantly, the package implements an S3 class system for spectra with a standardized interface, getters and setters, and several other methods. As a consequence, we see spectrolab as a catalyst product that will facilitate the development of new spectroscopy software and methods by the scientific community. spectrolab is available on (<https://github.com/annakat/spectrolab>) and can be installed directly from GitHub. The package has also been submitted to CRAN and waits for the final approval. The package citation is: Meireles J, Schweiger A and Cavender-Bares J (2017). spectrolab: Class and Methods for Hyperspectral Data. R package version 0.0.2, <https://github.com/annakat/spectrolab>.

Software or Netware.

Title: Hill Equation, Gompertz Growth Model. Biological ESTEEM website.

Author: Jungck

Publication Year: 2017

Software or Netware.

Title: NeuronUnit

Description: A package for data-driven validation of neuron and ion channel models using SciUnit

Author: Gerkin RC

Publication Year: 2016

Software or Netware.

Title: fsthet: Generating smoothed quantiles for the FST-heterozygosity distribution

Description: The goal of fsthet is to calculate smoothed quantiles from the existing dataset to identify loci with extreme Fst values relative to their heterozygosity. This allows the user to identify loci that have extreme Fst values without relying on a specific population genetics model.

Author: Flanagan SP

Publication Year: 2017

URL: https://github.com/spflanagan/fsthet_analysis/tree/master/fsthet

Software or Netware.

Title: gwscaR: Genome-wide selection components analysis in R

Description: This repository contains an R package with a number of population genomics tools, including a wrapper that will run an Fst-based genome-wide selection components analysis. Currently it only contains functions, but soon I will be adding documentation, including vignettes.

Author: Flanagan SP

Publication Year: 2017

URL: <https://github.com/spflanagan/gwscaR>

Models.

Title: Model code: the PACE model integrated with the CROADS Carbon Cycle model

Authors: Beckage B, Gross LJ, Lacasse K, Carr E, Metcalf SS, Winter JM, Howe PD, Fefferman N, Franck T, Zia A, Kinzig A, Hoffman FM

Publication Year: 2018

URL: <http://www.nimbios.org/products/software/pace.zip>

Models.

Title: Numerical algorithm for topological analysis of optical mapping recordings of cardiac arrhythmia

Author: Gurevich DG

Publication Year: 2017

Evaluation Instruments.

Quantitative Biology - Quantitative Act and Quantitative Literacy Assessment. Diagnostic assessment of pre-requisite quantitative skills. Piloted Fall 2016. Mayes R, Dauer J

Evaluation Instruments.

Quantitative Biology - Quantitative Interpretation and Quantitative Modeling Assessment. Diagnostic assessment piloted Fall 2016. Mayes R, Dauer J

Evaluation Instruments.

Quantitative Biology - Quantitative Modeling Assessment. Diagnostic assessment and associated interview protocol piloted Fall 2017. Mayes R, Dauer J

Grant Proposal.

Title: "NSF IUSE: Biology Undergraduate Mathematics Attitudes and Anxiety Program (BioMAPP)"

Authors: Wojdak J, Mayes R

Year: 2017

Status: Funded

Amount: \$298,846.00 USD

Funding Agency: NSF

Grant Proposal.

Title: "Stem Hydraulic Model for Trees"

Description: "Working Group Meetings at University of Nebraska - Lincoln"

Authors: RUSSO SE, LEDDER G

Year: 2016

Status: Funded

Amount: \$9,780.00 USD

Funding Agency: University of Nebraska at Lincoln, College of Arts and Sciences

Grant Proposal.

Title: "XSEDE Research Allocation: 100,000 CPU Hours at Texas Advanced Computing Center"

Author: Bucksch A

Year: 2017

Status: Funded

Funding Agency: Texas Advanced Computing Center

Media Coverage.

Title: Adult chimpanzees play more than adult lowland gorillas in captivity

Source: Public Library of Science

Date: 7 March 2018

URL: <https://phys.org/news/2018-03-adult-chimpanzees-lowland-gorillas-captivity.html>

Based on: Cordoni G, Norscia I, Bobbio M, Palagi E (2018) Differences in play can illuminate differences in affiliation: A comparative study on chimpanzees and gorillas. PLoS ONE 13(3): e0193096. doi.org/10.1371/journal.pone.0193096

Media Coverage.

Title: Exercise data reveal a couch potato nation

Author: Mohan G., at LA Times

Date: 21 FEB 2014

URL: <http://articles.latimes.com/2014/feb/21/science/la-sci-sn-exercise-sedentary-20140221>

Media Coverage.

Title: Humans Earth's only hope: Societal changes key to controlling rising temperatures

Container Title: International Business Times

Author: Radhakrishnan S

Date: 2 January 2018

URL: <http://www.ibtimes.com/humans-earths-only-hope-societal-changes-key-controlling-rising-temperatures-2635715>

Media Coverage.

Title: Let's stop making the solution to climate change seem impossible

Container Title: Earther

Author: Funes Y

Date: 3 January 2018

URL: <https://earther.com/let-s-stop-making-the-solution-to-climate-change-seem-i-1821714844>

Media Coverage.

Title: Obese Women Get Only One Hour Of Exercise in a Whole Year

Author: Sifferlin A., at Time Magazine Online

Date: 20 FEB 2014

URL: <http://time.com/8840/obese-women-exercise-an-hour-a-year/>

Media Coverage.

Title: Obese women only get one hour of vigorous exercise a year

Author: Castillo M., at CBS News

Date: 21 FEB 2014

URL: <https://www.cbsnews.com/news/obese-women-only-get-one-hour-of-vigorous-exercise-a-year-study/>

Media Coverage.

Title: Study Reveals Just How Abysmal Our Exercise Habits Are

Author: Mosbergen D., at Huffington Post

Date: 23 FEB 2014

URL: https://www.huffingtonpost.com/2014/02/23/exercise-habits-study_n_4843818.html

Media Coverage.

Title: Average Obese Woman Gets 1 Hour of Exercise a Year

Author: Dotinga R., at WebMD

Date: 20 FEB 2014

URL: <https://www.webmd.com/fitness-exercise/news/20140220/average-obese-woman-gets-just-1-hour-of-exercise-a-year-study#1>

Media Coverage.

Type: Media Coverage

Title: Adult chimpanzees play more than adult lowland gorillas in captivity: In adult animals, play is a sign of social cohesion and is inhibited by strong competition

Source: ScienceDaily

Date: 7 March 2018

URL: www.sciencedaily.com/releases/2018/03/180307141414.htm

Citation: PLOS. "Adult chimpanzees play more than adult lowland gorillas in captivity: In adult animals, play is a sign of social cohesion and is inhibited by strong competition." ScienceDaily. ScienceDaily, 7 March 2018. <www.sciencedaily.com/releases/2018/03/180307141414.htm>.

Media Coverage.

Type: Media Coverage

Title: Adult great apes - including people - may be more playful in egalitarian societies

Author: Meadows R

Date: 8 March 2018

URL: <http://researchnews.plos.org/2018/03/08/adult-great-ape-play/>

Other Publications

Ledbetter A (2016). *The Implementation of Mathematical Modeling in Health Care and its Relation to Nursing.*

Ledbetter A. 2016. The Implementation of Mathematical Modeling in Health Care and its Relation to Nursing. Fall 2016 Mathematics Senior Seminar Paper.. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Patents

Technologies or Techniques

Thesis/Dissertations

Garuccio A (Advised by Neilan R). *A Genetic Programming Approach to Solving Optimization Problems on Agent-Based Models.* (2016). Duquesne University. Acknowledgement of Federal Support = Yes

Levy B. *Modeling Feral Hogs in Great Smoky Mountains National Park.* (2016). University of Tennessee Knoxville. Acknowledgement of Federal Support = Yes

Hagg M. *The effect of climate change on the biodiversity of a multilayer network of plant-plant and plant-pollinator interactions.* (2017). Utrecht University, Utrecht, Netherlands. Acknowledgement of Federal Support = Yes

Websites

Participants/Organizations

What individuals have worked on the project?

Name	Most Senior Project Role	Nearest Person Month Worked
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Name	Most Senior Project Role	Nearest Person Month Worked
Gross, Louis	PD/PI	11
Gavrilets, Sergey	Co-Investigator	3
Lenhart, Suzanne	Co-Investigator	4
Bishop, Pam	Faculty	12
Brothers, Ernest	Faculty	1
Buchan, Alison	Faculty	2
Fefferman, Nina	Faculty	2
Giam, Xingli	Faculty	1
Gilchrist, Michael	Faculty	1
O'Meara, Brian	Faculty	1
Papes, Mona	Faculty	1
Sims, Charles	Faculty	1
Trout-Fryxell, Rebecca	Faculty	1
Chang, Charlotte	Postdoctoral (scholar, fellow or other postdoctoral position)	11
Flanagan, Sarah	Postdoctoral (scholar, fellow or other postdoctoral position)	10
Johnson, Quentin	Postdoctoral (scholar, fellow or other postdoctoral position)	1
Panchy, Nick	Postdoctoral (scholar, fellow or other postdoctoral position)	10
Siewe, Nourridine	Postdoctoral (scholar, fellow or other postdoctoral position)	12

Name	Most Senior Project Role	Nearest Person Month Worked
Smith-Ramesh, Lauren	Postdoctoral (scholar, fellow or other postdoctoral position)	10
Tarasov, Sergei	Postdoctoral (scholar, fellow or other postdoctoral position)	10
Taylor, Robin	Postdoctoral (scholar, fellow or other postdoctoral position)	5
Bartolini, Mary	Other Professional	12
Carr, Eric	Other Professional	12
Comiskey, Jane	Other Professional	12
Eskridge, Chandra	Other Professional	12
Kidder, Kevin	Other Professional	9
LoRe, Sondra	Other Professional	12
Peek, Mike	Other Professional	11
Richters, Ana	Other Professional	5
Spar, Jennifer	Other Professional	12
Wiggins, Greg	Other Professional	12
York, Meredith	Other Professional	1
Crawley, Catherine	Staff Scientist (doctoral level)	12
Welsh, Chris	Staff Scientist (doctoral level)	12
Burton, Danielle	Graduate Student (research assistant)	5
Landerer, Cedric	Graduate Student (research assistant)	5
LeBouille, Diane	Graduate Student (research assistant)	5
Musgrove, Matthew	Graduate Student (research assistant)	1

Name	Most Senior Project Role	Nearest Person Month Worked
Pullen, Robert	Graduate Student (research assistant)	5
Abbasi, Eeman	Research Experience for Undergraduates (REU) Participant	2
Alred, Brianna	Research Experience for Undergraduates (REU) Participant	2
Berle, Amelia	Research Experience for Undergraduates (REU) Participant	2
Blesi, Annastashia	Research Experience for Undergraduates (REU) Participant	2
Brock, Sarah	Research Experience for Undergraduates (REU) Participant	2
Brozak, Samantha	Research Experience for Undergraduates (REU) Participant	2
Castedo Pena, Diego	Research Experience for Undergraduates (REU) Participant	2
Chidambaran, Sadhana	Research Experience for Undergraduates (REU) Participant	2
Dai, Yi	Research Experience for Undergraduates (REU) Participant	2
De Angeli, Kevin	Research Experience for Undergraduates (REU) Participant	2
Gan, Alan	Research Experience for Undergraduates (REU) Participant	2
Kwarta, Brielle	Research Experience for Undergraduates (REU) Participant	2
Reber, Ben	Research Experience for Undergraduates (REU) Participant	2
Reed, Hanna	Research Experience for Undergraduates (REU) Participant	2

Name	Most Senior Project Role	Nearest Person Month Worked
Schenck, Benjamin	Research Experience for Undergraduates (REU) Participant	2

Full details of individuals who have worked on the project:

Louis J Gross

Email: gross@NIMBioS.org

Most Senior Project Role: PD/PI

Nearest Person Month Worked: 11

Contribution to the Project: Dr. Gross is the NIMBioS Director. He heads the NIMBioS leadership team, coordinates activities of the Associate Directors, interacts with the Advisory Board, and communicates the vision and mission of NIMBioS to numerous individuals and institutions. He oversees all aspects of the Center and coordinates future planning.

Funding Support: University of Tennessee

International Collaboration: Yes, Brazil, France, Germany, United Kingdom

International Travel: No

Sergey Gavrillets

Email: sergey@nimbios.org

Most Senior Project Role: Co-Investigator

Nearest Person Month Worked: 3

Contribution to the Project: Dr. Gavrillets 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 and is spearheading the development of the Center for the Dynamics of Social Complexity (DySoC) within NIMBioS.

Funding Support: NSF, University of Tennessee

International Collaboration: Yes, France, Germany, Japan, Netherlands, Russian Federation, United Kingdom

International Travel: Yes, Russian Federation - 0 years, 0 months, 6 days; United Kingdom - 0 years, 0 months, 5 days; Germany - 0 years, 0 months, 6 days; Switzerland - 0 years, 0 months, 5 days; Spain - 0 years, 0 months, 4 days; Sweden - 0 years, 0 months, 5 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

and coordinator and mentor for the 2018 Summer Research Experience for Undergraduates.

Funding Support: NSF, University of Tennessee

International Collaboration: Yes, Tanzania, United Republic Of

International Travel: Yes, Tanzania, United Republic Of - 0 years, 0 months, 11 days

Pam Bishop

Email: pbaird@utk.edu

Most Senior Project Role: Faculty

Nearest Person Month Worked: 12

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

Funding Support: NSF, University of Tennessee

International Collaboration: No

International Travel: No

Ernest Brothers

Email: ebrother@utk.edu

Most Senior Project Role: Faculty

Nearest Person Month Worked: 1

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

Funding Support: NSF, University of Tennessee

International Collaboration: No

International Travel: No

Alison Buchan

Email: abuchan@utk.edu

Most Senior Project Role: Faculty

Nearest Person Month Worked: 2

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

Funding Support: NSF, University of Tennessee

International Collaboration: No

International Travel: No

Nina Fefferman

Email: nfefferm@utk.edu

Most Senior Project Role: Faculty

Nearest Person Month Worked: 2

Contribution to the Project: Postdoc mentor, member of NIMBioS leadership team, and lead and director developing the Mathematical Modeling Consulting Center within NIMBioS.

Funding Support: NSF, University of Tennessee

International Collaboration: Yes, France, Israel

International Travel: No

Xingli Giam

Email: xgiam@utk.edu

Most Senior Project Role: Faculty

Nearest Person Month Worked: 1

Contribution to the Project: Dr. Giam serves as a post-doc mentor and is also a mentor for the 2018 Summer Research Experience for Undgraduates program.

Funding Support: NSF, University of Tennessee

International Collaboration: No

International Travel: No

Michael Gilchrist

Email: mikeg@utk.edu

Most Senior Project Role: Faculty

Nearest Person Month Worked: 1

Contribution to the Project: Dr. Gilchrist is a mentor for the 2018 Summer Research Experience for Undgraduates program.

Funding Support: University of Tennessee

International Collaboration: No

International Travel: No

Brian O'Meara

Email: bomeara@utk.edu

Most Senior Project Role: Faculty

Nearest Person Month Worked: 1

Contribution to the Project: Dr. O'Meara is the NIMBioS Associate Director for Postdoctoral Activities.

Funding Support: NSF

International Collaboration: Yes, Russian Federation

International Travel: No

Mona Papes

Email: mpapes@utk.edu

Most Senior Project Role: Faculty

Nearest Person Month Worked: 1

Contribution to the Project: Dr. Papes is a member of the NIMBioS leadership team, Director of the Spatial Analysis Lab, and is also a mentor for the 2018 Summer Research Experience for Undgraduates program.

Funding Support: University of Tennessee

International Collaboration: No

International Travel: No

Charles Sims

Email: cbsims@utk.edu

Most Senior Project Role: Faculty

Nearest Person Month Worked: 1

Contribution to the Project: Dr. Sims is an organizer for the Ecosystems Federalism working group and a mentor for the 2018 Summer Research Experience for Undgraduates program.

Funding Support: University of Tennessee

International Collaboration: No

International Travel: No

Rebecca Trout-Fryxell

Email: rfryxell@utk.edu

Most Senior Project Role: Faculty

Nearest Person Month Worked: 1

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

Funding Support: University of Tennessee

International Collaboration: No

International Travel: No

Charlotte Chang

Email: chchang@nimbios.org

Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)

Nearest Person Month Worked: 11

Contribution to the Project: Dr. Chang (Ecology & Evolutionary Biology, Princeton Univ.) is exploring the impact of diverse socio-cultural hunting practices as well as the response of hunting pressure to the spatial and temporal distribution of different harvested goods.

Funding Support: NSF

International Collaboration: Yes, Australia, China, India

International Travel: Yes, China - 0 years, 0 months, 10 days; India - 0 years, 0 months, 15 days

Sarah Flanagan

Email: sflanagan@nimbios.org

Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)

Nearest Person Month Worked: 10

Contribution to the Project: Sarah Flanagan (Biology, Texas A&M Univ., 2016) is developing different approaches to generate better a priori

Funding Support: NSF

International Collaboration: No

International Travel: Yes, New Zealand - 0 years, 0 months, 2 days

Quentin Johnson

Email: quentin.johnson@nimbios.org

Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)

Nearest Person Month Worked: 1

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

Funding Support: NSF

International Collaboration: No

International Travel: No

Nick Panchy

Email: panchy@nimbios.org

Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)

Nearest Person Month Worked: 10

Contribution to the Project: Dr. Panchy (Genetics, Michigan State Univ.) is exploring the role and regulation of intermediate epithelial-to-mesenchymal transition (EMT) cell-types by modeling gene regulatory networks controlling expression across EMT types.

Funding Support: NSF

International Collaboration: No

International Travel: No

Nourridine Siewe

Email: nourridine@nimbios.org

Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)

Nearest Person Month Worked: 12

Contribution to the Project: Nourridine Siewe (Mathematics, Howard Univ., 2016) is developing mathematical models of visceral leishmaniasis and malaria co-infection to improve the diagnosis and treatment process.

Funding Support: NSF

International Collaboration: No

International Travel: No

Lauren Smith-Ramesh

Email: lsmithramesh@nimbios.org

Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)

Nearest Person Month Worked: 10

Contribution to the Project: Lauren Smith-Ramesh (Biology, Indiana Univ., 2014) is investigating invasive plants in a food-web context and the direct and indirect effects to native communities and ecosystems.

Funding Support: NSF

International Collaboration: No

International Travel: No

Sergei Tarasov

Email: tarasov@nimbios.org

Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)

Nearest Person Month Worked: 10

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

Funding Support: NSF

International Collaboration: No

International Travel: No

Robin Taylor

Email: rtaylor@nimbios.org

Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)

Nearest Person Month Worked: 5

Contribution to the Project: Robin T. Taylor (Educational Psychology, Educational Research Methods and Analysis, Auburn University, 2012) was a Postdoctoral Fellow in Science Education Research and Evaluation for the National Institute for STEM Evaluation who assisted in the development and validation of a Quantitative Biology Concept Inventory (QBCI). The QBCI is intended as a diagnostic tool to identify misconceptions of calculus concepts for students enrolled in life science courses and to evaluate mathematical comprehension of students in the life sciences when learning mathematical concepts in a biological context. Once finalized, the QBCI will be disseminated on a broad scale for use in mathematical education, particularly in courses geared toward students interested in the life sciences.

Funding Support: Other grants

International Collaboration: No

International Travel: No

Mary Bartolini

Email: mbartoli@utk.edu

Most Senior Project Role: Other Professional

Nearest Person Month Worked: 12

Contribution to the Project: Mary is the NIMBioS Business Manager.

Funding Support: NSF

International Collaboration: No

International Travel: No

Eric Carr

Email: carr@nimbios.org

Most Senior Project Role: Other Professional

Nearest Person Month Worked: 12

Contribution to the Project: Eric is the full-time NIMBioS Computational Data Engineer. He provides support for all participant and staff HPC. He provides scientific computing support for groups as needed, provides IT support for all participants, and researches and recommends resources for virtual collaborations. He is managing the Spatial Analysis Laboratory at NIMBioS.

Funding Support: NSF

International Collaboration: No

International Travel: No

Jane Comiskey

Email: ecomiske@nimbios.org

Most Senior Project Role: Other Professional

Nearest Person Month Worked: 12

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

activities, and supports web-communications for activity participants.

Funding Support: NSF

International Collaboration: No

International Travel: No

Chandra Eskridge

Email: ceskridge@nimbios.org

Most Senior Project Role: Other Professional

Nearest Person Month Worked: 12

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

Funding Support: NSF

International Collaboration: No

International Travel: No

Kevin Kidder

Email: kkidder@vols.utk.edu

Most Senior Project Role: Other Professional

Nearest Person Month Worked: 9

Contribution to the Project: Kevin was an Evaluation Associate for NIMBioS' National Institute for STEM Evaluation and Research (NISER), specializing in mixed methods analyses. He was the evaluation lead for the Quantitative Undergraduate Biology Education and Synthesis project.

Funding Support: Other grants

International Collaboration: No

International Travel: No

Sondra LoRe

Email: sondra@utk.edu

Most Senior Project Role: Other Professional

Nearest Person Month Worked: 12

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

Funding Support: University of Tennessee

International Collaboration: No

International Travel: No

Mike Peek**Email:** peek@nimbios.org**Most Senior Project Role:** Other Professional**Nearest Person Month Worked:** 11

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

Funding Support: NSF, University of Tennessee

International Collaboration: No

International Travel: No

Ana Richters**Email:** richters@nimbios.org**Most Senior Project Role:** Other Professional**Nearest Person Month Worked:** 5

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

Funding Support: NSF

International Collaboration: No

International Travel: No

Jennifer Spar**Email:** jthomas@nimbios.org**Most Senior Project Role:** Other Professional**Nearest Person Month Worked:** 12

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

Funding Support: NSF

International Collaboration: No

International Travel: No

Greg Wiggins**Email:** wiggybug@utk.edu**Most Senior Project Role:** Other Professional**Nearest Person Month Worked:** 12

Contribution to the Project: Greg is the NIMBioS Outreach and Education Coordinator. He works closely with Associate Director for Outreach and Education Lenhart to develop and manage all NIMBioS outreach and

education activities.

Funding Support: NSF

International Collaboration: No

International Travel: No

Meredith York

Email: mcody@utk.edu

Most Senior Project Role: Other Professional

Nearest Person Month Worked: 1

Contribution to the Project: Meredith is an Evaluation Associate and provides support for STEM evaluation projects as part of NISER.

Funding Support: University of Tennessee; other grants

International Collaboration: No

International Travel: No

Catherine Crawley

Email: ccrawley@nimbios.org

Most Senior Project Role: Staff Scientist (doctoral level)

Nearest Person Month Worked: 12

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

Funding Support: NSF

International Collaboration: No

International Travel: No

Chris Welsh

Email: cwelsh@nimbios.org

Most Senior Project Role: Staff Scientist (doctoral level)

Nearest Person Month Worked: 12

Contribution to the Project: Dr. Welsh is the NIMBioS Deputy Director and member of the NIMBioS Leadership Team. He is responsible for overseeing day-to-day operations of the center, supervises most of the staff, and interacts regularly with activity organizers, visitors, and other collaborators.

Funding Support: NSF

International Collaboration: No

International Travel: No

Danielle Burton**Email:** dburton3@vols.utk.edu**Most Senior Project Role:** Graduate Student (research assistant)**Nearest Person Month Worked:** 5

Contribution to the Project: Danielle is a doctoral candidate in mathematics whose research focuses on optimal control of difference equations describing populations and on examining the effects of processes such as harvesting or dispersal on individual or coupled populations.

Funding Support: University of Tennessee

International Collaboration: Yes, Botswana, Germany, South Africa, Spain, Tanzania, United Republic Of, United Kingdom

International Travel: Yes, Tanzania, United Republic Of - 0 years, 0 months, 11 days

Cedric Landerer**Email:** clandere@vols.utk.edu**Most Senior Project Role:** Graduate Student (research assistant)**Nearest Person Month Worked:** 5

Contribution to the Project: Cedric Landerer is a doctoral student in ecology and evolutionary biology. His research focuses on the use and development of mathematical and computational methods to infer protein properties such as synthesis rate, co-translation folding, and optimal amino acid usage and their evolution within and across species, from patterns of codon usage.

Funding Support: University of Tennessee

International Collaboration: No

International Travel: No

Diane LeBouille**Email:** diane.lebouille@gmail.com**Most Senior Project Role:** Graduate Student (research assistant)**Nearest Person Month Worked:** 5

Contribution to the Project: Diane is a doctoral candidate in ecology and evolutionary biology. Her research focuses on spatial and temporal optimization of investments in protected areas.

Funding Support: University of Tennessee

International Collaboration: No

International Travel: No

Matthew Musgrove**Email:** mmusgro2@vols.utk.edu**Most Senior Project Role:** Graduate Student (research assistant)**Nearest Person Month Worked:** 1

Contribution to the Project: Matthew assists with activities related to NIMBioS' National Institute for STEM Evaluation and Research (NISER).

Funding Support: University of Tennessee

International Collaboration: No

International Travel: No

Robert Pullen

Email: rpullen2@vols.utk.edu

Most Senior Project Role: Graduate Student (research assistant)

Nearest Person Month Worked: 5

Contribution to the Project: Robert Pullen is a doctoral student in chemical engineering. His research uses computational methods to investigate how receptor-ligand binding kinetics and membrane mechanics govern the interactions of a T cell with an antigen-presenting cell.

Funding Support: University of Tennessee

International Collaboration: No

International Travel: No

Eeman Abbasi

Email: abbas22e@mtholyoke.edu

Most Senior Project Role: Research Experience for Undergraduates (REU) Participant

Nearest Person Month Worked: 2

Contribution to the Project: Participant in the NIMBioS' summer 2018 Summer Research Experience for undergraduate program.

Funding Support: NSF

International Collaboration: No

International Travel: No

Year of schooling completed: Junior

Home Institution: Mount Holyoke College

Government fiscal year(s) was this REU participant supported: 2018

Brianna Alred

Email: balred@vols.utk.edu

Most Senior Project Role: Research Experience for Undergraduates (REU) Participant

Nearest Person Month Worked: 2

Contribution to the Project: Participant in the NIMBioS' summer 2018 Summer Research Experience for undergraduate program.

Funding Support: NSF

International Collaboration: No

International Travel: No
Year of schooling completed: Junior
Home Institution: Univ. of Tennessee
Government fiscal year(s) was this REU participant supported: 2018

Amelia Berle

Email: ameliaberle@lclark.edu
Most Senior Project Role: Research Experience for Undergraduates (REU) Participant
Nearest Person Month Worked: 2

Contribution to the Project: Participant in the NIMBioS' summer 2018 Summer Research Experience for undergraduate program.

Funding Support: NSF

International Collaboration: No
International Travel: No
Year of schooling completed: Junior
Home Institution: Lewis & Clark College
Government fiscal year(s) was this REU participant supported: 2018

Annastashia Blesi

Email: hxb551@vols.utk.edu
Most Senior Project Role: Research Experience for Undergraduates (REU) Participant
Nearest Person Month Worked: 2

Contribution to the Project: Participant in the NIMBioS' summer 2018 Summer Research Experience for undergraduate program.

Funding Support: NSF

International Collaboration: No
International Travel: No
Year of schooling completed: Junior
Home Institution: Univ. of Tennessee
Government fiscal year(s) was this REU participant supported: 2018

Sarah Brock

Email: sbrock10@vols.utk.edu
Most Senior Project Role: Research Experience for Undergraduates (REU) Participant
Nearest Person Month Worked: 2

Contribution to the Project: Participant in the NIMBioS' summer 2018 Summer Research Experience for undergraduate program.

Funding Support: NSF

International Collaboration: No

International Travel: No
Year of schooling completed: Junior
Home Institution: Univ. of Tennessee
Government fiscal year(s) was this REU participant supported: 2018

Samantha Brozak

Email: sbrozak@asu.edu

Most Senior Project Role: Research Experience for Undergraduates (REU) Participant

Nearest Person Month Worked: 2

Contribution to the Project: Participant in the NIMBioS' summer 2018 Summer Research Experience for undergraduate program.

Funding Support: NSF

International Collaboration: No

International Travel: No

Year of schooling completed: Junior

Home Institution: Arizona State Univ.

Government fiscal year(s) was this REU participant supported: 2018

Diego Castedo Pena

Email: dcasted@ncsu.edu

Most Senior Project Role: Research Experience for Undergraduates (REU) Participant

Nearest Person Month Worked: 2

Contribution to the Project: Participant in the NIMBioS' summer 2018 Summer Research Experience for undergraduate program.

Funding Support: NSF

International Collaboration: No

International Travel: No

Year of schooling completed: Junior

Home Institution: North Carolina State Univ.

Government fiscal year(s) was this REU participant supported: 2018

Sadhana Chidambaran

Email: sadhana.chidambaran@gmail.com

Most Senior Project Role: Research Experience for Undergraduates (REU) Participant

Nearest Person Month Worked: 2

Contribution to the Project: Participant in the NIMBioS' summer 2018 Summer Research Experience for undergraduate program.

Funding Support: NSF

International Collaboration: No

International Travel: No
Year of schooling completed: Sophomore
Home Institution: Rutgers Univ.
Government fiscal year(s) was this REU participant supported: 2018

Yi Dai

Email: daiyi0215@outlook.com
Most Senior Project Role: Research Experience for Undergraduates (REU) Participant
Nearest Person Month Worked: 2

Contribution to the Project: Participant in the NIMBioS' summer 2018 Summer Research Experience for undergraduate program.

Funding Support: NSF

International Collaboration: No
International Travel: No
Year of schooling completed: Sophomore
Home Institution: Ohio State Univ.
Government fiscal year(s) was this REU participant supported: 2018

Kevin De Angeli

Email: kevindeangeli94@gmail.com
Most Senior Project Role: Research Experience for Undergraduates (REU) Participant
Nearest Person Month Worked: 2

Contribution to the Project: Participant in the NIMBioS' summer 2018 Summer Research Experience for undergraduate program.

Funding Support: NSF

International Collaboration: No
International Travel: No
Year of schooling completed: Junior
Home Institution: Texas A&M Univ.
Government fiscal year(s) was this REU participant supported: 2018

Alan Gan

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

Contribution to the Project: Participant in the NIMBioS' summer 2018 Summer Research Experience for undergraduate program.

Funding Support: NSF

International Collaboration: No

International Travel: No
Year of schooling completed: Sophomore
Home Institution: Univ. of Tennessee
Government fiscal year(s) was this REU participant supported: 2018

Brielle Kwarta

Email: brielle.kwarta19@houghton.edu
Most Senior Project Role: Research Experience for Undergraduates (REU) Participant
Nearest Person Month Worked: 2

Contribution to the Project: Participant in the NIMBioS' summer 2018 Summer Research Experience for undergraduate program.

Funding Support: NSF

International Collaboration: No
International Travel: No
Year of schooling completed: Junior
Home Institution: Houghton College
Government fiscal year(s) was this REU participant supported: 2018

Ben Reber

Email: benjamin.reber19@houghton.edu
Most Senior Project Role: Research Experience for Undergraduates (REU) Participant
Nearest Person Month Worked: 2

Contribution to the Project: Participant in the NIMBioS' summer 2018 Summer Research Experience for undergraduate program.

Funding Support: NSF

International Collaboration: No
International Travel: No
Year of schooling completed: Junior
Home Institution: Houghton College
Government fiscal year(s) was this REU participant supported: 2018

Hanna Reed

Email: hreed3@knights.ucf.edu
Most Senior Project Role: Research Experience for Undergraduates (REU) Participant
Nearest Person Month Worked: 2

Contribution to the Project: Participant in the NIMBioS' summer 2018 Summer Research Experience for undergraduate program.

Funding Support: NSF

International Collaboration: No

International Travel: No
Year of schooling completed: Other
Home Institution: Univ. of Central Florida
Government fiscal year(s) was this REU participant supported: 2018

Benjamin Schenck
Email: bschenck96@gmail.com
Most Senior Project Role: Research Experience for Undergraduates (REU) Participant
Nearest Person Month Worked: 2

Contribution to the Project: Participant in the NIMBioS' summer 2018 Summer Research Experience for undergraduate program.

Funding Support: NSF

International Collaboration: No
International Travel: No
Year of schooling completed: Junior
Home Institution: College of William & Mary
Government fiscal year(s) was this REU participant supported: 2018

What other organizations have been involved as partners?

Name	Type of Partner Organization	Location
AAAS-American Association for Advancement of Science	Academic Institution	Washington, D.C.
AIBS-American Institute of Biological Sciences	Academic Institution	Reston, VA
Cyverse	Academic Institution	Tucson, AZ
DIMACS-Center for Discrete Mathematics & Theoret. Comp. Sci.	Academic Institution	Rutgers University
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

Name	Type of Partner Organization	Location
Howard University	Academic Institution	Washington, D.C.
Innovative Computing Laboratory	Academic Institution	Knoxville, TN
Institute of Biomedical Engineering	Academic Institution	University of Tennessee
JICS-Joint Institute for Computational Science	Academic Institution	University of Tennessee
AWM-Association for Women in Mathematics	Other Nonprofits	Fairfax, VA
MBI-Mathematical Biosciences Institute	Academic Institution	Ohio State University
MSRI-Mathematical Sciences Research Institute	Academic Institution	Berkeley, CA
NCEAS-National Center for Ecological Analysis and Synthesis	Academic Institution	University of California - Santa Barbara
NEON-National Ecological Observatory Network, Inc.	Academic Institution	Boulder, CO
NICS-National Institute for Computational Science	Academic Institution	Oak Ridge, TN
NSF Mathematical Sciences Diversity Committee	Academic Institution	various
NSF Mathematical Sciences Institutes	Academic Institution	various
NSF-XSEDE Extreme Science and Engineering Environment	Academic Institution	various
National Academies of Sciences, Engineering, Medicine	Other Nonprofits	Washington, DC
NeuroNET	Other Organizations (foreign or domestic)	Knoxville, TN
Auburn University	Academic Institution	Auburn, AL
Oak Ridge National Laboratory	Other Organizations (foreign	Oak Ridge, TN

Name	Type of Partner Organization	Location
	or domestic)	
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
SIAM-Society for Industrial and Applied Mathematics	Academic Institution	Philadelphia, PA
SMB-Society for Mathematical Biology	Academic Institution	international
SMILES	Other Nonprofits	El Paso, TX
BioQUEST Curriculum Consortium	Other Nonprofits	Madison, WI
South-East Alliance for Persons with Disabilities	Academic Institution	Auburn, AL
TN-SCORE (Tennessee Solar Conversion and Storage using Outre	Academic Institution	Knoxville, TN
Tennessee Ornithological Society	Other Nonprofits	Clarksville, TN
Tennessee Science Teachers Association	Other Nonprofits	Tennessee
Tennessee State University	Academic Institution	Nashville, TN
U.S. Army Research Office	Other Organizations (foreign or domestic)	Research Triangle Park, NC

Name	Type of Partner Organization	Location
USDA - APHIS - WS - National Wildlife Research Center	Other Organizations (foreign or domestic)	Fort Collins, CO
UT Center for Wildlife Health	Academic Institution	Knoxville, TN
UT Health Sciences Center	Academic Institution	Memphis, TN
University of Tennessee - Biology in a Box	Academic Institution	Knoxville, TN
CEEMS-UT Center for Enhancing Education in Mathematics & Sci	Academic Institution	University of Tennessee
University of Texas El Paso	Academic Institution	El Paso, TX
VolsTeach	Academic Institution	University of Tennessee
sDiv	Other Nonprofits	Leipzig, Germany
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
Center for Synthesis and Analysis of Biodiversity	Academic Institution	Aix-en-Provence, France
Cultural Evolution Society	Other Nonprofits	Seattle, WA

Full details of organizations that have been involved as partners:

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 and AAAS collaborate on NSF INCLUDES initiatives, and NIMBioS Director Gross serves on the AAAS Data Advisory Board for the SEA Change initiative.

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 Associate Director Lenhart actively seeks collaboration on activities with this group.

Auburn University

Organization Type: Academic Institution

Organization Location: Auburn, AL

Partner's Contribution to the Project:

Collaborative Research

More Detail on Partner and Contribution: NIMBioS collaborates with Auburn's Southeast Alliance for Persons with Disabilities in STEM program on an NSF INCLUDES project, hosted a related workshop, and worked with undergraduates in the UT-NIMBioS STEM Alliance program.

BioQUEST Curriculum Consortium

Organization Type: Other Nonprofits

Organization Location: Madison, WI

Partner's Contribution to the Project:

Collaborative Research

Personnel Exchanges

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

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 and East TN STEM Hub on a variety of programs, including VolsTeach, to improve preparation of math and science teachers and STEM education. Collaborations include a Model with Math Teachers Workshop held in June 2018 in which NIMBioS Outreach presented mathematical modeling activities for teacher professional development.

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.

California State University San Marcos Foundation

Organization Type: Academic Institution

Organization Location: San Marcos, CA

Partner's Contribution to the Project:

Collaborative Research

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

Center for Synthesis and Analysis of Biodiversity

Organization Type: Academic Institution

Organization Location: Aix-en-Provence, France

Partner's Contribution to the Project:

Other: See detail

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

What other collaborators or contacts have been involved?

Nothing to report

Impacts

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

NIMBioS-supported activities have had strong impact on a number of biological sub-disciplines. Examples below cover many of the subject areas presented in Figure 1 (supporting file under Accomplishments). However, they are only a sample of the activities in these subject areas.

Postdoctoral Fellow Lauren Smith-Ramesh published a paper in *Ecology Letters*: “Predators in the plant–soil feedback loop: aboveground plant-associated predators may alter the outcome of plant–soil interactions.” Plant–soil feedback (PSF) can structure plant communities, promoting coexistence (negative PSF) or monodominance (positive PSF). At higher trophic levels, predators can alter plant community structure by re-allocating resources within habitats. When predator and plant species are spatially associated, predators may alter the outcome of PSF. Smith-Ramesh explored the influence of plant-associated predators on PSF using a generalized cellular automaton model that tracks nutrients, plants, herbivores and predators. She also explored key contingencies in plant–predator associations such as whether predators associate with live vs. senesced vegetation. Results indicate that plant-associated predators shift PSF to favor the host plant when predators colonize live vegetation, but the outcome of PSF will depend upon plant dispersal distance when predators colonize dead vegetation. Smith-Ramesh applied the model to two spider-associated invasive plants, finding that spider predators should shift PSF dynamics in a way that inhibits invasion by one forest invader, but exacerbates invasion by another.

Postdoctoral Fellow Suzanne M. O'Regan published a paper in the *Bulletin of Mathematical Biology* entitled “How stochasticity influences leading indicators of critical transitions.” This paper was co-authored by NIMBioS-supported graduate student, Danielle Burton. Many complex systems exhibit critical transitions. Of considerable interest are bifurcations, small smooth changes in underlying drivers that produce abrupt shifts in system state. Before reaching the bifurcation point, the system gradually loses stability (‘critical slowing down’). Signals of critical slowing down may be detected through measurement of summary statistics, but how extrinsic and intrinsic noises influence statistical patterns prior to a transition is unclear. The authors considered a range of stochastic models that exhibit transcritical, saddle-node and pitchfork bifurcations. Noise was assumed to be either intrinsic or extrinsic. Trends in summary statistics signaling the approach of each bifurcation depend on the form of noise. For example, models with intrinsic stochasticity may predict an increase or a decline in variance as the bifurcation parameter changes, whereas models with extrinsic noise applied additively predict an increase in variance. The ability to classify trends of summary statistics for a broad class of models enhances our understanding of how critical slowing down manifests in complex systems approaching a transition.

Members of a *joint SESYNC/NIMBioS Working Group* on “Integrating human risk perception of global climate change into dynamic earth system models” published a paper in *Nature Climate Change* entitled “Linking models of human behavior and climate alters projected climate change” by Beckage et al. Although not considered in climate models, perceived risk stemming from extreme climate events may induce behavioral changes that alter greenhouse gas emissions. The authors linked the C-ROADS climate model to a social model of behavioral change to examine how interactions between perceived risk and emissions behavior influence projected climate change. Their coupled climate and social model resulted in a global temperature change ranging from 3.4–6.2 °C by 2100 compared with 4.9 °C for the C-ROADS model alone, and led to behavioral uncertainty that was of a similar magnitude to physical uncertainty (2.8 °C versus 3.5 °C). Model components with the largest influence on temperature were the functional form of response to extreme events, interaction of perceived behavioral control with perceived social norms, and behaviors leading to sustained emissions reductions. Their results suggest policies emphasizing the appropriate attribution of extreme events to climate change and infrastructural mitigation

may reduce climate change the most.

Members of a *Working Group* on “Long Transients and Ecological Forecasting” published a paper in *Science* entitled “Transient phenomena in ecology” by Hastings et al. The importance of transient dynamics of both ecological systems and models that describe them has become increasingly recognized. However, previous work has typically treated each instance of these dynamics separately. Hastings et al. reviewed both empirical examples and model systems and outlined a classification of transient dynamics based on ideas and concepts from dynamical systems theory. Their classification provides ways to understand the likelihood of transients for particular systems and to guide investigations into timing of sudden switches in dynamics and other characteristics of transients. Implications for both management and underlying ecological theories emerge. A recognition of the difficulty of prediction caused by long transients and of the corresponding need to match dynamics to transient behaviors of models shows that basing either management or interpretation of ecological observations on long term dynamics only can be seriously flawed.

The *Working Group* “Prediction and Control of Cardiac Alternans” led to a paper in *Nature* by Christof et al.: “Electromechanical vortex filaments during cardiac fibrillation.” The self-organized dynamics of vortex-like rotating waves, also known as scroll waves, are the basis of the formation of complex spatiotemporal patterns in many excitable chemical and biological systems. In the heart, filament-like phase singularities associated with three-dimensional scroll waves are considered the organizing centers of life-threatening cardiac arrhythmias. Mechanisms that underlie the onset, maintenance and control of electromechanical turbulence in the heart are inherently three-dimensional phenomena. The authors showed that 3D mechanical scroll waves and filament-like phase singularities can be observed deep inside the contracting heart wall using high-resolution four-dimensional ultrasound-based strain imaging. They found mechanical phase singularities co-exist with electrical phase singularities during cardiac fibrillation. They also investigated dynamics of electrical and mechanical phase singularities by simultaneously measuring membrane potential, intracellular calcium concentration and mechanical contractions of the heart. They found cardiac fibrillation can be characterized using the 3D spatiotemporal dynamics of mechanical phase singularities, which arise inside the fibrillating contracting ventricular wall. The findings provide novel perspectives for non-invasive diagnostic imaging and therapeutic applications.

The *Investigative Workshop* “Conserving genes for the future: Improving statistical approaches for genetic resource monitoring” led to three publications in a special issue of *Evolutionary Applications*: “Guidelines for planning genomic assessment and monitoring of locally adaptive variation to inform species conservation” by Flanagan et al., “Diversity from genes to ecosystems: A unifying framework to study variation across biological metrics and scales” by Gaggiotti et al. and “Differentiation measures for conservation genetics” by Jost et al. These papers identify key considerations of genomics studies of locally adaptive variation, provide a road map for collaborations with genomics experts including key issues for study design and data analysis, and offer guidelines for interpreting and using genomic assessments to inform monitoring programs and conservation actions. The authors include several former NIMBioS Postdoctoral Fellows.

What is the impact on other disciplines?

Economics, Psychology and Anthropology

Participants of an *Investigative Workshop* “Evolutionary approaches to the understanding of decentralized warfare” have published a paper in *Nature Human Behavior* entitled “Spoils division rules shape aggression between natural groups” by Dogan et al. Violent intergroup conflicts cause widespread harm; yet, throughout human history, destructive hostilities occur time and time again. Benefits that are obtainable by victorious parties include territorial expansion, deterrence and ascendancy in between-group resource competition. Many of these are non-excludable goods that are available to all group members, whereas participation entails substantial individual risks and costs. Thus, a collective action problem emerges, raising the question why individuals participate in such campaigns at all. Distinguishing offensive and defensive intergroup aggression provides a

partial answer: Defensive aggression is adaptive under many circumstances. However, participation in offensive aggression, such as raids or wars of conquest, still requires an explanation. The authors focused on one condition that was hypothesized to facilitate the emergence of offensive intergroup aggression: asymmetric division of a conflict's spoils may motivate those profiting from such inequality to initiate between-group aggression, even if doing so jeopardizes their group's welfare. They tested this hypothesis by manipulating how benefits among victors are shared in a contest experiment among three Ethiopian societies whose relations are either peaceful or violent. Under equal sharing, between-group hostility increased contest contributions. By contrast, unequal sharing prompted offensive contribution strategies in privileged participants, whereas disadvantaged participants resorted to defensive strategies, both irrespective of group relations.

The Investigative Workshop has also led to several papers in a special issue of *Journal of Economic Behavior and Organization*. Their titles are: "The Psychology of Intergroup Conflict: A Review of Theories and Measures" by Bohm et al., "War and conflict in economics: theories, applications, and recent trends" by Kimbrough et al., "The logic of animal intergroup conflict: A review" by Rusch and Gavrillets, and "The evolutionary anthropology of war" by Glowacki et al.

What is the impact on the development of human resources?

In the Summer Research Experiences (SRE) for Undergraduates program, students were provided training in research procedures, mathematical modeling, media relations, and poster and oral presentations. Professional development activities included sessions on career opportunities, graduate school applications, and learning to work in teams, including the use of self-assessments. In summer 2018 participants included ten female and five male undergraduates in math and biology fields.

Our ninth annual Undergraduate Research Conference at the Interface of Biology and Mathematics (November 2017), which attracted 119 participant students and faculty from academic institutions across North America, included more than 60 undergraduate research talks and posters and provided professional development opportunities for all participants.

More details about our educational workshops and tutorials (for faculty, post-docs and teachers) are in the training and 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 educational interactions and collaborations. NIMBioS Postdoctoral Fellows gain cross-cultural experiences during these visits.

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. Activities are provided in a format that teaches important biological concepts and mathematical connections through hands-on community learning. Lessons are packaged within thematic units that are available in boxes at most school systems in Tennessee and offered to the worldwide audience at the project's web-site <http://biologyinabox.utk.edu>. Recent NIMBioS collaborative activities have involved presenting the Fossils thematic unit at our Adventures in STEM camp for middle school girls.

NIMBioS Associate Director for Diversity Enhancement Ernest Brothers provides strategies and best practices in diversity and inclusion presentations by request to departments and colleges, and he is also called upon by faculty to assist with grant proposals with regard to recruitment and retention of underrepresented minority students in STEM. He serves as a member on the Public Health Department Equity and Diversity Committee and on the Library Diversity Committee. In January 2017, Brothers presented "Strategies for Mentoring Diverse Graduate Students" at the University of Tennessee-Knoxville; "Best Practices in Recruiting Diverse Faculty" at the College of Communication, University of Tennessee-Knoxville, May 2017; "Diversity and Mentoring in Academia" at the Diversity in STEM and Best Practices to Improve Symposium at the Materials Science and Technology

Conference in Pittsburg, PA, October 2017; and “Enhancing Pathways to Graduate School for Students of Color,” MOC Forward Diversity Conference, University of Tennessee-Chattanooga, October 2017.

What is the impact on physical resources that form infrastructure?

NIMBioS space in the Claxton Building at the University of Tennessee was renovated prior to our occupying the space in April 2012. The renovation created high-quality meeting rooms controlled by NIMBioS that include two large conference rooms, two classrooms (one equipped for video-conferencing), and a tiered auditorium (with A/V recording capabilities) as well as offices for staff, visitors, and post-doctoral and sabbatical fellows. A movable wall between one classroom and the tiered auditorium allows for expansion of the auditorium to accommodate an audience of up to about 60 participants. NIMBioS has the capability to live-stream presentations from the auditorium, which is done routinely for workshops, tutorials, and seminars. This allows access to individuals dispersed around the world who could not be accommodated locally for these activities. NIMBioS allows use of these high-quality meeting rooms by other groups both internal and external to the University when not being used for NIMBioS activities. New physical resources added during this reporting period include equipment for the Spatial Analysis Laboratory, which has been developed as a resource for both internal and external researchers. The equipment includes a drone with multi-spectral cameras and a terrestrial LiDAR system, both of which have been made available for research and educational purposes, along with a variety of computers and software to carry out spatial data analysis. NIMBioS has also expanded the set of 3D printers available, and these were utilized extensively by the undergraduate students in the summer research experience program and by middle school students in the Adventures in STEM program.

What is the impact on institutional resources that form infrastructure?

NIMBioS has garnered institutional salary support that greatly facilitates collaboration across departments and across campuses. NIMBioS had had input into creation of three faculty lines within the College of Arts and Sciences to increase the number of NIMBioS-affiliated faculty from the initially-hired six faculty to a total of nine. Filling these lines has been done with the intent of enhancing and expanding expertise in areas related to the NIMBioS mission. One of the new faculty arrived at UTK during this reporting period and the other two recently hired individuals (T. Hong who joined the Department of Biochemistry, Cellular and Molecular Biology in January 2017 and M. Papes who joined the Department of Ecology and Evolutionary Biology in January 2017) have been closely involved in NIMBioS activities since arriving, including serving as mentors for postdoctoral fellows and assisting in organization of activities. M. Papes has expertise in GIS, remote sensing, and spatial analysis and has devoted considerable effort during this reporting period as the Director of the Spatial Analysis Lab to meet the needs of various researchers in the region. D. Talmy started his faculty position in the Department of Microbiology in February 2018 and brings to NIMBioS additional expertise in modeling of microbial communities.

NIMBioS staff have been directly involved with establishing University policies and practices that streamline the process of arranging lodging for participants and other visitors as well as discussions on information requirements for international visitors.

The University of Tennessee has co-located four major projects, each of which receives NSF support. These are NIMBioS, the UT/ORNL Joint Institute for Computational Science, the Computational Geography Research Group, and the Innovative Computing Laboratory. This physical proximity on different floors of the same building enhances the likelihood of further collaborations, joint activities, sharing meeting rooms, and also includes a shared computer facility that more efficiently utilizes machine room space for several users.

NIMBioS Evaluation

NIMBioS offers external evaluation services to the Science, Technology, Engineering, and Mathematics (STEM) research and education sector, with an emphasis on interdisciplinary programs. Under the guidance of NIMBioS

Associate Director for STEM Evaluation P. Bishop, the NIMBioS evaluation team provides independent, rigorous and transparent formative and summative evaluation services targeted at the unique goals for the program. What began as NIMBioS Evaluation Services has grown and is now recognized as the National Institute for STEM Evaluation and Research (NISER) under the NIMBioS umbrella. In addition to P. Bishop, the team during this reporting period included two evaluation associates, a postdoctoral fellow, partially supported two graduate students and supported several undergraduates. With expertise in evaluation theory, design and implementation, NISER is capable of evaluating large-scale projects to optimize decision-making and to untangle the complexity of program dynamics in order to understand how and why the project meets its objectives (or doesn't meet them).

Center for the Dynamics of Social Complexity (DySoC)

A number of NIMBioS-supported activities focusing on transferring methods and insights from mathematical and computational biology to social sciences have resulted in a momentum to establish a new Center during this reporting period that would unite researchers interested in combining system thinking, modeling tools, and big data to develop testable predictions and research into a variety of topics related to human social behavior, such as cooperation, conflict, cultural evolution and dynamics, mass behavior and psychology, and human origins. The Center for the Dynamics of Social Complexity (DySoC; dysoc.org) was opened in January of 2018. The Center's Director is Sergey Gavrilets who is the Associate Director for Scientific Activities at NIMBioS. The Center has started a seminar series, a monthly newsletter, and a series of joint lab meetings.

What is the impact on information resources that form infrastructure?

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

The Spatial Analysis Laboratory at NIMBioS enables cross-disciplinary research within the broader community of biologists and geographers engaged in bio- geographical modeling, spatial statistics, and anthropogenic dimensions of biodiversity conservation. The lab provides data storage and analysis; data visualization; new data collection; and training and outreach. Field instrumentation includes ground- based and low-altitude airborne remote sensing equipment, specifically a terrestrial laser scanner (FARO Focus S 350) and an unmanned aerial system (UAS) with multispectral and LiDAR capabilities. Trimble Juno and R1 units for high accuracy geolocation in the field. In addition, the lab offers high capacity server storage, state-of-the-art software, including ENVI, Trimble, ARCGIS, R, and MATLAB for remote sensing analyses and applications. Workstation support is available to integrate collected data from lab instruments and to support multiple projects in spatial data processing and analysis.

NIMBioS has developed a database system to effectively manage the variety of data we request of participants, to manage applications for activities, and to support the variety of evaluation activities carried out under NIMBioS auspices. This database system, use of which was launched in Fall of 2015, has been 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?

Throughout the year NIMBioS strives to make an impact on society in several ways: (1) education and outreach activities; (2) press releases, videos and radio; and (3) how we function as an organization. Each of these is discussed generally in the following.

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, workshops 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 issues press releases to inform 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. NIMBioS also issues a regular electronic newsletter and maintains a blog with regular posts informing the community about the latest news and events. In addition, as requested we work with the local University radio station by providing interview style conversations on NIMBioS to provide public visibility to the broader mission. NIMBioS activities are regularly announced to the broader University community through UT web announcements and listserves, and the live-stream of many activities allows these to be viewed broadly. NIMBioS maintains an extensive video collection that provides information to many viewers around the world.

The organizational structure and inherent mission of NIMBioS provides a broad impact on society through our various NSF-funded activities. These include increasing involvement of persons with disabilities and underrepresented minorities in STEM activities. Each supported event encourages participation of these groups and makes an effort to have these voices represented. For example, we have supported one working group that seeks to create new approaches in teaching STEM and another initiated during this reporting period that focuses on novel approaches to infuse community-college courses with an interdisciplinary flavor. Our postdoctoral training program is another important contribution in making an impact on the development of a diverse, competitive academic or industrial workforce. Finally, the enhanced infrastructure provided by NIMBioS offers a vital resource for bringing together diverse scientific groups for research and educational purposes.

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, 2017 – Jun 30, 2018

Y10-1. NIMBioS Board of Advisors Meeting Summaries

Y10-2. NIMBioS Evaluation Report

Y10-3. Participant List for NIMBioS Events and Activities

Y10-4. Description of Activities

Y10-5. Additional Products

Featured Articles

Websites

Media Coverage

**Y10-6. NSF Budget Office Reporting Requirement: Institutions, Partners,
Participants**

Addendum to NIMBioS Annual Report

Sep 1, 2017 - Jun 30, 2018

Y10-1. NIMBioS Board of Advisors Meeting Summaries

NIMBioS Advisory Board Meeting – 26-27 October 2017

Advisory Board Members participating – Linda Allen, Priyanga Amarasekare, Lydia Bourouiba, Zhilan Feng, John Glasser, Jake LaRiviere, Mark Lewis, Pete Richerson, Jorge Velasco-Hernandez, and Joshua Weitz.

NIMBioS Leadership Team Members participating – Alison Buchan, Nina Fefferman, Sergey Gavrillets, Louis Gross, Suzanne Lenhart, Brian O’Meara, Mona Papes, and Chris Welsh

Minutes:

The meeting was called to order by the Chair, Jorge Velasco-Hernandez, at 9 a.m. and following introductions of the Board members, Leadership Team members and staff present, Louis Gross proceeded with the Director’s report. This noted the recent activities, a summary of the evaluation results from the previous year of activities, and plans for the final years of NSF support for core programs, and plans for sustainability. It was noted that as NSF core support ends, NIMBioS will necessarily become more focused on making connections to activities at UTK. A brief discussion followed regarding planning, but most discussion was deferred until later in the agenda.

Sergey Gavrillets opened the discussion of requests for support for working groups (4 requests under consideration) and workshops (2 requests). The Board provided extensive comments about these requests and provided recommendations to the Leadership Team regarding which ones to provide support for and how some requests might be appropriately modified to respond to Board suggestions. The Board then provided a number of suggestions to further develop scientific activities, including connecting to NIMBioS “alumni,” creating a “Friends of NIMBioS” group who might collaboratively construct proposals for funding as NIMBioS proceeds, and suggesting several possible funding agencies to approach.

Suzanne Lenhart summarized the education and outreach activities that NIMBioS sponsored over the previous year. Board members suggested a number of possible new initiatives that could build on efforts such as the NSF-funded EAGER project to build a concept inventory in quantitative biology. It was specifically noted that there are needs for Tutorials in areas such as machine learning and artificial intelligence for targeted groups of life scientists, and NIMBioS could proceed to construct these and obtain external support for them. Another suggestion was for short courses on topics such as transmission modeling for epidemic intelligence officers and MDs, as well as considering what previous Working Groups might be approached to lead future Tutorials.

The afternoon of the first day wrapped up with an overview of plans for three entities within NIMBioS: the National Institute for STEM Evaluation and Research (NISER), the Spatial Analysis Lab (SAL), and the Math Modeling Consulting Center (MMCC). Louis Gross presented the NISER overview in place of NISER Director Pam Bishop, noting the success that NISER has had in attracting interest in the evaluation services they can provide. Mona Papes described development of SAL, and Nina Fefferman presented the vision for the MMCC. Following a joint reception with a Working Group in attendance and visits with NIMBioS postdocs, the meeting adjourned for a group dinner.

The second day of the Board meeting focused on sustainability planning. The Director noted that a formal sustainability plan was being developed for the leadership of UTK, was due in February, and comments from the Board were welcome. The Board provided its recommendations for the remaining funding period, noting that it is giving the NIMBioS

Leadership Team the authority to move forward with activities that support sustainability planning, without a need to return to the Board for their approval. The Board noted that as individuals they would be happy to provide comments on proposed activities that involve expenditure of NSF funds, but that they did not see any need for further group discussion and recommendations regarding requests for support. Thus, the Board agreed that this meeting would be the final formal Board meeting. They suggested that the Leadership Team should focus its efforts on how to best utilize the remaining resources to support long-term sustainability, realizing that many of the externally-focused activities, including working groups and workshops, may well not be sustainable after core NSF support ends.

Extensive discussion proceeded regarding possible avenues for continued activities and support. These included suggested connections to a variety of international entities, building private company partnership programs similar to those of some of the Math Sciences Institutes supported by NSF, developing mathematics problem-solving workshops in conjunction with companies (similar to the Math Clinic at Claremont), and considering repeats of past activities that were oversubscribed but establishing charges to attend now. The Board suggested a number of individuals to potentially contact at agencies and companies who may be interested in fostering activities at NIMBioS.

The Board meeting adjourned at noon.

Agenda

Wednesday October 25

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

Thursday, October 26

8:00-9:00 Breakfast at NIMBioS

9:00-9:15 Introductions

9:15-10:15 Director's report - summary of current status, recent reports, evaluation summary, funding (Lou Gross)

10:15-10:45 Initial Review of requests for support - Working Groups, Workshops (Sergey Gavrillets)

10:45-11:00 Break

11:00-12:00 Complete Review of requests for support

12:00-1:00 Lunch (joined by Leadership Team, postdocs, graduate students and joint with the Working Group on Long Transients and Ecological Forecasting)

1:00-1:30 Future planning for research activities including workshops and working groups (Sergey Gavrillets)

1:30-2:30 Education and outreach activities - summary of recent past and discussion of future planning including Tutorials and alternative funding mechanisms for these (Suzanne Lenhart)

2:30-2:45 Break

2:45-3:45 NISER activities, future planning and funding model (Pam Bishop - presented by Lou Gross)

3:45-4:15 Spatial Analysis Lab planning (Mona Papes)

4:15-4:45 Math Modeling Consulting Center planning (Nina Fefferman)

4:45-6:00 Reception with Postdocs, faculty and Working Group members

6:30 Meet at Hotel to walk to dinner

Friday October 27

8:00-9:00 Breakfast at NIMBioS - including individual meetings with post-docs and grad students if desired

9:00-10:00 Sustainability discussion I - major center or larger funding initiatives, role of Advisory Board over next several years (Lou Gross)

10:00-10:30 Sustainability Discussion II - ongoing grant initiatives for workshops, research, etc. in collaboration with UTK and external researchers

10:30-10:45 Break

10:45-12:00 Sustainability discussion III - what opportunities have we not discussed (e.g. foundations, industry, government partnerships)

12:00- Lunch

Addendum to NIMBioS Annual Report

Sep 1, 2017 – Jun 30, 2018

Y10-2. NIMBioS Evaluation Report



NIMBioS

National Institute for Mathematical
and Biological Synthesis

NIMBioS EVALUATION REPORT
REPORTING PERIOD TEN
SEPTEMBER 1, 2017 - JUNE 30, 2018

National Institute for Mathematical and Biological Synthesis
July 2018

National Institute for STEM Evaluation and Research

115 Philander P. Claxton Education Building

The University of Tennessee, Knoxville

p. (865) 974-9348

f. (865) 974-9300

<http://www.nimbios.org/evaluation>

This work was conducted at the National Institute for Mathematical and Biological Synthesis, sponsored by the National Science Foundation through NSF Award #DBI-1300426, with additional support from The University of Tennessee, Knoxville.



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CIPP Model

Context Evaluation assesses needs, assets, problems and opportunities within a defined environment.

Input Evaluation identifies and compares relevant approaches by examining resources, strategies, and work plans of different approaches.

Process Evaluation is an ongoing check regarding implementation of program activities and documentation of the process.

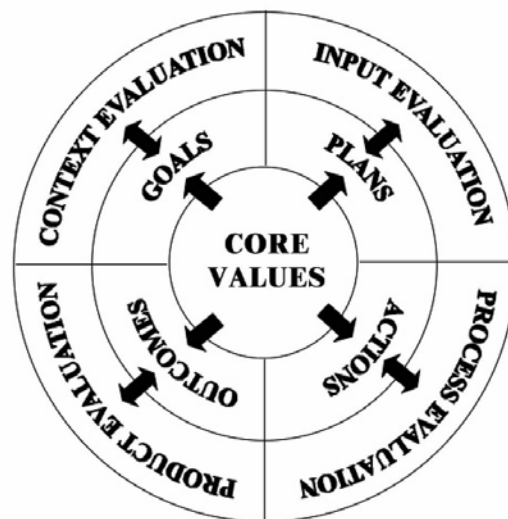
Product Evaluation assesses outcomes of the program.

Stufflebeam, D. L. (2003). The CIPP Model for evaluation. In D. L. Stufflebeam, G. F. Madaus, & T. Kellaghan (Eds.), *Evaluation Models* (2nd ed. Pp. 279-317). Norwell, MA: Kluwer

INTRODUCTION

This is an evaluation summary of NIMBioS activities during the ninth annual reporting period (RP 10) to the National Science Foundation. This report covers the period of September 1, 2017 through June 30, 2018. The NIMBioS evaluation program follows the CIPP systems approach, which considers 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:

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 EVALUATION

Context evaluation 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.

INPUT EVALUATION

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:

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

PROCESS EVALUATION

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.

PRODUCT EVALUATION

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.

ACTIVITIES – REPORTING PERIOD 10

Table 1. Research program activities

Activity	RP10	Overall
Working Groups (# meetings hosted)	10 (11)	58 (172)
Investigative Workshop	2	44
Tutorials	2	22
Postdoctoral Fellows	7	47
Short-term visitors	16	360
Visiting graduate student fellow	1	8
Visiting Scholar	1	1
Sabbatical	0	17

Education and Outreach (EO) program activity highlights:

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

Applications of Spatial Data: Ecological Niche Modeling Tutorial

The Search for Selection Tutorial

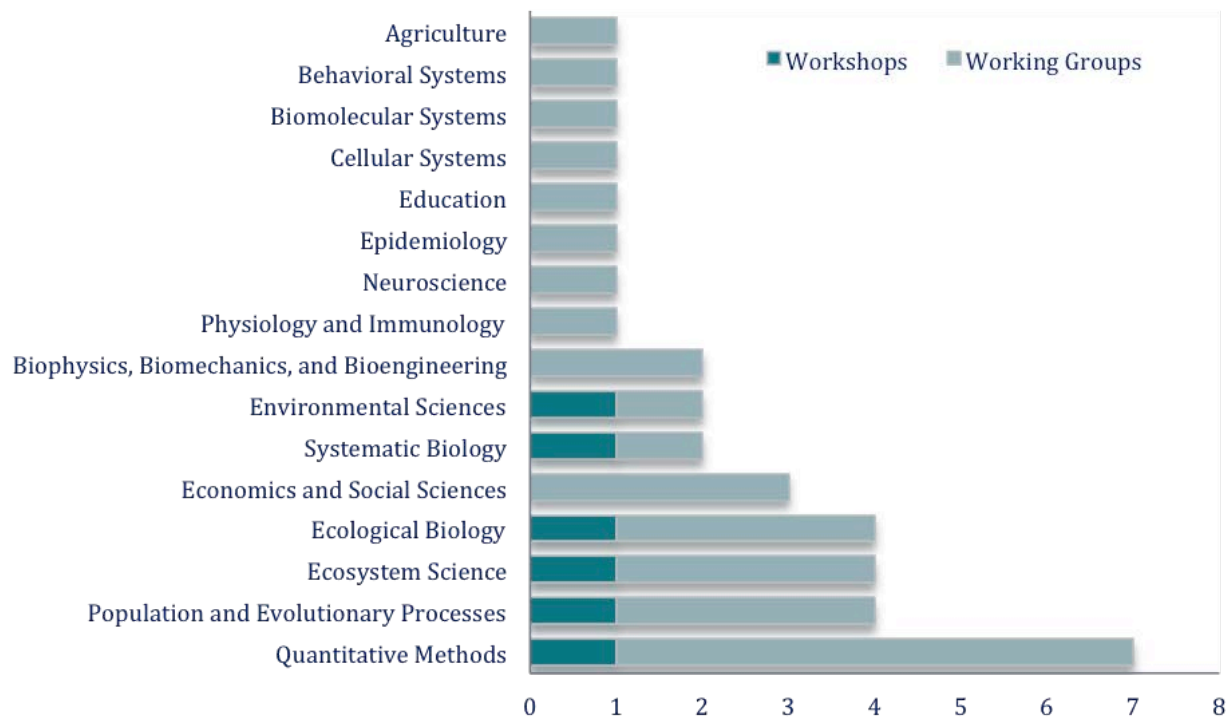
Modern Math Workshop at SACNAS meeting

Other events: 1 Advisory Board Meeting (Oct 2017)

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. Diversity of Working Group and Investigative Workshop topic areas



DIVERSITY OF PARTICIPANTS

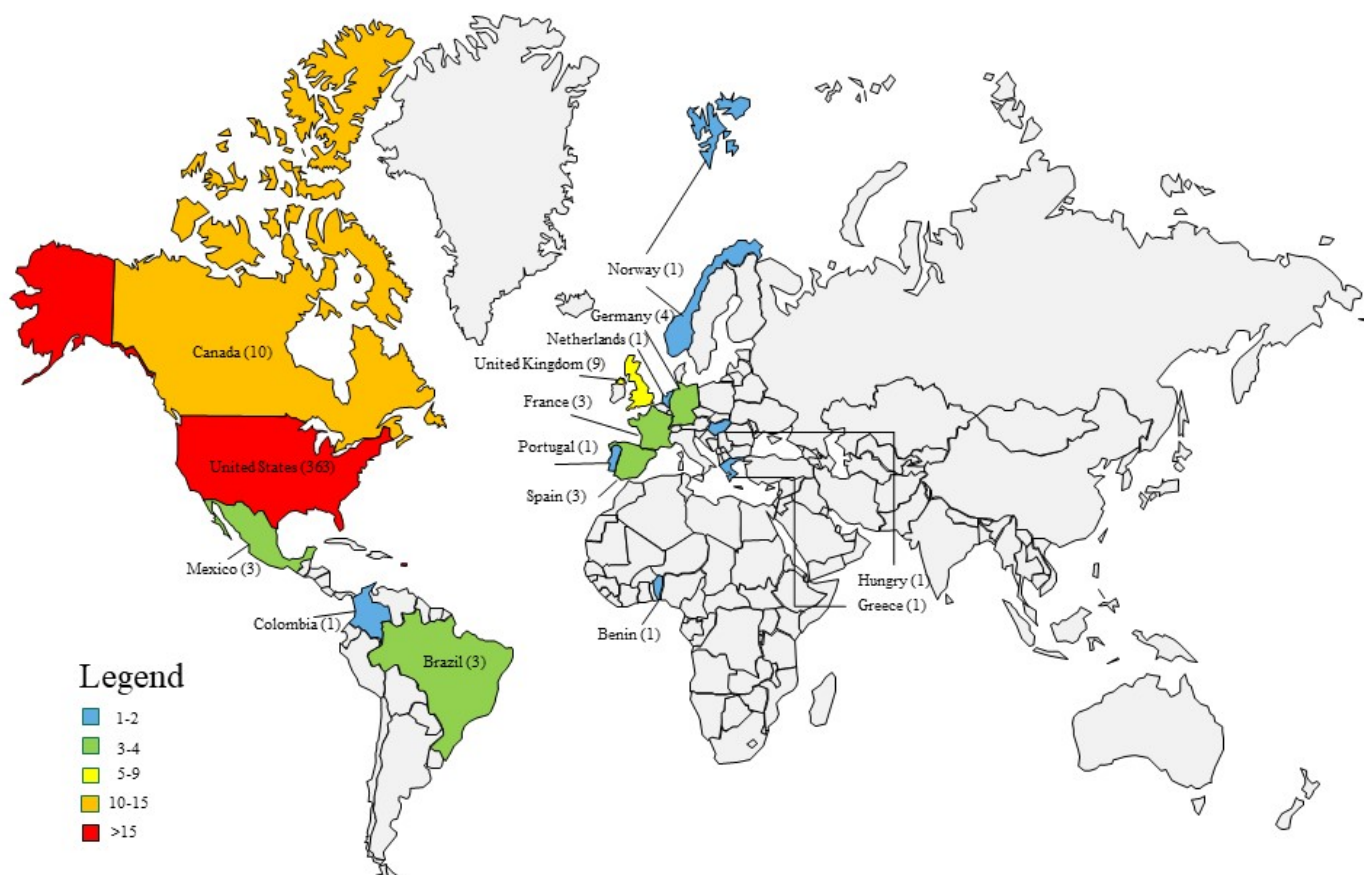
One of the core values of NIMBioS is to increase the diversity of researchers and educators at the interface of mathematics and biology. NIMBioS collects voluntary demographic data from event applicants to gauge whether our program is fairly reaching and benefitting everyone regardless of demographic 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. Electronic submission of demographic variables aligned to the reporting requirements of the National Science Foundation is requested of participants before participation in any NIMBioS event.

Demographic questions regarding gender, race, ethnicity, and disability status were optional. When feasible, the evaluation staff supplied missing demographic data from other sources (e.g. institution, primary field of study). The evaluation staff did not assume race, ethnicity, or disability status for any

participant who did not report this information. All demographic information is confidential, and results are reported only in the aggregate.

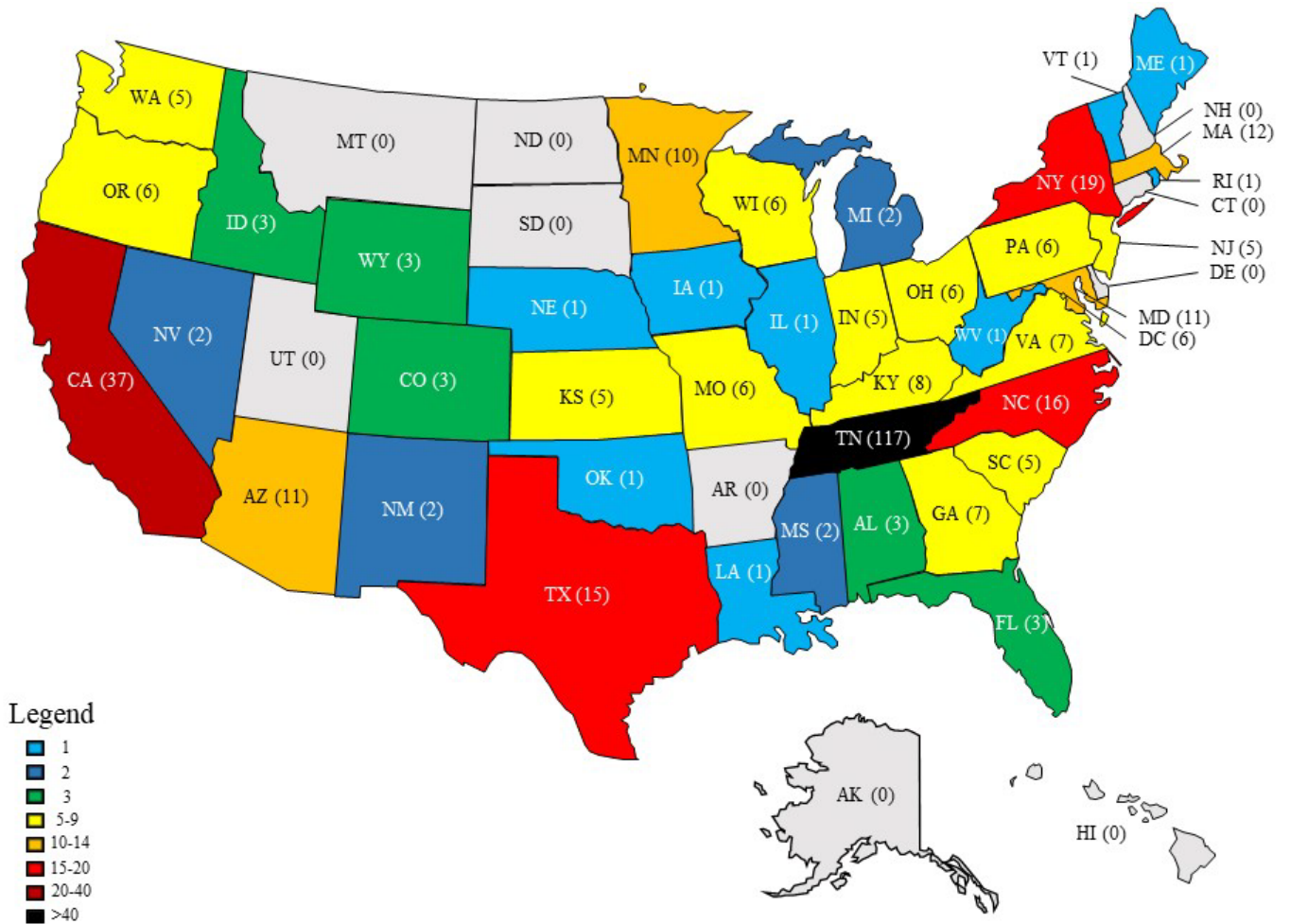
Geographic Diversity. During RP 10, 408 participants (350 unique individuals) from 15 countries participated in NIMBioS events. Most participants came from the United States (89%), followed by Canada (2%) and The United Kingdom (2%) (Figure 3). Roughly 1% of participants did not indicate country.

Figure 3. NIMBioS RP 10 participants by country



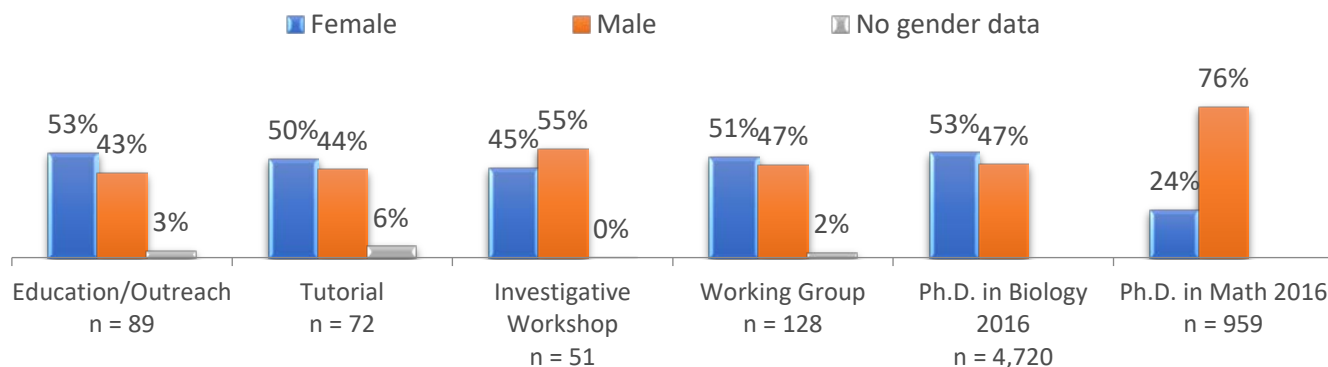
Within the U.S., 40 different states, as well as the District of Columbia, were represented. The largest percentage of participants came from within Tennessee (33%), followed by California (9%), North Carolina (5%), New York (5%), Texas (3%), and Massachusetts (3%) (Figure 4).

Figure 4. NIMBioS RP 10 participants by U.S. state



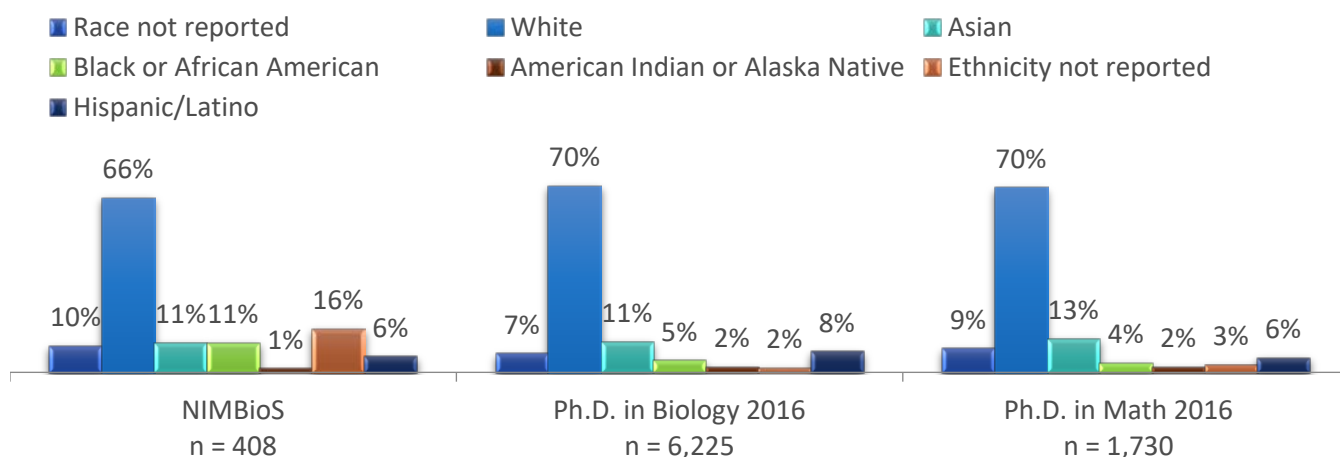
Gender, Racial, and Ethnic Diversity. Across all events during RP 10, female participation was 48% (no gender data for 3.8%). Within specific activity types, the gender ratio varied slightly, from 53% in Education/ Outreach to 45% in Investigative Workshops (**Figure 5**). Comparison groups shown are all individuals receiving doctorates, and all individuals receiving doctorates in biology and mathematics in the U.S. in 2016 (data from NSF Survey of Earned Doctorates). The overall distribution of females in NIMBioS activities falls within the range of practicing Ph.D.'s in biology and mathematics in the U.S.

Figure 5. Gender composition of participants by event type



Overall minority representation across NIMBioS events during RP 10 was 12% and falls within ranges for doctoral recipients in the biological and mathematical sciences (Figure 6). Comparison groups shown are all U.S. citizen and permanent residents receiving doctorates and receiving doctorates in biology and mathematics in the U.S. in 2016¹. Minority representation varied among programs.

Figure 6. Minority representation of NIMBioS participants

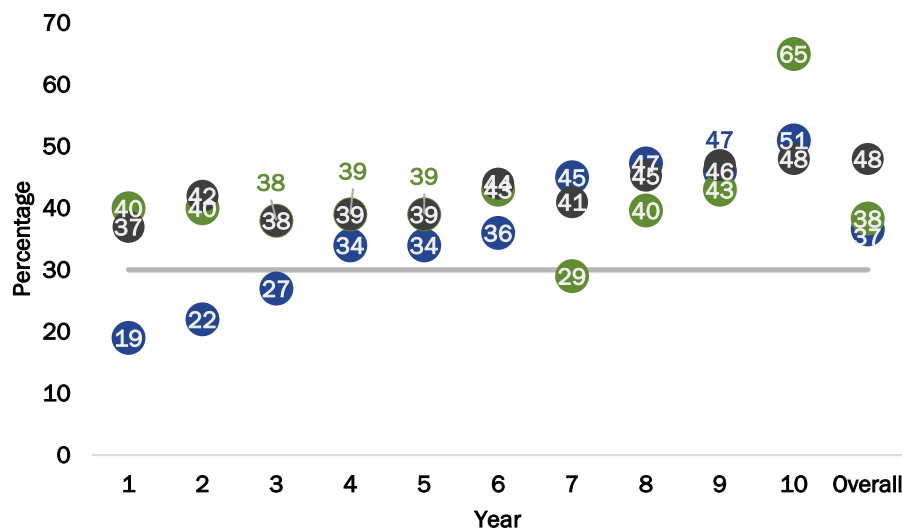


¹ For the purposes of this report, “minority” refers to those who self-identify as American Indian or Alaska Native, black or African American, and/or Hispanic or Latino (NSF Survey of Earned Doctorates, 2016 Data)

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 committee that we establish a variety of benchmarks for our programs. The site review committee 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 are provided in Figures

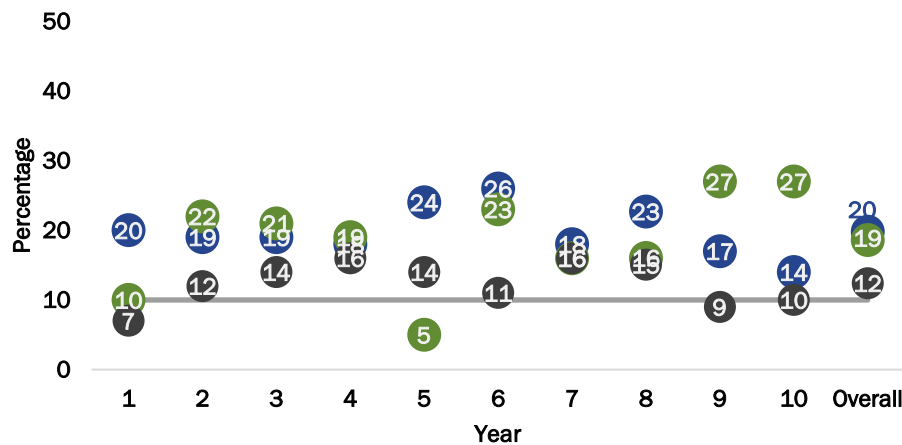
Figure 7 to Figure 12:

Figure 7. Proportion of female participants across all NIMBioS activities, Working Groups and Investigative Workshops by year



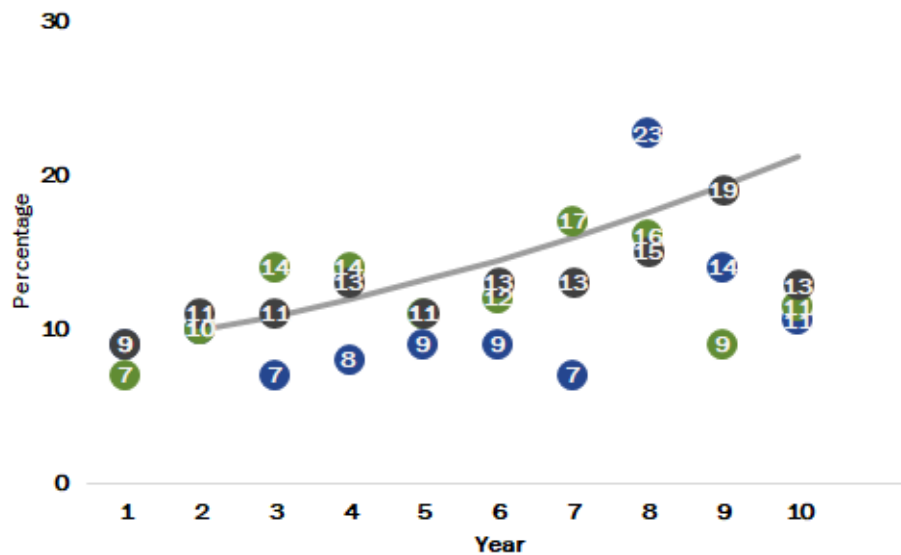
Benchmark.
The proportion of female participants will be at least 30%.

Figure 8. Proportion of international participants across all NIMBioS activities, Working Groups and Investigative Workshops by year



Benchmark.
The proportion of participants from outside the United States will be at least 10%.

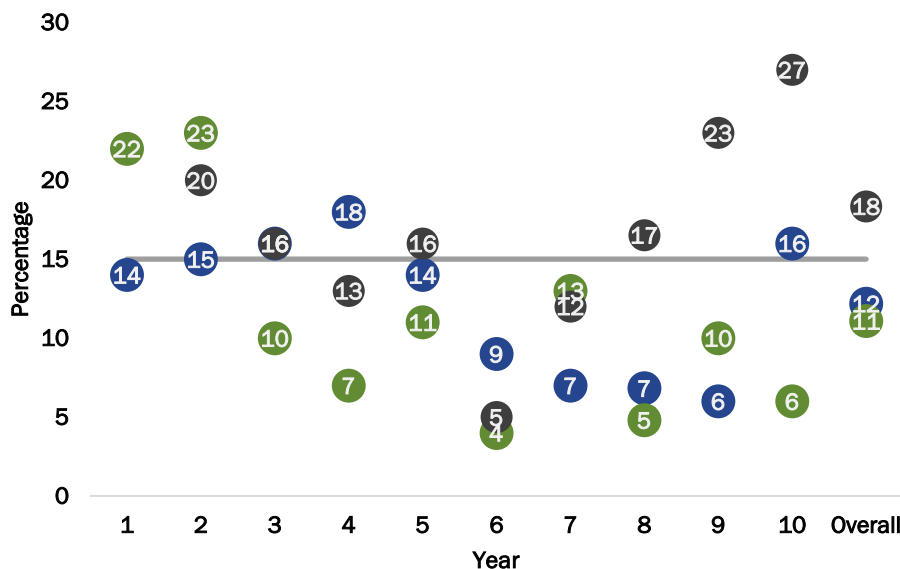
Figure 9. Proportion of participants from under-represented groups across all NIMBioS activities, Working Groups and Investigative Workshops



Benchmark. Increase the percentage of participants from under-represented groups across all NIMBioS activities (including for Working Groups and Investigative Workshops) by approximately 10% per year.

Note. $F(t+1) = 1.1F(t)$ 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) .

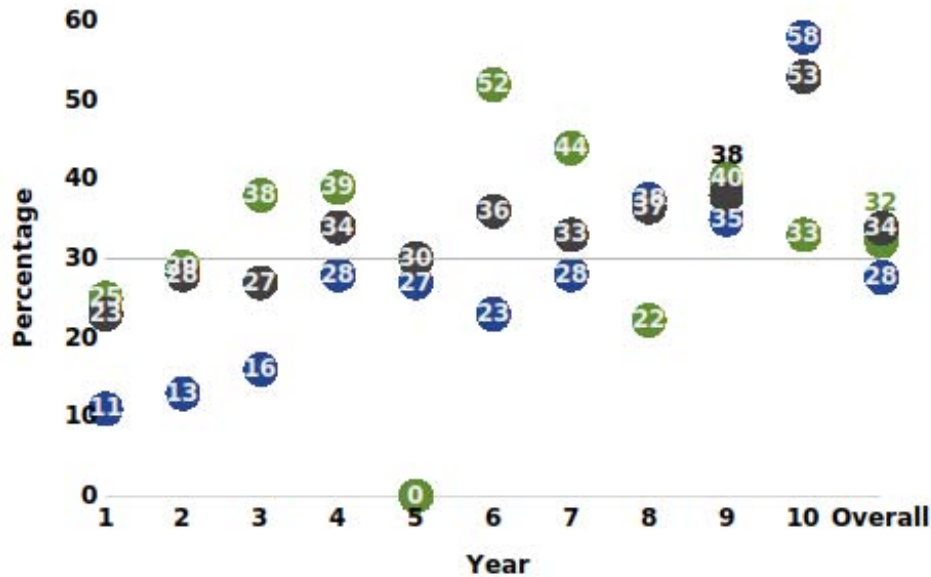
Figure 10. Proportion of local participants across all NIMBioS activities, Working Groups and Investigative Workshops



Benchmark. Limit the participation by UT/ORNL faculty/staff to approximately 15% of the total participants in Working Groups and Investigative Workshops.

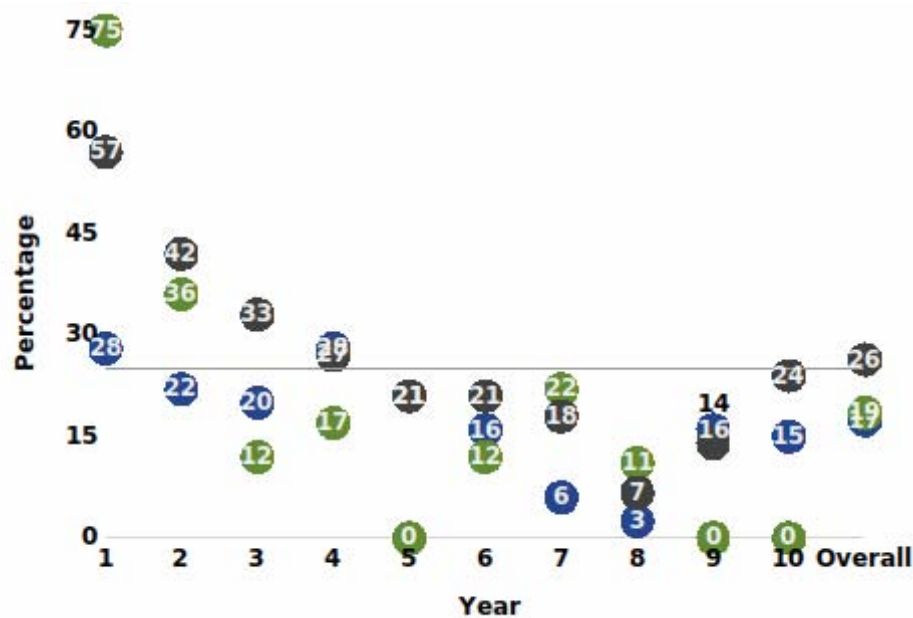
BENCHMARKS FOR DIVERSITY IN ACTIVITY ORGANIZERS:

Figure 11. Proportion of female organizers across all Working Groups and Investigative Workshops by year



Benchmark.
The proportion of female organizers will be at least 30%.

Figure 12. Proportion of local organizers across Working Groups and Investigative Workshops

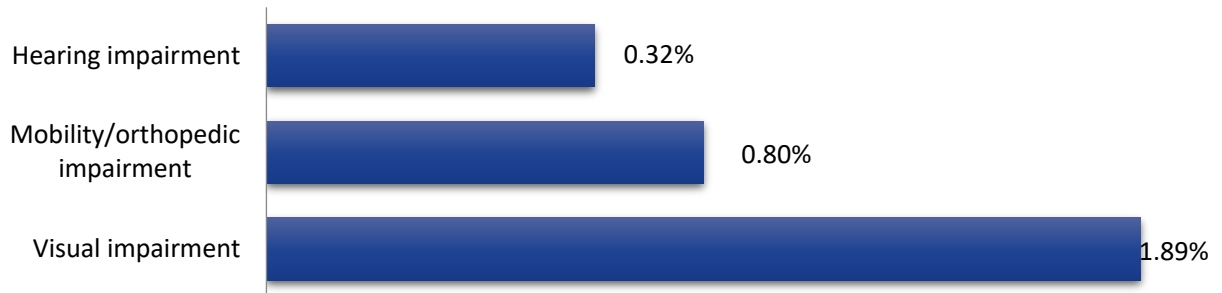


Benchmark.
The participation by local UT/ORNL organizers will be less than 25% of all organizers.

While NIMBioS encourages researchers from underrepresented groups to be organizers/co-organizers of requests for support, no specific goal is set because of the small number of organizers.

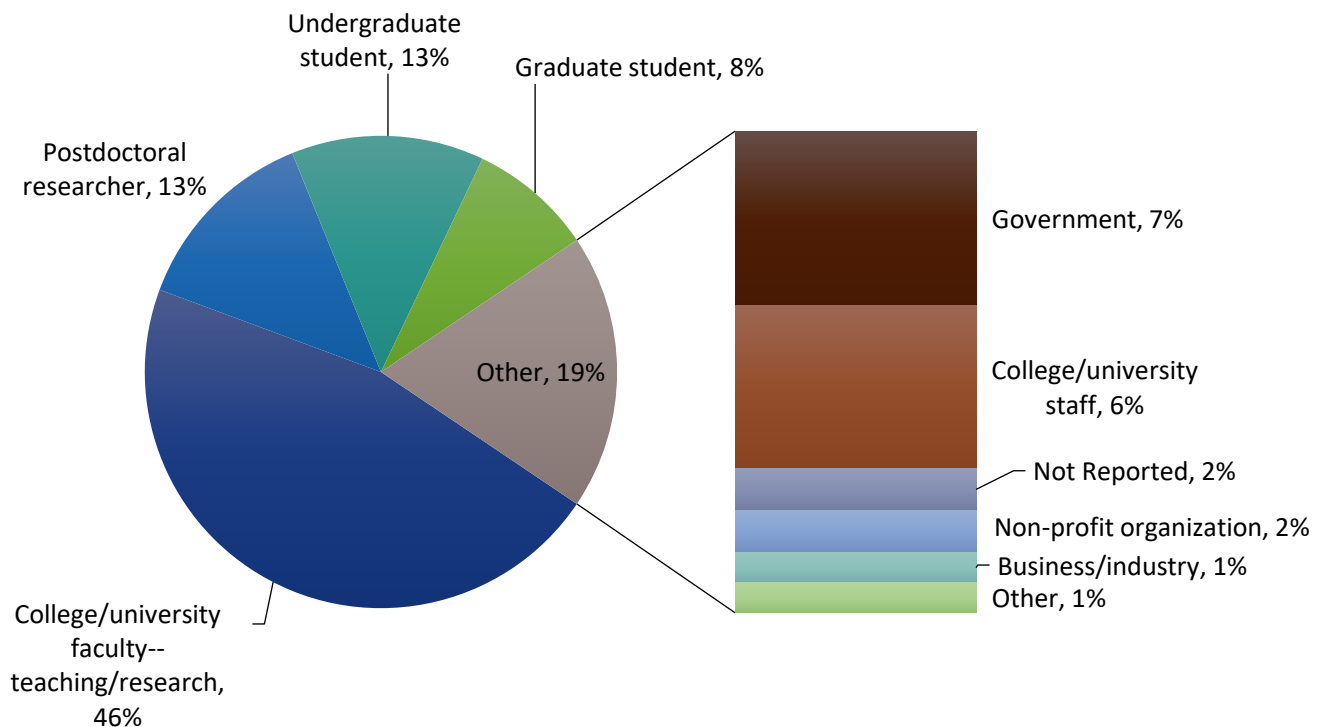
ABILITY DIVERSITY. Disclosure of disability status by participants to NIMBioS is optional. Around 3.5% overall indicated having some sort of disability during RP 10 (**Figure 13**).

Figure 13. Disability status of participants (n = 408)



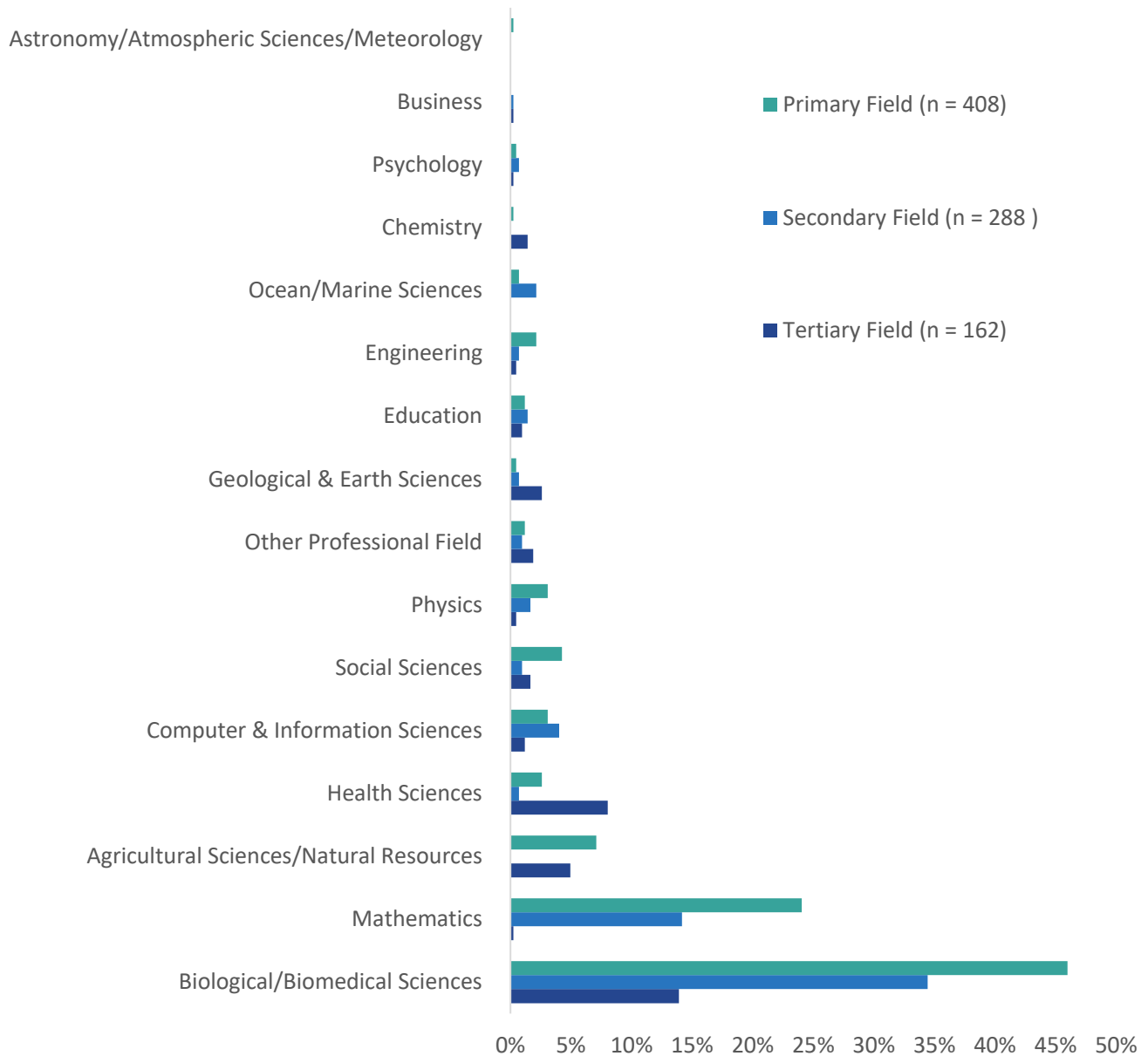
OCCUPATIONAL DIVERSITY. The majority of NIMBioS participants were college/university faculty, undergraduate students, or postdoctoral researchers; however, participants came from government, industry, non-profit, or other positions as well (**Figure 14**).

Figure 14. Employment status of participants (n = 408)



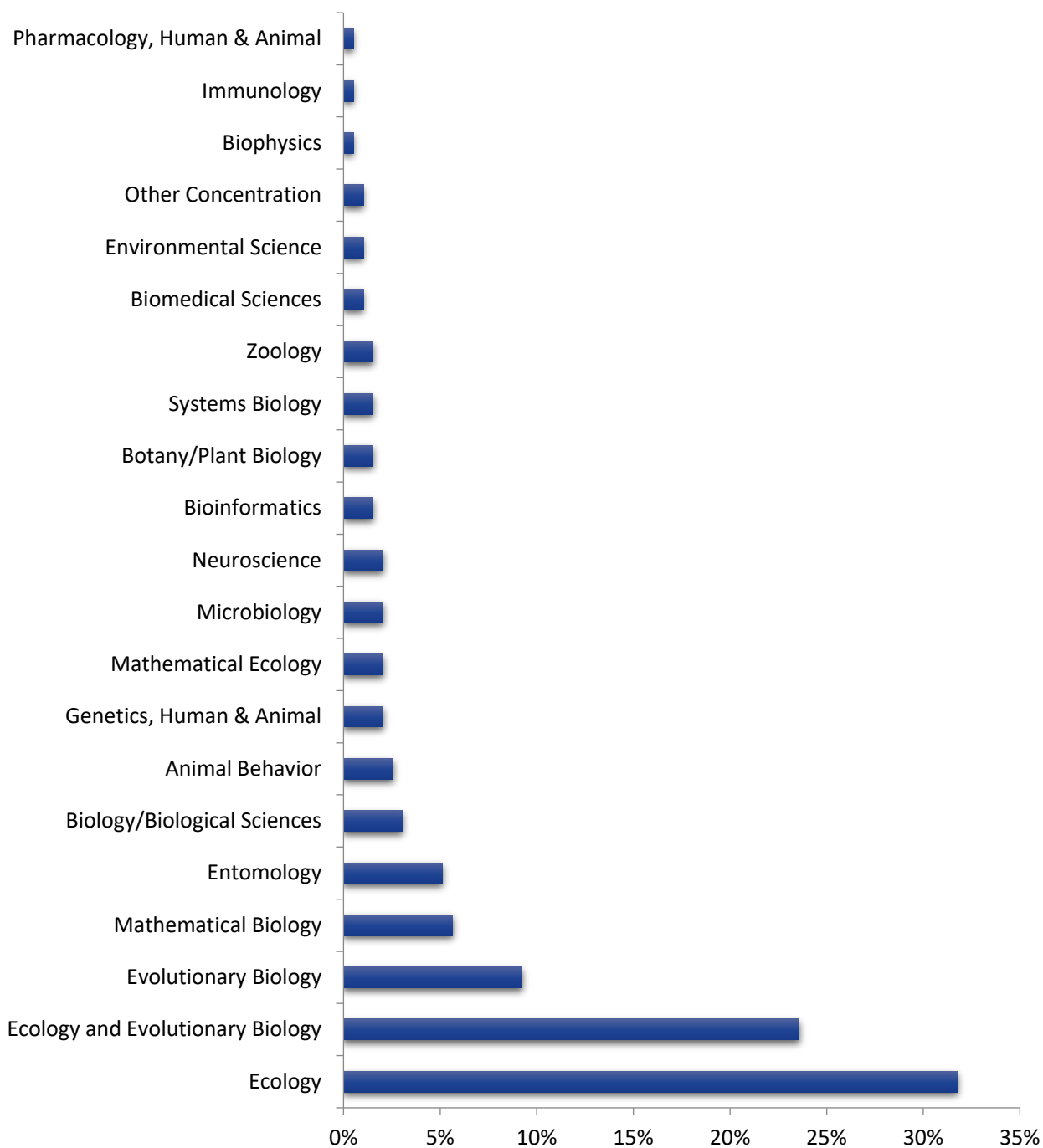
DISCIPLINARY DIVERSITY. Most participants at NIMBioS indicated their primary fields of study, as well as areas of concentration within those fields. Many indicated their secondary and tertiary fields of study as well. The most commonly reported fields of study included biological/biomedical sciences and mathematics although many other disciplines were represented (**Figure 15**).

Figure 15. Primary, secondary, and tertiary discipline areas of participants



The 195 participants indicating Biological/Biomedical Sciences as their primary field of study indicated 21 different areas of concentration within which they would classify their primary areas of research/expertise. The most commonly indicated area of concentration was ecology (32%), followed by ecology & evolutionary biology (24%), and evolutionary biology (9%) (Figure 16).

Figure 16. Participant expertise area concentrations within biological/biomedical sciences field of study ($n = 195$)



INSTITUTIONAL DIVERSITY. Participants during RP 10 represented 174 different institutions, including colleges and universities, government institutions, industry, and non-profits (Figure 17). Of the 146 universities represented, 135 were classified as comprehensive (having undergraduate and graduate programs). **Figure 18** details more information about institutional diversity.

Figure 17. Types of institutions represented ($n = 174$)

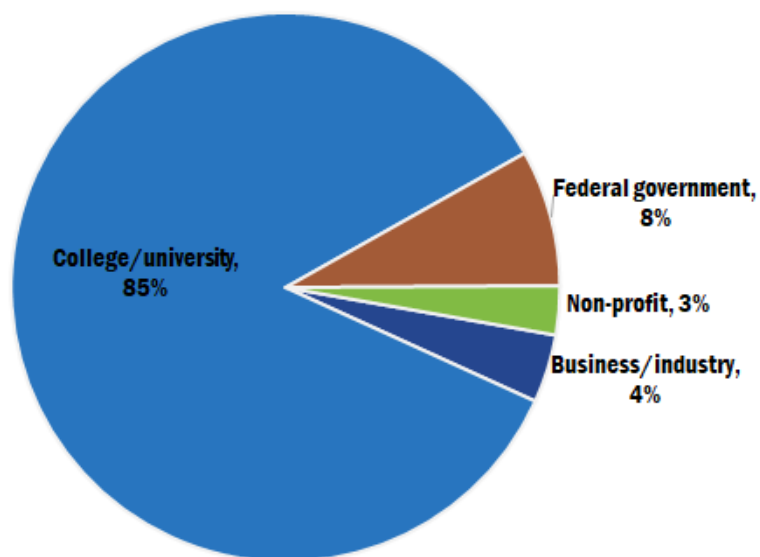
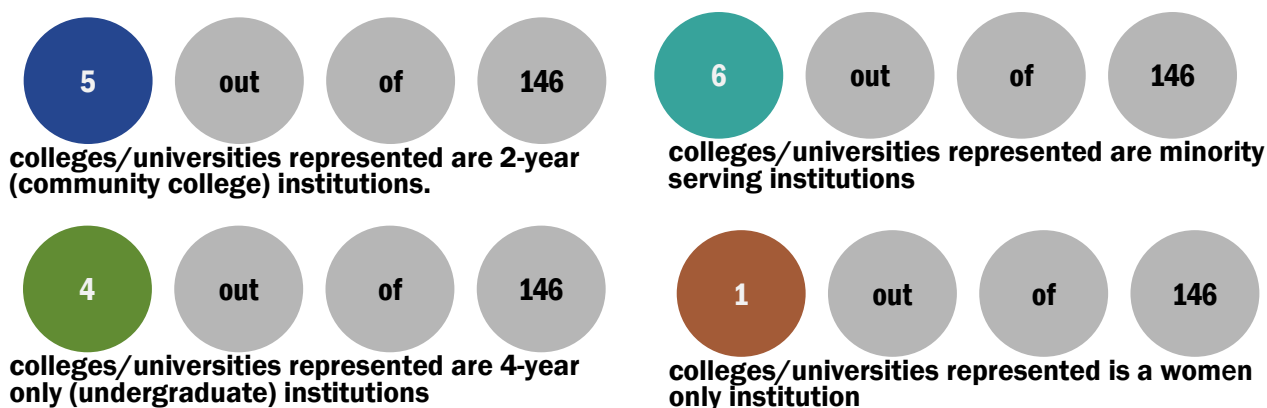


Figure 18. Characteristics of participants' universities ($n = 146$)



PROCESS EVALUATION

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

NIMBioS conducted formal process evaluations of its first and last Working Group meetings, Investigative Workshops, Undergraduate Research Conference at the Interface of Biology and Mathematics, Postdoctoral Fellowship program, Tutorial, and Summer Research Experience programs. Evaluations were carried out via electronic surveys sent to all participants either after participation in a NIMBioS event, or both before and after participation if a pre/post comparison of responses was warranted. Evaluation findings, along with suggestions for improvement, were shared with event organizers, as well as NIMBioS staff as needed. Improvements to program content and format, as well as NIMBioS' overall operations, are made accordingly. Following is a summary of the process evaluations of NIMBioS' major activities during RP 10.

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: RP 10 Summary

Number of Working Groups
supported by NIMBioS
during RP10

10

Total Meetings

11

Total participation:

128

Total unique participation:

110

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 2-5 days; however, the number of participants, number of meetings, and duration of each meeting is flexible, depending on the needs and goals of the Group. Plans can include visits to NIMBioS for subsets of Working Group members to collaborate with NIMBioS IT staff and researchers on Working Group needs. Working Group evaluation highlights are aggregated across all events in their respective categories.

Working Group Summary. During RP 10, NIMBioS hosted 11 Working Group meetings, including the start of 3 new groups and the return of 7 established groups – see Figure 19. A total of 128 participants (110 unique) from 76 institutions took part in the Working Groups. During RP 10, participants came together from 11 different major fields of study to focus on the respective scientific questions of their groups.

Figure 19 . Timeline of RP10 Working Group and Investigative Workshop events

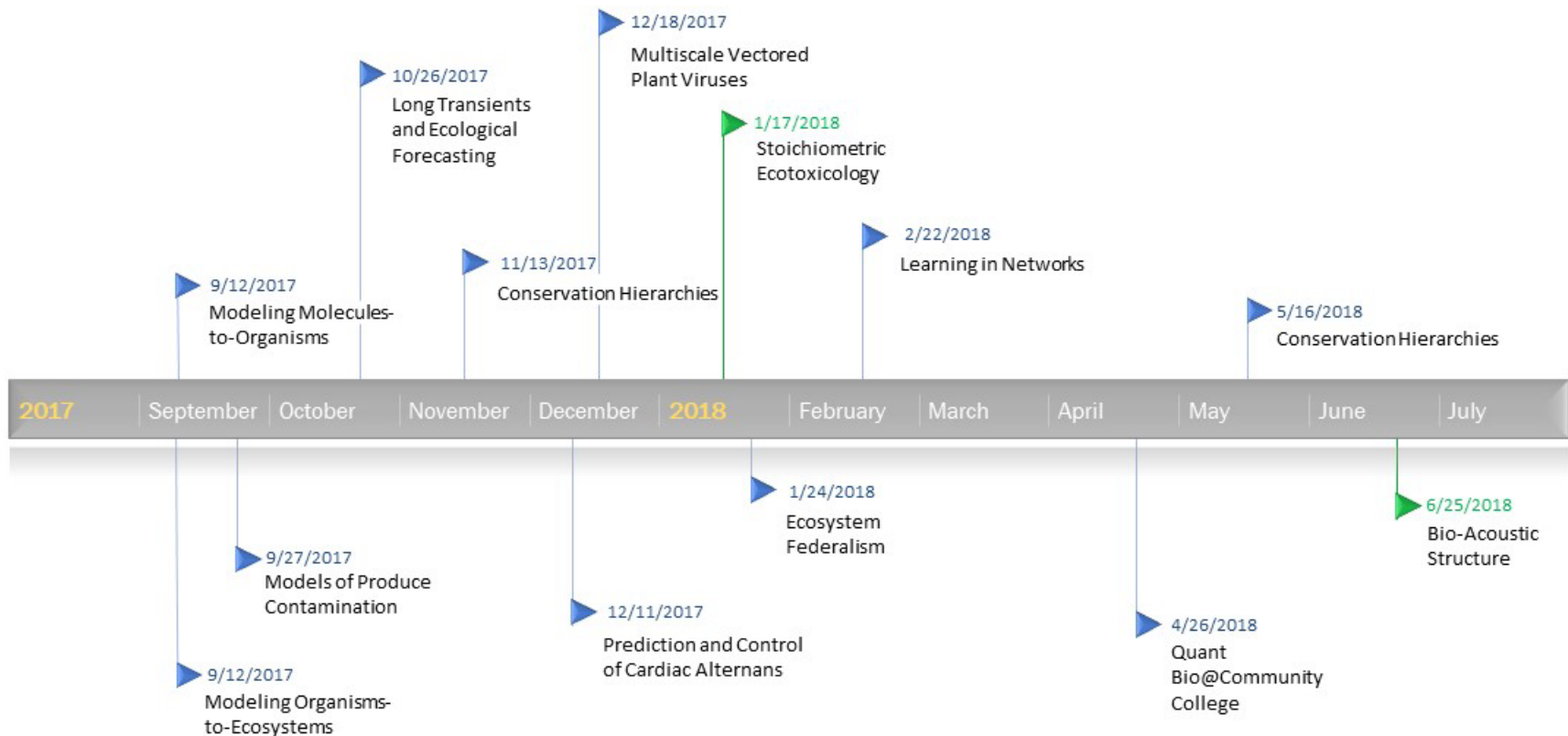
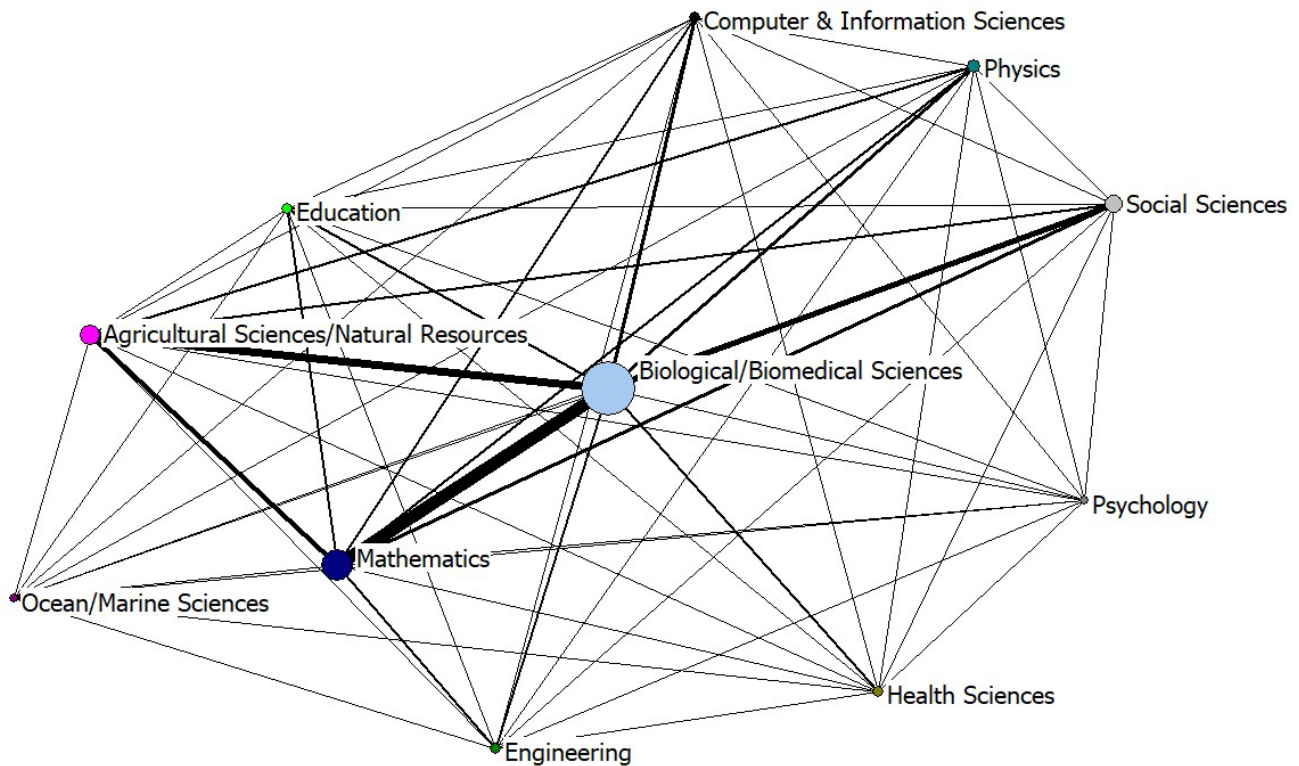


Figure 20 shows the cross-disciplinary connections fostered among Working Group members through the meetings hosted at NIMBioS during RP 10. Node radius is representative of the log scaled number of participants in each field of study. Line size is representative of the number of times researchers from each field were brought together to collaborate and problem-solve at NIMBioS.

Figure 20. Working Group cross-disciplinary collaboration



Working Group Organizer feedback

NIMBioS collects overall satisfaction feedback from Working Group organizers to the following question: As an event organizer, how satisfied were you overall with the way your event was managed by NIMBioS? 100% of organizer respondents ($n = 8$) were very satisfied with how NIMBioS managed their working group event.

100% of organizers were satisfied with how NIMBioS handled their events

Working Groups: Feedback

“NIMBioS staff did an amazing job. Everything came together very smoothly which only happens because of the hard-work the NIMBioS staff did in the background before, during and after the meeting.

“Really rich mix of expertise, yet enough common overlap to facilitate good conversation. Very impressed with the curation of this group!

The most useful aspect of the working group:

“In addition to domain-specific content, more open discussion of the type of messages and arguments that are compelling in adjacent fields interested in the domain area was really helpful. I've wanted to publish in more domain-oriented venues (not just my own discipline), and feel like I learned a lot towards that goal.

From the organizers:



Fantastic hosts. We really appreciated the entire NIMBioS team's help.

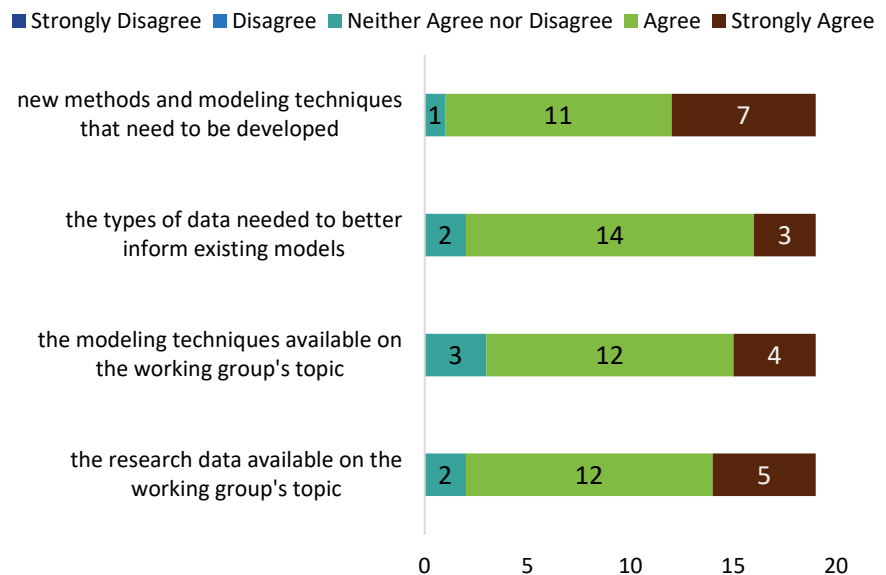
NIMBioS was incredible!

Working group First Meetings

During RP 10, NIMBioS hosted the first meetings of three Working Groups, with a total of 37 participants. Evaluation surveys were sent to all participants. A total of 27 participants took part in the evaluation of the first meetings of their Working Groups. Eight of these participants were organizers and only answered questions about how they felt NIMBioS managed their events. (See <http://www.NIMBioS.org/workinggroups/> for more details about specific Working Groups).

HIGHLIGHTS OF WORKING GROUP FIRST MEETING EVALUATION RESPONSES (FIGURE 21 AND FIGURE 22)

Figure 21. Overall agreement with level of learning about various topics during working group meeting



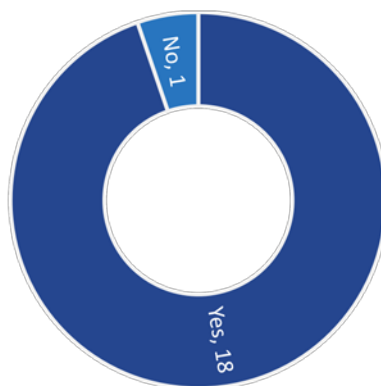
95% of participants indicated they had a better understanding of the research happening in the field in disciplines other than their own because of participating in this Working Group.

Working Groups: Feedback

“ It is a very strong group with people having a somewhat different but complementary research experience. It includes people at different career stages ranging from a relatively junior (postdoc or assistant professorship) to a very senior (Distinguish Professor), and everybody have been equally helpful and efficient, and highly motivated too. A very positive experience altogether; a strong chance to generate new knowledge and to publish a good paper in a top level journal.

“ NIMBioS staff did a great job in supporting the Working Group. There was a lot of activity in NIMBioS at the time (e.g., we were overlapping a tutorial). This obviously placed greater demands on staff. Everything went seamlessly, which is a testament to their professionalism and hard-work.

Figure 22. Participant response to whether 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 three Working Groups, with 32 participants, the third meeting of two Working Groups, with 20 participants, and the fourth meeting of three groups, with 35 participants. 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.

Concluded Working Groups

To date, total of 51 working groups have concluded with NIMBioS. It is the policy of NIMBioS to send follow-up evaluation surveys to Working Group participants after the final meeting. A total of 323 participants responded to the final evaluation for their groups.

Working Groups: Feedback

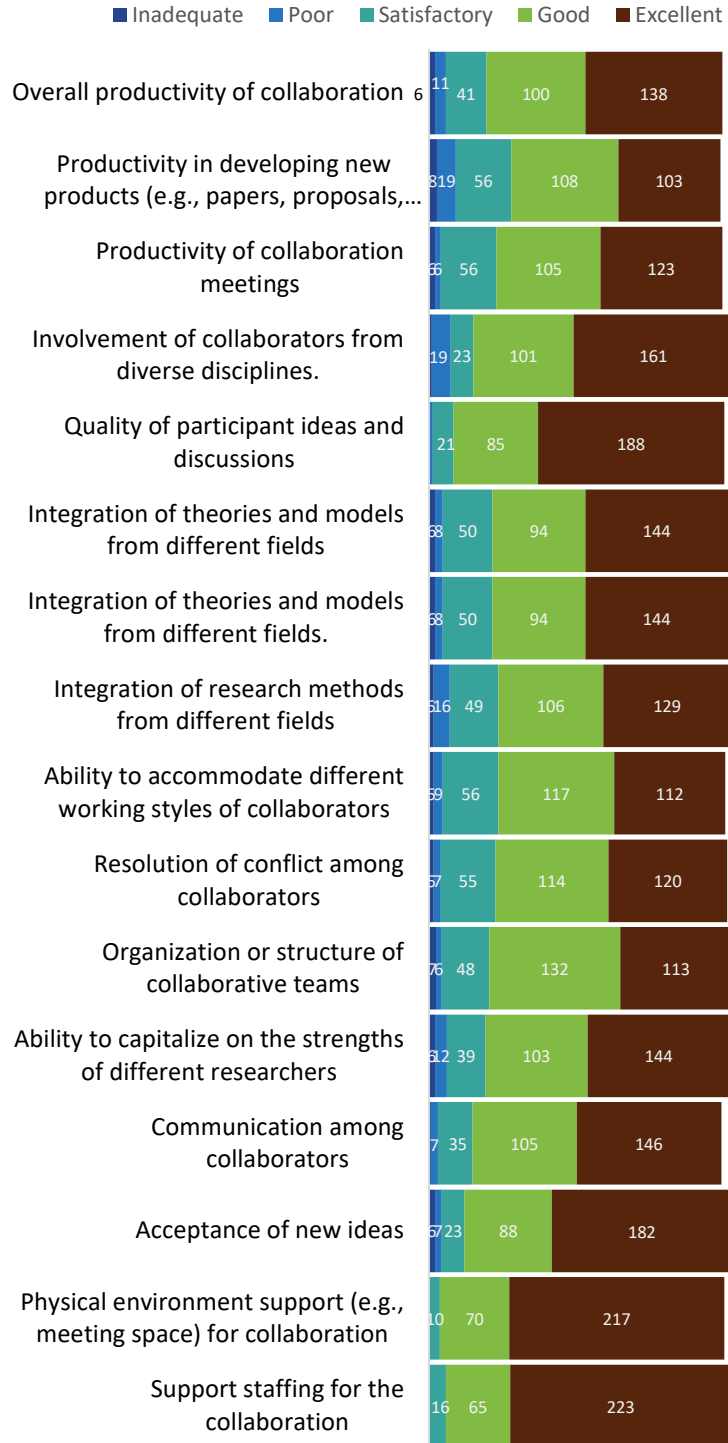
“Because we struggled to talk to three different audiences: mathematicians, biologists, and STEM education researchers, the conversations stretched all of us to understand standards within these communities different than our own.

“Some spin-off collaborations are still actively pursuing some of the ideas generated by the working group.

“As a result of the working group, I think we actually understand the problem/issue much better than we did. While we will have measurable outcomes, overall I think the problem was perhaps more difficult than we thought. We attempted to integrate across working groups, for example, and that proved a significant challenge.

HIGHLIGHTS OF WORKING GROUP FOLLOW-UP EVALUATION RESPONSES (FIGURES 23 TO 25)

Figure 23. Evaluation of various aspects of Working Groups



Working Groups: Feedback

“Regarding the questions on transdisciplinary research. I'm not convinced our working group did this. Our topic was fairly focused and already had a decent amt of mathematical theory underlying it. My other research is much more transdisciplinary than NIMBioS. Our working group started slow as it took time to build trust given a few strong personalities, but ended fairly strong and a number of papers continue to be developed, as well as longer term collaborations among subsets of folks. We also made great progress on the focal topic.

“The group published or will publish more than 13 manuscripts based on NIMBioS WG program, which is way more than we envisioned at the beginning!

Figure 24. Evidence to support **new insights** and **collaborations** within the group

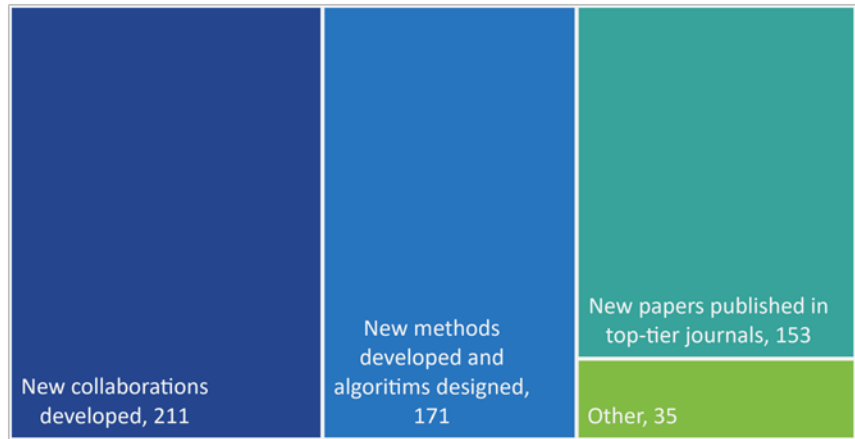
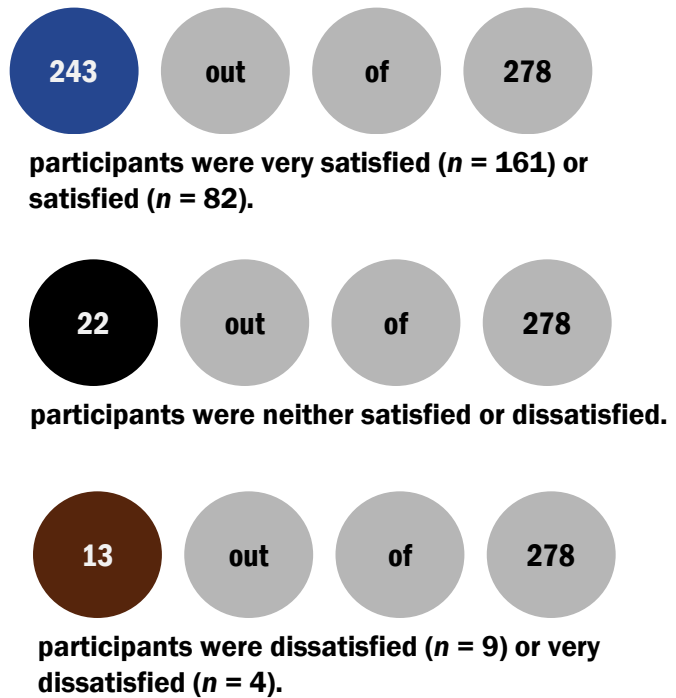


Figure 25. Overall satisfaction level with the Working Group



Investigative Workshops: RP 10 Summary

Number of Investigative Workshops supported by NIMBioS

2

Total participants

51

INVESTIGATIVE WORKSHOPS

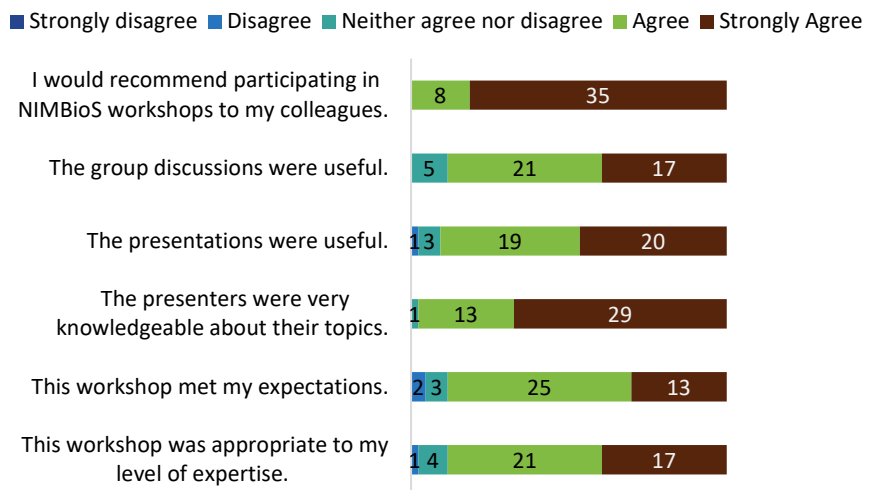
NIMBioS Investigative Workshops differ from Working Groups in that they focus on a broader topic or set of related topics at the interface of biology and mathematics and have relatively large size (30-40 participants). Workshops attempt to summarize/synthesize the state of the art and identify future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

NIMBioS hosted two Investigative Workshops during RP 10 with a total of 51 on-site participants and 3 virtual participants (Figure 19). Evaluation surveys were sent to all on-site Workshop participants. A total of 27 participants took part in the evaluation of the Workshop (including 3 organizers who only answered questions about NIMBioS' handling of the event).

HIGHLIGHTS OF WORKSHOP EVALUATION RESPONSES (FIGURES 26 TO 27)

100% OF ORGANIZERS WERE SATISFIED WITH HOW NIMBIOS HANDLED THE WORKSHOP

Figure 26. Overall satisfaction with the content and format of the Workshop



Workshop Feedback

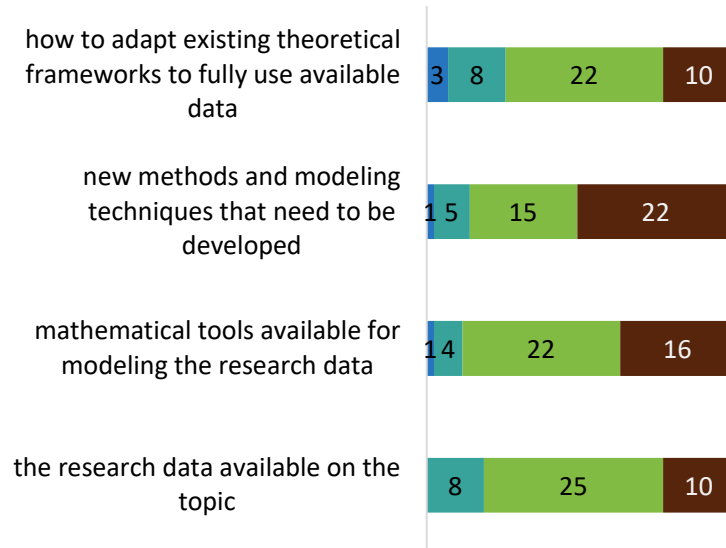
“One of the best workshops I have attended because it connected disciplines that routinely do not substantively engage. This workshop is stimulating progress and could facilitate development of a new focus area within subdisciplines.

“Thank you so much for making this possible. I am energized to try new methods that I otherwise wouldn't have known where to start with.

“I was really impressed by all of the help with the workshop. The snow on day 1 threw us for a loop and I would suggest having better back-up plans for this type of scenario in the future. Despite this hiccup, everything that we needed was available and everyone I spoke to throughout the event went great. Thanks for supporting and running this workshop for us.

Figure 27. Participant responses to the following question-- As a result of participating in this Workshop, I have a better understanding of:

■ Strongly disagree ■ Disagree ■ Neither agree nor disagree ■ Agree ■ Strongly Agree



Tutorials: RP10 Summary

Number of Tutorials
supported by NIMBioS

2

Total participation:

72

EDUCATION AND OUTREACH PROGRAM ACTIVITIES

Tutorials

NIMBioS Tutorials bring participants up to speed quickly on a variety of tools and topics. NIMBioS hosted two Tutorials during RP 10 with a total of 72 participants. At the time of writing, the evaluation survey for the Search for Selection Tutorial is still being collected. Reported here are data from the Applications of Spatial Data: Ecological Niche Modeling Tutorial. Evaluation surveys were sent to all on-site Tutorial participants. A total of 24 participants took part in the evaluation of the Tutorial.

Figure 28. Participant overall satisfaction with the content and format of the Tutorial

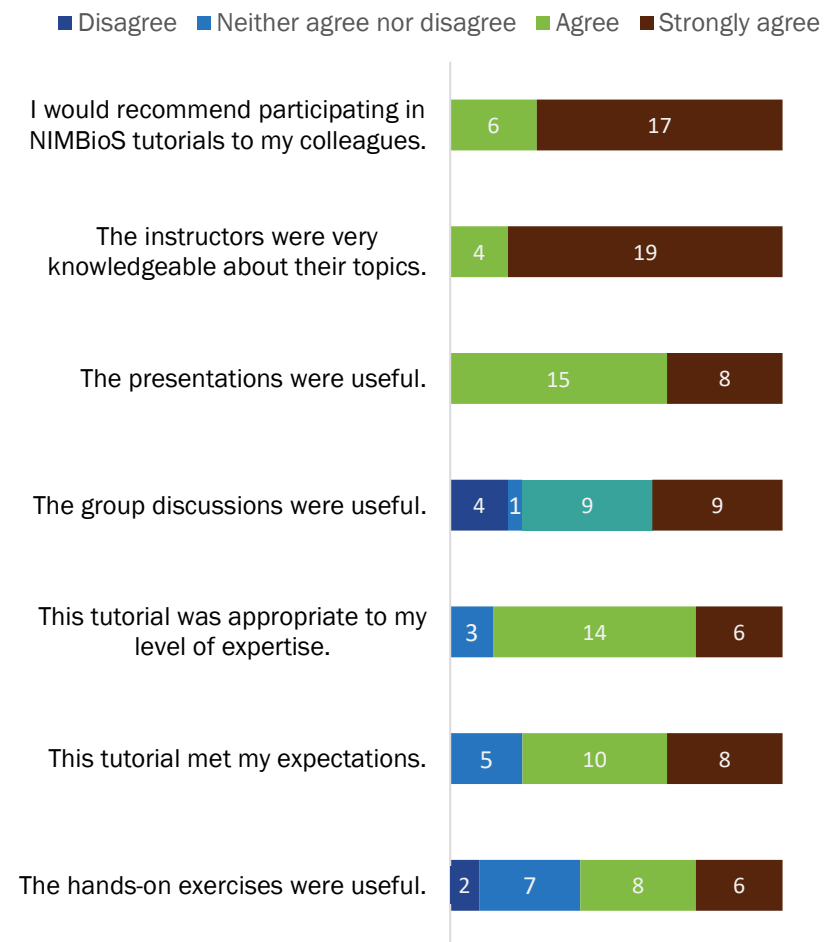
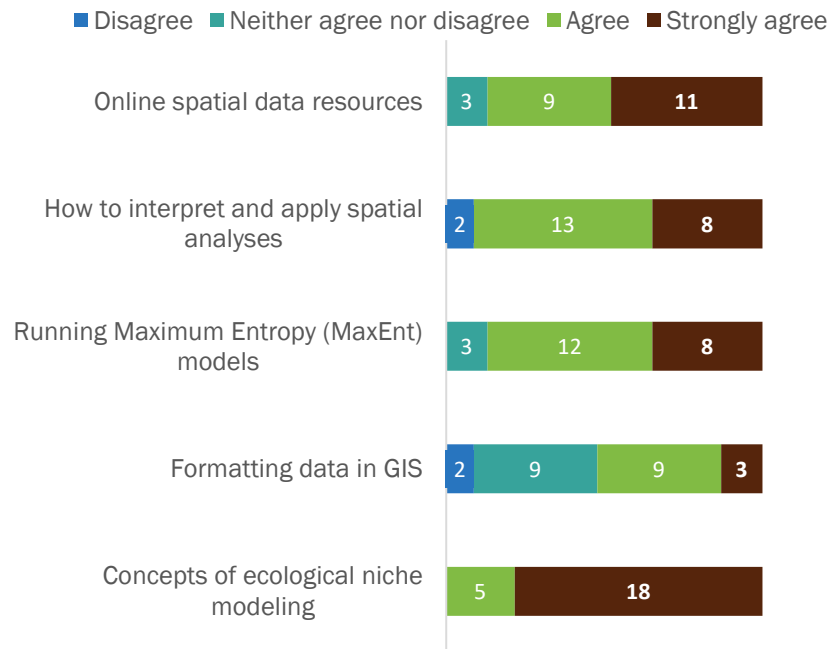


Figure 29. Participant learning: As a result of participating in this tutorial, I have a better understanding of:



17 out of 24

attendees felt this was a very effective format for achieving their goals.

20 out of 23

attendees were satisfied or very satisfied with the opportunities provided during the tutorial presentations and discussions to ask questions and/or make comments.

SRE Highlights



of SRE participants were very satisfied (n = 9) or satisfied (n = 5) with the research experience.

93%

of SRE Participants would recommend the program to others

100%

of 2017 SRE Mentors were satisfied with the NIMBioS SRE program

Summer Research Experience

The NIMBioS Summer Research Experience (SRE) program took place on the University of Tennessee, Knoxville (UT) Knoxville campus June 5-July 28, 2018. Fifteen undergraduates and one teacher were chosen to participate in the program. (While this SRE program technically fell within the dates of reporting period nine (RP 9), the SRE program for 2018 will not conclude until after the RP 10 annual report is due, so results from the previous year's SRE evaluation are provided each year.)

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

The five research projects for the 2017 program included: Mating Patterns in Birds' Evolution; Temporal Dynamics in Multi-Host Systems - How Important is Seasonality?; Modeling the Spread of La Crosse Virus in East Tennessee; Modeling the Immune System Battleground in Host-Virus Conflict; and Developing Computer Games for Teaching Biology.

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.

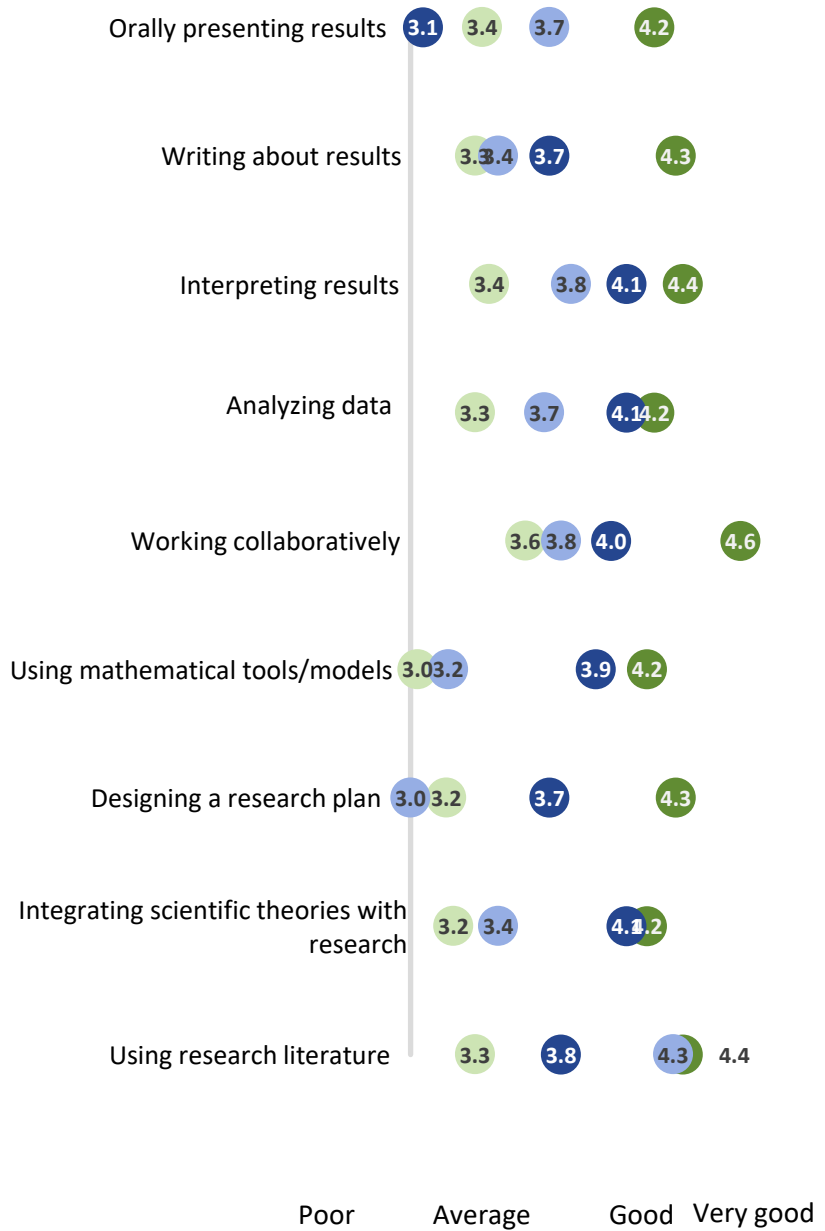
HIGHLIGHTS OF SRE EVALUATION RESPONSES (FIGURES 30 TO 31)

SRE Feedback

Before I participated in the SRE I lacked confidence that I had the aptitude to do research and go to graduate school. The interactions I had with other participants and my ability to contribute to the project allayed those fears. My SRE mentor was instrumental in making me feel that I could go to graduate school; they welcomed me into their lab and was always available to listen and give me advice.

A barrier that prevented my group from working well together was when we had different ideas. In the beginning of the SRE this was the case as our project idea was very broad and we didn't have a direction. However, this was resolved once we all came to an agreement in the direction we wanted to head into.

Figure 30. Participant pre-and post-program skills as rated by SRE participants and Mentors. (Lighter colors indicate pre-scores and darker colors indicate post-scores.)

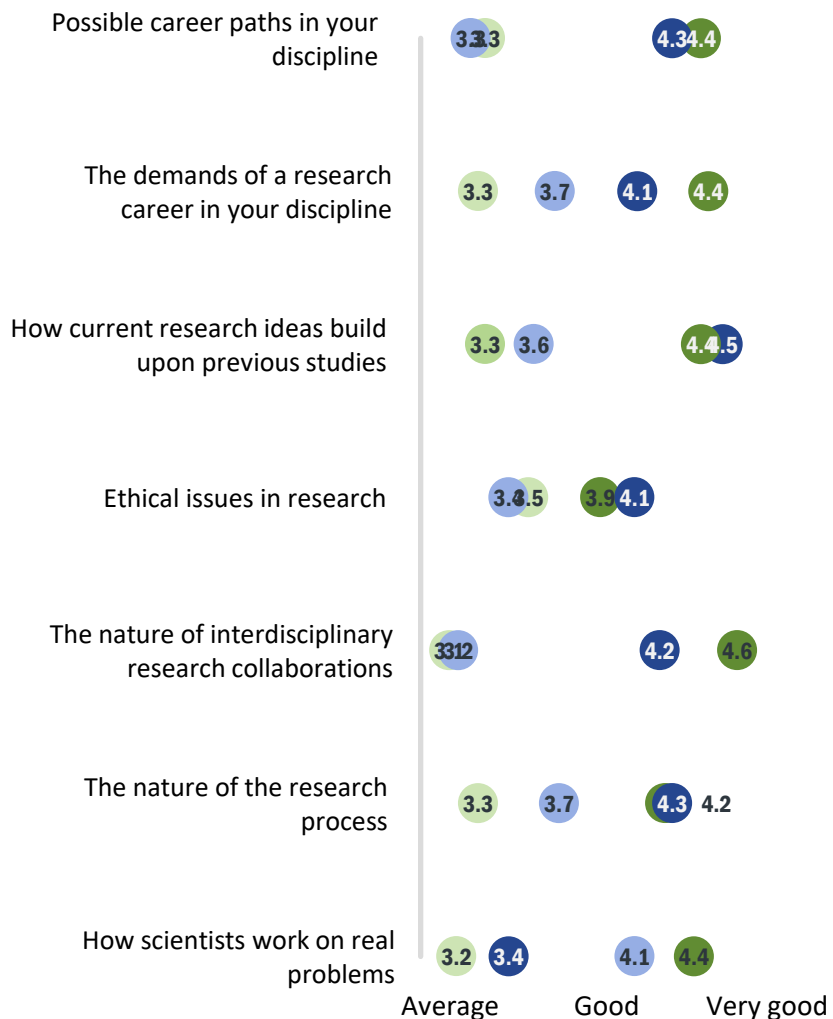


SRE Feedback

☺☺ I enjoyed the NIMBioS SRE program and everyone involved. It was a great experience and I am really proud of our research project. I appreciate that the students were grouped in a way in which everyone, regardless of major or academic level, were able to be engaged and assist throughout the duration of the project. Everyone had an important role, and I highly value that.

☺☺ NIMBioS was a great experience and I truly appreciate all the work that is put into making the program a possibility for the participants. All the mentors and administrative staff deserve a lot of thanks, and they're doing a great job making NIMBioS a positive experience.

Figure 31. (above) Participant pre- and post-program knowledge as rated by SRE participants and Mentors. (Lighter colors indicate pre-scores and darker colors indicate post-scores.)



URC Feedback

“ It was interesting seeing all of the different projects and meeting the students that worked on them. Most of us come from a similar mathematical and biological background, but there were differences in what our interests were. I enjoyed connecting with other students about their projects and why they thought they were important.

“ I met a lot of professional staff at UTK who helped explain to me my options for future study. I also enjoyed talking to students with completely different majors than my own but who were interested in studying the same thing .

“ It was interesting seeing all of the different projects and meeting the students that worked on them. Most of us come from a similar mathematical and biological background, but there were differences in what our interests were. I enjoyed connecting with other students about their projects and why they thought they were important.

Undergraduate Research Conference at the Interface of Biology and Mathematics (URC)

The NIMBioS ninth 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 11-12, 2017. The event was organized by the NIMBioS Associate Director for Education and Outreach Suzanne Lenhart and NIMBioS Education and Outreach Coordinator Greg Wiggins.

A total of 119 participants attended the ninth annual Undergraduate Research Conference, which provided opportunities for undergraduates to present their research at the interface of biology and mathematics. Student talks and posters were featured as well as a panel discussion on career opportunities. Evaluation surveys were sent to all participants in the conference. A total of 57 participants took part in a feedback survey. Of those, 40 (70%) were undergraduate students and 17 (30%) were non-undergraduate students.

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 32 TO FIGURE 35)

Figure 32. Respondent agreement levels with statements about various aspects of the conference for **undergraduate** participants.

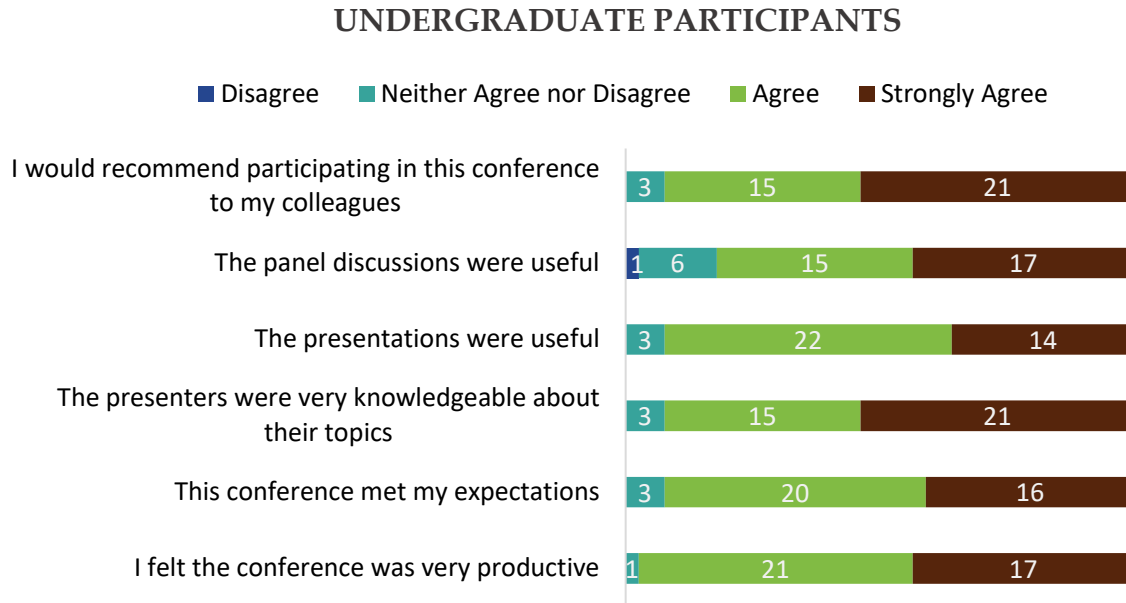


Figure 33. Respondent agreement levels with statements about various aspects of the conference for **non-undergraduate** participants.

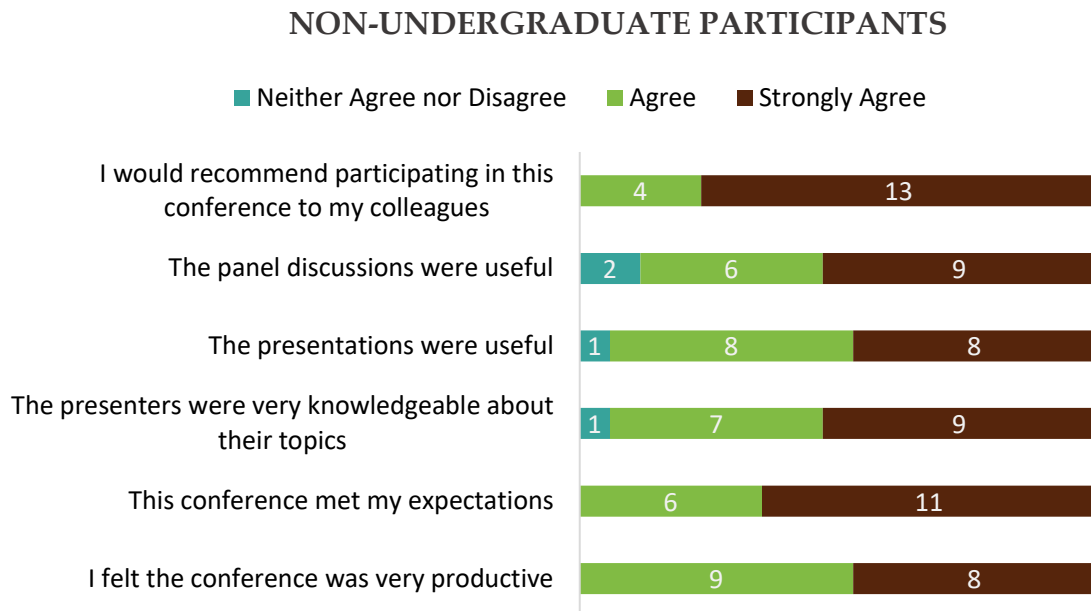


Figure 34. For **undergraduate** participants-- As a result of attending this conference, I have a better understanding of:

UNDERGRADUATE PARTICIPANTS

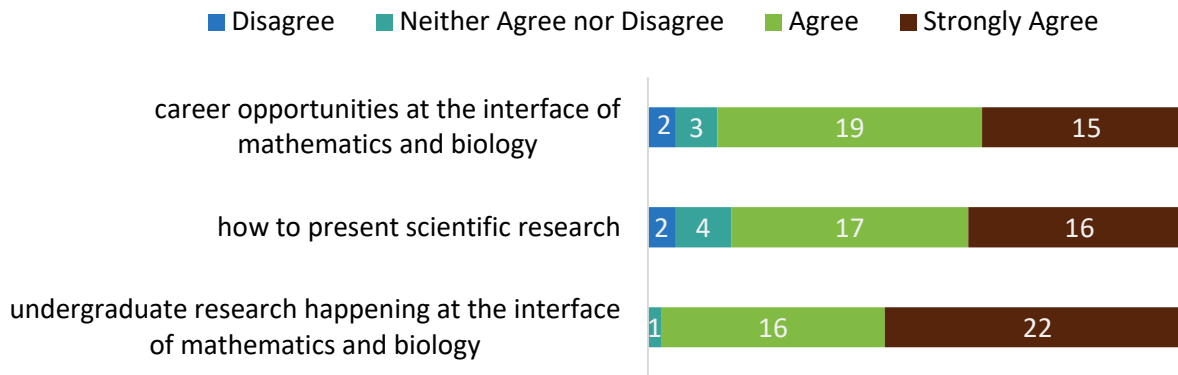
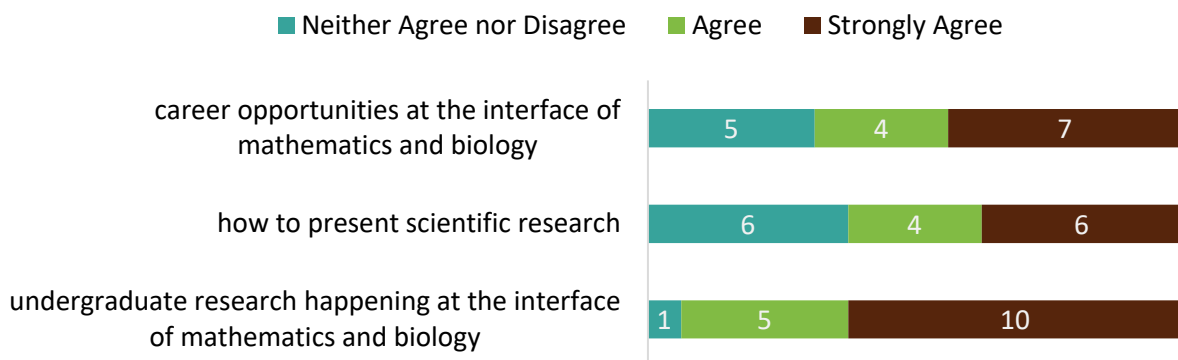


Figure 35. For **non-undergraduate** participants-- As a result of attending this conference, I have a better understanding of:

NON-UNDERGRADUATE PARTICIPANTS



Postdoc Overall Summary

Postdoctoral alumni
40

RP 10 postdocs
7

Average appointment:
1.91 years
(SD = 0.44)

NIMBIOS POSTDOCTORAL FELLOWSHIP PROGRAM

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

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

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.

Postdoc Feedback

“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 thing 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.

“The independent nature of the postdoc is valuable. The opportunity to collaborate with other postdoc was also a positive from my experience at 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, 36 (90%) alumni from the program have filled out the form.

HIGHLIGHTS OF POSTDOCTORAL FELLOWSHIP PROGRAM RESPONSES (FIGURES 36 TO 38)

Figure 36. Postdoctoral fellow satisfaction with program mentors

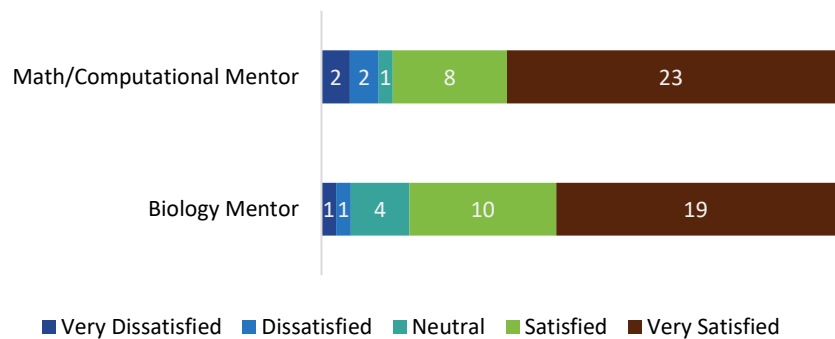
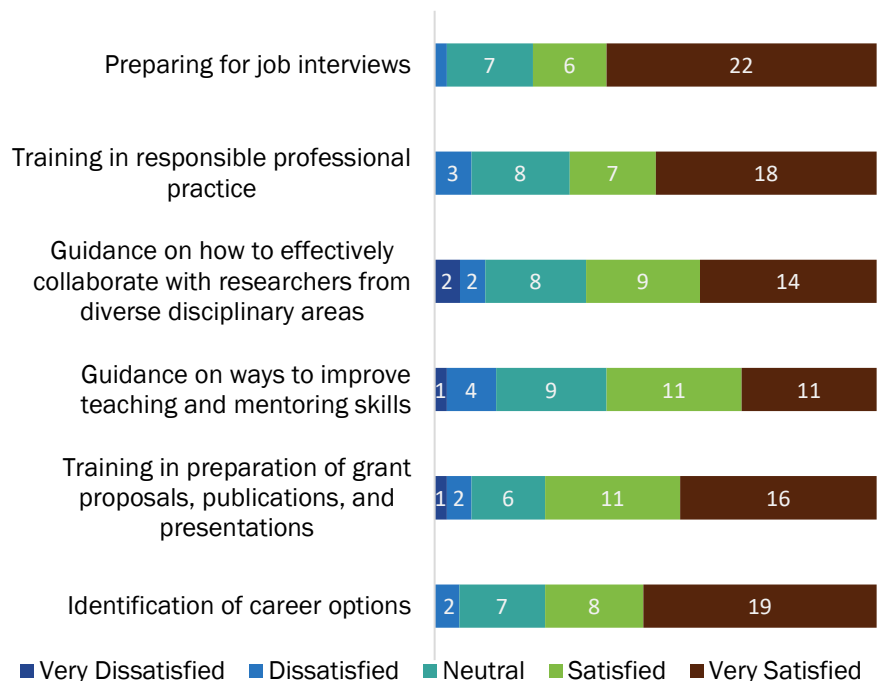


Figure 37. Postdoctoral fellow satisfaction with advice/assistance received from program mentors



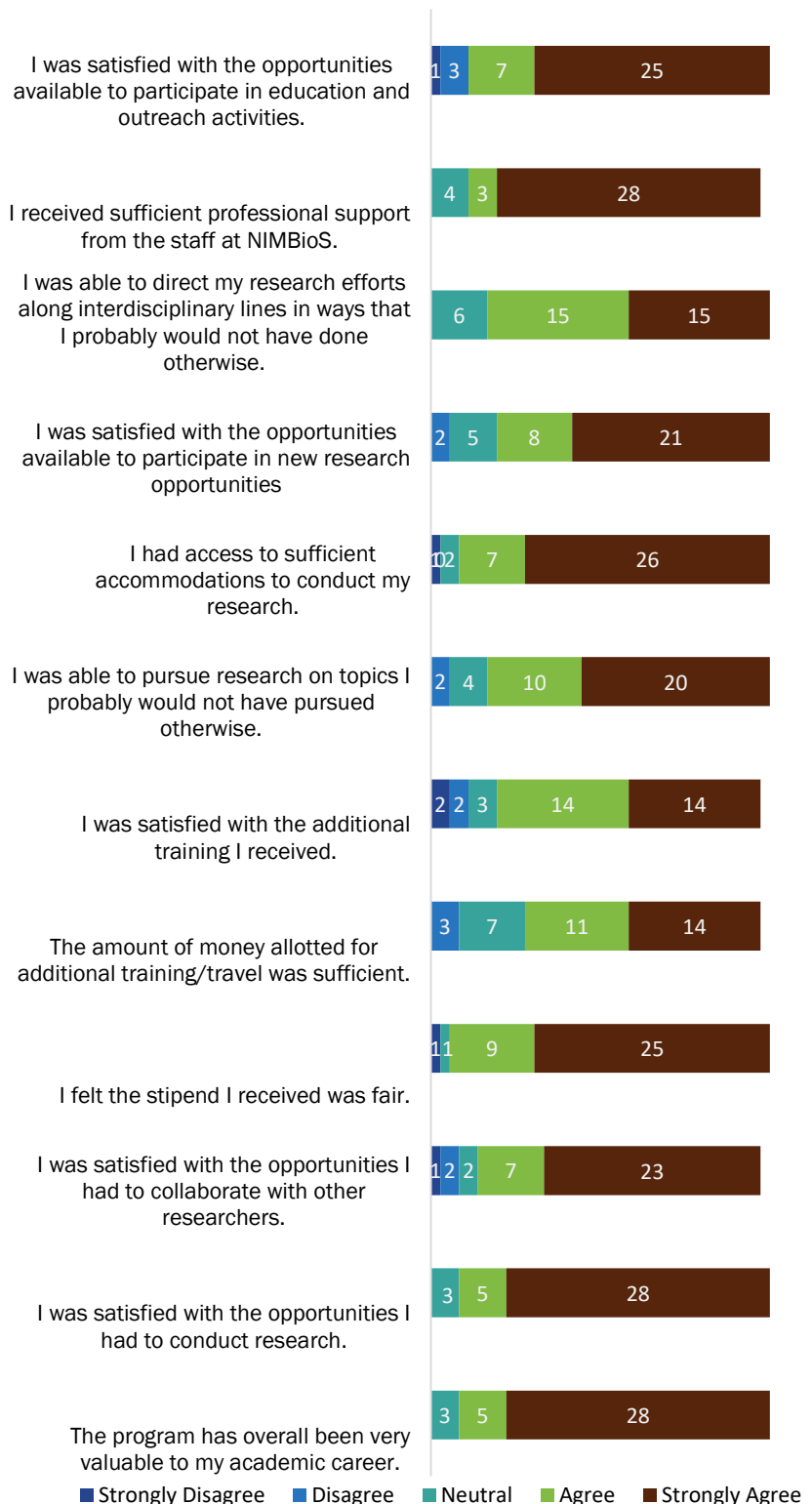
Postdoc Feedback

☺☺ My experience here at NIMBioS had been very satisfactory, the atmosphere had been very warm and homely and the staff very supportive. The support I got from my mentors had been tremendous both morally and in terms of research. I was able to organize the workshop on malaria modelling and control largely due to the support I got from both my mentors.

☺☺ 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.

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

Figure 38. Postdoctoral fellow satisfaction with overall program experience



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 909 published journal articles on a range of subjects from January 2009-June 2018, (Figures 39 to 40 and Table 1). An additional 15 are in press at writing and 21 have been submitted for review. The articles cover research ranging across many areas of ecology, evolutionary biology, applied mathematics, and computational biology.

Figure 39. Most common words from NIMBioS publication abstracts, all years

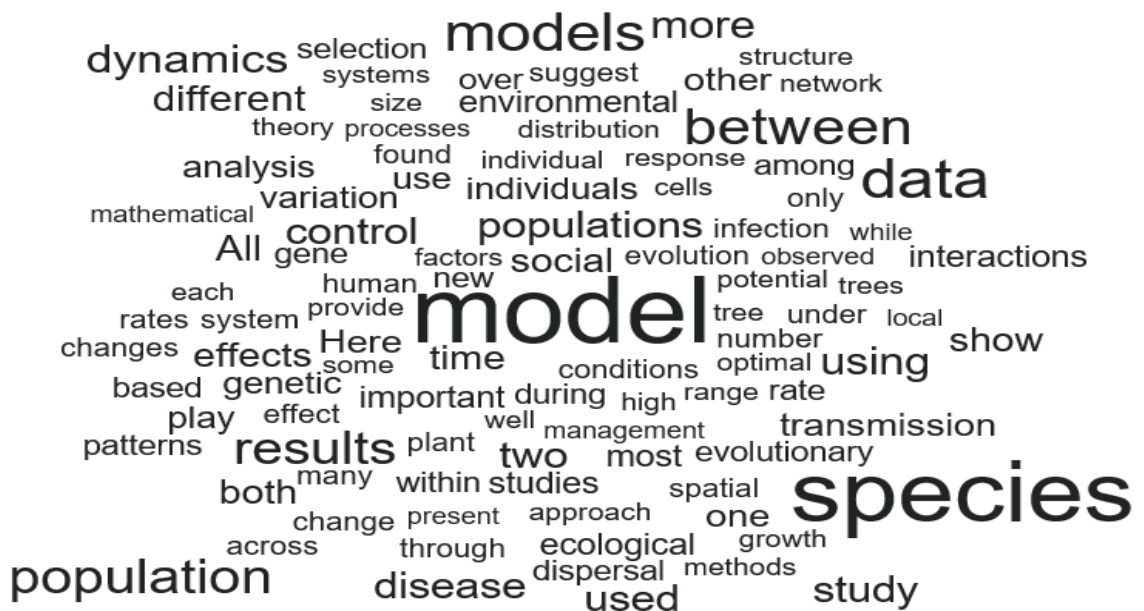
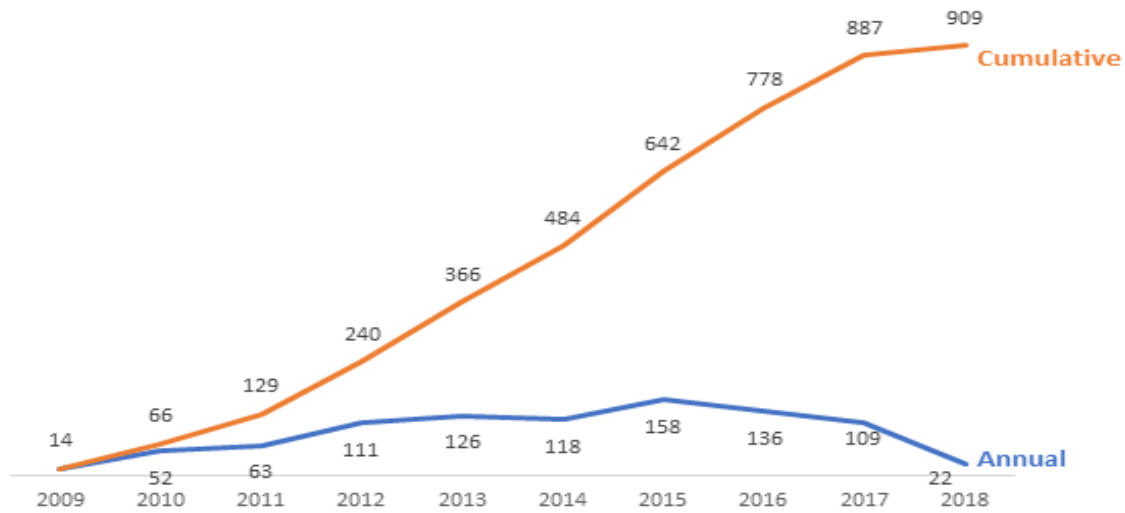


Figure 40. Number of **cumulative** and **annual** published journal articles reported from NIMBioS activities since 2009, by publication year



Note. 2018 includes publications submitted by participants to NIMBioS through June 2018

NIMBioS products are published in many high-ranking journals in their respective fields. Table 2 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.

NIMBioS publications come from a variety of activities, although Working Group participants tend to publish the largest portion of journal articles (30%), followed by NIMBioS Postdoctoral Fellows (25%) and Investigative Workshops (20%)(Figure 41).

Figure 41. Distribution of journal publications submitted to NIMBioS by participants

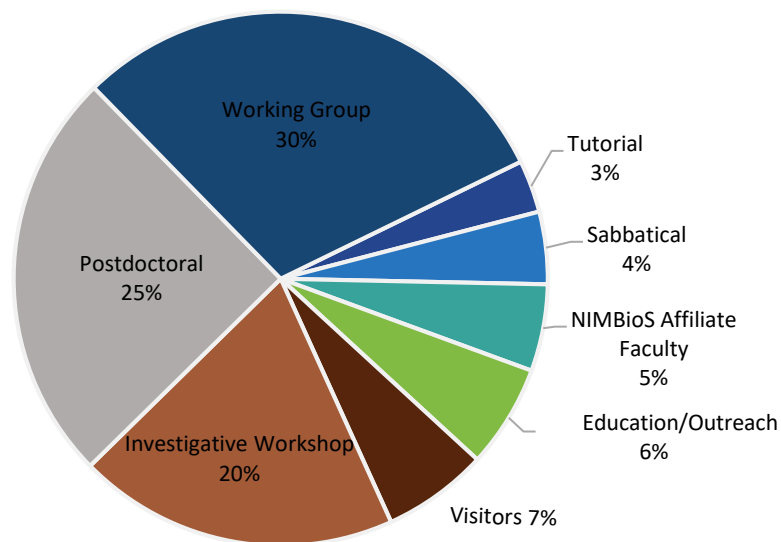


Table 2. Number of NIMBioS articles published in a selection of high-impact journals during the current reporting period (through June 2018) and since NIMBioS' inception, sorted by journal 5-Year Impact Factor

Journal Title	5-Year Impact Factor *	# of NIMBioS Publications in Year 10 **	# of NIMBioS Publications Since Inception ***
Nature	43.77	0	4
Cell	34.10	0	1
Science	38.06	2	10
Nature Climate Change	22.36	1	1
Trends in Ecology and Evolution	18.35	2	9
Ecology Letters	13.33	2	13
Systematic Biology	13.67	3	10
PLoS Biology	10.21	0	3
Nature Communications	13.09	1	3
Proceedings of the National Academy of Sciences	10.41	3	22
Current Biology	9.70	0	1
PLoS Genetics	7.06	0	2
Nucleic Acids Research	9.34	0	3
Phil Trans of the Royal Soc B-Biological Sciences	6.92	1	8
Molecular Ecology	6.64	1	12
Ecology	5.77	6	13
Proc of the Royal Soc B-Biological Sciences	5.42	1	13
PLoS Computational Biology	5.04	3	11
Evolution	4.56	1	18
Journal of Animal Ecology	5.06	3	7
American Naturalist	4.38	4	17
Journal of the Royal Society Interface	4.13	0	5
PLoS One	3.39	5	41
Animal Behaviour	3.28	2	11
BMC Bioinformatics	3.45	0	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: $\text{cites in year } n \text{ to articles published in year } (n-1 + n-2) / \text{number of articles published in year } (n-1 + n-2)$.

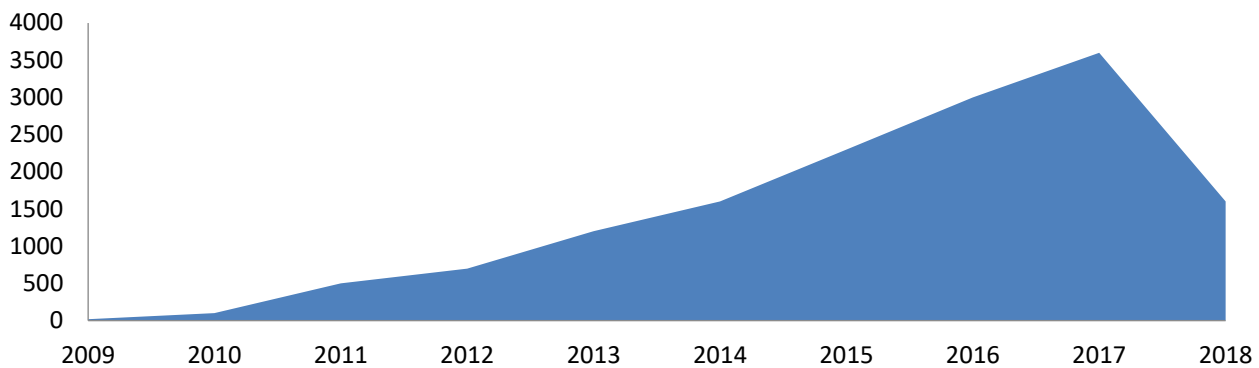
** Number of publications in Year 10 includes all publications reported since compilation of the previous Annual Report (April 2017) through June 2018.

*** September 2008 – June 2018

Bibliometric Indicators

CITATION ANALYSIS OF PUBLICATIONS. Of the 909 journal articles reported by NIMBioS participants, 819 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 2,355 researchers from 919 unique institutions spanning 61 countries. These articles have appeared in 303 different journals, many of which are considered to have high-impact in the academic community. These articles have been collectively cited 14,602 times, with an average of 17.92 cites per article, and an h-index of 51 (Figure 42). The cites per article is greater than either of the two major research fields of the publications during the last 10 years; mathematics (4.17 citers/paper) and biology (16.08 citers/paper). Ninety-eight participants have authored five or more papers each as a result of NIMBioS affiliated collaborations.

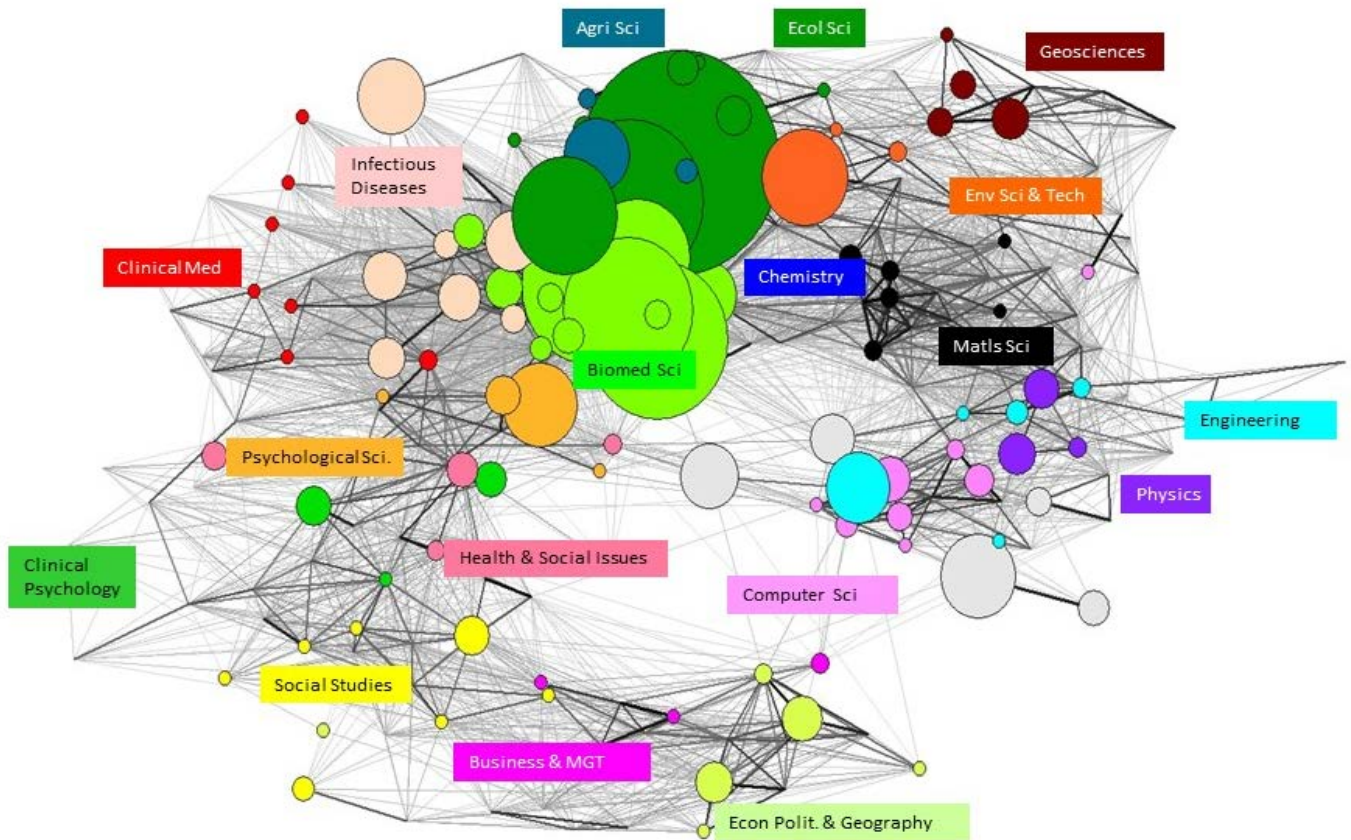
Figure 42. Citations per year for NIMBioS articles



DISCIPLINARY SPAN OF PUBLICATIONS. The 819 published articles in WOS span 104 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 43 locates the subject categories of the 819 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 (230), followed by Evolutionary Biology (123), Biology (116), Mathematical & Computational Biology (115), Multidisciplinary Sciences (98), and Genetics & Heredity (63).

Figure 43. Web of Science categories for 819 WoS journal articles to date



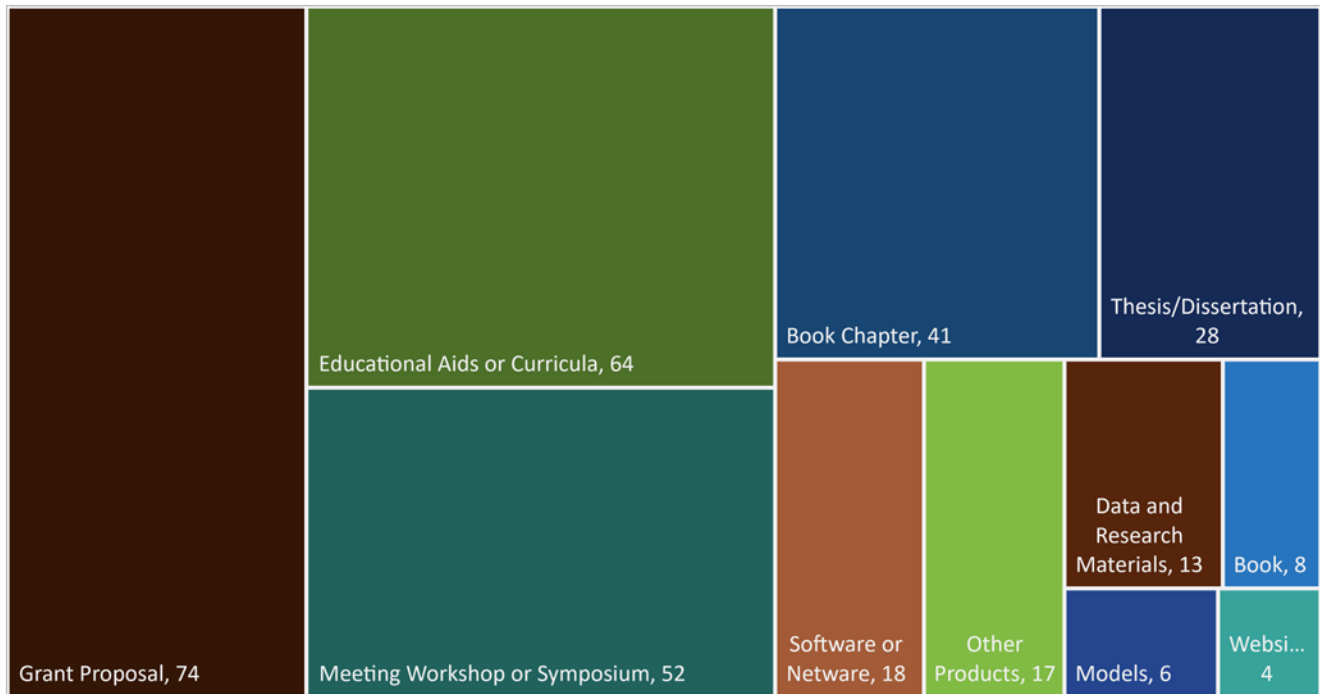
Rafols, Porter and Leydesdorff (2009)

COAUTHORSHIP. One of the core values of NIMBioS is to take a collaborative approach to science and science education. We are interested, therefore, in examining the number of co-authors on NIMBioS-related publications as one indicator of scientific collaboration. For the 819 publications reported thus far, the average number of co-authors per paper is 4.6 (Figure 44). Sixty percent of NIMBioS-related publications had 2-4 co-authors, while 32% had five or more co-authors.

OTHER SCHOLARLY PRODUCTS

In addition to journal publications, participants report other types of products that have resulted from their activities at NIMBioS. Figure 47 summarizes these types of products for the ten-year period. In addition to the items listed in Figure 43, NIMBioS participants have reported 910 conference presentations related to NIMBioS affiliation.

Figure 47. Number of non-journal publication products arising from NIMBioS events



Addendum to NIMBioS Annual Report

Sep 1, 2017 – Jun 30, 2018

Y10-3. Participant List for NIMBioS Events and Activities

Participant List for NIMBioS Events and Activities

Event organizers and SRE project mentors are denoted by an asterisk.

Undergraduate Research Conference (URC) 2017 (2017/11/11 – 2017/11/12)

Adams, Alison (Univ. of Georgia Athens)
Agusto, Folashade (Univ. of Kansas)
Baktay, Joshua (Duquesne Univ.)
Banks, Rylan (Transylvania Univ, KY)
Barker, Samuel (King Univ, TN)
Bezbaruah, Manaswinee (Univ. of Minnesota Twin Cities)
Bintz, Jason (Houghton College, NY)
Brettin, Andrew (Univ. of Minnesota Twin Cities)
Brewer, Sharee (Fisk Univ, TN)
Burke, Tianna (Howard Univ, DC)
Caldes, Holly (Montclair State Univ, NJ)
Clear, Anthony (King Univ, TN)
Cole, Samantha (King Univ, TN)
Cosgrove, Emily (Auburn Univ-Montgomery)
Dautel, Kimberly (Marist College, NY)
Dille, Hannah (Anderson Univ, SC)
Dixon, Eliot (Univ. of North Carolina Asheville)
Dougherty, Owen (Univ. of Tennessee Knoxville)
Duncan, Myles (Anderson Univ, SC)
Erovenko, Igor (Univ. of North Carolina Greensboro)
Evans, Katherine (Kate) (Oak Ridge National Laboratory (ORNL))
Falgout, Elise (Louisiana State Univ. Baton Rouge)
Fay, Charles (Emory and Henry College)
Ferrer, Laura (Univ. of Tennessee Knoxville)
Florida, Ryan (Middle Tennessee State Univ.)
French, Rachel (Western Kentucky Univ.)
Friel, Kaeley (Univ. of Tennessee Knoxville)
Garagnani, Justin (Transylvania Univ, KY)
Ghatak, Maitraya (Univ. of Tennessee Knoxville)
Ginther, Abigail (Univ of WI-Milwaukee)
Goddard II, Jerome (Auburn Univ.)
Gohari, Zahra (Univ of WI-Milwaukee)
Goryl, Kyle (Univ of WI-Milwaukee)
Guajardo, Henry (Brigham Young Univ, UT)
Hakizimana, Marlyne (Saint Olaf College)
Hankel, Camille (Georgetown Univ.)
Hommes, Audrey (Vanderbilt Univ, TN)
Hota, Sanjukta (Fisk Univ, TN)

Hu, Jingzhen (Southern Methodist Univ, TX)
Ignacz, Amanda (King Univ, TN)
Ivankovic, Diana (Anderson Univ, SC)
Jacobson, Sawyer (St Olaf College, MN)
Jasper, Christian (Transylvania Univ, KY)
Jennings, Erin (King Univ, TN)
Kanthawar, Arjun (Western Kentucky Univ.)
Kattel, Pradip (Howard Univ, DC)
Kelly, Michael (Transylvania Univ, KY)
Kennedy, Sonia (King Univ, TN)
Krishna, Nikhil (Western Kentucky Univ.)
Kwarta, Brielle (Houghton College, NY)
*Lenhart, Suzanne (Univ. of Tennessee Knoxville)
Liendo, Martha (King Univ, TN)
Lindsey, Eddie (Auburn Univ-Montgomery)
Li, Qingxia (Fisk Univ, TN)
Little, Megan (Transylvania Univ, KY)
Low, Jonathan (Anderson Univ, SC)
Machado, Jonathan (UNC-Greensboro)
Menix, Jacob (Western Kentucky Univ.)
Mercer, Arissa (Southwestern Oklahoma State Univ)
Mo, Kaiying (Pace Univ, NY)
Morris, Jerome (Fisk Univ, TN)
Murphy, Quiyana (Univ. of Kentucky)
Naidugari, Janki (Western Kentucky Univ.)
Nguyen, David (Eastern Washington Univ.)
Nguyen, Phuc (Macalester College, MN)
Oduniyi, Erick (Univ of KS)
Ogle, Kiona (Arizona State Univ.)
Pellett, Jordan (Univ. of Wisconsin La Crosse)
Pescitelli, Jaclyn (Georgia College & State Univ.)
Peyton Knapp, Mary (Anderson Univ, SC)
Pinter, Gabriella (Univ. of Wisconsin Milwaukee)
Power, Aisling (Univ. of North Carolina Asheville)
Prager, David (Anderson Univ, SC)
Pruckler, Patrick (Georgia College & State Univ.)
Reber, Ben (Houghton College, NY)
Reed, Jordan (Fisk Univ, TN)
Reynolds, Ashley (King Univ, TN)
Rosenbalm, Noah (King Univ, TN)
Rowell, Jonathan (Univ. of North Carolina Greensboro)
Salter, Kaitlin (Univ of WI-Milwaukee)
Sanchez, J Guillermo (Fisk Univ, TN)
Schugart, Richard (Western Kentucky Univ.)

Smiley, Adrienne (Fisk Univ, TN)
Summers, Jeffery (Middle Tennessee State Univ.)
Thomas Mathew, Sara (Georgia Inst. of Technology)
Urcuyo, Javier (Arizona State Univ.)
Vaughan, Kelly (King Univ, TN)
Wakhare, Tanay (Univ. of Maryland College Park)
Watson, Tykeena (Fisk Univ, TN)
Weishaar, Kyle (Regis Univ, CO)
*Wiggins, Greg (Univ. of Tennessee Knoxville)

BoA Meeting Oct. 2017 (2017/10/26 - 2017/10/27)

Allen, Linda (Texas Tech Univ.)
Amarasekare, Priyanga (Univ. of California Los Angeles)
Bourouiba, Lydia (Massachusetts Inst. of Technology)
Feng, Zhilan (Purdue Univ.)
Glasser, John (Centers for Disease Control and Prevention)
Hoffmann, Alexander (Univ. of California Los Angeles)
LaRiviere, Jacob (Microsoft Research)
Lewis, Mark (Univ. of Alberta)
Richerson, Peter (Pete) (Univ. of California Davis)
Velasco-Hernandez, Jorge (Universidad Nacional Autonoma de Mexico)
Weitz, Joshua (Georgia Inst. of Technology)

Applications of Spatial Data: Ecological Niche Modeling Tutorial (2018/05/16 - 2018/05/18)

Blackburn, Laura (U.S. Department of Agriculture (USDA))
Bodner, Korryn (Univ. of Toronto)
Carter, Anna (Iowa State Univ.)
Chunco, Amanda (Elon Univ.)
Dias Barros Medeiros, Camila (Univ. of California Los Angeles)
Egan, Katharine (Univ. of the Virgin Islands)
*Feng, Xiao (Univ. of Arizona)
Ganusov, Vitaly (Univ. of Tennessee Knoxville)
Gienger, Chris (Austin Peay State Univ.)
Golinski, G. (Smithsonian Institution)
Hodo, Carolyn (Texas A&M Univ. College Station)
Huang, Ta-Ken (Univ. of Arizona)
Idohou, Rodrigue (Univ. of Abomey-Calavi)
Lampley, Jayne (Univ. of Tennessee Knoxville)
Lubkin, Sara (National Aeronautics and Space Administration (NASA))
Martinez Lanfranco, Juan Andres (Mississippi State Univ.)
Monroe, Dillon (California State Univ. Northridge)

Ojo, Mayowa (Univ. of Kansas)
*Papes, Mona (Univ. of Tennessee Knoxville)
Perez, Timothy (Univ. of Miami)
*Peterson, A. Townsend (Univ. of Kansas)
Rogan, Jordan (Texas A&M Univ. College Station)
Sandoval-Arenas, Sergio (Fundacion Caipora)
Spence, Emma (Morton Arboretum)
Strickland, Christopher (Univ. of Tennessee Knoxville)
Stuhler, John (Texas Tech Univ.)
Trout Fryxell, Rebecca (Univ. of Tennessee Knoxville)
Walker, Cassandra (Oklahoma State Univ.)
Washington, Talitha (Howard Univ.)
Weisent, Jennifer (Univ. of Tennessee Knoxville)
Welsh, Chris (Univ. of Tennessee Knoxville)
*Wiggins, Greg (Univ. of Tennessee Knoxville)
Wilkening, Jennifer (U.S. Fish and Wildlife Service)

The Search for Selection Tutorial

(2018/06/18 - 2018/06/22)

Balisi, Mairin (Univ. of California Los Angeles)
Barnard-Kubow, Karen (Univ. of Virginia)
Benoit, Amanda (Univ. of Tennessee Knoxville)
Bialic-Murphy, Lalsia (Univ. of Tennessee Knoxville)
Brock, Jordan (Washington Univ. Saint Louis)
Brueniche-Olsen, Anna (Purdue Univ.)
Correa Pavinato, Vitor Antonio (Centre de Biologie pour la Gestion des Populations - UMR)
DeLeo, Victoria (Pennsylvania State Univ. University Park (main campus))
Dong, Xiaoli (Duke Univ.)
Fasanello, Vincent (Washington Univ. Saint Louis)
Flanagan, Sarah (Univ. of Tennessee Knoxville)
Freitas, Cintia (Universidade Federal de Goiás)
Greene, Deborah (Duke Univ.)
Jackson, Jason (Univ. of Alabama Tuscaloosa)
Joines, Jason (Clemson Univ.)
Kawano, Sandy (California State Univ. Long Beach)
Lackey, Alycia (Binghamton Univ.)
Love, Cara (Univ. of Georgia Athens)
MacPherson, Maggie (Univ. of Missouri)
McElderry, Robert (Univ. of Tennessee Knoxville)
Melo, Diogo (Univ. of Sao Paulo)
Moody, Kristine (Univ. of Tennessee Knoxville)
Mucci, Nicholas (Univ. of Tennessee Knoxville)
Penna, Anna (Univ. of Texas at San Antonio)

Perukkaranai Madabhushi, Shreenidhi (Washington Univ. Saint Louis)
Peterson, Christopher (Univ. of Texas Austin)
Piculell, Bridget (College of Charleston)
Pimsler, Meaghan (Univ. of Alabama Tuscaloosa)
Rice, Jonathan (Univ. of California Merced)
Ryan, Sean (Univ. of Tennessee Knoxville)
Salazar Tortosa, Diego (Univ. of Granada)
Simon, Monique (Oregon State Univ.)
Song, Jingwei (College of William and Mary)
Summers, Jennifer (Univ. of Tennessee Knoxville)
Sztepanacz, Jacqueline (Florida State Univ.)
Taub, Daniel (Southwestern Univ.)
Vasconcellos Caldas, Ian (Cornell Univ.)
*Walsh, Bruce (Univ. of Arizona)
Weissman, Jake (Univ. of Maryland College Park)
Yiu, Hao (Univ. of Maryland College Park)

Prediction and Control of Cardiac Alternans Working Group M3

(2017/12/11 - 2017/12/13)

Cherry, Elizabeth (Rochester Inst. of Technology)
Echebarria, Blas (Universitat Politecnica de Catalunya)
Fenton, Flavio (Georgia Inst. of Technology)
Gilmour, Robert (Univ. of Prince Edward Island)
Grigoriev, Roman (Georgia Inst. of Technology)
Krogh-Madsen, Trine (Cornell Univ.)
Munoz, Laura (Rochester Inst. of Technology)
Shiferaw, Yohannes (California State Univ. Northridge)
*Talkachova, Alena (Univ. of Minnesota Twin Cities)
*Zhao, Xiaopeng (Univ. of Tennessee Knoxville)

Conservation Hierarchies Working Group M1

(2017/11/13 - 2017/11/15)

Alagador, Diogo (Univ. of Evora)
Albers, Heidi (Univ. of Wyoming)
*Armsworth, Paul (Univ. of Tennessee Knoxville)
Chang, Charlotte (Univ. of Tennessee Knoxville)
Dilkina, Bistra (Univ. of Southern California)
Dissanayake, Sahan (Portland State Univ.)
Giam, Xingli (Univ. of Tennessee Knoxville)
Helmstedt, Kate (Univ. of California Berkeley)
*Kroetz, Kailin (Resources for the Future)
*Nolte, Christoph (Boston Univ.)
Ochoa-Ochoa, Leticia (Universidad Nacional Autonoma de Mexico)

Papes, Mona (Univ. of Tennessee Knoxville)
Sims, Charles (Univ. of Tennessee Knoxville)
Soberon, Jorge (Univ. of Kansas)
Spencer, Gwen (Smith College)

Conservation Hierarchies Working Group M2

(2018/05/16 - 2018/05/18)

Albers, Heidi (Univ. of Wyoming)
*Armsworth, Paul (Univ. of Tennessee Knoxville)
Chang, Charlotte (Univ. of Tennessee Knoxville)
Dilkina, Bistra (Univ. of Southern California)
Dissanayake, Sahan (Portland State Univ.)
Fovargue, Rachel (Univ. of Oklahoma)
Giam, Xingli (Univ. of Tennessee Knoxville)
Helmstedt, Kate (Univ. of California Berkeley)
*Kroetz, Kailin (Resources for the Future)
*Nolte, Christoph (Boston Univ.)
Papes, Mona (Univ. of Tennessee Knoxville)
Sims, Charles (Univ. of Tennessee Knoxville)
Spencer, Gwen (Smith College)

Ecosystem Federalism Working Group M2

(2018/01/24 - 2018/01/26)

Armsworth, Paul (Univ. of Tennessee Knoxville)
*Blackwood, Julie (Williams College)
Dilkina, Bistra (Univ. of Southern California)
Fitzpatrick, Ben (Loyola Marymount Univ.)
Kling, David (Oregon State Univ.)
Lenhart, Suzanne (Univ. of Tennessee Knoxville)
Neubert, Michael (Woods Hole Oceanographic Institution)
Papes, Mona (Univ. of Tennessee Knoxville)
Sanchirico, James (Jim) (Univ. of California Davis)
Shea, Katriona (Pennsylvania State Univ. University Park (main campus))
*Sims, Charles (Univ. of Tennessee Knoxville)
Springborn, Michael (Mike) (Univ. of California Davis)
Yakubu, Abdul-Aziz (Howard Univ.)

Long Transients and Ecological Forecasting Working Group M2

(2017/10/26 - 2017/10/28)

Abbott, Karen (Case Western Reserve Univ.)
Cuddington, Kim (Univ. of Waterloo)
Francis, Tessa (Univ. of Washington)

Gellner, Gabriel (Colorado State Univ.)
Hastings, Alan (Univ. of California Davis)
Lai, Ying-Cheng (Arizona State Univ.)
Morozov, Andrew (Leicester Univ.)
Petrovskii, Sergei (Univ. of Leicester)
Scranton, Katherine (Univ. of California Los Angeles)
Zeeman, Mary Lou (Bowdoin College)

Modeling Molecules-to-Organisms Working Group M4 (2017/09/12 - 2017/09/15)

Antczak, Philipp (Univ. of Liverpool)
Garcia-Reyero, Natalia (U.S. Army Engineer Research and Development Center (ERDC))
Gergs, Andre (Aachen Univ. Germany)
Lika, Dina (Univ. of Crete)
Mathews, Terry (Oak Ridge National Laboratory (ORNL))
Muller, Erik (Univ. of California Santa Barbara)
*Murphy, Cheryl (Michigan State Univ.)
Nacci, Diane (U.S. Environmental Protection Agency (EPA))
*Nisbet, Roger (Univ. of California Santa Barbara)
Remien, Christopher (Chris) (Univ. of Idaho Moscow)
Schultz, Irvin (National Oceanic and Atmospheric Administration (NOAA))
Stevenson, Louise (Univ. of California Santa Barbara)
Watanabe, Karen (Arizona State Univ.)

Learning in Networks Working Group M1 (2018/02/22 - 2018/02/24)

*Bassett, Danielle (Univ. of Pennsylvania)
Diedrichsen, Jorn (Western Univ.)
Gold, Joshua (Univ. of Pennsylvania)
*Grafton, Scott (Univ. of California Santa Barbara)
Hartley, Catherine (New York Univ.)
Mason, Porter (Univ. of California Los Angeles)
O'Doherty, John (California Inst. of Technology)
Shohamy, Daphna (Columbia Univ.)

Modeling Organisms-to-Ecosystems Working Group M4 (2017/09/12 - 2017/09/15)

Accolla, Chiara (Minnesota State Univ. Mankato)
Birniir, Bjorn (Univ. of California Santa Barbara)
Bruins, Randall (U.S. Environmental Protection Agency (EPA))
Ducrot, Virginie (Bayer CropScience AG)
*Forbes, Valery (Univ. of Minnesota Twin Cities)

Galic, Nika (Univ. of Minnesota Twin Cities)
Garber, Kristina (Kris) (U.S. Environmental Protection Agency (EPA))
Jager, Henriette (Yetta) (Oak Ridge National Laboratory (ORNL))
Kanarek, Andrew (U.S. Environmental Protection Agency (EPA))
Pastorok, Robert (Integral Consulting Inc)
Railsback, Steven (Lang, Railsback and Associates)
Rebarber, Richard (Univ. of Nebraska Lincoln)
*Salice, Christopher (Towson Univ.)
Thorbek, Perrnille (Syngenta)

Models of Produce Contamination Working Group M3 (2017/09/27 - 2017/09/29)

Allende, Ana (Spanish National Research Council (CSIC))
*Bourouiba, Lydia (Massachusetts Inst. of Technology)
Brandl, Maria (U.S. Department of Agriculture (USDA))
*Ivanek, Renata (Cornell Univ.)
Liu, Rongsong (Univ. of Wyoming)
Luo, Yaguang (Sunny) (U.S. Department of Agriculture (USDA))
*Munther, Daniel (Cleveland State Univ.)
Oryang, David (U.S. Food and Drug Administration (FDA))
Wiedmann, Martin (Cornell Univ.)
Wu, Jianhong (York Univ. Toronto)

Quant Bio@Community College Working Group M1 (2018/04/26 - 2018/04/28)

Aikens, Melissa (Univ. of Texas Austin)
*Bissell, Ahrash (The NROC Project)
Corwin, Lisa (Univ. of Colorado Boulder)
Gross, Louis (Univ. of Tennessee Knoxville)
*Jenkins, Kristin (BioQUEST)
Karpakakunjaram, Vedham (Montgomery College)
*Kiser, Stacey (Lane Community College)
Lenhart, Suzanne (Univ. of Tennessee Knoxville)
LoRe, Sondra (Univ. of Tennessee Knoxville)
*Miller, Jillian (Roane State Community College)
Neuhauser, Claudia (Univ. of Minnesota Twin Cities)
Nieuwsma, Christianne (South Mountain Community College)
Weisstein, Anton (Tony) (Truman State Univ.)
Wiggins, Greg (Univ. of Tennessee Knoxville)

Multiscale Vectored Plant Viruses Working Group M4 (2017/12/18 - 2017/12/20)

*Allen, Linda (Texas Tech Univ.)
*Bokil, Vrushali (Oregon State Univ.)
Cunniffe, Nicholas (Univ. of Cambridge)
Gross, Louis (Univ. of Tennessee Knoxville)
Hamelin, Frederic (Agrocampus Ovest)
Hilker, Frank (Osnabruck Univ.)
Manore, Carrie (Tulane Univ.)
*Power, Alison (Cornell Univ.)
Rua, Megan (Wright State Univ.)

Bio-acoustic Structure Investigative Workshop (2018/06/25 - 2018/06/27)

*Archer, Eric (National Oceanic and Atmospheric Administration (NOAA))
Chang, Charlotte (Univ. of Tennessee Knoxville)
Dassow, Angela (Carthage College)
Elliott, Taffeta (New Mexico Inst. of Mining and Technology)
Gentry, Katherine (Purdue Univ.)
Glanz, Hunter (California Polytechnic State Univ. San Luis Obispo)
Heise, David (Lincoln Univ.)
Hughes, Melissa (College of Charleston)
Johnson, Mike (Univ. of Kentucky)
Kershenbaum, Arik (Univ. of Cambridge)
Lewis, Rebecca (Univ. of Manchester)
Noriega Romero Vargas, Maria Florencia (Technische Universitat, Germany)
Nyari, Arpad (Univ. of Tennessee Knoxville)
Oswald, Julie (Scottish Oceans Institute)
Podos, Jeff (Univ. of Massachusetts Amherst)
Ravignani, Andrea (Vrije Univ. Brussel)
Robredo, Everardo (Comision Nacional para el Conocimiento y Uso de la Biodiversidad)
Roch, Marie (San Diego State Univ.)
Sakai, Taiki (National Oceanic and Atmospheric Administration (NOAA))
Sayigh, Laela (Woods Hole Oceanographic Institution)
Schroth-Glanz, Maddie (California Polytechnic State Univ. San Luis Obispo)
Simoes, Pedro (Pontificia Universidade Catolica do Rio Grande do Sul)
Urbanowicz, Ryan (Univ. of Pennsylvania)
Van Cise, Amy (Woods Hole Oceanographic Institution)
Zsebok, Sandor (Eotvos Lorand Univ. of Budapest)

Stoichiometric Ecotoxicology Workshop (2018/01/17 - 2018/01/19)

Accolla, Chiara (Minnesota State Univ. Mankato)
Antczak, Philipp (Univ. of Liverpool)
Brooks, Bryan (Baylor Univ.)
Costello, David (Kent State Univ.)
Danger, Michael (Univ. of Lorraine)
Everett, Rebecca (North Carolina State Univ.)
Flores, Kevin (North Carolina State Univ.)
*Frost, Paul (Trent Univ.)
Heggerud, Christopher (Univ. of Alberta)
Kang, Yun (Arizona State Univ.)
Karimi, Roxanne (State Univ. of New York (SUNY) Stony Brook)
Kuang, Yang (Arizona State Univ.)
Larson, James (U.S. Geological Survey (USGS))
Mathews, Terry (Oak Ridge National Laboratory (ORNL))
Mayer, Greg (Texas Tech Univ.)
Murdock, Justin (Tennessee Technological Univ.)
Murphy, Cheryl (Michigan State Univ.)
Nisbet, Roger (Univ. of California Santa Barbara)
*Peace, Angela (Angie) (Texas Tech Univ.)
Pollesch, Nathan (U.S. Environmental Protection Agency (EPA))
Rutter, Erica (North Carolina State Univ.)
Schulz, Kimberly (State Univ. of New York College (SUNY) of Environmental Science & Forestry)
Scott, Thad (Baylor Univ.)
Stevenson, Louise (Univ. of California Santa Barbara)
Wagner, Nicole (Cornell Univ.)
Wang, Hao (Univ. of Alberta)

NIMBioS Affiliate Faculty

Abel, Steven (Chemical & Biomolecular Engineering, UTK)
Armsworth, Paul (Ecology & Evolutionary Biology, UTK)
Berry, Michael (Electrical Engineering & Computer Science, UTK)
Bruce, Barry (BCMB, UTK)
Dale, Virginia (ORNL; EEB, UTK)
Day, Judy (Mathematics; Electrical Engineering & Computer Science, UTK)
Eda, Shigetoshi (Forestry, Wildlife & Fisheries, UTK)
Feng, Xiaobing (Mathematics, UTK)
Fordyce, James (Ecology & Evolutionary Biology, UTK)
Ganusov, Vitaly (Microbiology, Mathematics, UTK)
Gaoue, Orou (Ecology & Evolutionary Biology, UTK)
Giam, Xingli (Ecology & Evolutionary Biology, UTK)
Gilchrist, Michael (Ecology & Evolutionary Biology, UTK)

Goodrich-Blair, Heidi (Microbiology, UTK)
Hong, Tian (Biochemistry and Cellular & Molecular Biology, UTK)
Jager, Yetta (ORNL; Ecology & Evolutionary Biology, UTK)
Kalisz, Susan (Ecology & Evolutionary Biology, UTK)
Kintziger, Kristina (Public Health, UTK)
Lavrentovich, Maxim (Physics & Astronomy, UTK)
Mannik, Jaan (Physics & Astronomy, UTK)
Odoi, Agricola (Comparative Medicine, UTK)
Pan, Chongle (Microbiology, UTK)
Shaw, Shih-Lung (Geography, UTK)
Sheldon, Kimberly (Ecology & Evolutionary Biology, UTK)
Simberloff, Daniel (Ecology & Evolutionary Biology, UTK)
Simpson, Michael (ORNL; Bredesen Center, UTK)
Smith, Jeremy (Biochemistry and Cellular & Molecular Biology, UTK; ORNL)
Strickland, Christopher (Mathematics, UTK)
Su, Chunlei (Microbiology, UTK)
Talmy, David (Microbiology, UTK)
von Arnim, Albrecht (Biochemistry and Cellular & Molecular Biology, UTK)
Wilhelm, Steven (Microbiology, UTK)
Wise, Steven (Mathematics, UTK)
Zhao, Xiaopeng (Mechanical, Aerospace, & Biomedical Engineering, UTK)

NIMBioS Board of Advisors

Allen, Linda (Texas Tech Univ.)
Amarasekare, Priyanga (Univ. of California Los Angeles)
Bourouiba, Lydia (Massachusetts Inst. of Technology)
Feng, Zhilan (Purdue Univ.)
Glasser, John (Centers for Disease Control and Prevention)
Guttieri, Mary (Metabiota)
Hoffmann, Alexander (Univ. of California Los Angeles)
LaRiviere, Jacob (Microsoft Research)
Lewis, Mark (Univ. of Alberta)
Liebhold, Andrew (Sandy) (U.S. Department of Agriculture (USDA))
McPeck, Mark (Dartmouth College)
Munoz-Zanzi, Claudia (Univ. of Minnesota Twin Cities)
Palacios, Gustavo (U.S. Army Medical Research Inst. of Infectious Diseases)
Plotkin, Joshua (Univ. of Pennsylvania)
Richerson, Peter (Pete) (Univ. of California Davis)
Velasco-Hernandez, Jorge (Universidad Nacional Autonoma de Mexico)
Weitz, Joshua (Georgia Inst. of Technology)

NIMBioS Graduate Research Assistant

Burton, Danielle (Univ. of Tennessee Knoxville)
Landerer, Cedric (Univ. of Tennessee Knoxville)
Le Bouille, Diane (Univ. of Tennessee Knoxville)
Pullen, Robert (Univ. of Tennessee Knoxville)

Visiting Graduate Student Fellow

Miyaoka, Tiago (Univ. of Campinas)

NIMBioS Leadership Team

Bishop, Pamela (Univ. of Tennessee Knoxville)
Brothers, Ernest (Univ. of Tennessee Knoxville)
Buchan, Alison (Univ. of Tennessee Knoxville)
Fefferman, Nina (Univ. of Tennessee Knoxville)
Papeş, Monica (Univ. of Tennessee Knoxville)
Gavrilets, Sergey (Univ. of Tennessee Knoxville)
Gross, Louis (Univ. of Tennessee Knoxville)
Lenhart, Suzanne (Univ. of Tennessee Knoxville)
O'Meara, Brian (Univ. of Tennessee Knoxville)
Welsh, Chris (Univ. of Tennessee Knoxville)

Postdoctoral Fellow

Chang, Charlotte (Univ. of Tennessee Knoxville)
Flanagan, Sarah (Univ. of Tennessee Knoxville)
Johnson, Quentin (Univ. of Tennessee Knoxville)
Panchy, Nicholas (Univ. of Tennessee Knoxville)
Siewe, Nourridine (Univ. of Tennessee Knoxville)
Smith-Ramesh, Lauren (Univ. of Tennessee Knoxville)
Tarasov, Sergei (Univ. of Tennessee Knoxville)

Postdoctoral Fellow Mentor

Day, Judy (Univ. of Tennessee Knoxville)
Fefferman, Nina (Univ. of Tennessee Knoxville)
Lenhart, Suzanne (Univ. of Tennessee Knoxville)
Fordyce, James (Univ. of Tennessee Knoxville)
O'Meara, Brian (Univ. of Tennessee Knoxville)
Kalisz, Susan (Univ. of Tennessee Knoxville)
Simberloff, Dan (Univ. of Tennessee Knoxville)

NIMBioS Seminar Series

Borer, Elizabeth (Univ. of Minnesota Twin Cities)
Chang, Charlotte (Univ. of Tennessee Knoxville)
Emrich, Scott (Univ. of Notre Dame)
Ke, Ruian (North Carolina State Univ.)
Nuismer, Scott (Univ. of Idaho Moscow)
Panchy, Nicholas (NIMBioS)
Rajakaruna, Harshana (Univ. of Tennessee Knoxville)
Strickland, Christopher (NIMBioS)
Shipman, Patrick (NIMBioS)

DySoC/NIMBioS Seminar

Bentley, Alex (Univ. of Tennessee Knoxville)
Prins, Brandon (Univ. of Tennessee Knoxville)
Shteynberg, Garriy (Univ. of Tennessee Knoxville)

SAL/NIMBioS Seminar

Moersch, Jeffrey (Univ. of Tennessee Knoxville)
Jeffreys, Pamela (Univ. of Tennessee Knoxville)

Summer Research Experiences (SRE)

Abbasi, Eeman (Mount Holyoke College)
Alred, Brianna (Univ. of Tennessee Knoxville)
Berle, Amelia (Lewis & Clark College)
Blesi, Annastashia (Univ. of Tennessee Knoxville)
Brock, Sarah (Univ. of Tennessee Knoxville)
Brozak, Samantha (Arizona State Univ.)
Castedo Pena, Diego (North Carolina State Univ.)
*Chang, Charlotte (Univ. of Tennessee Knoxville)
Chidambaran, Sadhana (Rutgers Univ. New Brunswick/Piscataway)
Dai, Yi (The Ohio State Univ.)
De Angeli, Kevin (Texas A&M Univ. Kingsville)
Fisher, Teresa (Univ. of Tennessee Knoxville)
Gan, Alan (Univ. of Tennessee Knoxville)
*Giam, Xingli (Univ. of Tennessee Knoxville)
*Gilchrist, Michael (Univ. of Tennessee Knoxville)
Jennings, Teresa (Univ. of Tennessee Knoxville)
Kwarta, Brielle (Houghton College)
*Lenhart, Suzanne (Univ. of Tennessee Knoxville)
*O'Meara, Brian (Univ. of Tennessee Knoxville)
*Papes, Mona (Univ. of Tennessee Knoxville)
Reber, Ben (Houghton College)
Reed, Hanna (Univ. of Central Florida)

Schenck, Benjamin (College of William and Mary)
*Sims, Charles (Univ. of Tennessee Knoxville)
*Trout Fryxell, Rebecca (Univ. of Tennessee Knoxville)
*Wiggins, Greg (Univ. of Tennessee Knoxville)

NIMBioS Staff

Bartolini, Mary (Univ. of Tennessee Knoxville)
Carr, Eric (Univ. of Tennessee Knoxville)
Comiskey, Jane (Univ. of Tennessee Knoxville)
Crawley, Catherine (Univ. of Tennessee Knoxville)
Eskridge, Chandra (Univ. of Tennessee Knoxville)
Peek, Michael (Univ. of Tennessee Knoxville)
Richters, Ana (Univ. of Tennessee Knoxville)
Spar, Jennifer (Univ. of Tennessee Knoxville)
Wiggins, Greg (Univ. of Tennessee Knoxville)

Short-term Visitor

Acevedo, Miguel (University of Puerto Rico)
Agusto, Folashade (Univ. of Kansas)
Borer, Elizabeth (Univ. of Minnesota Twin Cities)
Carrignon, Simon (Barcelona Supercomputing Center)
Che, Eric Ngang (Howard Univ.)
Drohan, Sarah (Princeton Univ.)
DeSilva, Kokum (Univ. of Peradeniya, Sri Lanka)
Emrich, Scott (Univ. of Notre Dame)
Fiedler, Anna (Technische Universitaet Muenchen)
Hilker, Frank (Osnabruck Univ.)
Tony Jhwueng (Feng-Chia Univ.)
Levy, Benjamin (Fitchburg State Univ.)
Louzoun, Yoram (Bar-Ilan Univ. Ramat-Gan, Israel)
Marion, Zachary (Univ. of Nevada Reno)
McManus, Lisa (Rutgers Univ.)
Nuismar, Scott (Univ. of Idaho Moscow)
Candice Price (UC San Diego)
Prosper, Olivia (Univ. of Kentucky)
Shipman, Patrick (Colorado State Univ.)
Ruktanonchai, Nick (Univ. Southampton, UK)
Tilman, Andrew (Univ. of Pennsylvania)

Undergraduate Worker

Vorhees, Tor (Univ. of Tennessee Knoxville)
Yopp, Stephanie (Univ. of Tennessee Knoxville)

Visiting Scholar

Liu, Xiangping (Univ. of Tennessee)

Udiani, Oyita (National Science Foundation (NSF))

Sustainment Activities

DySoC Critical Workshop: Modeling Complex Systems in Archaeology (2018/6/9 – 2018/6/10)

Bentley, Alex (Univ. of Tennessee, Knoxville)

Carrignon, Simon (Barcelona Supercomputing Center)

*Collins-Elliott, Stephen (Univ. of Tennessee, Knoxville)

Crawford, Katherine (Univ. of Southampton)

Hanson, Jack (Univ. of Colorado)

NIMBioS Postdoctoral Fellow in Science Education Research and Evaluation

Taylor, Robin

NISER Evaluation Associate

Kidder, Kevin

LoRe, Sondra

York, Meredith

NISER Graduate Assistants

Chen, Miranda

Musgrove, Matt

Women in Math Biology Conference

Beck, Jessica (Univ. of Tennessee Knoxville)

Burnett, Jessica (Univ. of Nebraska)

Dale, Renee (Louisiana State Univ.)

Dorabiala, Olga Maria (Pennsylvania State Univ.)

Drohan, Sarah (Princeton Univ.)

Lemanski, Natalie (Univ. of Tennessee Knoxville)

Nield, Lindsey (Colorado School of Mines)

Oldfield, Sarah (Duke Univ.)

Terry, Rebecca (Univ. of Utah)

Climate Science Center (CSC) Working Group: Research Needs for Conservation Policy and Resource Management (2017/12/4 - 2017/12/6)

*Armsworth, Paul (Univ. of Tennessee Knoxville)

*Blum, Michael (Univ. of Tennessee Knoxville)

Brandeis, Tom (Southern Research Station, USDA Forest Service)

Brooks, Bjorn (USDA Forest Service)

Burkman, William (Southern Research Station, USDA Forest Service)

Dale, Virginia (Integrative Ecosystem Science, ORNL)

Daniels, Harry (North Carolina State Univ.)

Eaton, Mitchell (Southeast Climate Science Center, USGS)

Fu, Joshua (Univ. of Tennessee Knoxville)

Hickman, Caleb (Eastern Band of the Cherokee)

Kalisz, Susan (Univ. of Tennessee Knoxville)

Palmer, Sally (The Nature Conservancy)

*Sims, Charles (Univ. of Tennessee Knoxville)

Super, Paul (Great Smoky Mountains National Park, NPS)

Terando, Adam (North Carolina State Univ.)

Wathen, Greg (Gulf Coastal Plains & Ozarks LCC, TWRA)

Addendum to NIMBioS Annual Report

Sep 1, 2017 - Jun 30, 2018

Y10-4. Description of Activities

Addendum-Description of Activities

DESCRIPTION OF MAJOR ACTIVITIES SEPTEMBER 1, 2017 – AUGUST 31, 2018

During September 1, 2017 through August 31, 2018 reporting period, NIMBioS hosted (or will host this summer) 10 meetings of 11 different Working Groups, two Investigative Workshops, two Tutorials, monthly XSEDE HPC workshops, five INCLUDES webinars, and many Outreach and Education activities. There are projected to be more than 400 participants in NIMBioS-hosted activities during this period with 7 Postdoctoral Fellows in residence, and 21 Short-term Visitors, one Visiting Scholar and one Visiting Graduate Student Fellow.

Demographics data on all participants are available for events from September 1, 2017 through June 30, 2018 and are presented in detail in the NIMBioS Evaluation Report (see Section Y10-2 of the attached addendum to this Annual Report) and summarized below. There were 408 participants through June 30, 2018, from 15 countries and 40 U.S. states as well as the District of Columbia representing 174 different institutions. International participants amounted to 10% of all participants. Most participants were college or university faculty (46%), but undergraduates (13%), post-doctoral researchers (13%), and graduate students (8%) accounted for a significant fraction of participants. Across all events female representation was 48%. Overall minority representation across NIMBioS events was 12%, which falls within ranges for doctoral recipients in the biological and mathematical sciences. Twenty-one short-term visitors from September 1, 2017 through August 31, 2018 represented 20 different institutions and collaborated with NIMBioS post-doctoral fellows and faculty from five University of Tennessee departments.

Below is a short description of each of the Working Groups, Investigative Workshops, and Tutorials held September 1, 2017 and planned through August 31, 2018 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 Y10-3 of this addendum.

WORKING GROUPS

Working Group: Modeling Molecules-to-Organisms

http://www.nimbios.org/workinggroups/WG_m2o

Organizers: Cheryl A. Murphy (Fisheries and Wildlife, Lyman Briggs College, Michigan State Univ.) and Roger Nisbet (Ecology, Evolution, and Marine Biology, Univ. of California at Santa Barbara)

This Working Group brings together a multi-disciplinary group of molecular biologists, systems biologists, DEB (dynamic energy budget) and AOP (adverse outcome pathway) modelers, ecotoxicologists and mathematicians with interest and expertise in developing dynamic, mechanistic models to predict impacts on individuals from high throughput assays used to screen chemicals for potential risk. Using a case study approach to demonstrate proof of concept, the Group will aim to develop not only example models but a general framework for model development, evaluation, and communication that can be applied across different levels of biological organization and ecotoxicological endpoints relevant to the individual. This Group closely coordinates with the NIMBioS Working Group on Modeling Organisms-to-Ecosystems

using the same case study species (i.e. daphnids and trout) with the intent to develop a modeling framework that ultimately can link from molecular responses (AOPs) through whole organism responses to ecosystem service delivery.

Meeting dates: Sept. 12-15, 2017

Working Group: Modeling Organisms-to-Ecosystems

http://www.nimbios.org/workinggroups/WG_o2e

Organizers: Valery E. Forbes (Biological Sciences, University of Nebraska-Lincoln) and Christopher Salice (Director of Environmental Science and Studies, The Jess and Mildred Fisher College of Science and Mathematics, Towson University, Towson, MD)

This multidisciplinary Working Group brings together population-, community-, and ecosystem ecologists, ecotoxicologists, and mathematicians with interest and expertise in developing dynamic, mechanistic models of complex systems to predict impacts on ecosystem function and service delivery from data typically collected to support chemical risk assessments. In particular, the models that we develop will be designed to bridge the gap between the properties of populations and the delivery of ecosystem services. This Group works closely with the NIMBioS Working Group on Modeling Molecules-to-Organisms.

Meeting dates: Sept. 12-15, 2017

Working Group: Models of Produce Contamination

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

Organizers: Lydia Bourouiba (Civil and Environmental Engineering, MIT), Renata Ivanek (Population Medicine and Diagnostic Sciences, Cornell Univ.), Daniel Munther (Mathematics, Cleveland State Univ.), and Jianhong Wu (Mathematics, York Univ.)

Foodborne illnesses associated with fresh produce continue to impose heavy public health and socio-economic burdens. To advance produce food safety, it is critical to adopt a mechanistic approach that uses mathematical modeling for holistic understanding of processes shaping pathogen introduction and transfer at the preharvest level. Toward that goal, we have assembled researchers from food science, microbiology, epidemiology, mathematics and biostatistics, and government agencies to develop detailed pathogen/produce specific mathematical models. The developed models will elucidate how underlying small-scale processes, such as raindrops or irrigation types, contribute to the patterns of spread of contaminants in a field. These results are expected to inform future experimental work and redesign of the existing macroscale (e.g., risk assessments) models, both of which will uniquely support submission of research grant proposals. Ultimately, these efforts will lead to development of improved tools to prioritize prevention and surveillance efforts in produce food safety.

Meeting dates: Sept. 27-29, 2017

Working Group: Long Transients and Ecological Forecasting

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

Organizers: Alan Hastings (Environmental Science and Policy, Univ. of California, Davis); Kim Cuddington (Biology, Univ. of Waterloo, Canada); Andrew Morozov (Mathematics, Univ. of Leicester, UK); and Sergei Petrovskii (Mathematics, Univ. of Leicester, UK)

A new challenge for theoretical and empirical ecology is to understand the implications of long-

living transients (LLT). The presence of LLT can be an explanation of regimes shifts alternative to "tipping points," so understanding of LLT would substantially improve the quality of long-term forecasting and crisis anticipation. This Working Group seeks to make substantial progress in better understanding the role of LLT in ecology and in developing appropriate research techniques for long-term ecosystem management. The overall goal is to construct a unifying theory of LLT by combining the existing empirical facts, mathematical models, computational approaches and appropriate methods of data analysis.

Meeting dates: Oct. 26-28, 2017

Working Group: Conservation Hierarchies

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

Organizers: Paul Armsworth, (Ecology & Evolutionary Biology, Univ. of Tennessee, Knoxville); Kailin Kroetz (Resource for the Future, Washington DC.) and Christoph Nolte (Earth and the Environment, Boston Univ.)

Governments and NGOs invest billions of dollars each year to establish new protected areas to combat continuing declines in biodiversity. Over the past 2-3 decades, mathematical biologists have led efforts to systematize and optimize how conservation funds are allocated. Software they have developed casts the task of identifying habitats for protection as an integer programming problem where the aim is to choose sets of potential protected areas that together offer complementary protection to species. While such tools have seen wide uptake by conservation organizations, the impact they have on informing actual conservation decisions and any associated gains in biodiversity protection has often been questioned. One obvious limitation is that currently available tools and approaches fail to acknowledge the importance of institutional structures and constraints on conservation decision-making. Resource allocation decisions in conservation often take place hierarchically; a state, national or international program allocates funding and other resources to regional programs or other local groups where staff then decide which parcels of land should be protected. This Working Group will examine how spatial optimization approaches that aim to inform protected area priorities should take into account this hierarchical structure. The group pays specific attention to objectives of programs at various scales in the hierarchy, information flow (about species distribution, land costs, etc.) and propagation of uncertainty across the decision hierarchy, and uses game theory to examine possible consequences of and remedies for coordination and incentive misalignment problems that can affect conservation initiatives.

Meeting dates: Nov. 13-15, 2017; May 16-18, 2018

Working Group: Prediction and Control of Cardiac Alternans

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

Alena Talkachova (Biomedical Engineering, Univ. of Minnesota) and Xiaopeng Zhao (Mechanical, Aerospace, and Biomedical Engineering, Univ. of Tennessee, Knoxville)

Cardiac alternans manifests at the cellular level as a beat-to-beat alternation in action potential duration (APD) and at the whole heart level as an alternating change in the amplitude or shape of the T-wave in the electrocardiogram (ECG). Specifically, we use a system-based approach to develop and test new algorithms for APD alternans prediction, both at cellular and tissue levels; translate the criteria for predicting APD alternans into whole-heart ECG recording; and develop novel control schemes to suppress alternans using bifurcation control and optimization

techniques.

Meeting dates: Dec. 11-13, 2017

Working Group: Multiscale Vectored Plant Viruses

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

Organizers: Vrushali A. Bokil (Mathematics, Oregon State Univ., Corvallis), Linda J. S. Allen (Mathematics and Statistics, Texas Tech Univ., Lubbock), and Alison Power (Ecology & Evolutionary Biology, Cornell Univ.)

This group is working on current problems related to multiscale aspects of the spatial and temporal transmission and the evolution of vectored plant viruses. The group's goals are to derive novel mathematical, statistical, and computational methods that incorporate multiple hosts and multiple pathogens operating at varying spatial and temporal scales to bring insight into the effects of climate change and human activities on the emergence of new plant viruses.

Meeting dates: Dec. 18-20, 2017

Working Group: Ecosystem Federalism

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

Organizers: Julie Blackwood (Mathematics and Statistics, Williams College, Williamstown, MA) and Charles Sims (Economics, Univ. of Tennessee; Howard H. Baker Jr. Center for Public Policy, Knoxville)

The characterization of problems and solutions in managed ecosystems is often guided by the current allocation of regulatory authority between different levels of government. For instance, in the United States, it is common for federal agencies to set minimum standards for ecosystem protection while states and local governments are charged with identifying the policy or set of policies that will best meet those standards. This group will explore mathematical, control/optimization, game theoretic, and econometric frameworks and tools that can be used to determine how regulatory authority over ecological outcomes should be allocated between a central (federal) government and local (state, municipal) governments. Our goal is to develop novel mathematical, statistical, and computational methods that incorporate optimal strategic, adaptive management of ecosystem services at multiple interacting levels of government. The group is co-sponsored and partially supported by the Howard Baker Center for Public Policy at the University of Tennessee.

Meeting dates: Jan. 24-26, 2018

Working Group: Learning in Networks

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

Organizers: Danielle S. Bassett (Bioengineering and Electrical and Systems Engineering, Univ. of Pennsylvania) and Scott T. Grafton (Neuroscience, Institute of Collaborative Biotechnologies Univ. of California, Santa Barbara)

Efforts to describe learning empirically can be greatly expanded by quantitative theories that map changes in neurophysiology to changes in behavior. Recent advances in network science offer tools and a general perspective that may be particularly useful in understanding types of learning that are supported by distributed neural circuits. Recent applications of these tools to neuroimaging data provide important insights into adaptive neural processes, the attainment of knowledge, and the acquisition of new skills, forming a network neuroscience of human

learning. While promising, the tools have yet to be linked to well-formulated models of behavior used in cognitive psychology. This working group develops the mathematical methodological necessary to connect network approaches to neuroscience data with quantitative models of behavior. This intersection is critical for fundamental, quantitative theories of brain and behavior across spatial scales and species. The group seeks to develop tools and models for the networks involved in learning, which are inherently multi-layered and embedded, including spatially distributed circuits in cortex and local networks in the basal ganglia and cerebellum. The group targets specific computational and theoretic challenges for mathematical development including models for non-stationary network dynamics, coupled multilayer stochastic block models and dynamics atop them, and extensions of temporal non-negative matrix factorization to annotated graphs. These efforts will lead to new mathematical techniques that will benefit the mathematics community. To evaluate techniques, the working group develops challenge problems using extensive datasets available from the participating neuroscientists.

Meeting dates: Feb. 22-24, 2018

Working Group: Quant Bio@Community College

http://www.nimbios.org/workinggroups/WG_quantbio-cc

Organizers: Jillian Miller, Mathematics (Roane State Community College); Stacey Kiser (Biology, Lane Community College); Kristin Jenkins (Director, BioQUEST); and Ahrash Bissell (Director of Strategic Partnerships, EdReady Manager, The NROC Project, Monterey Institute for Technology and Education)

Biology is becoming an increasingly quantitative discipline, and preparing students to succeed requires more emphasis on quantitative skills and quantitative reasoning, the ability to apply quantitative skills in a biological context. Acquiring strong quantitative biology skills presents a challenge to all students, but students starting at community colleges face additional barriers we cannot ignore. Over 40 percent of undergraduates are enrolled at community colleges, with disproportionate numbers of students typically underrepresented in STEM starting their college careers at the community colleges. Over half of community college students are referred to remedial math courses, and spending time in remedial courses reduces significantly a student's chance to complete a degree. New models for providing remediation in a more effective and less problematic way are being developed, including interdisciplinary remediation by placing remedial skills units in introductory courses like biology. It is challenging to develop and implement interdisciplinary models in part because biology faculty are, in general, poorly prepared to teach mathematical concepts beyond the methods they themselves are familiar with, and mathematics faculty are ill-equipped to teach mathematics in a biological context. To develop resources that will help faculty and students learn quantitative biology skills will require the combined effort of practitioners from math and biology education. The goal of this working group is to synthesize educational research on quantitative biology and remedial mathematics education at community colleges, apply this information to identify core quantitative biology skills and develop supporting educational and professional development resources for both two- and four-year biology faculty.

Meeting dates: April 26-28, 2018

INVESTIGATIVE WORKSHOPS

Investigative Workshop: Stoichiometric

Ecotoxicology http://www.nimbios.org/workshops/WS_ecotox

Organizers: Angela Peace (Mathematics and Statistics, Texas Tech Univ.) and Paul Frost (Biology, Trent Univ.)

Accurately assessing the risks of contaminants requires more than an understanding of the effects of contaminants on individual organisms, but requires further understanding of complex ecological interactions, elemental cycling, and interactive effects of natural and contaminant stressors. There is increasing evidence that organisms experience interactive effects of contaminant stressors and food conditions, such as resource stoichiometry and nutrient availability. The development of ecotoxicological models over the last few decades have significantly contributed to interpreting how contaminants impact organisms and cycle through food webs. Existing modeling efforts take a variety of approaches to predict the effects of diverse chemical contaminants on organismal growth and survival; however, current models do not consider dynamical interactive effects of contaminant stressors and stoichiometric constraints, such as nutrient/light availability and food quality. This investigative workshop provided a forum for discussions of incorporating multiple essential elements and contaminants in ecotoxicological models. Discussions and breakout sessions throughout the workshop shed light on nutrient and chemical contaminant cycling with the aim of helping to improve toxicological risk assessment protocols. The objectives for the workshop included (1) discussing the importance of linking Ecological Stoichiometry with Ecotoxicology and summarizing the current state of the synthesis of these two theories; (2) formulating a series of empirically testable and robust models of individual and population dynamics subject to stoichiometric constraints and contaminant stressors; and (3) identifying future directions for models to be used in practice for ecological risk assessments and determining areas where empirical data are lacking in order to parameterize, test, and improve the models.

Meeting dates: Jan. 17-19, 2018

Investigative Workshop: Bio-acoustic Structure

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

Organizers: Frederick Archer and Shannon Rankin (Southwest Fisheries Science Center, La Jolla, CA)

Acoustic repertoires may serve as a central component for social cohesion, foraging, and reproduction; in turn, these sounds may reflect population or species boundaries for many taxa. As acoustic monitoring has increased in popularity, so has interest in using this data to identify population structure and quantify biological diversity. In cases where it is difficult to obtain other biological samples, acoustic data may be the only source of information from which population structure can be inferred. Historically, acoustic research on different taxa has proceeded independently, utilizing different features and developing different methods for classification or quantifying regional differences. Additionally, while it is clear that there is a genetic component to some bio-acoustic features, the degree to which they are shaped by the environment or can be used as a proxy for relatedness is still uncertain. In order to make progress on the promise of using acoustics to characterize population structure, this workshop brought together experts in bio-acoustics of multiple taxa, including birds, frogs, primates, and cetaceans, with mathematicians and computer scientists with expertise in classification, clustering, and

information theory to develop a unified approach. This was accomplished by: 1) compiling guidelines of best practices for designing acoustic surveys, 2) reviewing acoustic features of each taxon useful for identifying regional and taxonomic differences, and 3) reviewing methods for quantifying and comparing information content, generating classification models, and identifying biologically significant clusters. The results of this workshop described the current state of using acoustics to assess population structure, created a community bridging taxonomic disciplines, and provided new non-invasive tools for conservation.

Meeting dates: June 25-27, 2018

SUSTAINMENT ACTIVITIES

XSEDE HPC Monthly Workshops at NIMBioS

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

Organizers: The National Institute for Computational Sciences and NIMBioS

An XSEDE workshop on different topics is held at NIMBioS each month related to high performance computing. The in-person workshops are presented using the Wide Area Classroom (WAC) training platform telecast to several satellite sites in the U.S., including NIMBioS.

Meeting dates: 2017: Sept. 12-13, Oct. 3-4, Dec. 5-6; 2018: Jan. 9, Feb. 7-8, March 6, April 3-4, May 1-2, June 4-7, Aug. 7

UT-NIMBioS STEM Alliance Workshop at NIMBioS: Transitions for STEM Students with Disabilities

<http://www.nimbios.org/stem/stemworkshop>

Organizers: Suzanne Lenhart (NIMBioS, Math, Univ. of Tennessee, Knoxville) and Annazette House (Office of Student Disability Services, Univ. of Tennessee, Knoxville)

The UT-NIMBioS STEM Alliance hosted a workshop for high school and college educators to share their experiences in efforts to transition students with disabilities in STEM disciplines from high school to college. The STEM Alliance aims to improve the success of students with disabilities in the STEM disciplines. The STEM Alliance is part of the South East Alliance for Persons with Disabilities in STEM (SEAPD-STEM) program, a network of education institutions in the southeastern US and Washington, DC with a goal to significantly advance a collaborative approach to improve the success of students with disabilities in the STEM disciplines.

Meeting date: Nov. 28, 2017

NIMBioS/NISER Monthly INCLUDES Webinars

<http://www.nimbios.org/IncludesConf/webinars>

Organizers: Pam Bishop (NIMBioS), Louis Gross (NIMBioS) and Sondra LoRe (NIMBioS)

Effective program evaluation is an essential component of STEM education and workforce development. These no-cost evaluation-focused webinars on various topics were designed to help viewers develop evaluation plans to meet the needs of INCLUDES (Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science) Pilot and Alliance Projects. Webinars were aimed at individuals involved in current or upcoming INCLUDES projects, those considering collaborating in such projects, and STEM

educators considering inclusion of formal evaluation in their projects.

Meeting dates: Feb 1, March 1, April 5, May 3 and June 7, 2018

Spatial Analysis Lab Brown Bag Seminar Series: UAS at UTK – Drones for Research

<http://www.nimbios.org/SAL/uas-seminars>

Organizers: Eric Carr (NIMBioS) and Mona Papes (Ecology & Evolutionary Biology, Univ. of Tennessee, Knoxville)

The Spatial Analysis Lab (SAL) at NIMBioS hosted a series of seminars focusing on the use of Unmanned Aerial Systems (UAS) use at UTK. The format was a casual brown bag lunch with a short talk, followed by a question/answer period.

Meeting dates: April 13, May 4, 2018

DySoC Critical Workshop: Modeling Complex Systems in Archaeology

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

Organizer: Stephen Collins-Elliott (Classics, Univ. of Tennessee, Knoxville)

The field of archaeology has long dealt with complex datasets, whether in the collection and analysis of archaeological finds, inter-site comparisons, regional analysis, evolutionary change, or in the framing of research questions which depend on multiple variables, factors, or other sparse and noisy datasets. The popularization of formal methods in the field has resulted in a variety of methods toward addressing these questions, largely borrowed from other fields, which should be subjected to a critical evaluation and discussion. To give just one example, the comparison of archaeological assemblages has been undertaken using a host of mathematical approaches: clustering techniques, principal components analysis, correspondence analysis, similarity coefficients, evolutionary models, and network analysis, and thus raises questions about the relationships between these different methods and their application to the same problem. The problem of inference, too, lurks in the background, and finding ways to evaluate a measure of confidence, certainty, or credibility in the results of modeling complex systems is in need of discussion. These issues can become ramified when dealing with methods, which are predicated on higher numbers of variables. The aim of this workshop was therefore to bring awareness to the variety of techniques, engage in critical comparison and evaluation of the ways in which these tools are used, and examine how we should treat model selection, evaluation, and statistical inference in complex problems in archaeology.

Meeting dates: June 9-10, 2018

Women in Math Peer Networking Workshop

Organizer: Nina Fefferman (Ecology & Evolutionary Biology, Univ. of Tennessee, Knoxville)

This workshop, fully funded by the Association for Women in Mathematics, provided early-career women with the opportunity to meet with female mentors in a small group setting. During the workshop, participating students will collaborate to interview mentors and produce videos documenting their career trajectories and research.

Meeting dates: May 16-18, 2018

SHORT-TERM VISITORS

Candice Price (Mathematics, UC San Diego) collaborated with N. Fefferman to develop novel mathematical metrics for studying multi-layer networks influence on animal and human behavior. (July 25-Aug 1, 2018)

Yoram Louzoun (Mathematics, Bar Ilan Univ., Israel) is collaborating with V. Ganusov on HLA haplotype-based modeling of human population dynamics. (July 23-Aug 8, 2018)

Tony Jhweung (Statistics, Feng-Chia Univ.) collaborated with B. O'Meara to investigate a numerical parameter estimation issue in phylogenetic comparative methods. (July 23-Aug. 9, 2018)

Lisa McManus (Ecology, Evolution, & Natural Resources, Rutgers Univ.) and Andrew Tilman (Biology, Univ. of Pennsylvania) collaborated on a project with C. Chang to develop a model to elucidate the socio-economic drivers that constrain an individual's decision to harvest in terrestrial vs. marine systems. (July 4-12, 2018)

Simon Carrignon (Barcelona Supercomputing Center) collaborated on a project with A. Bentley and M. Gilchrist to apply the tools of evolutionary biology toward modeling cultural evolution. (June 4-30, 2018)

Miguel Acevedo (Biology, Univ. of Puerto Rico); Nick Ruktanonchai (Geography, Univ. of Southampton); and Olivia Prosper (Mathematics, Univ. of Kentucky) collaborated with N. Siewe on a project to develop theory and design experiments for investigating the influence of spatial complexity in vector-borne disease dynamics. (May 31-June 2, 2018)

Patrick Shipman (Mathematics, Colorado State Univ.) gave a seminar. (April 10, 2018)

Zachary Marion (Biology, Univ. of Nevada) collaborated on a project with J. Fordyce to develop prediction and causal inference models to examine interactions within plant-insect microbial networks. (March 13-24, 2018)

Kokum De Silva (Mathematics, Univ. Peradeniya, Sri Lanka) worked with S. Lenhart on optimal control of PDE models for cooperating populations. (Mar 12-16, 2018)

Eric Ngang Che (Mathematics, Howard University) collaborated on a project with N. Siewe on a project to develop a high and low risk structured model of cholera infection dynamics in Cameroon. (March 9-17, 2018)

Sarah Drohan (Applied Mathematics, Princeton Univ.) collaborated on a project with C. Chang to predict threshold value of body mass under which it is not optimal for a hunter to shoot. (Jan. 15-26, 2018)

Ben Levy (Mathematics, Fitchburg State Univ.) collaborated with S. Lenhart, O. Gaoue, and C. Edholm on a project to develop models of plant and insect communities in Benin. He also collaborated on a project with Lenhart, Edholm and D. Burton to develop elephant population models using data from Amboselli Park, Kenya. (Jan. 15-16, 2018)

Frank Hilker (Univ. of Osnabruck, Germany) and Daniel Franco (ETSI Industriales, Madrid) collaborated on a project with S. Lenhart and D. Burton on analysis and control management for harvesting strategies in population models. (Dec. 14-17, 2017; March 2018 – Hilker only)

Scott Nuismer (Biological Sciences, Univ. of Idaho) gave a seminar and visited with postdoctoral fellows. (Nov. 14-15, 2017)

Fola Agosto (Ecology & Evolutionary Biology, Univ. of Kansas) collaborated with C. Edholm and N. Fefferman to build a models to explore the impacts of Zika virus control efforts that respond to epidemiological risk and/or community level risk perception. (Nov. 8-10, 2017)

Ruian Ke (Mathematics, North Carolina State Univ.) gave a seminar. (Oct. 10, 2017)

Scott J. Emrich (Bioinformatics, Univ. of Notre Dame) gave a seminar and visited with postdoctoral fellows. (Oct. 17, 2017)

Elizabeth Borer (Ecology, Evolution, and Behavior, Univ. of Minnesota) gave a seminar and visited with postdoctoral fellows. (Sept. 26, 2017)

Anna Fiedler (Computational Biology, Institute of Computational Biology, German Research Center for Environmental Health) collaborated on a project with V. Ganusov to model of the interplay between tuberculosis bacteria and immune response. (Aug. 16-Sept. 22, 2017)

Visiting Scholars:

Xiangping Liu (Agricultural and Resource Economics, Univ. of Tennessee, Knoxville) is conducting postdoctoral research for the labs of P. Armsworth and S. Cho on a USDA-sponsored project to design payment mechanisms for carbon sequestration on forest land. (May 2, 2018-TBA)

Oyita Udiani (NSF Postdoctoral Fellow) visited on a fellowship with N. Fefferman to develop learning in models of animal behavior. (Sept. 1, 2017-Aug. 31, 2018)

Visiting Graduate Fellow:

Tiago Yuzo Miyaoki (Applied Mathematics, University of Campinas, Brazil) was a Visiting Graduate Fellow collaborating on a project with N. Siewe and S. Lenhart on applying control techniques to Zika models. (Sept - Dec 2017)

EDUCATION AND 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, Adventures in STEM Camp), high school (math/biology curriculum programs, teacher workshops), and undergraduates (undergraduate math/biology research conference, visits to MSI partners, SRE program) to graduate students and general science population

(summer graduate school with MBI, seminars, presentations). Various institutional partner visits were also made for partnering with minority-serving institutions.

The section below describes NIMBioS outreach and education activities completed or planned between September 1, 2017 and August 31, 2018.

2018 Summer Research Experience (SRE) for Undergraduates Program

Fifteen undergraduates participated in the 2018 NIMBioS Summer Research Experience (SRE) for undergraduates. During the eight-week program, participants live on campus at the University of Tennessee, Knoxville (UT), and work in teams with NIMBioS postdocs and UT faculty to conduct research at the interface of mathematics and biology. The award includes a stipend, housing and some funding to support travel. The projects this year are: Ecological Niche Modeling and Risk Assessment of Thousand Cankers Disease, Mosquito Population Response to Environmental Variables', 'Modeling the Management of Feral Cats with Economic Impacts, Spatial Interactions between Hunting and Plant Gathering in Tropical Forests, Using Phylogenetics to Understand Cancer Tumor Evolution. (May through July 2018)

Minority-Serving Institution Partner Visits

Visits were arranged for NIMBioS researchers to visit our minority-serving institution partners: Fisk University (N. Siewe, October 2017; C. Chang, April 2018). Lenhart participated in discussion and evaluation of curriculum and course issues related to NSF-TIP funded program at Fisk University at their advisory committee meeting on March 16, 2018.

Joint Math Meetings

The Joint Mathematics Meetings are held for the purpose of advancing mathematical achievement, encouraging research, and providing the communication necessary to progress in the field. Annually, NIMBioS and the NSF Mathematics Institutes sponsor a reception with presentations on opportunities available through these NSF-funded Institutes. Lenhart hosted the NIMBioS table at the reception in San Diego, January 2018. At this meeting, Lenhart attended the Directors meeting of the Mathematical Sciences Institutes. Lenhart spoke in a special session about La Crosse mosquito modeling from an SRE project.

NIMBioS co-sponsored the Modern Math Workshop held in conjunction with the Annual Meeting of the Society for the Advancement of Chicanos and Native Americans in Science (SACNAS), Salt Lake City, UT. As a part of that workshop, we co-hosted a reception and NIMBioS postdoctoral fellow O. Udiani gave a talk. Lenhart and Wiggins represented NIMBioS at this workshop. (October 18-20, 2017)

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 ninth annual conference. The conference included student talks and posters, two guest plenary speakers (Kiona Ogle and Katherine Evans), 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 60 undergraduate research talks and posters. (November 11-12, 2017)

NIMBioS Interdisciplinary Seminars

The NIMBioS Interdisciplinary Seminar Series was 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. (Fall 2017 and Spring 2018)

NIMBioS Collaboration with Biology in a Box

Kashina Hickson presented “Biology in a Box: Fossils” for the Adventures in STEM Camp for Middle School Girls conducted by the Center for Ultra-wide-area Resilient Electric Energy Transmission Networks (CURENT) and NIMBioS. (June 2018)

Teaching Workshops

Lenhart, Wiggins and Cameron Cook (UT math graduate student) presented activities showing mathematical modeling for a teacher professional development workshop (Math Counts: Modeling with Math) at NIMBioS in cooperation with Knox County STEM-Hub and UT Center for Enhancing Education in Math and Science (CEEMS). Twelve high school teachers attended. (June 2018)

Lenhart organized a STEM teachers workshop in Arusha, Tanzania, for 25 middle and high school teachers. (November 2017)

Adventures in STEM Camp

NIMBioS collaborated with CURENT to offer a week-long summer day camp for rising 7th and 8th grade girls on STEM (Science, Technology, Engineering, Mathematics). Lenhart, Wiggins, N. Panchy, and M. Peek did presentations. (June 2018)

Tutorials

Lenhart and Wiggins helped to organize the following two tutorials:

Tutorial: Applications of Spatial Data: Ecological Niche Modeling

Organizers: M. Papeş (Ecology & Evolutionary Biology, Univ. of Tennessee, Knoxville and Spatial Analysis Lab at NIMBioS) and G. Wiggins (NIMBioS)

Instructors: M. Papeş; Town Peterson (Ecology & Evolutionary Biology and Biodiversity Institute, Univ. of Kansas, Lawrence, KS); Xiao Feng (Institute of the Environment, Univ. of Arizona, Tucson, AZ)

The distribution of a species may be influenced by an array of factors. The combination of these factors results in the ecological niche, the set of conditions that allow a species to exist in a geographic area. However, defining these conditions is difficult, due to the complexity of natural

systems. One approach to characterizing the ecological niche uses spatial data, GIS software, and modeling algorithms. The objectives of this tutorial were to teach participants the concepts of ecological niche modeling, introduce them to select analytical techniques (formatting data in GIS; running Maximum Entropy (MaxEnt) models), and present how to interpret and apply spatial analyses. Participants were familiarized with several commonly-used and/or newly-available online spatial data resources. Participants were provided datasets to use in hands-on simulations, but could also bring their own data if desired. This tutorial was intended for advanced graduate students, postdocs, and faculty interested in learning how to incorporate ecological niche modeling into their research. Some basic knowledge of GIS software and ecology preferred. Little to no programming was involved, with ecological niche modeling and spatial analysis conducted using existing applications (MaxEnt) and packages in QGIS and R. Meeting dates: May 16-18, 2018

Tutorial: The Search for Selection

Organizer: J. Bruce Walsh (Ecology & Evolutionary Biology, Univ. of Arizona, Tucson, AZ)
Biologists are obsessed (indeed, seduced) by the search for signatures of selection in organismal features of interest, ranging from specific traits to genome-wide signatures. A vast number of approaches have been suggested in this search for selection, including genomic-based signatures of recent or ongoing selection, tests based on either excessive amounts or nonrandom patterns of divergence (in both fossil sequences and functional genomics data) and the more classical Lande-Arnold fitness estimates (direct association of phenotypic values with fitness estimates) and their modern extensions (such as aster models). Given the breadth of such searches, a large amount of machinery has been developed, but is rarely presented in a unified fashion. This tutorial presented an integrated overview of all these approaches, highlighting common themes and divergent assumptions. The goal of this tutorial was to expose investigators from all branches of biology to this rich menagerie of tests, applicable for population geneticists, genome biologists, evolutionary ecologists, paleontologists, functional morphologists, and just about any biologist who ponders on how to formally demonstrate that a feature (or features) of interest might have been shaped by selection. The intended audience was advanced graduate students, postdocs, and faculty with an interest in searching for targets of selection, be they particular genomic sequences or particular traits.

Meeting dates: June 18-22, 2018

School Visits, Field Trips, Conferences and Meetings

Lenhart visits Bearden High School once a week during the school year for math club enrichment activities. Lenhart helped to organize the quiz bowl at the state Mu Alpha Theta convention at Oak Ridge High School in November.

Wiggins presented math-biology outreach activities at Ask-a-Scientist STEAM Con. (July 29, 2018)

Wiggins accompanied Gross and Bishop to the NSF INCLUDES Summit: Broadening Participation through Center-Scale Research Activities. Bishop presented a poster on evaluation activities at NIMBioS/NISER, and Wiggins served on the Town Hall Interactive Panel, which

facilitated discussion of approaches by NSF Centers to enhance participation of underserved and underrepresented groups. (January 2018)

Wiggins attended the Annual Meeting of the Entomological Society of America in Denver, CO. A poster authored by Wiggins, Lenhart, and Crawley discussing selected NIMBioS outreach activities was selected as one of eight inaugural Highlighted Posters and was displayed at the entrance of the Exhibition Hall throughout the entirety of the meeting.

Lenhart gave seminars presenting ideas about NIMBioS at these locations: Institute for Mathematics and its Applications (Minneapolis, MN June 2018), Mathematical Biosciences Institute (Ohio State U, March 2018), Southeastern Atlantic Regional Conference on Differential Equations (Kennesaw State U., October 2017), York University (Toronto, March 2018) and AMS meeting (Vanderbilt U. March 2018).

Lenhart served as a judge at the St. Joseph School Science Fair. (February 2018)

Lenhart presented about NIMBioS opportunities at the UT Undergraduate Mathematics Conference. (April 2018)

UT Summer STEM Poster Symposium

NIMBioS organized a poster symposium with several STEM-oriented REU programs on the campus of the University of Tennessee during the summer of 2018. All NIMBioS SRE students presented posters, and a total of 50 posters from eight undergraduate research programs were presented. (July 2018)

South East Alliance for Persons with Disabilities in STEM

During the Fall 2017 and Spring 2018 semesters, five and six undergraduate students, respectively, participated in the NIMBioS program for STEM students with disabilities, as a part of the NSF-funded INCLUDES program, South East Alliance for Persons with Disabilities in STEM (SEAPD-STEM) (based at Auburn University). Students from this group participated in three outreach programs to high school students with disabilities. (2017-2018)

As a part of this Alliance program, Wiggins and Lenhart organized a workshop on Transitions for STEM Students with Disabilities at NIMBioS. Speakers included Directors of Disabilities Services from Auburn University at Montgomery and the University of Tennessee, and there were 25 attendees ranging from high school teachers, UT faculty, and UT undergraduate and graduate students. (Nov. 29, 2017)

Lenhart attended a meeting at Vanderbilt University on future planning for expansion and upscaling of the INCLUDES SEAPD STEM Alliance program. Wiggins attended via video conference call. (March 17, 2018)

Addendum to NIMBioS Annual Report

Sep 1, 2017 – Jun 30, 2018

Y10-5. Additional Products

Featured Articles

Websites

Media Coverage

Addenda -- Additional Products (featured articles, websites, media coverage)
SEPTEMBER 1, 2017 – AUGUST 31, 2018

Feature Articles/Press Releases

(current reporting period)

May 30, 2018. A decade of summer undergrad research underway (blog post)
May 25, 2018. Nature paper sheds light on human brain evolution (blog post)
May 21, 2018. TN state assembly honors Director Gross (blog post)
May 16, 2018. French connection: NIMBioS, CESAB discuss new collaborations across the pond (blog post)
May 15, 2018. Landmark collaborations lead to UT successes via NIMBioS (blog post)
April 25, 2018. Students with disabilities reach out to high schoolers (blog post)
April 19, 2018. NIMBioS sweep: Spring awards round-up (blog post)
April 17, 2018. Defense Department supports new DySoC research on political instability (press release)
March 29, 2018. NIMBioS/NISER efforts highlighted in NSF report to nation (blog post)
March 28, 2018. Congrats to Director Gross (blog post)
March 20, 2018. New roster of summer undergrads announced (blog post)
February 1, 2018. New center explores dynamics of social complexity (press release)
January 1, 2018. Curbing climate change: Study finds strong rationale for the human factor (press release)
December 19, 2017. Climate change may favor large plant eaters over small competitors (press release)
November 30, 2017. Spanning the globe: Fall updates from Education & Outreach (blog post)
November 14, 2017. Enhancing STEM diversity at Field of Dreams (blog post)
October 4, 2017. Lenhart named National Women in Math Fellow (blog post)
September 15, 2017. Working groups tour SAL@NIMBioS (blog post)
(missing from last year's reporting period)
August 25, 2017. NIMBioS receives best publication award (blog post)
July 26, 2017. Gross named Fellow of Society for Mathematical Biology (blog post)
July 13, 2017. A predator-prey model of poverty traps, new paper from Ngonghala (blog post)
June 29, 2017. Gross named new director of NIMBioS (press release)
June 20, 2017. Mathematical biology tackles destructive plant virus (press release)
June 15, 2017. Synthesis centers provide the 'special sauce' (blog post)
June 13, 2017. Grizzlies feel the heat (blog post)
June 9, 2017. Summer research program begins (blog post)
June 6, 2017. Major accomplishments: The 9th annual report, NIMBioS edition (blog post)

Websites

Title: The NIMBioS Website

URL: www.nimbios.org

Short Description of the Website: This is the main website for NIMBioS. As of June 2018, the website contained 1,244 pages and 2,079 pdf documents.

NIMBioS maintains a number of WordPress sites for Tutorials and Investigative Workshops. The sites are designed to facilitate group communication and information sharing before, during and after the event, and are typically open to the public, although some areas can be set to private. These sites include the following titles and URLs:

Title: DySoC/NIMBioS Investigative Workshop: Social Norms
URL: <http://www.nimbios.org/wordpress-training/socialnorms/>

Title: NIMBioS Investigative Workshop: Bio-acoustic Structure
URL: <http://www.nimbios.org/wordpress-training/bioacoustics/>

Title: NIMBioS Tutorial: The Search for Selection
URL: <http://www.nimbios.org/wordpress-training/selection/>
Title: NIMBioS Tutorial: Applications of Spatial Data: Ecological Niche Modeling
URL: <http://www.nimbios.org/wordpress-training/spatialdata/>

Title: NIMBioS Investigative Workshop: Stoichiometric Ecotoxicology
URL: <http://www.nimbios.org/wordpress-training/ecotox/>

Title: NIMBioS Tutorial: Uncertainty Quantification for Biological Models
URL: <http://www.nimbios.org/wordpress-training/uncertainty/>

Title: NIMBioS Investigative Workshop: Pan-microbial Trait Ecology
URL: <http://www.nimbios.org/wordpress-training/microbes/>

Title: NIMBioS Investigative Workshop: Species' Range Shifts in a Warming World
URL: <http://www.nimbios.org/wordpress-training/rangeshifts/>

Title: NIMBioS Investigative Workshop: Next Generation Genetic Monitoring
URL: <http://www.nimbios.org/wordpress-training/nextgen/>

Title: NIMBioS Tutorial: Evolutionary Quantitative Genetics 2016
URL: <http://www.nimbios.org/wordpress-training/eqq3/>

Title: NIMBioS Tutorial: Evolutionary Quantitative Genetics 2015
URL: <http://www.nimbios.org/wordpress-training/eqq2/>

Title: NIMBioS Tutorial: Evolutionary Quantitative Genetics 2014
URL: <http://www.nimbios.org/wordpress-training/eqq/>

Title: NIMBioS Investigative Workshop: Algebraic Mathematical Biology
URL: <http://www.nimbios.org/wordpress-training/algebraicmathbio/>

Title: Mathematics of Planet Earth+ Workshop: Education for the Planet Earth of Tomorrow
URL: <http://www.nimbios.org/wordpress-training/mpe/>

Title: NIMBioS Investigative Workshop: Morphological Plant Models
URL: <http://www.nimbios.org/wordpress-training/plantmorph/>

Title: NIMBioS Investigative Workshop: Evolution and Warfare
URL: <http://www.nimbios.org/wordpress-training/warfare/>

Title: NIMBioS Investigative Workshop: Computational Advances in Microbiome Research
URL: <http://www.nimbios.org/wordpress-training/microbiome/>

Title: NIMBioS Investigative Workshop: Malaria-Leishmania Co-infection
URL: <http://www.nimbios.org/wordpress-training/coinfection/>

Title: NIMBioS Investigative Workshop: Many-cell System Modeling
URL: <http://www.nimbios.org/wordpress-training/manycell/>

Title: NIMBioS Graduate Workshop on Current Issues in Statistical Ecology
URL: <http://www.nimbios.org/wordpress-training/gradconf2015/>

Title: NIMBioS Investigative Workshop: Information and Entropy
URL: <http://www.nimbios.org/wordpress-training/entropy/>

Title: NIMBioS Investigative Workshop: Olfactory Modeling
URL: <http://www.nimbios.org/wordpress-training/olfactory/>

Title: NIMBioS Investigative Workshop: Neurobiology of Expertise
URL: <http://www.nimbios.org/wordpress-training/expertise/>

Title: NIMBioS Investigative Workshop: Lymphoid Cells in Acute Inflammation
URL: <http://www.nimbios.org/wordpress-training/lymphoid/>

Title: NIMBioS Investigative Workshop: Heart Rhythm Disorders
URL: <http://www.nimbios.org/wordpress-training/cardiac/>

Title: NIMBioS Tutorial: Algebraic and Discrete Biological Models for the Undergraduate Classroom
URL: <http://nimbios.org/wordpress-training/mathbio/>

Title: NIMBioS Investigative Workshop: Leptospirosis Modeling
URL: <http://nimbios.org/wordpress-training/leptospirosis/>

Title: NIMBioS Tutorial: Parameter Estimation for Dynamic Biological Models
URL: <http://nimbios.org/wordpress-training/parameter/>

Title: NIMBioS Investigative Workshop: Predictive Models for ERA
URL: <http://nimbios.org/wordpress-training/era/>

Title: NIMBioS Tutorial: Computing in the Cloud
URL: <http://nimbios.org/wordpress-training/cloud/>

Title: NIMBioS Investigative Workshop: Vectored Plant Viruses
URL: <http://nimbios.org/wordpress-training/plantviruses/>

Title: NIMBioS Investigative Workshop: Interface Disease Models
URL: <http://nimbios.org/wordpress-training/interface/>

Title: NIMBioS Investigative Workshop: Modeling Contamination of Fresh Produce
URL: <http://nimbios.org/wordpress-training/produce/>

Title: NIMBioS Investigative Workshop: Animal Social Networks
URL: <http://nimbios.org/wordpress-training/animalsocialnet/>

Title: NIMBioS Investigative Workshop: Insect Pest Resistance Evolution

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

Title: NIMBioS Investigative Workshop: Analyzing Animal Vocal Communication Sequences

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

Title: NIMBioS Investigative Workshop: Modeling Blood Cell Interactions

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

Title: NIMBioS Tutorial: Mathematical Modeling for the Cell Biology Researcher and Educator

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

Title: NIMBioS Blog

URL: <http://www.nimbios.org/wordpress/>

Short Description of the Website: Established in August 2010, the NIMBioS blog is an interactive social media site to showcase NIMBioS news and to provide an outlet for readers' commentary.

Title: NIMBioS Twitter

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

Short Description of the Website:

The NIMBioS Twitter account is an interactive social media site that features NIMBioS news events and happenings as well as re-tweets of relevant news to the scientific community.

Title: NIMBioS Flickr

URL: <http://www.flickr.com/photos/nimbios/>

Short Description of the Website: The NIMBioS Flickr features sets of posed and candid photos from various NIMBioS activities and events.

Media Coverage

(missing from last year's reporting period)

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4/21/17, Gavrilets elected member of American Academy of Arts and Sciences, Tennessee Today, <http://tntoday.utk.edu/2017/04/20/gavrilets-elected-member-american-academy-arts-sciences/>

5/22/17, The right thing to do: Why do we follow unspoken group rules?, Phys.org, <https://phys.org/news/2017-05-unspoken-group.html>

5/23/17, Are you a conformist? Or an outlier? Fitting in dictates many of our decisions, study says, Medical Daily, <http://www.medicaldaily.com/are-you-conformist-or-outlier-fitting-dictates-many-our-decisions-study-says-417815>

5/23/17, Researchers study the power of social norms, Tennessee Today,
<http://tntoday.utk.edu/2017/05/23/nimbios-researchers-study-power-social-norms/>

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<https://www.sciencedaily.com/releases/2017/05/170523083301.htm>

5/26/17, Research about social norms could help us better understand extremism - A new study on human cooperation could shed light on why some take radical steps, Huffington Post,
http://www.huffingtonpost.com/entry/social-norms-extremism_us_5925c6bae4b0ec129d31b3b5

6/09/17, Unity College faculty research measures impact of climate change on threatened Yellowstone grizzlies, Bangor Daily News, <http://bangordailynews.com/community/unity-college-faculty-research-measures-impact-of-climate-change-on-threatened-yellowstone-grizzlies/>

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https://www.morningagclips.com/fighting-disease-with-mathematics/?utm_content=articles&utm_campaign=NLCampaign&utm_source=Newsletter&utm_term=newsletteredition&utm_medium=email

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<https://www.earth.com/news/mathematical-fight-plant-diseases/>

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<http://tntoday.utk.edu/2017/06/23/nimbios-mathematical-biology-tackles-destructive-plant-virus/>

7/12/17, UT students study mosquitoes, spread of deadly virus, WBIR,
<http://www.wbir.com/news/local/ut-students-study-mosquitoes-spread-of-deadly-virus/456150004>

7/12/17, Mosquitoes on the rise in East Tennessee, WATE,
<http://wate.com/2017/07/12/mosquitoes-on-the-rise-in-east-tennessee/>

7/12/17, Warm, wet weather brings renewed risk of Lacrosse virus in mosquitos, WVLT,
<http://www.local8now.com/content/news/Warm-wet-weather-brings-renewed-risk-of-Lacrosse-virus-in-mosquitoes-434145483.html>

7/14/17, UT students research mosquitoes, spread of La Crosse Encephalitis virus in East Tennessee, Knoxville News Sentinel,
<http://www.knoxnews.com/story/news/education/2017/07/14/ut-students-research-mosquitoes-spread-la-crosse-encephalitis-virus-east-tennessee/475330001/>

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<http://tntoday.utk.edu/2017/07/26/gross-named-fellow-society-mathematical-biology/>

7/31/17, The dynamics of disease and poverty, UFL News,
<http://news.ufl.edu/articles/2017/07/the-dynamics-of-disease-and-poverty-.php>

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1/3/18, New climate change model may provide hope, UVM News, <https://www.uvm.edu/~uvmpr/?Page=news&storyID=25400&category=ucommall>

1/4/18, NIMBioS study: Curbing climate change, Tennessee Today, <https://news.utk.edu/2018/01/04/nimbios-study-curbing-climate-change/>

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1/12/18, Human behavior a factor in reducing climate change, Rhode Island College News, <http://www.ric.edu/news/Pages/Human-Behavior-a-Factor-in-Reducing-Climate-Change.aspx>
1/12/18, Tiny individual decisions really could help avert climate chaos, New Scientist, <https://www.newscientist.com/article/2158432-tiny-individual-decisions-really-could-help-avert-climate-chaos/>

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1/23/18, Climate change, climate sensitivity and behavioral changes, Solarify/Max Planck Society, <https://www.solarify.eu/2018/01/23/614-klimawandel-klimasensibilitaet-und-verhaltensaenderungen/>

1/24/18, The psychology of wrecking or saving the planet, Radio Ecoshock, <https://www.ecoshock.org/2018/01/the-psychology-of-wrecking-or-saving-a-planet.html>

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2/16/18, Birds and beans: Study shows best coffee for bird diversity, Science Daily, <https://www.sciencedaily.com/releases/2018/02/180216084808.htm>

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3/29/18, Texas A&M Spotlight on Students – Kevn De Angeli, Texas A&M, http://www.tamuk.edu/artsci/math/student_spotlight.html

4/12/18, NIMBioS mentioned in "Discover" video for UT President DiPietro's 2018 State of the Union Address, UT System, http://www.nimbios.org/videos/vid_discover

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Addendum to NIMBioS Annual Report

Sep 1, 2017 -Jun 30, 2018

**Y10-6. NSF Budget Office Reporting Requirement: Institutions, Partners,
Participants**

NSF Budget Office Reporting Requirement: institutions, partners, participants

The NSF Budget Office requests information from all synthesis centers on number of participating institutions, partners, and participants where participating institutions includes all academic institutions that have faculty/staff or students who participated in a NIMBioS activity during the year; number of partners is the total number of non-academic participants, including those from industry, states, and other federal agencies; and number of participants is the total number of people who used NIMBioS facilities during the reporting period, not just those directly supported by NSF. Note that total participants does not include the many participants in educational activities, including K-12, because we do not track those participants individually.

Table 1 includes NIMBioS data from the previous four reporting periods as well as data through June 30th, 2018 for the current reporting period. The NIMBioS Annual Report is submitted before 8/31/2018, the end of the reporting period, so data for the current reporting period include only the period from 9/1/2017 through 6/30/2018; they do not include projections for activities occurring between 7/1/2018 and 8/31/2018. Next year's annual report will include updated values for this reporting period.

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

Reporting Period	Academic institutions	Partners	Total participants
9/1/2013 - 8/31/2014	230	28 ^b	1123 (922 indiv.)
9/1/2014 - 8/31/2015	239	69 ^c	944 (751 indiv.)
9/1/2015 - 8/31/2016	232	51 ^d	917 (649 indiv.)
9/1/2016 - 8/31/2017	221	51 ^e	773 (650 indiv.)
9/1/2017 - 6/30/2018 ^a	147	28 ^f	443 (370 indiv.)

^a Numbers reported here only include the period from 9/1/2017-6/30/2018; they do not include projections for activities occurring between 7/1/2018-8/31/2018.

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

^c 16 business/industry, 28 federal, 24 non-profit, 1 state

^d 10 business/industry, 27 federal, 9 non-profit, 5 other

^e 7 business/industry, 28 federal, 14 non-profit, 1 state, 1 other

^f 5 business/industry, 15 federal, 6 non-profit, 2 other