



# 2019 Annual Report

National Institute for Mathematical and Biological Synthesis

Reporting Period September 2018 – August 2019

Submitted to the National Science Foundation July 2019

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# Preview of Award 1300426 - Annual Project Report

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## Cover

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Signature of Submitting Official (signature shall be submitted in accordance with agency specific instructions)	Louis J Gross

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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 eleventh year for NIMBioS, and as the NSF funding was limited to funds carried forward for the no-additional-cost extension of the cooperative agreement supporting NIMBioS, 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. These new initiatives are described in more detail below under Key Outcomes.

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

Major Activities:

During the reporting period from September 1, 2018 through August 31, 2019, NIMBioS will have hosted 12 meetings of nine different Working Groups, six Investigative Workshops, and three Tutorials. There were 592 participants in NIMBioS-hosted activities during this period with five Postdoctoral Fellows in residence, 30 Short-term Visitors, and five Visiting Scholars.

The Working Groups that met during this period were: Long Transients and Ecological Forecasting (September 2018, May 2019), Quant Bio@Community Colleges (October 2018, May 2019), Remotely Sensing Biodiversity (October 2018), Ecosystem Federalism (December 2018), Conservation Hierarchies (January 2019, May 2019), Ecological Network Dynamics (February 2019), Learning in Networks (February 2019), Optimal Control of Neglected Tropical Diseases (July 2019), and Multiscale Vectored Plant Viruses (August 2019). No new Working Groups began in this reporting period.

The Investigative Workshops were: Extending the Theory of Sustainability (December 2018), Human Origins 2021 (February 2019), Social Norms (April 2019), Mathematics of Gun Violence (May 2019), Scientific Collaboration enabled by High Performance Computing (May 2019), and Transients in Biological Systems (May 2019).

The Tutorials were: Applications of Spatial Data (December 2018), Network Modeling (February 2019), and Search for Selection (June 2019).

Demographics data available for participants in events from September 1, 2018 through June 30, 2019 are presented in detail in the NIMBioS Evaluation Report (see section Y11-1 of the addendum to this Annual Report) and summarized below. There were 558 participants through June 30, 2019 from 19 countries and 44 U.S. states as well as the District of Columbia and Puerto Rico, representing 223 different institutions. International participants amounted to 11% of all participants. Most participants were college or university faculty (50%), but post-doctoral researchers (14%), undergraduates (12%), and graduate students (12%) accounted for a significant fraction of participants. Across all events female representation was 51%, and minority representation was 13%. Representation of various minority categories was slightly above levels of minority representation for doctoral recipients in the biological sciences and the mathematical sciences for most groups.

Short-term Visitors from September 1, 2018 through June 30, 2019 were from 25 different institutions and collaborated with NIMBioS post-doctoral fellows and faculty from three University of Tennessee departments.

NIMBioS also hosted a training course, Risk Assessment Calculator Training, in March 2019. This was in collaboration with the Risk Assessment Group in The Institute for Environmental Modeling. 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. A number of Working Groups held their final meetings this reporting period, and no new Working Groups have been approved. One Working Group maintained its activities through a collaboration with SESYNC, another NSF-supported Synthesis Center. Other major activities include Investigative Workshops, Tutorials, and Short-term Visits. These 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. To meet this objective NIMBioS Outreach and Education supported a number of activities for individuals at diverse levels of experience, detailed below.

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 Adventures in STEM Camp (Science, Technology, Engineering, and Mathematics) is an example 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 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 18 undergraduates in math and biology fields from 14 different institutions. The students engaged in team research projects in one of six different topics:

- Biochemical pathways for aerotaxis in motile bacteria
- Climate change as a driver of change in human-wildlife interactions
- Investigating viral infection rates of marine phytoplankton
- Modeling cell differentiation
- Modeling networking and the opioid epidemic
- The impact of shifting climate on co-evolution in vector-borne diseases

The goal of this program is to further enhance the students' abilities to work independently and as part of a team to develop quantitative approaches to answering biological questions. An indicator of the success of the NIMBioS SRE program is the progression of many former participants into graduate programs in STEM fields.

In fall 2018, NIMBioS hosted its Tenth 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.

NIMBioS did not provide financial support for Graduate Research Assistants during this reporting period, but graduate students have been regular participants in many NIMBioS research activities, particularly workshops, tutorials, and short-term visits.

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 five Postdoctoral Fellows with at least

partial NIMBioS support in residence for at least part of this reporting period. In addition, there were three NIMBioS-affiliated Postdoctoral Fellows supported by other grants or awards. An objective of NIMBioS is to enhance career opportunities for current and former Postdoctoral Fellows, and career development seminars and workshops are held regularly.

Significant Results:

NIMBioS relies upon participants to self-report products that were derived from their participation in NIMBioS activities. From January 2009 through June 2019 there have been 2,297 products reported, including 975 published peer-reviewed journal articles, 43 book chapters, 29 dissertations and theses, 35 software/netware/data and research materials, 938 presentations/posters, 91 grant requests, 65 educational aids or curricula, and 56 meetings, workshops or symposiums. Details on publications in journals, books, and conference proceedings are included in the Products section; details on featured articles, websites, and media coverage are included as Additional Products in Section Y11-4 of the Addendum to this annual report.

Since inception, NIMBioS-supported activities have resulted in publications across a broad range of topics as designated by ISI Web of Science categories. Ecology has been the most common subject category, followed by Evolutionary Biology, Biology, Mathematical & Computational Biology, Multidisciplinary Sciences, and Zoology. Figure 1 (appended at the end of this section) illustrates the diversity of scientific topics covered by Working Groups and Investigative Workshops hosted by NIMBioS between September 1, 2018 and June 30, 2019. More information on interpretation of this figure is available in the NIMBioS Evaluation Report (see Figure 2 and associated text in Section Y11-1 of the addendum to this annual report).

A number of the publications resulting from NIMBioS activities have appeared in top national and international journals with high impact factors, including Nature, Science, Cell, Nature Climate Change, Trends in Ecology and Evolution, Ecology Letters, Nucleic Acids Research, Proceedings of the National Academy of Sciences, Systematic Biology, Current Biology, Methods in Ecology and Evolution, PLoS Biology, eLife, New Phytologist, Philosophical Transactions of the Royal Society B, Ecography, Molecular Ecology, and PLoS Genetics. Table 1 (appended at the end of this section) provides details on NIMBioS-derived publications in certain high-impact journals.

Key outcomes or Other achievements:

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

**The National Institute for STEM Evaluation and Research (NISER)** was founded in 2016 and operated as a Center within NIMBioS for the majority of this reporting period. Through the support of NIMBioS, NISER Director P. Bishop has been able to grow NISER into a world-class STEM evaluation center with a staff of three research associates. This success led to NISER moving to a permanent home at the University of Tennessee on July 1, 2019, in UT's lead research administration unit, the Office of Research and Engagement (ORE). NISER's success and its move to be part of ORE enhances UT's reputation as one of the nation's leading universities providing high quality program evaluation and builds on the highly interdisciplinary approach to science and education fostered by NIMBioS. Under ORE, NISER will continue its mission to support STEM-related education and research and expand its portfolio to work with ORE to evaluate the

research enterprise at UT.

Twenty projects have been awarded to date to NISER, supported by the National Science Foundation, National Institutes of Health, US Department of Agriculture, Howard Hughes Medical Institute and others. This includes several major University of Tennessee STEM-related projects: the NIH-funded Program for Excellence & Equity in Research (PEER) and Possibilities in Post-Secondary Education in Science (PiPES); and the NSF-funded Adaptations for a Sustainable Climate of Excellence and Diversity (ASCEND), VolsTeach for Appalachia, and Appalachian Students Promoting the Integration of Research in Education (ASPIRE). Additionally, NISER evaluated the STEM education projects at Harvard University's Materials Research and Engineering Center.

Three current projects are the NSF-funded Quantitative Biology Education and Synthesis project on biology faculty use of open educational resources; the NIH-funded PiPES project on undergraduate and graduate student journaling in STEM-based K-12 programs; and an NSF-funded project on the BioCalculus Concept Instrument.

NIMBioS' **Spatial Analysis Laboratory** (SAL) has become a resource for Knoxville-area faculty and institutions fostering a collaborative, cross-disciplinary environment for spatial research through supporting proposal submissions, spatial analyses for funded projects, organizing tutorials and seminars, providing access to geospatial technology, and leveraging other spatial analysis capabilities available at UT. A UT recharge center, SAL offers consultation, drone flight, and terrestrial LiDAR scanning services. SAL aims to build and support a community interested in spatial analyses and is being considered as a UT Core Facility.

SAL activities this period included creating a web application to disseminate biodiversity data and collecting drone data for an internally-funded project describing Knoxville's Urban Wilderness. SAL contributed to National Geographic, NASA, NIH, and NSF proposals for external funding. SAL was an integral part of the NIMBioS Summer Research Experience for Undergraduates program with SAL Director M. Papes and NIMBioS postdoc L. Carrasco-Tornero mentoring a student group using ecological niche modeling to examine effects of climate change on pollinators. M. Papes co-organized the NIMBioS Tutorial: Applications of Spatial Data and Niche Modeling. M. Papes received a USFS contract to support a post-doctoral fellow who will investigate use of National Agriculture Imagery Program digital surface model data to estimate forest structure and biomass beginning August 2019. The accuracy of the method will be evaluated with field measured tree heights collected by the USFS Forest Inventory Analysis program, as well as through comparison with other canopy height products developed with airborne LiDAR data.

The **Center for the Dynamics of Social Complexity** (DySoC; [dysoc.org](http://dysoc.org)) has arisen through the long-term efforts of S. Gavrillets to build at UT a collaborative program at the leading edge of research in quantitative evolutionary aspects of human social systems. Established in January 2018, the Center now has 21 members from 11 departments (Anthropology, Child and Family Studies, Classics, Ecology and Evolutionary Biology, Mathematics, Mechanical, Aerospace and Biomedical Engineering, Physics, Political Science, Philosophy, Psychology, and Sociology), the School of Information Sciences, the School of Journalism and Electronic Media, the Center for Ultra-wide-area Resilient Electrical Energy Transmission Networks and three UT colleges.

The DySoC mission is to promote transdisciplinary research into the origins, evolution, and futures of human social complexity. Members study human behaviors and social interactions that underlie past and present societies in the pursuit of transformative discovery. Through theory, data, and synthesis, they help realize evidence-based innovations to address grand challenges of our time.

DySoC pursues its mission through distinctive evolutionary and quantitative approaches. Considering human cognition, culture, and societies as evolved—and evolving—phenomena opens new frontiers in the exploration of human psychology, behavior, and

social organization. Drawing comparisons between humans and other biological organisms or between past and present societies can reveal parallels that promote greater understanding of general principles, which in turn can reframe understanding of cooperation and conflict in contemporary societies. Use of mathematical models enables delving further into biological, cultural, and social evolution to explore foundational and new ideas. This can not only increase predictive capacity, it can also afford invaluable opportunities to train our intuition and interpretation of social complexity.

In the past year, in collaboration with NIMBioS, the Center organized four Investigative Workshops: Extending the Theory of Sustainability; Human Origins 2021; Social Norms: Emergence, Persistence, and Effects; and Mathematics of Gun Violence. DySoC also hosted seven seminars at NIMBioS. In November, DySoC was awarded funding from the John Templeton Foundation to develop web-based educational materials for graduate students and postdoctoral researchers and to create a new textbook on applying methods of dynamical systems theory to the evolution of institutions.

The **Mathematical Modeling Consulting Center (MMCC)** provides expertise on model development, simulation and analysis linking models to data. The Center provides consulting and research help to researchers who might not have the time or resources to build or employ mathematical models independently. The MMCC hosted two workshops on mathematical models, what they can do, and how they may aid research. For graduate students, post-docs and faculty, the workshops included a presentation about types of models, a question and answer session about how modeling might fit into grant proposals, research, and teaching, and collaborative break-out sessions to discuss areas of research with potential for modeling.

#### **\* 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 Y11-3 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 five Postdoctoral Fellows with at least partial NIMBioS support in residence for at least part of this reporting period. In addition there were three Postdoctoral Fellows supported by other grants or awards.

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 Fellows 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. 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. New postdocs participate in a training session on how to communicate their science to the media and to non-scientific audiences; topics include using social media, talking to a reporter, on-camera interviewing, and poster and slide presentation tips. 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 Fellows are asked to complete online profiles that require them to succinctly describe their work and to participate in a media training which culminates in a video recording describing their research in broad terms as succinctly as possible. 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

The NIMBioS Graduate Award Program gave out twenty Graduate Awards in 2019 using non-NSF funds. The awards were



designed to supplement resources available for UTK/UTIA graduate students to enhance their research and education, not to provide salary to the student. The most commonly planned uses for the funds were travel to professional conferences and covering research expenses. Two of the awardees were granted the opportunity to take advantage of NIMBioS' Mathematical Modeling Consulting Center, and 19 of the 20 awardees participated in a seminar on science communication, which culminated in video training for an on-camera interview.

NIMBioS Tutorials provide training on specific research tools for all groups but are important for graduate student professional development. Tutorials on Applications of Spatial Data, Network Modeling, and on Search for Selection provided opportunities for graduate students to learn techniques for working with and analyzing spatial data, methods in network science, and how to identify whether features may have been shaped by selection.

Three UT graduate students worked on projects related to the National Institute for STEM Evaluation and Research (NISER). Two additional graduate students (Oscar Martinez and Irina Vortkamp) were short-term visitors at NIMBioS.

#### Undergraduates

The NIMBioS 2019 Summer Research Experiences for Undergraduates program provided training in research procedures, mathematical modeling, Python, R, Netlogo, and MATLAB programming, and poster and oral and poster presentations. In this program, professional development activities included sessions on career opportunities, graduate school applications, and learning to work in teams, including the use of self-assessments. The NIMBioS Undergraduate Research Conference at the Interface of Biology and Mathematics (October 2018) exposed more than 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.

Through an initiative involving STEM undergraduates with disabilities, NIMBioS provided activities to build a community and to provide career advice and skills for being successful in obtaining 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. Seven undergraduates received scholarships through this program.

#### Sustainability

An NSF proposal to obtain additional funding for the NIMBioS undergraduate conference was awarded in 2018, and a similar proposal was submitted for the 2019 conference. Proposals for funding to expand the NIMBioS undergraduate summer research program are also planned. Funding to enhance this summer program was received from the National Security Agency in 2019, and a submission for support for the summer 2020 SRE program is planned. Also planned is a proposal to the NSF INCLUDES program to continue the NIMBioS program for STEM undergraduates with disabilities.

#### **\* 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 2019, the website contained 1320 pages and 1882 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 to the scientific community about research at the interface of mathematics and biology; to attract potential scientists, researchers and students to participate in the work and/or educational offerings of NIMBioS; and to provide scientific information to a generalized audience.

The audience for [nimbios.org](http://www.nimbios.org) is multifaceted with a wide range of needs and interests, primarily consisting of scientists from academic institutions, state and federal government agencies and non-governmental organizations, as well as secondary, undergraduate and graduate students. 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, and discover a wide variety of NIMBioS education and outreach opportunities for all ages.

The website provides up-to-date and accurate information about the wide range of topics addressed by NIMBioS groups and researchers, while familiarizing users with the NIMBioS mission and activities. It also provides a comprehensive listing of research results via NIMBioS products, which includes 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, educational and research opportunities, and selected recent publication. As of July 2019, there were more than 7,600 subscribers. The newsletter typically has an average click-through rate of 30 percent, which is well above industry standards.

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 and a round-up of news and other recent announcements.

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 570 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 over 1,300 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.

To disseminate press releases nationally, NIMBioS uses EurekAlert!, an online, global news service which reaches thousands of journalists. Press releases are written for a non-specialized audience interested in science topics. For local publicity, NIMBioS collaborates with UT's media office. NIMBioS also collaborates with the press offices of visiting scientists' institutions, which increases dissemination of research results via press releases. Press releases derived from NIMBioS activities have led to news coverage in local, regional, national and international press including Science, Nature, The New York Times, the Los Angeles Times, National Public Radio, CNN, and many other outlets.

Other ways NIMBioS reaches wider audiences are through its social media sites, including Twitter, LinkedIn, Flickr, 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.

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. 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 Adventures in STEM summer camp for middle school girls. For a complete listing of all of our outreach activities during the reporting period, please see the Description of Activities in the Addendum.

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

NIMBioS activities will necessarily be reduced in scope, relative to previous years, due to the limited funding for participant support remaining as part of the no-additional-cost extension which is in place through August 2020. 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.

NSF support will be utilized for the Undergraduate Research Conference at the Interface of Mathematics and Biology, a Tutorial on spatial environmental analysis, a Workshop on graduate quantitative education for biologists, and the Summer Research Experience for Undergraduates program. Additionally, NIMBioS has been proactive about publicizing the short-term visit program through which small collaborative groups of up to six researchers (focused on those from within the US) are encouraged to apply for support for novel research that aligns with the mission of NIMBioS. With funding from a small supplement, a graduate student will carry out analysis of the large data sets available on NIMBioS participation and outcomes, producing two reports for publication about the effectiveness of NIMBioS activities in fostering interdisciplinary research and education. One report will focus on data from more than 50 completed NIMBioS Working Groups with more than 500 participants using hierarchical modeling methods to examine the group and individual level diversity factors that may influence productivity. The second will use network analysis methods to evaluate the growth and productivity of NIMBioS Working Groups over a 10-year period to understand the patterns of change in the composition of Working Group participants over time as well as the patterns of connectedness among Working Group participants across disciplinary and geographic boundaries and over time.

Over the recent years, NIMBioS has developed Affiliated Centers that expand on its mission, and arise from efforts towards sustainability. One of these is the National Institute for STEM Evaluation and Research (NISER), which as mentioned in another section of this report has, effective July 2019, become a core operation of the UT Office of Research and Engagement. The NISER staff continue to collaborate on a variety of NIMBioS-connected projects requiring evaluation expertise, including those related to the supplement discussed above.

The other affiliated centers are the Spatial Analysis Laboratory (SAL), the Center for the Dynamics of Social Complexity (DySoC), and the Mathematical Modeling Consulting Center (MMCC). Each of these, in conjunction with NIMBioS leadership, have developed plans for several years of activities that carry on research in areas associated with NIMBioS, and each have been successful in generating new funding that augments that provided by UT and NIMBioS. Over the next year, a transition plan will be established that places NIMBioS and these affiliated centers under the UT College of Arts and Sciences. Several postdoctoral fellows will be based at NIMBioS during this year, funded through a variety of awards from various agencies and by UT. These postdocs will be carrying out research on targeted projects in conjunction with faculty mentors, and professional development activities similar to those held in the past for NIMBioS postdocs will be available to them.

**The Spatial Analysis Laboratory (SAL)** has been established as a recharge center that will be supporting several postdoctoral fellows and serves as a local, regional and national resource. SAL has worked collaboratively with several UT units to expand the scope of spatial environmental analyses available and has been coalescing a community of scholars to disseminate information and bridge funding opportunities.

**The Center for the Dynamics of Social Complexity (DySoC)** will continue communicating activities via its web page, host a monthly seminar series, publish a bimonthly newsletter, and organize a joint lab meeting that promotes interdisciplinary science. Several groups of DySoC-associated faculty are collaborating to support postdocs who will be based at NIMBioS through several awards already received.

**The Mathematical Modeling Consulting Center (MMCC)** continues to grow as an affiliated center through which modeling expertise is made available to the UT and regional community. Several postdocs are associated with the primary faculty leading MMCC and will provide additional expertise as the center expands activities over the next year. Activities will include continued development of training activities in modeling.

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# **Supporting Files for NIMBioS Annual Report**

## **Sep 1, 2018 – Aug 31, 2019**

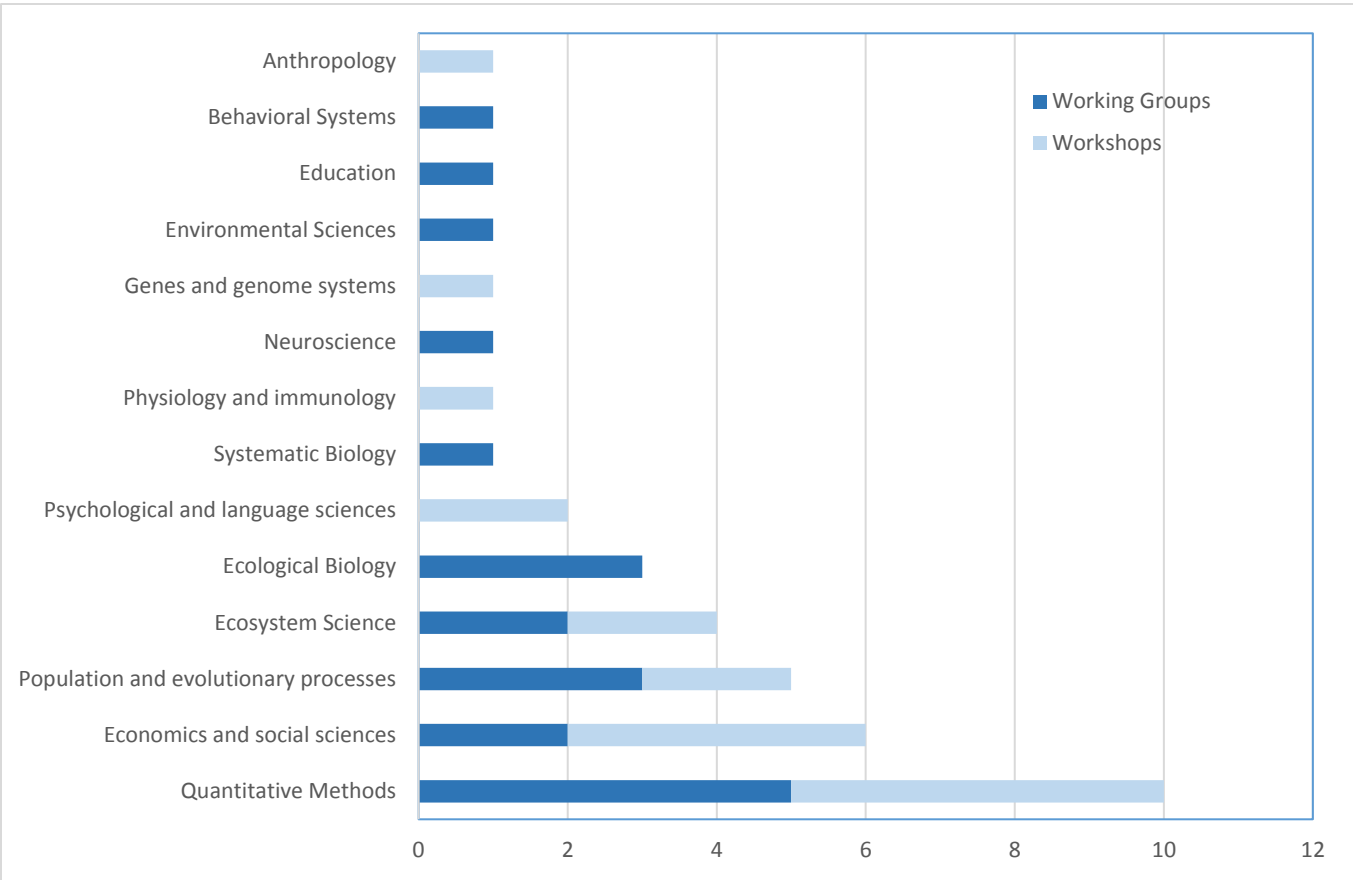
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**Figure 1. Working Group and Workshop subject area diversity**

**Figure 2. Working Group cross-disciplinary connections**

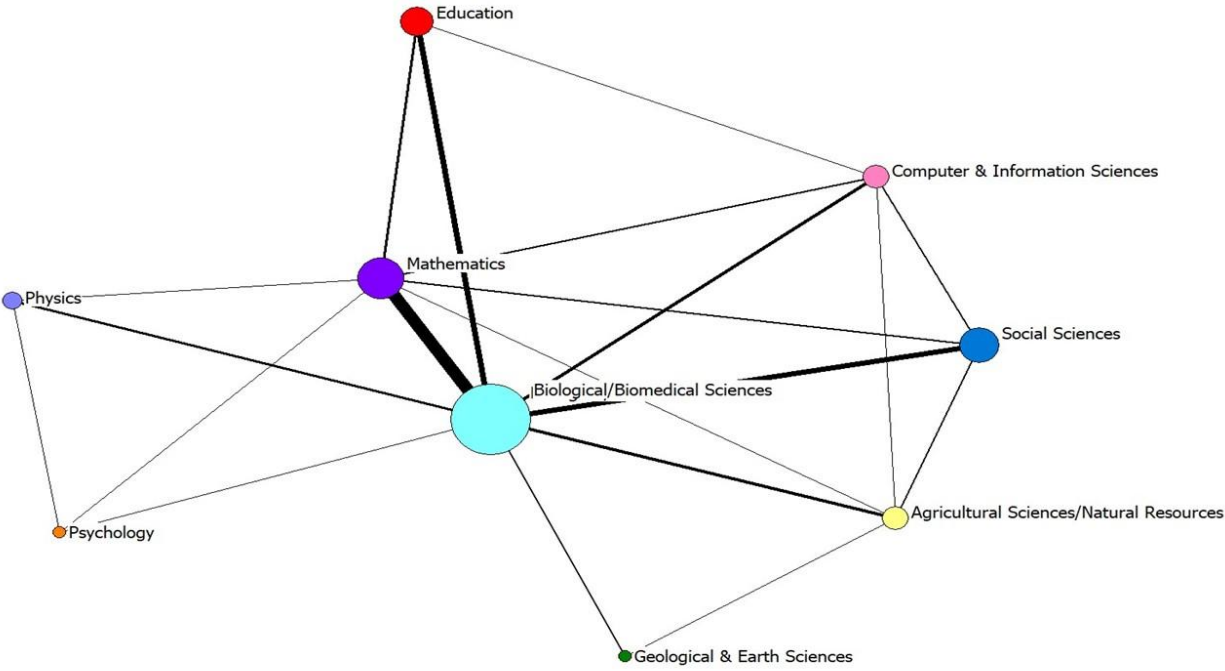
**Table 1. Summary of high impact journal articles**

**Table 2 and Figure 3. Trends in NIMBioS website visits**



**Figure 1. Diversity of subject areas represented in NIMBioS Working Group (WG) meetings and Investigative Workshops (WS) during the period from September 1, 2018 through June 30, 2019.**

**Figure 2. Cross-disciplinary connections fostered among Working Group members through the meetings hosted at NIMBioS from September 1, 2018 through June 30, 2019. 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 2019) and since NIMBioS' inception, sorted by journal 5-Year Impact Factor**

Journal Title	5-Year Impact Factor*	Average JIF Percentile	# of NIMBioS Publications**
Nature	45.82	99.3%	3
Science	43.64	92.7%	8
Cell	36.43	99.5%	1
Trends in Ecology and Evolution	18.96	99.1%	7
Nature Communications	13.81	94.5%	2
Frontiers in Ecology and the Environment	11.96	98.7%	1
Ecology Letters	11.58	96.0%	10
Nucleic Acids Research	10.73	95.5%	3
Proceedings of the National Academy of Sciences	10.60	90.6%	18
Systematic Biology	10.48	91.0%	7
Current Biology	10.09	91.9%	1
Methods in Ecology and Evolution	9.54	94.8%	6
PLoS Biology	9.31	94.6%	3
eLife	8.52	96.0%	1
New Phytologist	8.34	96.7%	4
Philosophical Transactions of the Royal Society B	7.21	92.5%	6
Ecography	6.69	93.5%	5
Molecular Ecology	6.61	88.0%	11
PLoS Genetics	6.28	87.1%	2
Conservation Biology	6.11	94.0%	2
Functional Ecology	5.83	88.1%	1
Ecology	5.46	83.8%	6
Proceedings of the Royal Society B	5.39	83.8%	12
PLoS Computational Biology	5.04	90.8%	8
Journal of Animal Ecology	5.02	92.1%	4
Ecological Applications	5.00	83.4%	3
PLOS Neglected Tropical Diseases	4.72	93.9%	1
Journal of Biogeography	4.64	78.3%	1
Quarterly Review of Biology	4.55	82.2%	1
Scientific Reports	4.53	79.0%	4
Diversity and Distributions	4.50	84.5%	3
Molecular Phylogenetics and Evolution	4.38	74.7%	1
Evolution	4.09	71.1%	17
American Naturalist	4.06	77.0%	2
Journal of the Royal Society Interface	4.04	77.5%	5

Oikos	3.77	74.7%	4
Heredity	3.68	66.1%	2
PLoS One	3.34	65.9%	35
Oecologia	3.32	68.6%	6
Animal Behaviour	3.10	79.8%	9
Biological Invasions	2.91	74.8%	1
Ecological Modeling	2.85	61.9%	9
BMC Bioinformatics	2.51	63.6%	2
SIAM Journal on Control and Optimization	2.39	64.4%	1
CBE - Life Sciences Education	2.38	74.4%	1
Physical Review E	2.38	73.0%	1
Journal of Theoretical Biology	2.04	57.1%	22
Theoretical Ecology	2.01	43.6%	6
Journal of Mathematical Biology	1.89	59.7%	3
Bulletin of Mathematical Biology	1.64	47.7%	1
Behaviour	1.40	35.8%	10
Mathematical Methods in the Applied Sciences	1.35	72.6%	2

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\*Impact factor calculation:  $\text{cites in year } n \text{ to articles published in year } (n-1 + n-2) / \text{number of articles published in year } (n-1 + n-2)$ .

\*\*September 2008 – June 2019



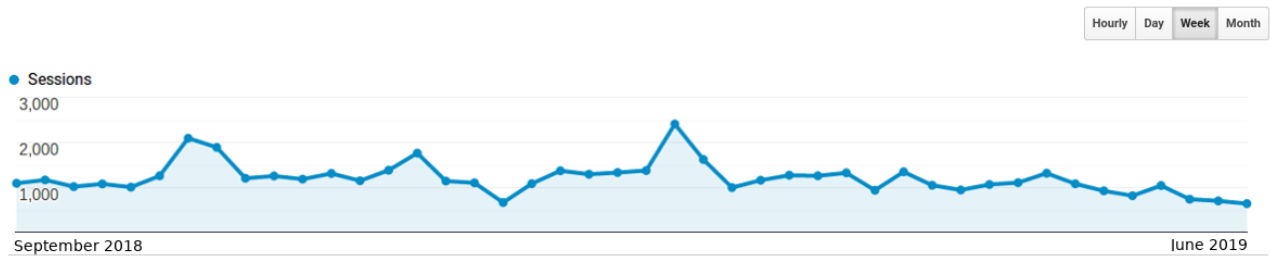
This supporting file contains Table 2 and Figure 3, which show overall trends of *nimbios.org* website visits and unique visitors through the reporting periods (site use data from Google Analytics).

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

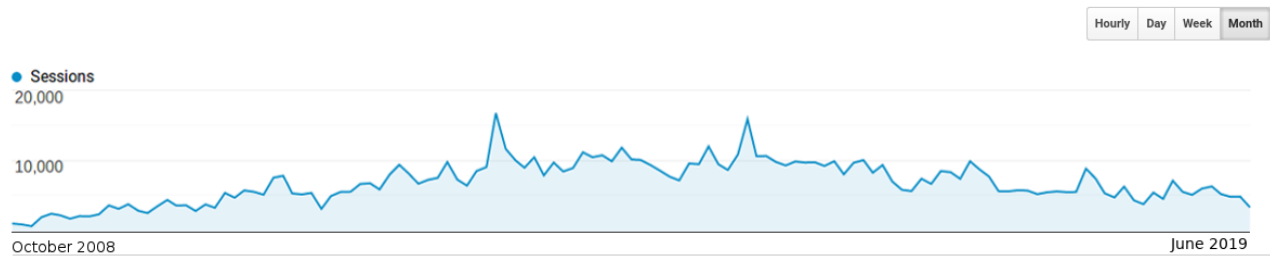
<b>Reporting year</b>	<b>Unique visitors</b>	<b>Visits</b>
Sep 1, 2008 - Aug 31, 2009	9259	19951
Sep 1, 2009 - Aug 31, 2010	21278	41700
Sep 1, 2010 - Aug 31, 2011	33449	65208
Sep 1, 2011 - Aug 31, 2012	45084	88398
Sep 1, 2012 - Aug 31, 2013	74123	116473
Sep 1, 2013 - Aug 31, 2014	73906	116331
Sep 1, 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 - Aug 31, 2018	42912	67504
Sep 1, 2018- Jun 30, 2019*	32820	52255

\*Partial year

(a)



(b)



**Figure 3.** Number of *nimbios.org* website visits for (a) the 2019 reporting year (weekly, September 1, 2018 through June 30, 2019) and (b) monthly for the period October 1, 2008 through June 30, 2019. 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

#### Book Chapters

Morrison K, Curto C (2018). Predicting neural network dynamics via graphical analysis. *Algebraic and Combinatorial Computational Biology 1*. R. Robeva, M. Macaulay (eds). Elsevier Science. Cambridge, MA. 241. Status = PUBLISHED; Acknowledgement of Federal Support = Yes ; Peer Reviewed = Yes ; ISBN: 978-0128140666.

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### Inventions

#### Journals or Juried Conference Papers

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Baggio JA; Hillis V (2018). Managing ecological disturbances: Learning and the structure of social-ecological networks. *Environmental Modelling and Software*. 109 32. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.envsoft.2018.08.002

Bennett A, Preedy K, Golubski A, Umbanhowar J, Borrett S, Byrne L, Apostol K, Bever JD, Biederman L, Classen AT, Cuddington K, de Graaff MA, Garrett KA, Gross L, Hastings A, Hoeksema JD, Hryniv V, Karst J, Kummel M, Lee CT, Liang C, Liao W, Mack K, Miller L, Ownley B, Rojas C, Simms EL, Walsh VK, Warren M, Zhu J (2018). Beyond the black box: Promoting mathematical collaborations for elucidating interactions in soil ecology. *EcoScience*. . Status = AWAITING\_PUBLICATION; Acknowledgment of Federal Support = Yes

Boehm R, Rusch H, Barron J (2018). The Psychology of Intergroup Conflict: A Review of Theories and Measures. *Journal of Economic Behavior and Organization*. . Status = AWAITING\_PUBLICATION; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.jebo.2018.01.020

Brook G. Milligan; Frederick I. Archer; Anne-Laure Ferchaud; Brian K. Hand; Elizabeth M. Kierepka; Robin S. Waples (2018). Disentangling genetic structure for genetic monitoring of complex populations. *Evolutionary Applications*. 11 1149. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1111/eva.12622

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Byosiere, SE; Espinosa, J; Marshall-Pescini, S; Smuts, B; Range F (2016). Investigating the function of play bows in dog and wolf puppies (*Canis lupus familiaris*, *Canis lupus occidentalis*). *PLoS ONE*. 11 (12), e0168570. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1371/journal.pone.0168570

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## Licenses

### Other Conference Presentations / Papers

C. Sample, J. Bieri, B. Allen, Y. Dementieva, A. Carson, S. Qiu, C. Higgins, S. Piat (2018). *A model for quantifying the importance of habitats in a migratory network*. Joint Mathematics Meeting. San Diego, CA. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

A. Carson, S. Qiu, B. Allen, C. Sample, and Y. Dementieva (2018). *A model to quantify the importance of habitats in a migratory network*. Joint Mathematics Meeting. San Diego, CA. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

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Couvreur V, Meunier F, Ledder G, Sulis M, Manzoni S, Lobet G, Russo S, Javaux M, Vanderborcht J, Draye X. (2019). *Emergent properties of plant hydraulic architecture: From root cells to cavitating stems and land surface models (Austria)*. European Geophysical Union General Assembly. Vienna, Austria. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Couvreur V, Meunier F, Ledder G, Sulis M, Manzoni S, Lobet G, Russo S, Javaux M, Vanderborcht J, Draye X (2019). *Emergent properties of plant hydraulic architecture: From root cells to cavitating stems and land surface models (Luxembourg)*. Luxembourg Institute of Science and Technology. Esch-sur-Alzette, Luxembourg. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Couvreur V, Meunier F, Ledder G, Sulis M, Manzoni S, Lobet G, Russo S, Javaux M, Vanderborcht J, Draye X. (2018). *Emergent properties of plant hydraulic architecture: From root cells to cavitating stems and land surface models (Washington, D.C.)*. American Geophysical Union Fall Meeting. Washington, D.C.. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Gorris, ME, Salamone, A, Clifford, W, Zender, CS, Treseder, KK, & Randerson, JT (2019). *Environmental niche modeling of Coccidioides ssp. in Washington State*. 63rd Coccidioidomycosis Study Group Meeting. Sacramento, CA. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Lacasse, K., Zia, A., Fefferman, N., Kinzig, A., Howe, P., Hoffman, F., Winter, J., Beckage, B., Metcalf, S., Frank, T., Gross, L., & Carr, E. (2019). *Insights from applying machine learning to climate survey data*. Sustainability Psychology Preconference of the Society of Personality and Social Psychology. Portland, OR. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

LoRe S (2019). *Math skills in biology education: A Principles-Focused Evaluation (PF-E) of Community College faculty needs*. Women in STEM Symposium. University of Tennessee, Knoxville, TN. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

C. Higgins, S. Piatt, B. Allen, C. Sample, and Y. Dementieva (2017). *Mathematical modeling of migratory species*. Mathematics Association of America (MAA) MathFest. Chicago, IL. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Thurston, LP; Bass, K; Bishop, P; Kaczmarczyk, L (2017). *Multi-scale evaluation and INCLUDES Alliance Projects*. American Evaluation Association Annual Conference. Washington D.C.. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

DeWitt TJ (2018). *Old typologies must die: Phenotypic plasticity in the real world produces traditional specialists and generalists, plus unique nontraditional, integrated strategies*. Annual Meeting of the American Society of Ichthyologists & Herpetologists. Rochester, NY. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Dylewski, R; Rice, JR; Eda, S (2019). *Parameter optimization and sensitivity analysis for an agent-based model of Johnes's disease granuloma*. EUReCA. Knoxville, TN. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Albers, H.J., C.H. Chang, K. Kroetz, et al. (2018). *Reserve Site Selection with Enforcement Costs and Illegal Harvest*. 6th World Congress of Environmental and Resource Economists. Gothenburg, Sweden. Status = PUBLISHED; Acknowledgement of

Federal Support = Yes

Kiser, S., LoRe. S, Corwin, L., Aikens, M. & Miller, J (2018). *Teaching quantitative biology in Community College: A mixed methods needs assessment*. National Association for Biology Teachers (NABT) Professional Development Conference. San Diego, CA. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Aydeniz M; Ritter O (2017). *Understanding student engagement in model-based argumentation*. Multi-Scale Evaluation in STEM Education. Knoxville, TN. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

## Other Products

### Other Publications

Garuccio A (2016). *A Genetic Programming Approach to Solving Optimization Problems on Agent-Based Models*. Thesis <https://search.proquest.com/docview/1796371249?pq-origsite=gscholar>. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Crall AW; Lunch C (2018). *Bringing Conversations on Diversity and Inclusion in Data Science to the Ecological and Environmental Sciences*. Grant Proposal. Status = ACCEPTED; Acknowledgement of Federal Support = Yes

Crall AW; Lunch C (2019). *Bringing Conversations on Diversity, Equity, and Inclusion in Data Science to the Environmental Sciences*. Meeting Workshop or Symposium NSF INCLUDES Conference, National Ecological Observatory Network. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Jenkins K; Karpakakunjaram, Kiser, K. (2019). *Building Faculty Collaborations to enhance Community College Quantitative Biology*. Grant Proposal. Status = UNDER\_REVIEW; Acknowledgement of Federal Support = Yes

Talkachova & Otani (2017). *Collaborative research: Extending multi-scale ideas to the large-scale spatial-temporal control and dynamics of waves in excitable cardiac systems*. Grant Proposal (Pending). Status = OTHER; Acknowledgement of Federal Support = Yes

Qin H (2016). *Connecting emergent aspect of gene networks to cellular aging*. Grant Proposal. Status = SUBMITTED; Acknowledgement of Federal Support = Yes

Gross, L., Beals, M. & Harrell, S. et al. (2019). *Contribution to QUBES Open Education Resources*. Software or Netware <https://qubeshub.org/community/groups/qbcc>. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Rinberg D, Koulakov A, Gerkin RC, Bozza T, Franks K, Mainland JB, Fleischmann A, Datta B. (2018). *Cracking The Olfactory Code*. Grant Proposal (Pending). Status = OTHER; Acknowledgement of Federal Support = Yes

Chang CH (2018). *David H. Smith Conservation Research Fellowship*. Grant Proposal. Status = ACCEPTED; Acknowledgement of Federal Support = Yes

Sparks EE, Pradal C (2018). *Engineering aerial roots for plant stability*. Grant Proposal (Funded). Status = OTHER; Acknowledgement of Federal Support = Yes

Qin H (2017). *Exploratory: STEM ICE: Inspire, Communicate, Educate*. Grant Proposal. Status = SUBMITTED; Acknowledgement of Federal Support = Yes

Chang CH (2018). *Extreme Science and Engineering Discovery Environment (XSEDE)*. Grant Proposal. Status = ACCEPTED; Acknowledgement of Federal Support = Yes

Gurarie, D. (2018). *Immune selection of malaria quasi-species*. Meeting Workshop or Symposium SMB 2018, Sydney, Australia. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Qin H, Marz A (2017). *Invasive Growth Response to DNA Repair Stress in Saccharomyces cerevisiae Biofilms*. Grant Proposal. Status = SUBMITTED; Acknowledgement of Federal Support = Yes

Qin H, Klug H, Boyd J, Hossain A, Skjellum A (2018). *Investigating the potential network modular configuration rule for system-level biological robustness with respect to intrinsic and extrinsic variations*. Grant Proposal. Status = SUBMITTED; Acknowledgement of Federal Support = Yes

Dauer J, Mayes R, Rittschof K (2017). *NSF Core Research: Assessment of Quantitative Modeling by Undergraduate Students (QM BUGS)*. Grant Proposal. Status = SUBMITTED; Acknowledgement of Federal Support = Yes



Gerkin RC, Mainland JB (2018). *Pyrfume: A Library for Mammalian Olfactory Psychophysics*. Grant Proposal (Pending). Status = OTHER; Acknowledgement of Federal Support = Yes

Dauer J, Mayes R (2017). *Quantitative Biology Assessment of Model Reasoning (QBAM)*. Grant Proposal (Pending). Status = OTHER; Acknowledgement of Federal Support = Yes

E Archer, C Parobek, S Hoban, A Strand, M Depranger Levin, L Liggins. (2017). *R package: Skelesim*. Software or Netware. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Qin H (2016). *REU Site: IComputeB2 - Engaging undergraduates in interdisciplinary computing for biological and biomedical research*. Grant Proposal. Status = SUBMITTED; Acknowledgement of Federal Support = Yes

Qin H (2017). *REU Site: ICompBio - Engaging Undergraduates in Interdisciplinary Computing for Biological Research*. Grant Proposal. Status = SUBMITTED; Acknowledgement of Federal Support = Yes

Buck CL, Hindle A, Galic N. (2017). *Research Coordination Network (RCN): Predicting vertebrate responses to a changing climate: modeling genomes to phenomes to populations (G2P2PoP)*. Grant Proposal (Funded). Status = OTHER; Acknowledgement of Federal Support = Yes

S Hoban, A Strand, J Robinson, A Smith, A Dawson (2017). *S Hoban, A Strand, J Robinson, A Smith, A Dawson. Submitted (2017). Collaborative Research: ABI Innovation: Quantifying biogeographic history: A novel model-based approach to integrating data from genes, fossils, specimens, and environments. NSF Advances in Biological Informatics. \$600,000..* Grant Proposal. Status = SUBMITTED; Acknowledgement of Federal Support = Yes

Qin H (2017). *Spokes: MEDIUM: SOUTH: Collaborative: Integrating Biological Big Data Research into Student Training and Education*. Grant Proposal. Status = SUBMITTED; Acknowledgement of Federal Support = Yes

Merchant N, Sahneh FD, Kobourov S, Papes M (2018). *TRIPODS+X:VIS: Data Science Pathways for a Vibrant TRIPODS Commons at Scale*. Grant Proposal. Status = ACCEPTED; Acknowledgement of Federal Support = Yes

Elliott S (2017). *The Aims and Structures of Research Projects That Use Gene Regulatory Information with Evolutionary Genetic Models*. Dissertation: Arizona State University. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

## Patents

## Technologies or Techniques

## Thesis/Dissertations

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
Gross, Louis	PD/PI	11
Gavrilets, Sergey	Co-Investigator	2
Lenhart, Suzanne	Co-Investigator	2
Alexiades, Vasilios	Faculty	1
Armsworth, Paul	Faculty	1

<b>Name</b>	<b>Most Senior Project Role</b>	<b>Nearest Person Month Worked</b>
Bialic-Murphy, Lalasia	Faculty	3
Bishop, Pam	Faculty	12
Collins, Charles	Faculty	1
Fefferman, Nina	Faculty	1
Ganusov, Vitaly	Faculty	3
Giam, Xingli	Faculty	1
Hong, Tian	Faculty	1
McCord, Rachel	Faculty	3
Papes, Mona	Faculty	1
Strickland, Christopher	Faculty	1
Talmy, David	Faculty	1
Von Arnim, Albrecht	Faculty	3
Carrasco Tornero, Luis	Postdoctoral (scholar, fellow or other postdoctoral position)	12
Chang, Charlotte	Postdoctoral (scholar, fellow or other postdoctoral position)	9
Jiao, Jing	Postdoctoral (scholar, fellow or other postdoctoral position)	12
Myers, Kellen	Postdoctoral (scholar, fellow or other postdoctoral position)	6
Panchy, Nick	Postdoctoral (scholar, fellow or other postdoctoral position)	3
Smith-Ramesh, Lauren	Postdoctoral (scholar, fellow or other postdoctoral position)	6
Suarez, Gonzalo	Postdoctoral (scholar, fellow or other postdoctoral position)	8
Zhu, Gengping	Postdoctoral (scholar, fellow or other postdoctoral position)	10
Bartolini, Mary	Other Professional	8
Carr, Eric	Other Professional	12
Comiskey, Jane	Other Professional	12
Echols, Erica	Other Professional	6
Eskridge, Chandra	Other Professional	6

<b>Name</b>	<b>Most Senior Project Role</b>	<b>Nearest Person Month Worked</b>
Jackson, Heather	Other Professional	3
LoRe, Sondra	Other Professional	10
Minshall, Nichole	Other Professional	7
Murr, Louise	Other Professional	3
Peek, Mike	Other Professional	11
Spar, Jennifer	Other Professional	12
Wiggins, Greg	Other Professional	12
York, Meredith	Other Professional	10
Crawley, Catherine	Staff Scientist (doctoral level)	12
Welsh, Chris	Staff Scientist (doctoral level)	11
Adewunmi, Eniola	Research Experience for Undergraduates (REU) Participant	2
Azeredo-Tseng, Cassandra	Research Experience for Undergraduates (REU) Participant	2
Bechtel, Ambrose	Research Experience for Undergraduates (REU) Participant	2
Cho, Priscilla	Research Experience for Undergraduates (REU) Participant	2
Colon Cabezudo, Giovanni	Research Experience for Undergraduates (REU) Participant	2
Fiet, Lucas	Research Experience for Undergraduates (REU) Participant	2
Grandison, Brandon	Research Experience for Undergraduates (REU) Participant	2
Jodoin, Vincent	Research Experience for Undergraduates (REU) Participant	2
Kilgore, Ana	Research Experience for Undergraduates (REU) Participant	2
Knight, Margaret	Research Experience for Undergraduates (REU) Participant	2

Name	Most Senior Project Role	Nearest Person Month Worked
Lochner, Ellie	Research Experience for Undergraduates (REU) Participant	2
Luo, Michael	Research Experience for Undergraduates (REU) Participant	2
Payne, Sheridan	Research Experience for Undergraduates (REU) Participant	2
Randall, Natalie	Research Experience for Undergraduates (REU) Participant	2
Ruiz, Brandyn	Research Experience for Undergraduates (REU) Participant	2
Todd, Meagan	Research Experience for Undergraduates (REU) Participant	2
Williams, Abigail	Research Experience for Undergraduates (REU) Participant	2
Yin, Hannah	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:** NSF and University of Tennessee

**International Collaboration:** Yes, Canada, France, Germany, United Kingdom

**International Travel:** Yes, Canada - 0 years, 0 months, 5 days; France - 0 years, 0 months, 4 days

**Sergey Gavrillets**

**Email:** sergey@nimbios.org

**Most Senior Project Role:** Co-Investigator

**Nearest Person Month Worked:** 2

**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 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, Russian Federation, Spain, Sweden, Switzerland, United Kingdom

**International Travel:** Yes, China - 0 years, 0 months, 10 days; Austria - 0 years, 0 months, 3 days; Japan - 0 years, 0

months, 3 days; Russian Federation - 0 years, 0 months, 10 days; Singapore - 0 years, 0 months, 5 days; Spain - 0 years, 0 months, 2 days; Switzerland - 0 years, 0 months, 3 days

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**Suzanne Lenhart**

**Email:** lenhart@math.utk.edu

**Most Senior Project Role:** Co-Investigator

**Nearest Person Month Worked:** 2

**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 2019 Summer Research Experience for Undergraduates.

**Funding Support:** NSF, University of Tennessee

**International Collaboration:** Yes, Germany, Spain, Tanzania, United Republic Of, United Kingdom

**International Travel:** Yes, Botswana - 0 years, 0 months, 10 days

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**Vasilios Alexiades**

**Email:** alexiades@utk.edu

**Most Senior Project Role:** Faculty

**Nearest Person Month Worked:** 1

**Contribution to the Project:** Dr. Alexiades (Mathematics) is a mentor for the 2019 Summer Research Experience for Undergraduates program.

**Funding Support:** University of Tennessee

**International Collaboration:** No

**International Travel:** No

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**Paul Armsworth**

**Email:** p.armsworth@utk.edu

**Most Senior Project Role:** Faculty

**Nearest Person Month Worked:** 1

**Contribution to the Project:** Dr. Armsworth is a Professor of Ecology & Evolutionary Biology. He is the lead organizer for the Conservation Hierarchies working group. Paul is the lead for the Resources for the Future grant.

**Funding Support:** University of Tennessee

**International Collaboration:** Yes, France, India

**International Travel:** No

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**Lalasia Bialic-Murphy**

**Email:** lbialicm@utk.edu

**Most Senior Project Role:** Faculty

**Nearest Person Month Worked:** 3

**Contribution to the Project:** Dr. Bialic Murphy is a research assistant professor in the department of Ecology and Evolutionary Biology. She works with Dr. Paul Armsworth on efforts related to a grant with the Southeastern Climate Science Center.

**Funding Support:** University of Tennessee

**International Collaboration:** No

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**International Travel:** No

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**Pam Bishop**

**Email:** pbaird@utk.edu

**Most Senior Project Role:** Faculty

**Nearest Person Month Worked:** 12

**Contribution to the Project:** Dr. Bishop was the NIMBioS Associate Director for STEM Evaluation through June 2019. 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 is Director of the National Institute for STEM Evaluation and Research (NISER), which moves under the University of Tennessee's Office of Research as of July 1, 2019.

**Funding Support:** NSF, University of Tennessee

**International Collaboration:** No

**International Travel:** No

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**Charles Collins**

**Email:** collins@utk.edu

**Most Senior Project Role:** Faculty

**Nearest Person Month Worked:** 1

**Contribution to the Project:** Dr. Collins (Associate Dean & Professor, Mathematics) is a mentor for the 2019 Summer Research Experience for Undergraduates program.

**Funding Support:** University of Tennessee

**International Collaboration:** No

**International Travel:** No

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**Nina Fefferman**

**Email:** nfefferm@utk.edu

**Most Senior Project Role:** Faculty

**Nearest Person Month Worked:** 1

**Contribution to the Project:** Dr. Fefferman is a member of NIMBioS leadership team and directs and leads development of the Mathematical Modeling Consulting Center within NIMBioS. She is also a mentor for the 2019 Summer Research Experience for Undergraduates program and for Postdoctoral Fellows Jing Jiao, Kellen Myers, and Gonzalo Suarez.

**Funding Support:** University of Tennessee

**International Collaboration:** Yes, France, Israel

**International Travel:** No

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**Vitaly Ganusov**

**Email:** vitaly@utk.edu

**Most Senior Project Role:** Faculty

**Nearest Person Month Worked:** 3

**Contribution to the Project:** Dr. Ganusov is an Associate Professor of Microbiology. He spent time working on Enhancing Quantitative & Data Science Education with Dr. Louis Gross

**Funding Support:** University of Tennessee

**International Collaboration:** Yes, Australia, Portugal

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**International Travel:** Yes, Australia - 0 years, 0 months, 7 days

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**Xingli Giam**

**Email:** xgiam@utk.edu

**Most Senior Project Role:** Faculty

**Nearest Person Month Worked:** 1

**Contribution to the Project:** Dr. Giam is an Assistant Professor for Ecology & Evolutionary Biology. He spent time working on Optimal Spatial Targeting grant with Dr. Paul Armsworth

**Funding Support:** University of Tennessee

**International Collaboration:** No

**International Travel:** No

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**Tian Hong**

**Email:** hongtian@utk.edu

**Most Senior Project Role:** Faculty

**Nearest Person Month Worked:** 1

**Contribution to the Project:** Dr. Hong is a mentor for the 2019 Summer Research Experience for Undgraduates program as well as for postdoctoral fellow Nick Panchy.

**Funding Support:** University of Tennessee

**International Collaboration:** Yes, Japan

**International Travel:** No

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**Rachel McCord**

**Email:** rmccord@utk.edu

**Most Senior Project Role:** Faculty

**Nearest Person Month Worked:** 3

**Contribution to the Project:** Dr. McCord is an Assistant Professor of Biochemistry & Cellular and Molecular Biology. She spent time working on Enhancing Quantitative & Data Science Education with Dr. Louis Gross

**Funding Support:** University of Tennessee

**International Collaboration:** No

**International Travel:** No

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**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 2019 Summer Research Experience for Undgraduates program.

**Funding Support:** University of Tennessee

**International Collaboration:** Yes, Guatemala

**International Travel:** No

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**Christopher Strickland****Email:** cstric12@utk.edu**Most Senior Project Role:** Faculty**Nearest Person Month Worked:** 1

**Contribution to the Project:** Dr. Strickland (Mathematics) is a mentor for the 2019 Summer Research Experience for Undergraduates program.

**Funding Support:** University of Tennessee

**International Collaboration:** No

**International Travel:** No

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**David Talmy****Email:** dtalmy@utk.edu**Most Senior Project Role:** Faculty**Nearest Person Month Worked:** 1

**Contribution to the Project:** Dr. Talmy is a mentor for the 2019 Summer Research Experience for Undergraduates program.

**Funding Support:** University of Tennessee

**International Collaboration:** No

**International Travel:** No

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**Albrecht Von Arnim****Email:** vonarnim@utk.edu**Most Senior Project Role:** Faculty**Nearest Person Month Worked:** 3

**Contribution to the Project:** Dr. Von Arnim is an Assistant Professor of Biochemistry & Cellular and Molecular Biology. He spent time working on Enhancing Quantitative & Data Science Education with Dr. Louis Gross

**Funding Support:** University of Tennessee

**International Collaboration:** No

**International Travel:** No

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**Luis Carrasco Tornero****Email:** lcarrasc@utk.edu**Most Senior Project Role:** Postdoctoral (scholar, fellow or other postdoctoral position)**Nearest Person Month Worked:** 12

**Contribution to the Project:** Luis (Ecology and Evolutionary Biology, Univ. Tsukuba, Japan, 2015) is a Targeted Postdoctoral Fellow in Spatial Biology working on integrating remote sensing tools to explain biodiversity spatial patterns under global change. His work is related to NIMBioS' Spatial Analysis Lab. Luis is also a mentor for the 2019 Summer Research Experience for Undergraduates program.

**Funding Support:** NSF, University of Tennessee

**International Collaboration:** No

**International Travel:** No

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**Charlotte Chang****Email:** chchang@nimbios.org**Most Senior Project Role:** Postdoctoral (scholar, fellow or other postdoctoral position)



**Nearest Person Month Worked:** 9

**Contribution to the Project:** Dr. Chang (Ecology & Evolutionary Biology, Princeton Univ.) was a NIMBioS postdoctoral fellow 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. She finished at NIMBioS as of June 2019.

**Funding Support:** NSF

**International Collaboration:** Yes, Australia, China

**International Travel:** No

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**Jing Jiao**

**Email:** jjiao3@utk.edu

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

**Nearest Person Month Worked:** 12

**Contribution to the Project:** Jing (Theoretical Ecology and Conservation Biology, Univ. Florida, 2017) is a Targeted Postdoctoral Fellow working on predicting the evolution of vector-borne disease dynamics in a changing world. Jing is also a mentor for the 2019 Summer Research Experience for Undergraduates program.

**Funding Support:** University of Tennessee

**International Collaboration:** No

**International Travel:** Yes, Canada - 0 years, 0 months, 6 days

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**Kellen Myers**

**Email:** kellenmyers@gmail.com

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

**Nearest Person Month Worked:** 6

**Contribution to the Project:** Kellen (Mathematics, Rutgers Univ., 2015) is a Targeted Postdoctoral Fellow looking at computational foundations in mathematical biology.

**Funding Support:** NSF, University of Tennessee

**International Collaboration:** No

**International Travel:** No

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**Nick Panchy**

**Email:** panchy@nimbios.org

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

**Nearest Person Month Worked:** 3

**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. Nick is also a mentor for the 2019 Summer Research Experience for Undergraduates program.

**Funding Support:** NSF, University of Tennessee

**International Collaboration:** No

**International Travel:** No

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**Lauren Smith-Ramesh**

**Email:** lsmithramesh@nimbios.org

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

**Nearest Person Month Worked:** 6

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**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

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**Gonzalo Suarez**

**Email:** gsuarez1@utk.edu

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

**Nearest Person Month Worked:** 8

**Contribution to the Project:** Dr. Gonzalo Suarez is a postdoctoral fellow working with Dr. Nina Fefferman.

**Funding Support:** University of Tennessee

**International Collaboration:** No

**International Travel:** No

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**Gengping Zhu**

**Email:** gzhu6@utk.edu

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

**Nearest Person Month Worked:** 10

**Contribution to the Project:** Gengping (Zoology, Nankai Univ., China, 2011) is a Targeted Postdoctoral Fellow studying optimal spatial targeting of payments for forest-based ecosystem services under climate change and market risks.

**Funding Support:** University of Tennessee

**International Collaboration:** No

**International Travel:** No

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**Mary Bartolini**

**Email:** mbartoli@utk.edu

**Most Senior Project Role:** Other Professional

**Nearest Person Month Worked:** 8

**Contribution to the Project:** Mary was the NIMBioS Business Manager. She retired in spring 2019.

**Funding Support:** NSF, University of Tennessee

**International Collaboration:** No

**International Travel:** No

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**Eric Carr**

**Email:** carr@nimbios.org

**Most Senior Project Role:** Other Professional

**Nearest Person Month Worked:** 12

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

**Funding Support:** NSF, University of Tennessee

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**International Collaboration:** No  
**International Travel:** No

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**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, University of Tennessee

**International Collaboration:** No  
**International Travel:** No

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**Erica Echols**

**Email:** eechols1@utk.edu

**Most Senior Project Role:** Other Professional

**Nearest Person Month Worked:** 6

**Contribution to the Project:** Erica 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

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**Chandra Eskridge**

**Email:** ceskridge@nimbios.org

**Most Senior Project Role:** Other Professional

**Nearest Person Month Worked:** 6

**Contribution to the Project:** Chandra served as Executive and Business Assistant for NIMBioS, supporting the Director and operating as a key member of the business and travel staff. She managed the main office and processed reimbursement requests for all staff and visitors prior to retiring early in 2019.

**Funding Support:** NSF

**International Collaboration:** No  
**International Travel:** No

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**Heather Jackson**

**Email:** hjacks15@utk.edu

**Most Senior Project Role:** Other Professional

**Nearest Person Month Worked:** 3

**Contribution to the Project:** Heather is a Research Assistant Professor for Ecology & Evolutionary Biology. She spent time working on Resources for the Future grant with Dr. Paul Armsworth

**Funding Support:** University of Tennessee

**International Collaboration:** No  
**International Travel:** No

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**What other organizations have been involved as partners?**

<b>Name</b>	<b>Type of Partner Organization</b>	<b>Location</b>
AAAS-American Association for Advancement of Science	Academic Institution	Washington, D.C.
AIBS-American Institute of Biological Sciences	Academic Institution	Reston, VA
City of Knoxville	State or Local Government	Knoxville, TN
Cultural Evolution Society	Other Nonprofits	Seattle, WA
Cyverse	Academic Institution	Tucson, AZ
DIMACS-Center for Discrete Mathematics & Theoret. Comp. Sci.	Academic Institution	Rutgers University
Ecological Society of America	Academic Institution	Washington, D.C.
FARO	Industrial or Commercial Firms	Lake Mary, FL
Fisk University	Academic Institution	Nashville, TN
Great Smoky Mountains National Park	Other Organizations (foreign or domestic)	Gatlinburg, TN
H2O'Lyon	Academic Institution	Lyon, France
Howard H. Baker Jr Center for Public Policy	Academic Institution	Knoxville, TN
AWM-Association for Women in Mathematics	Other Nonprofits	Fairfax, VA
Howard University	Academic Institution	Washington, D.C.
Innovative Computing Laboratory	Academic Institution	Knoxville, TN
JICS-Joint Institute for Computational Science	Academic Institution	University of Tennessee
Legacy Parks Foundation	Other Nonprofits	Knoxville, TN
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

<b>Name</b>	<b>Type of Partner Organization</b>	<b>Location</b>
NSF Mathematical Sciences Institutes	Academic Institution	various
Auburn University	Academic Institution	Auburn, AL
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
Oak Ridge National Laboratory	Other Organizations (foreign or domestic)	Oak Ridge, TN
PEER-Program for Equity and Excellence in Research	Academic Institution	University of Tennessee
QUBES (Quantitative Undergraduate Biology Education and Synt	Academic Institution	Unity College, Unity, ME
SACNAS-Society for the Advancement of Chicanos and Native Am	Academic Institution	Santa Cruz, CA
SAMSI-Statistical and Applied Mathematical Sciences Institut	Academic Institution	Research Triangle Park, NC
SESYNC-National Social-Environmental Synthesis Center	Academic Institution	University of Maryland
SHADES-Sharing Adventures in Engineering & Science	Academic Institution	Knoxville, TN
BioQUEST Curriculum Consortium	Other Nonprofits	Madison, WI
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
South Big Data Spokes	Academic Institution	Spelman College
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

Name	Type of Partner Organization	Location
Tennessee State University	Academic Institution	Nashville, TN
The Institute for Environmental Modeling	Academic Institution	University of Tennessee
U.S. Army Research Office	Other Organizations (foreign or domestic)	Research Triangle Park, NC
Burroughs Wellcome Fund	Other Organizations (foreign or domestic)	Research Triangle Park, NC
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
University of Texas El Paso	Academic Institution	El Paso, TX
Women in STEM Center	Academic Institution	Middle Tennessee State Univ.
sDiv	Other Nonprofits	Leipzig, Germany
CEEMS-UT Center for Enhancing Education in Mathematics & Sci	Academic Institution	University of Tennessee
CURRENT: 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

#### 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.

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**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 through the Teacher Partnership Program.

---

**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 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.

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**Burroughs Wellcome Fund**

**Organization Type:** Other Organizations (foreign or domestic)

**Organization Location:** Research Triangle Park, NC

**Partner's Contribution to the Project:**

Financial support

**More Detail on Partner and Contribution:** NIMBioS Director L. Gross leads a project with BWF on enhancing quantitative and data science-education for graduate students in biomedical science at the University of Tennessee.

---

## **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. Collaborations include a Modeling with Math Teachers Workshop held in June 2019 in which NIMBioS Outreach presented mathematical modeling activities for teacher professional development.

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## **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 collaborated 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 a formal partnership agreement.

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## **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.

---

## **City of Knoxville**

**Organization Type:** State or Local Government

**Organization Location:** Knoxville, TN

**Partner's Contribution to the Project:**

Collaborative Research

**More Detail on Partner and Contribution:** NIMBioS' Spatial Analysis Lab collaborates with members of Knoxville's Urban Wilderness Planning Group with SAL resources used to collect drone data for mapping the Urban Wilderness.

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## Cultural Evolution Society

**Organization Type:** Other Nonprofits

**Organization Location:** Seattle, WA

**Partner's Contribution to the Project:**

Collaborative Research

**More Detail on Partner and Contribution:** NIMBioS Associate Director S. Gavrillets is collaborating with members of the Cultural Evolution Society on projects connected to the launch of NIMBioS' Center for the Dynamics of Social Complexity.

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## Cyverse

**Organization Type:** Academic Institution

**Organization Location:** Tucson, AZ

**Partner's Contribution to the Project:**

Collaborative Research

**More Detail on Partner and Contribution:** Formerly iPlant. NIMBioS collaborates with Cyverse on research related to spatial data analyses, The BIO Center Directors have discussed potential collaborations on research and communication.

---

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

**Organization Type:** Academic Institution

**Organization Location:** Rutgers University

**Partner's Contribution to the Project:**

Collaborative Research

**More Detail on Partner and Contribution:** NIMBioS staff and leadership communicate with DIMACS about planning joint activities.

---

## Ecological Society of America

**Organization Type:** Academic Institution

**Organization Location:** Washington, D.C.

**Partner's Contribution to the Project:**

Collaborative Research

**More Detail on Partner and Contribution:** NIMBioS Director and NIMBioS-affiliated faculty organized symposia and oral sessions on theoretical ecology and conservation biology at the 2019 annual meeting of ESA.

---

## FARO

**Organization Type:** Industrial or Commercial Firms

**Organization Location:** Lake Mary, FL

**Partner's Contribution to the Project:**

Collaborative Research

**More Detail on Partner and Contribution:** Staff of NIMBioS' Spatial Analysis Lab are in discussion with FARO staff regarding potential collaboration on a tutorial on use of lidar technology.

---

## **Fisk University**

**Organization Type:** Academic Institution

**Organization Location:** Nashville, TN

**Partner's Contribution to the Project:**

Collaborative Research

**More Detail on Partner and Contribution:** NIMBioS Associate Director Lenhart visited Fisk Univ. in March 2019 to participate in discussion and evaluation of curriculum and course issues related to their NSF-TIP funded program.

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## **Great Smoky Mountains National Park**

**Organization Type:** Other Organizations (foreign or domestic)

**Organization Location:** Gatlinburg, TN

**Partner's Contribution to the Project:**

Collaborative Research

**More Detail on Partner and Contribution:** NIMBioS leadership and staff communicate with park staff to explore areas of collaborative research and activities.

---

## **H2O'Lyon**

**Organization Type:** Academic Institution

**Organization Location:** Lyon, France

**Partner's Contribution to the Project:**

Collaborative Research

**More Detail on Partner and Contribution:** NIMBioS Director L. Gross is on the international science advisory board for this interdisciplinary graduate program in water sciences and hydrosystems.

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## **Howard H. Baker Jr Center for Public Policy**

**Organization Type:** Academic Institution

**Organization Location:** Knoxville, TN

**Partner's Contribution to the Project:**

Collaborative Research

Personnel Exchanges

**More Detail on Partner and Contribution:** NIMBioS and the Baker Center co-sponsored working groups and short-term visitors in fall 2018 and spring 2019.

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## **Howard University**

**Organization Type:** Academic Institution

**Organization Location:** Washington, D.C.

**Partner's Contribution to the Project:**

Collaborative Research

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

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## What other collaborators or contacts have been involved?

Miranda Chen - assisted with NISER projects

Estella Clark - part-time office assistant in Dec-Jan

Audra Hinson - mentor for SRE program

Matthew Musgrove - assisted with NISER

Stephanie Yopp - assisted with NISER projects

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## Impacts

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

Many publications resulting from NIMBioS activities appeared this reporting year in top national and international journals with high impact factors, including Nature Reviews Neuroscience, Nature Ecology and Evolution, Trends in Ecology and Evolution, Annual Reviews of Ecology and Evolution, and Systematics. Table 1 in the supporting file included with this section provides details on NIMBioS-derived publications in certain high-impact journals over the time period since 2008.

Activities supported by NIMBioS have had strong impact on a number of biological sub-disciplines. The following provides some highlights grouped by the type of activity. We have chosen these examples as they cover most of the subject areas present in Figure 1 in the supporting file uploaded to the Accomplishments portion of this report. However, what we present is a sample of the activities in the subject areas.

NIMBioS postdoc L. Carrasco Tornero published two papers in Remote Sensing: "Metrics of Lidar-derived 3D vegetation structure reveal contrasting effects of horizontal and vertical forest heterogeneity on bird species richness" and "Evaluating combinations of temporally aggregated Sentinel-1, Sentinel-2 and Landsat 8 for land cover mapping with Google Earth Engine." The first paper built new LiDAR structural metrics based on the Leaf Area Density (LAD) at each vegetation height layer and used these metrics to study how different aspects of forest structural heterogeneity explain variation in bird species richness. The authors used discrete LiDAR data together with 61 breeding landbird points provided by the National Ecological Observatory Network at five eastern US forest sites. They showed that metrics based on LAD measurements had better explanatory power (43% of variance explained) than those based on the variation of canopy heights (32% of variance explained). Bird species richness increased with horizontal heterogeneity, while vertical heterogeneity had negative effects, contrary to previous research. The findings highlight the need for structure-animal diversity studies to incorporate metrics that are able to capture different aspects of forest 3D heterogeneity. The second paper provided the first formal comparison of the accuracy between land cover maps created with temporal aggregation of Sentinel-1 (S1), Sentinel-2 (S2), and Landsat-8 (L8) data from one year and tested whether this method matches the accuracy of traditional approaches. Thirty-two datasets were created for Wales by applying automated cloud-masking and temporally aggregating data over different time intervals, using Google Earth Engine. Manually processed S2 data was used for comparison using a traditional two-date composite approach. Supervised classifications were created, and their accuracy was assessed using field-based data. This study highlights the need for identifying optimal combinations of satellite data and aggregation parameters in order to match the accuracy of manually selected and processed image composites.

Former NIMBioS postdoc W. Godsoe published a paper in Trends in Ecology and Evolution entitled "Niche estimation above and below the species level." The authors show that modeling niches at the species level disregards information about evolutionary processes above and below the level of species. Moreover, species-level models ignore the potential for locally adaptive responses and assume that current distributions reflect the entire set of suitable conditions. In many cases, splitting taxa into subunits and modeling each separately or lumping related taxa can improve niche estimates. Partial pooling of lineages into a single multi-response framework has underutilized potential for niche estimation, especially when accounting for phylogenetic relationships. The authors argue that advancement of evolutionarily-informed niche models will be accelerated by emphasizing their ability to generate biologically plausible niche envelopes over their ability to recreate geographic distributions, which can be shaped by factors unrelated to the fundamental niche.

Members of the NIMBioS Working Group on "Darwinian morphometrics: Cross-topology registration of shape" published a review entitled "Variation and evolution of function-valued traits" in Annual Reviews of Ecology, Evolution, and Systematics. Function-valued traits—phenotypes whose expression depends on a continuous index (such as age, temperature, or space)—occur throughout biology and like any trait, it is important to understand how they vary and evolve. Although methods for

analyzing variation and evolution of function-valued traits are well developed, they have been underutilized by evolutionists, especially those who study natural populations. The authors seek to summarize advances in the study of function-valued traits and to make their analyses more approachable to biologists who could benefit from their use. To that end, they explain how curve thinking benefits conceptual understanding and statistical analysis of functional data. They also provide a detailed guide to the most flexible and statistically powerful methods and include worked examples (with R code) as supplemental material.

Members of a NIMBioS Working Group on "Plant-soil feedback theory" published a paper in *Nature Ecology and Evolution* entitled "Frequency-dependent feedback constrains plant community coexistence." The authors showed how frequency-dependent feedback constrains community coexistence, regardless of the number of species and inherent fitness inequalities between them. Any interaction network can be characterized by a single community interaction coefficient,  $IC$ , which determines whether community-level feedback is positive or negative. Negative feedback is a necessary (but not sufficient) condition for persistence of the entire community. Even in cases where the coexistence equilibrium state cannot recover from perturbations,  $IC < 0$  can enable species persistence via cyclic succession. The number of coexisting species is predicted to increase with the average strength of negative feedback. This prediction was supported by patterns of tree species diversity in more than 200,000 deciduous forest plots in the eastern US, which can be reproduced in simulations that span the observed range of community feedback. By providing a quantitative metric for the strength of negative feedback needed for coexistence, researchers can now integrate theory and empirical data to test whether observed feedback-diversity correlations are strong enough to infer causality.

Participants in the NIMBioS Working Group on "Learning in networks" published a paper entitled "On the nature and use of models in network neuroscience" in *Nature Reviews Neuroscience*. Network theory provides an intuitively appealing framework for studying relationships among interconnected brain mechanisms and their relevance to behavior. As the space of its applications grows, so does the diversity of meanings of the term network model. This diversity can cause confusion, complicate efforts to assess model validity and efficacy, and hamper interdisciplinary collaboration. The paper examines the field of network neuroscience, focusing on organizing principles that can help overcome these challenges. First, it describes the fundamental goals in constructing network models. Second, it reviews the most common forms of network models, which can be described parsimoniously along the following three primary dimensions: from data representations to first-principles theory; from biophysical realism to functional phenomenology; and from elementary descriptions to coarse-grained approximations. Third, the authors draw on biology, philosophy and other disciplines to establish validation principles for these models. The paper closes with a discussion of opportunities to bridge model types and point to exciting frontiers for future pursuits.

## **What is the impact on other disciplines?**

### *Economics, Psychology and Anthropology*

In the last year NIMBioS and DySoC have organized a number of high-profile activities at the intersection of biological, social, mathematical, and computational sciences.

The Investigative Workshop "Extending the Theory of Sustainability" met in December of 2018. This Workshop reviewed the state of sustainability theory. Major themes of the workshop included the role of cultural evolution, the role of evolving technology and R&D investments, diffusion of technology, uncertainty in ecosystem management, models of institutional change, and non-autonomous dynamics of important socio-environmental processes, e.g. climate change.

The Investigative Workshop "Human Origins 2021" met in February of 2019. The overall goal of the gathering was to leverage the upcoming 150th anniversary of Darwin's book "The Descent of Man" to (i) advance scientific research focusing on the evolutionary forces and mechanisms that drove the origins of the human species and on implications of our evolutionary past for modern humans and (ii) promote public understanding of the significance of this research across various segments of society, including educators, politicians, business leaders, and medical doctors.

The Investigative Workshop on "Social norms: emergence, persistence, and effects" met in April, 2019. This Workshop brought together active scholars interested in various aspects of social norms with the aim of stimulating new synergies, insights, and collaborations. The meeting was a transdisciplinary gathering of researchers from diverse disciplines including sociology, anthropology, psychology, economics, evolutionary biology, cultural evolution, neurobiology, political science, history, and experts on extremism, marketing, and communications, as well as policy scholars and practitioners.

The Investigative Workshop on "Mathematics of Gun Violence" met in May 2019. This Workshop brought together researchers from diverse disciplinary backgrounds to (i) review the existing approaches on the mathematics and modeling of gun violence, (ii) identify and prioritize areas in the field that require further research, (iii) develop cross-disciplinary collaborations to gain new perspectives, and (iv) suggest research and data-collection that could assist evidence-based policy recommendations.

As these meetings happened very recently, no publications stimulated by them have been reported to NIMBioS. However, each meeting has fostered new transdisciplinary collaborations.

### **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, 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. The summer 2019 program included 18 undergraduates in math and biology fields, 11 of whom were female.

Our tenth annual Undergraduate Research Conference at the Interface of Biology and Mathematics (October 2018), which attracted more than 100 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, graduate students and teachers) are in the training and professional development section of this report. Throughout its history, as well as in the current reporting period, NIMBioS has held career development activities for postdocs and graduate students to assist them in planning their long-term objectives. During this reporting period, using UT funds, NIMBioS held an open competition for UT graduate awards of \$2500 to advance a student's career through support for field or lab work, meeting attendance, or collaboration with the MMCC. NIMBioS provided 20 awards to students from across ten different UT graduate programs.

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.

### **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 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. NIMBioS' Spatial Analysis Laboratory (SAL) has been developed as a resource for both internal and external researchers. The equipment available through SAL 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 also has an expanded 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. Since the inception of NIMBioS, the University has hired nine faculty to enhance and expand expertise in areas related to the NIMBioS mission.

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 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**

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, through July 1, 2019 and now under the University of Tennessee's Office of Research and Engagement (ORE). In addition to P. Bishop, the team during this reporting period included three evaluation associates and several undergraduate and graduate assistants. 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 a project meets or fails to meet its objectives.

#### Center for the Dynamics of Social Complexity (DySoC)

A number of NIMBioS-supported activities focused on transferring methods and insights from mathematical and computational biology to social sciences and have resulted in establishment of this Center. This Center unites 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 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. A particular emphasis has been a collaboration with an NSF-INCLUDES supported project based at Auburn University to support the training of students with disabilities. NIMBioS also hosted a world-premiere performance this reporting period by the rap music artist Baba Brinkman of his Rap Guide to Culture. The performance was widely advertised and open to the broad Knoxville community. Brinkman visited

NIMBioS to participate in the Investigative Workshop on Social Norms, as part of which he created "rap-ups" of each day's discussions, videos of which are posted on the NIMBioS website.

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 listservs, 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.

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## 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, 2018 – Aug 31, 2019**

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**Y11-1. NIMBioS Evaluation Report**

**Y11-2. Participant List for NIMBioS Events and Activities**

**Y11-3. Description of Activities**

**Y11-4. Additional Products**

**Featured Articles**

**Websites**

**Media Coverage**

**Y11-5. NSF Budget Office Reporting Requirement: Institutions, Partners,  
Participants**

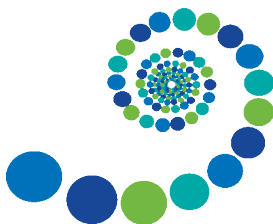


# **Addendum to NIMBioS Annual Report**

## **Sep 1, 2018 – Aug 31, 2019**

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**Y11-1. NIMBioS Evaluation Report**



NIMBioS

National Institute for Mathematical  
and Biological Synthesis

## **NIMBioS EVALUATION REPORT**

**REPORTING PERIOD ELEVEN**

**SEPTEMBER 1, 2018 – JUNE 30, 2019**

**National Institute for Mathematical and Biological Synthesis**

**July 2019**

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National Institute for STEM Evaluation and Research

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This work was conducted at the National Institute for Mathematical and Biological Synthesis, supported by the National Science Foundation through NSF Award #DBI-1300426, with additional support from The University of Tennessee, Knoxville. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.



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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.

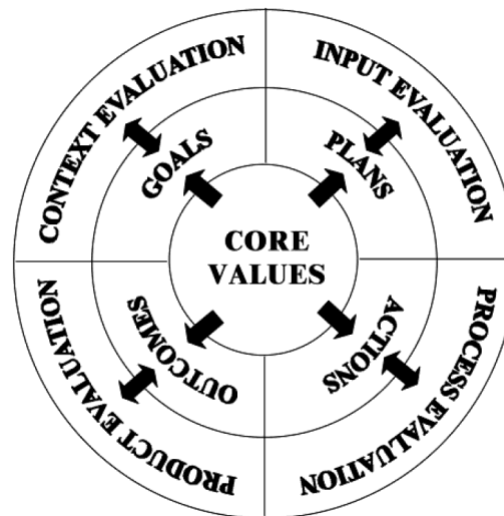
**Product Evaluation** assesses outcomes of the program.

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

## INTRODUCTION

This is an evaluation summary of NIMBioS activities during the eleventh annual reporting period (RP 11) to the National Science Foundation. This report covers the period of September 1, 2018 through June 30, 2019. 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 it is continuously maintaining a diverse atmosphere in a number of ways. Data sources for input evaluations include the participant demographic information and accepted requests for support. At this phase, several goals comprise the context for the input evaluation:

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

## **PROCESS 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. 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 11

Table 1. Research program activities

Activity	RP 11	All Years
Working Groups (# meetings hosted)	7 (10)	59 (183)
Investigative Workshops	6	53
Tutorials	3	27
Postdoctoral Fellows	5	49
Short-term visitors	16	383
Visiting graduate student fellows	0	8
Visiting Scholars	3	7
Sabbaticals	0	17

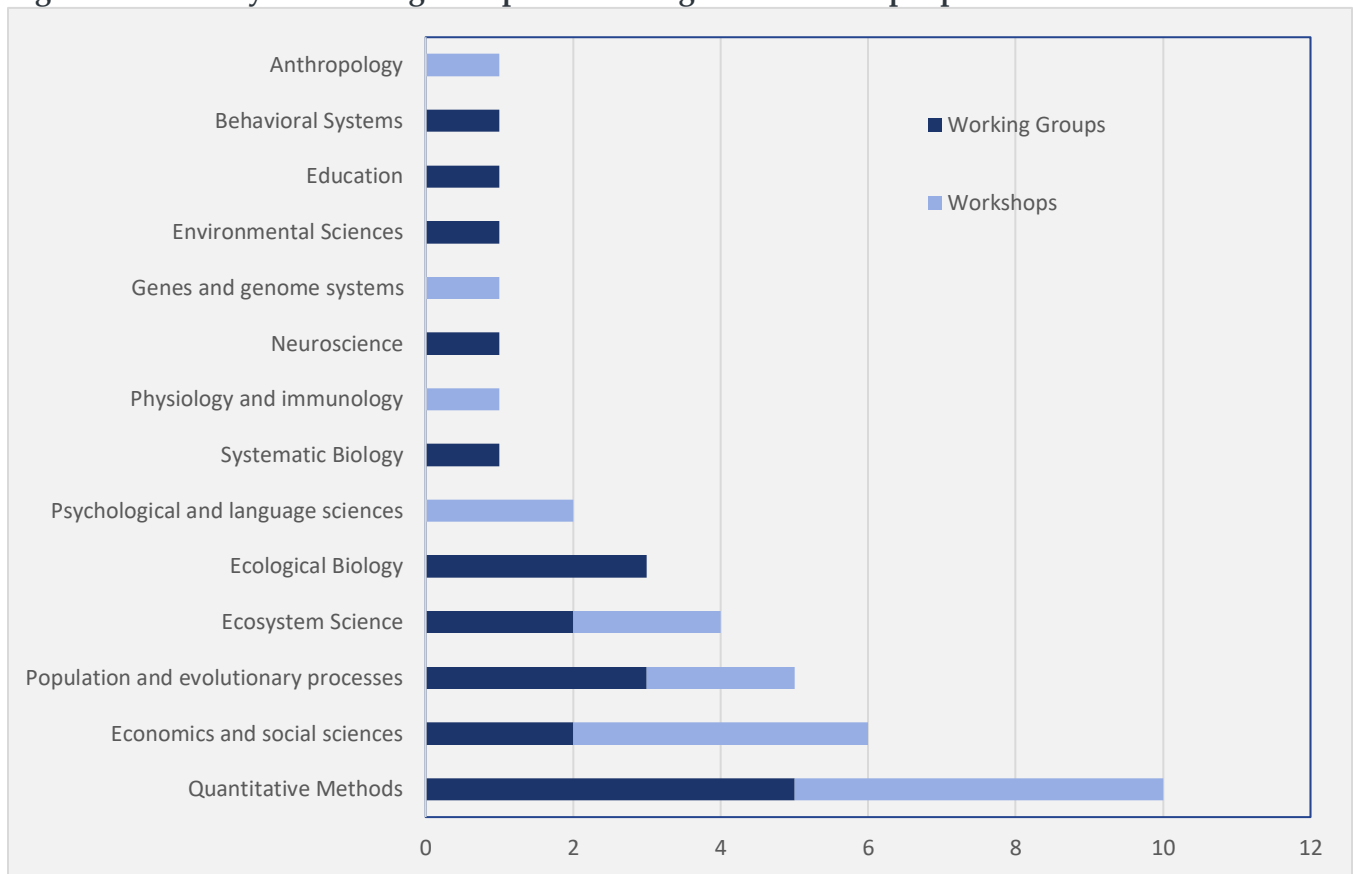
Education and Outreach (EO) program activity highlights (RP 11) include:

- NIMBioS Interdisciplinary Seminar Series
- 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
- Network Modeling Tutorial

## 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 ensure that a broad range of research areas are covered (**Figure 2**).

**Figure 2. Diversity of Working Group and Investigative Workshop topic areas**



## DIVERSITY OF PARTICIPANTS

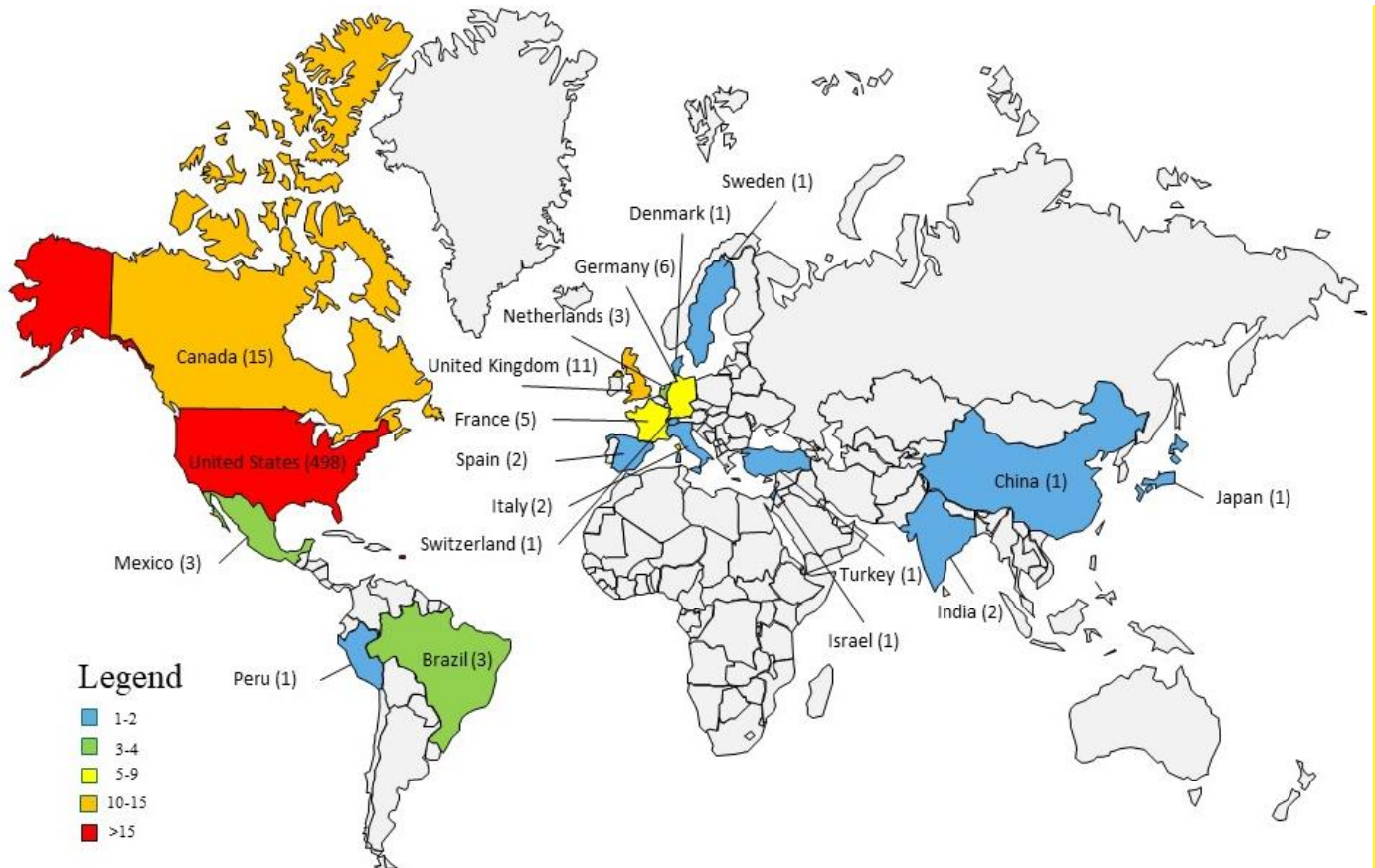
One of the core values of NIMBioS is to increase the diversity of researchers and educators at the interface of mathematics and biology. NIMBioS collects voluntary demographic data from event applicants to gauge whether its program is fairly reaching and benefitting everyone regardless of demographic 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 are optional. When feasible, 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.

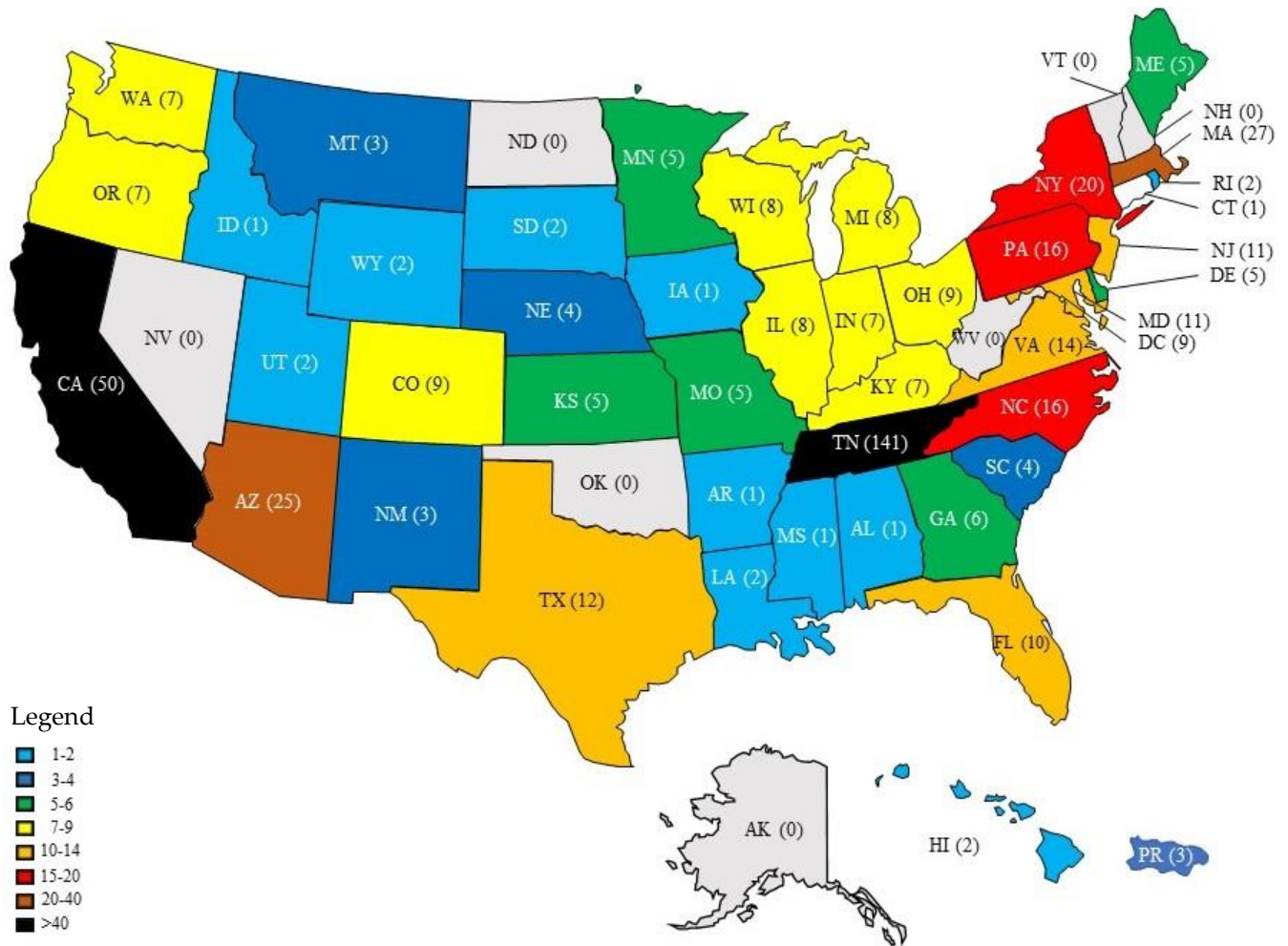
**Geographic Diversity.** During RP 11, 558 participants (449 unique individuals) from 19 countries participated in NIMBioS events. Most participants came from the United States (89%), followed by Canada (3%) and The United Kingdom (2%) (**Figure 3**).

**Figure 3. NIMBioS RP 11 participants by country**



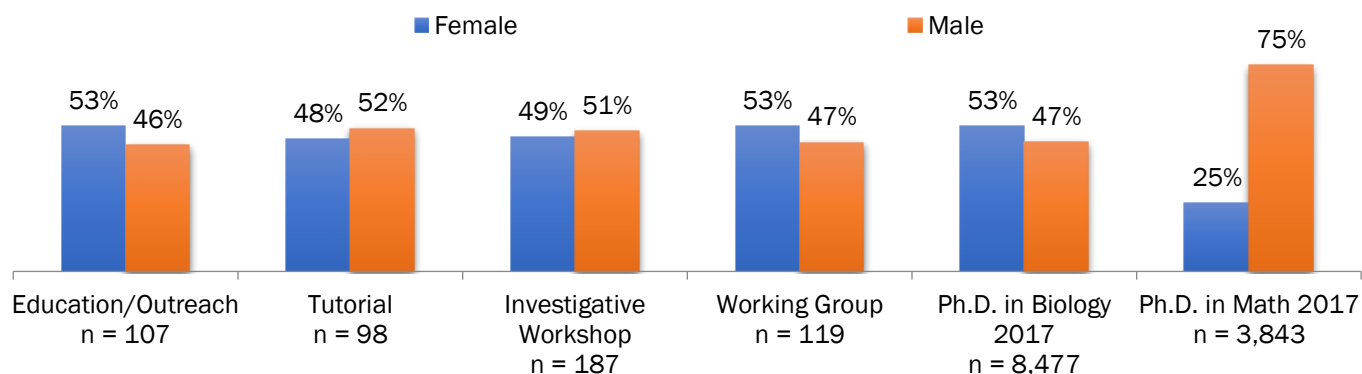
Within the United States., 44 different states, as well as the District of Columbia and Puerto Rico, were represented. The largest percentage of participants came from within Tennessee (28%), followed by California (10%), North Carolina (10%), Massachusetts (5%), Arizona (5%), and New York (4%) (**Figure 4**).

**Figure 4. NIMBioS RP 11 participants by U.S. state**



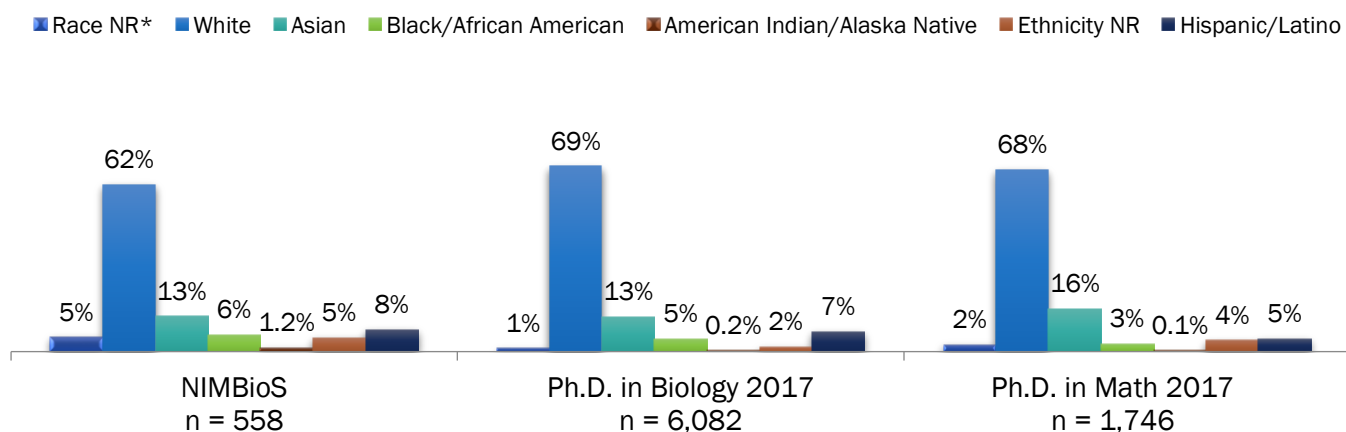
**Gender, Racial, and Ethnic Diversity.** Across all events during RP 11, female participation was 51%. Within specific activity types, the gender ratio varied slightly, from 53% in Education/ Outreach and Working Groups to 48% in Tutorials (**Figure 5**). Comparison groups shown are all individuals receiving doctorates in biology and mathematics in the U.S. in 2017 (data from NSF Survey of Earned Doctorates). The overall distribution of females in NIMBioS activities falls within the range of awarded Ph.D.s in biology in the U.S. and is roughly twice the number of awarded Ph.D.s in mathematics.

**Figure 5. Gender composition of participants by event type**



Overall minority representation across NIMBioS events during RP 11 was 13% and exceeds the numbers for doctoral recipients in the biological and mathematical sciences (**Figure 6**). Comparison groups shown are all U.S. citizens and permanent residents receiving doctorates in biology and mathematics in the U.S. in 2017. Minority representation varied among programs<sup>1</sup>.

**Figure 6. Minority representation of NIMBioS participants**



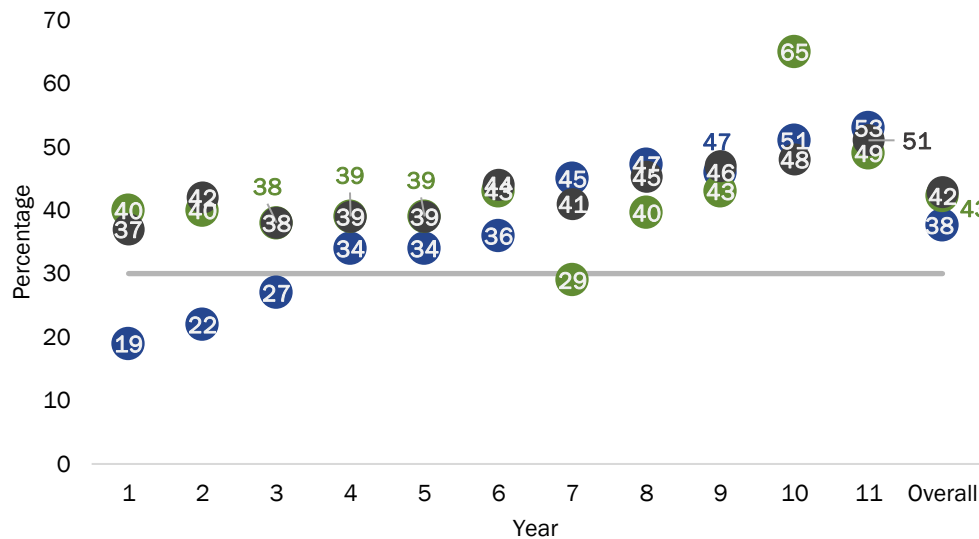
\*NR = not reported

<sup>1</sup> 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, 2017 Data)

**Diversity Benchmarks.** The NIMBioS leadership team consulted with the NIMBioS advisory board in response to the recommendation by the site review committee in June 2010 that it establish a variety of benchmarks for its programs. The site review committee particularly recommended that benchmarks be developed for 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 7 to 12.**

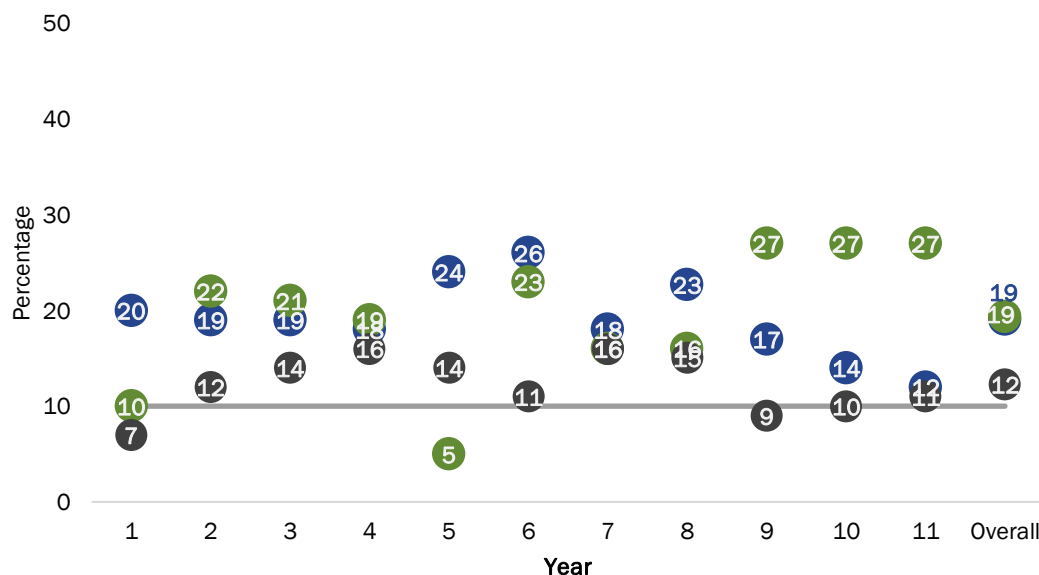
**BENCHMARKS FOR DIVERSITY IN ALL PARTICIPANTS**

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



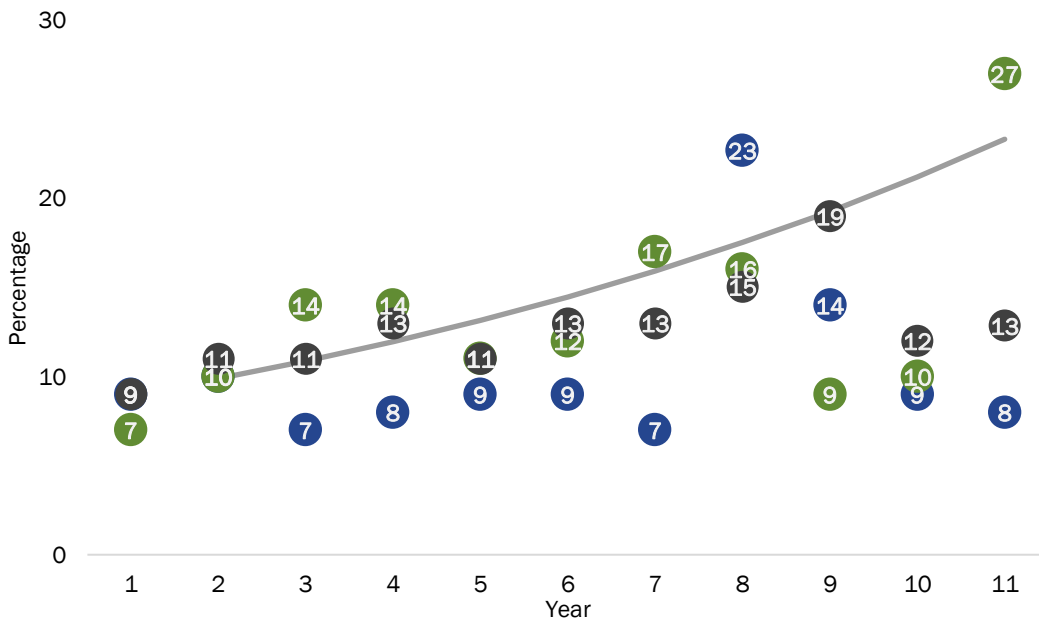
**Benchmark.**  
The proportion of female participants will be at least 30%.

**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%.

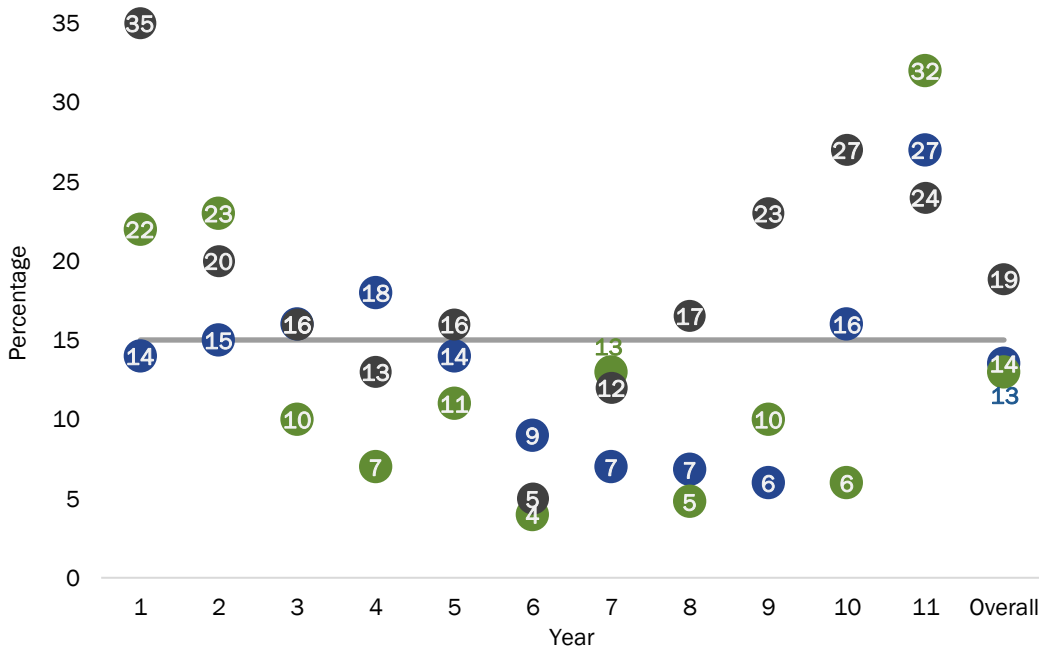
**Figure 9. Proportion of participants from underrepresented groups across all NIMBioS activities, Working Groups and Investigative Workshops**



**Benchmark.** Increase the percentage of participants from underrepresented 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  $(t=1)$ .

**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 ONLY  
 ONLY ORGANIZERS WHO ATTEND EVENTS ARE INCLUDED IN COUNTS

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

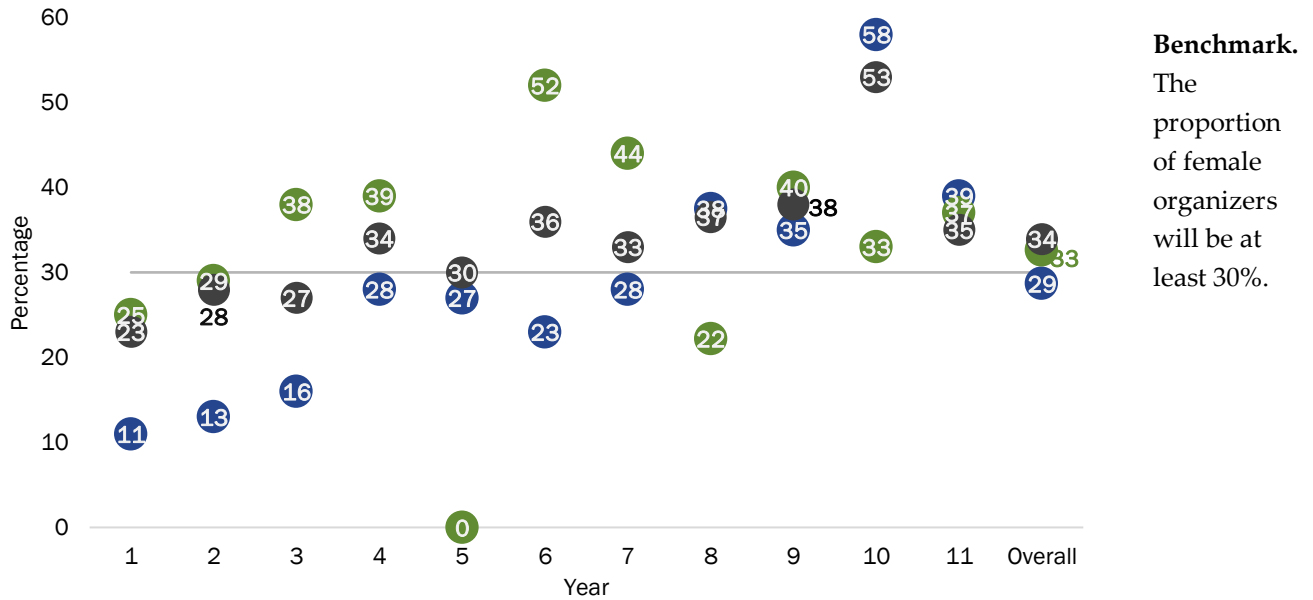
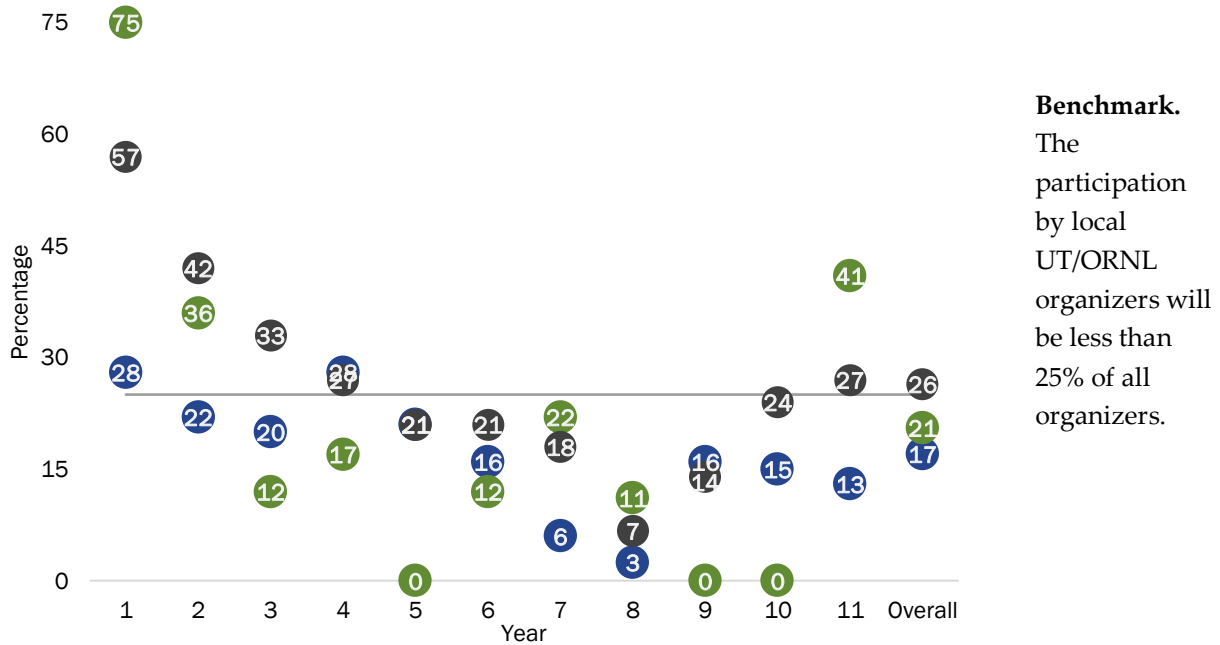


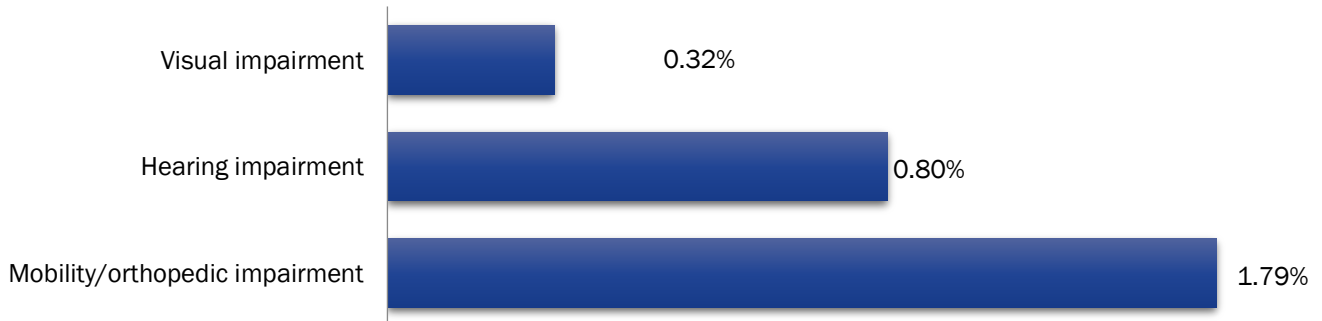
Figure 12. Proportion of local organizers across Working Groups and Investigative Workshops



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.

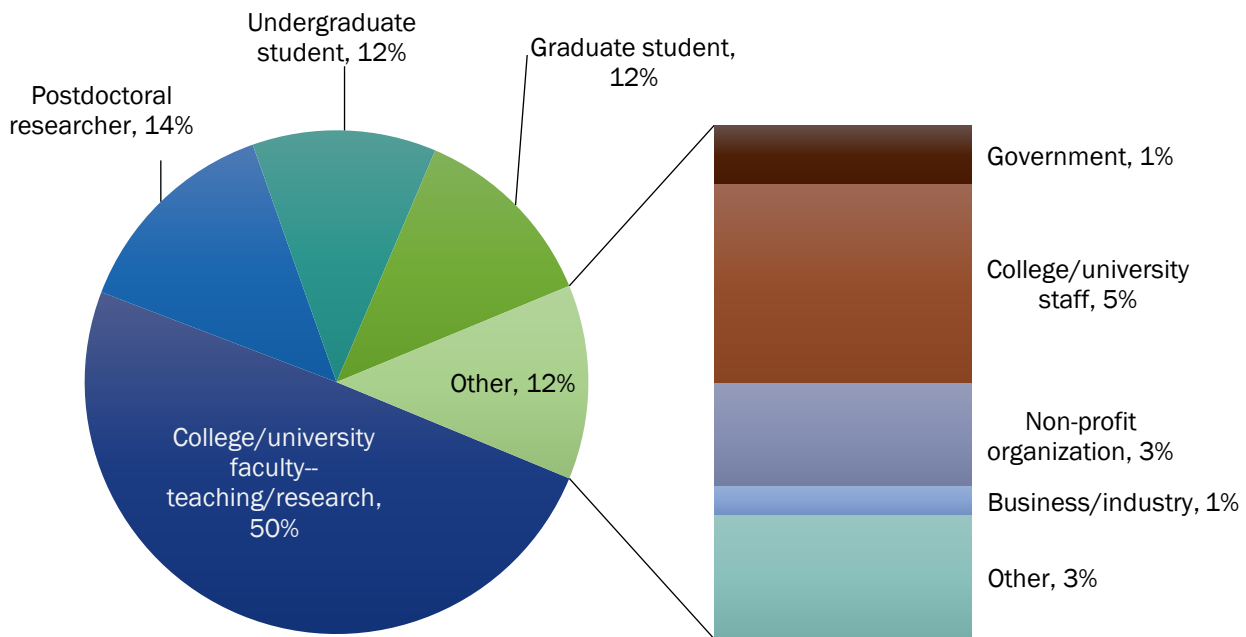
**ABILITY DIVERSITY.** Disclosure of disability status by participants to NIMBioS is optional. Around 2% overall indicated having some sort of disability during RP 11 (**Figure 13**).

**Figure 13. Disability status of participants (n = 558)**



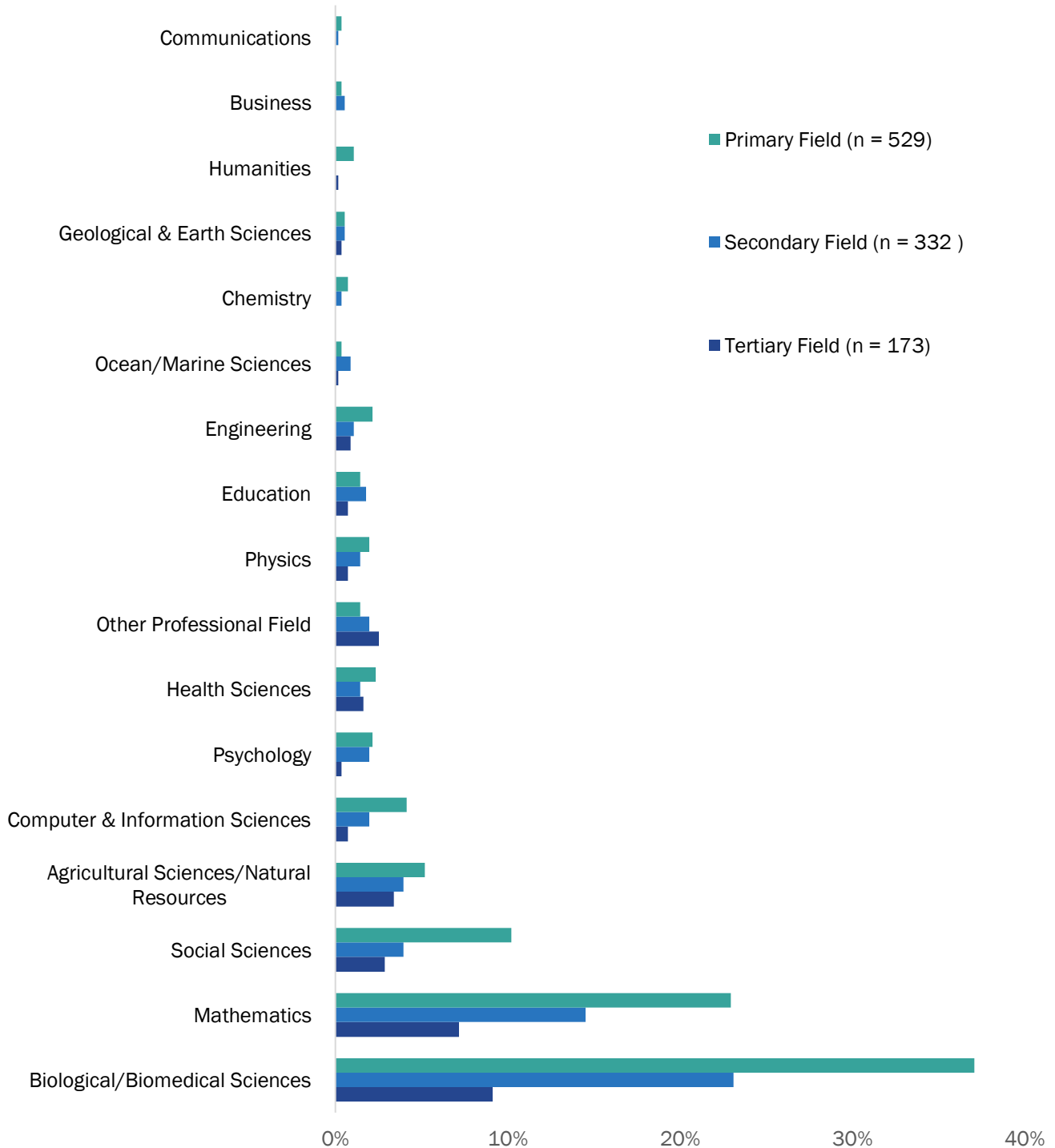
**OCCUPATIONAL DIVERSITY.** The majority of NIMBioS participants were college/university faculty, postdoctoral researchers, undergraduate students, or graduate students; however, participants came from government, industry, non-profit, and other positions as well (**Figure 14**).

**Figure 14. Employment status of participants (n = 558)**



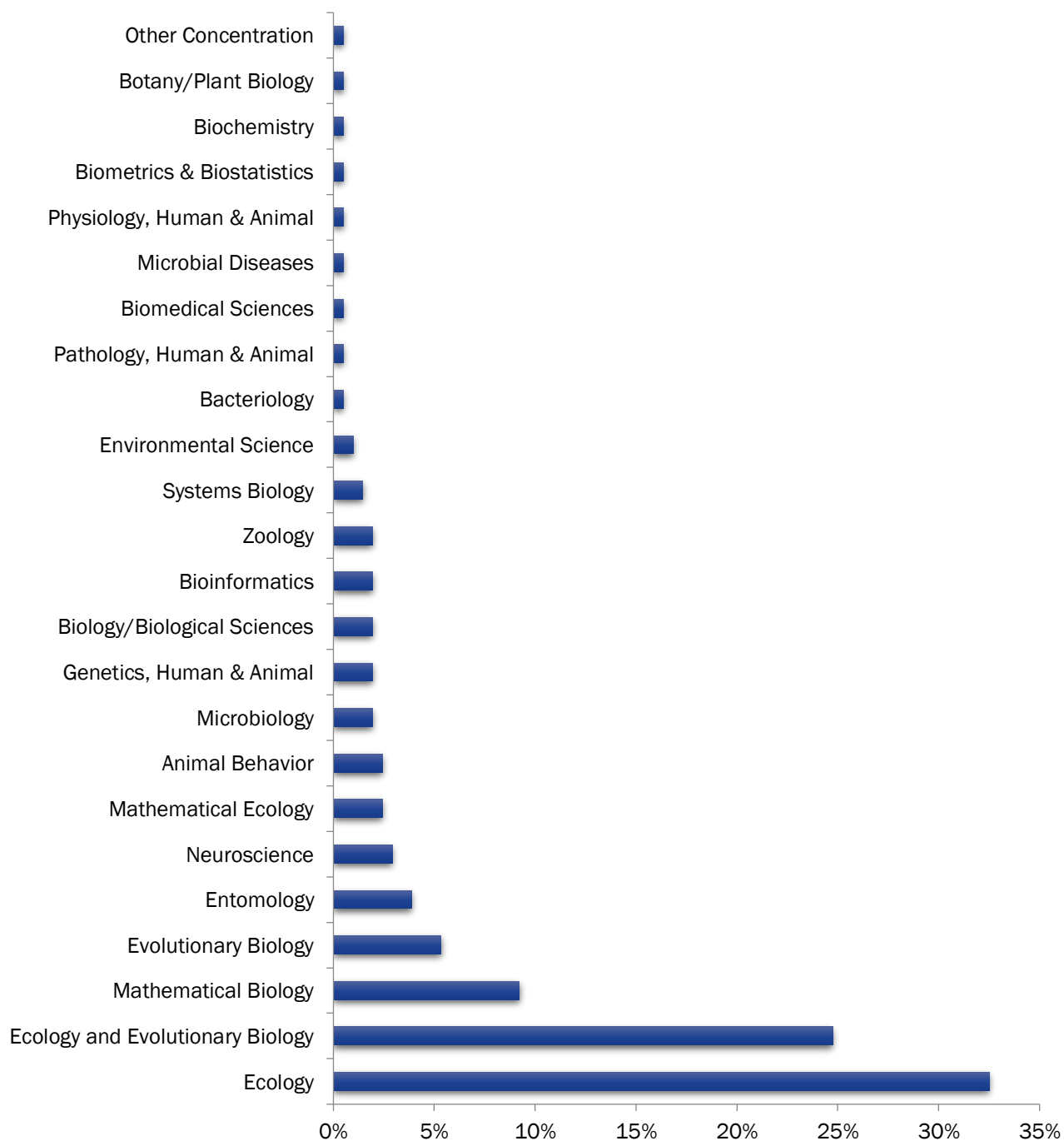
**DISCIPLINARY DIVERSITY.** Most participants at NIMBioS indicated their primary fields of study, as well as areas of concentration within those fields. Many indicated their secondary and tertiary fields of study as well. The most commonly reported fields of study included biological/biomedical sciences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

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



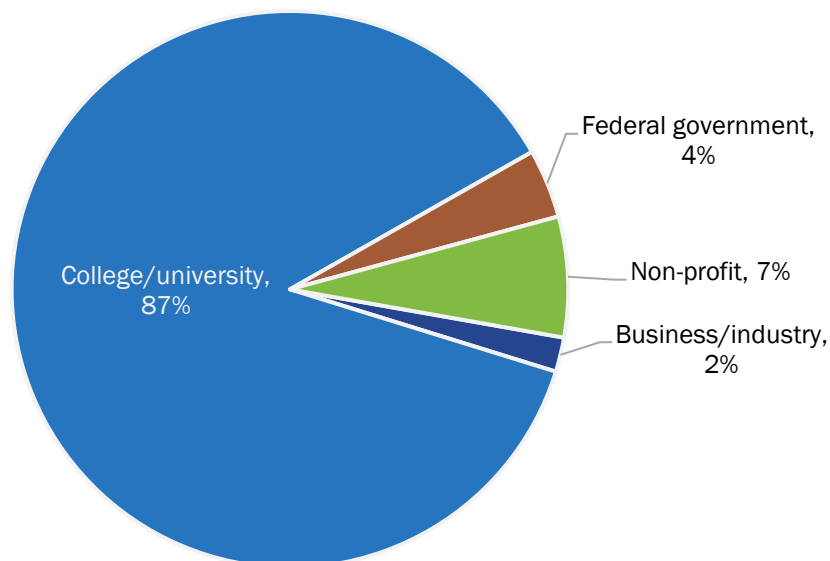
The 206 participants indicating Biological/Biomedical Sciences as their primary field of study indicated 24 different areas of concentration within which they would classify their primary areas of research/expertise. The most commonly indicated area of concentration was ecology (33%), followed by ecology & evolutionary biology (25%), and mathematical biology (9%) (Figure 16).

**Figure 16. Participant expertise area concentrations within biological/biomedical sciences field of study ( $n = 206$ )**

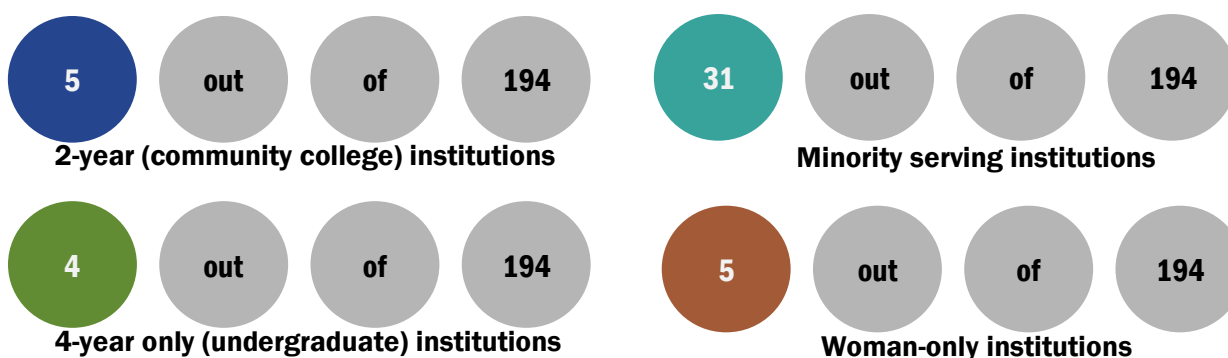


INSTITUTIONAL DIVERSITY. Participants during RP 11 represented 223 different institutions, including colleges and universities, government institutions, industry, and non-profits (**Figure 17**). Of the 194 colleges/universities represented, 185 were classified as comprehensive (having undergraduate and graduate programs). **Figure 18** provides more information about institutional diversity.

**Figure 17. Types of institutions represented (n =223)**



**Figure 18. Characteristics of participants' colleges/universities (n = 194)**



## 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 have included 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 conducts formal process evaluations of its Working Group meetings, Investigative Workshops, Undergraduate Research Conference at the Interface of Biology and Mathematics, Postdoctoral Fellowship program, Tutorials, 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 leadership and 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 11.

### 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 11 Summary

Number of different  
Working Groups supported  
by NIMBioS during RP 11

7

Total Meetings

10

Total participants

118

Total unique participants

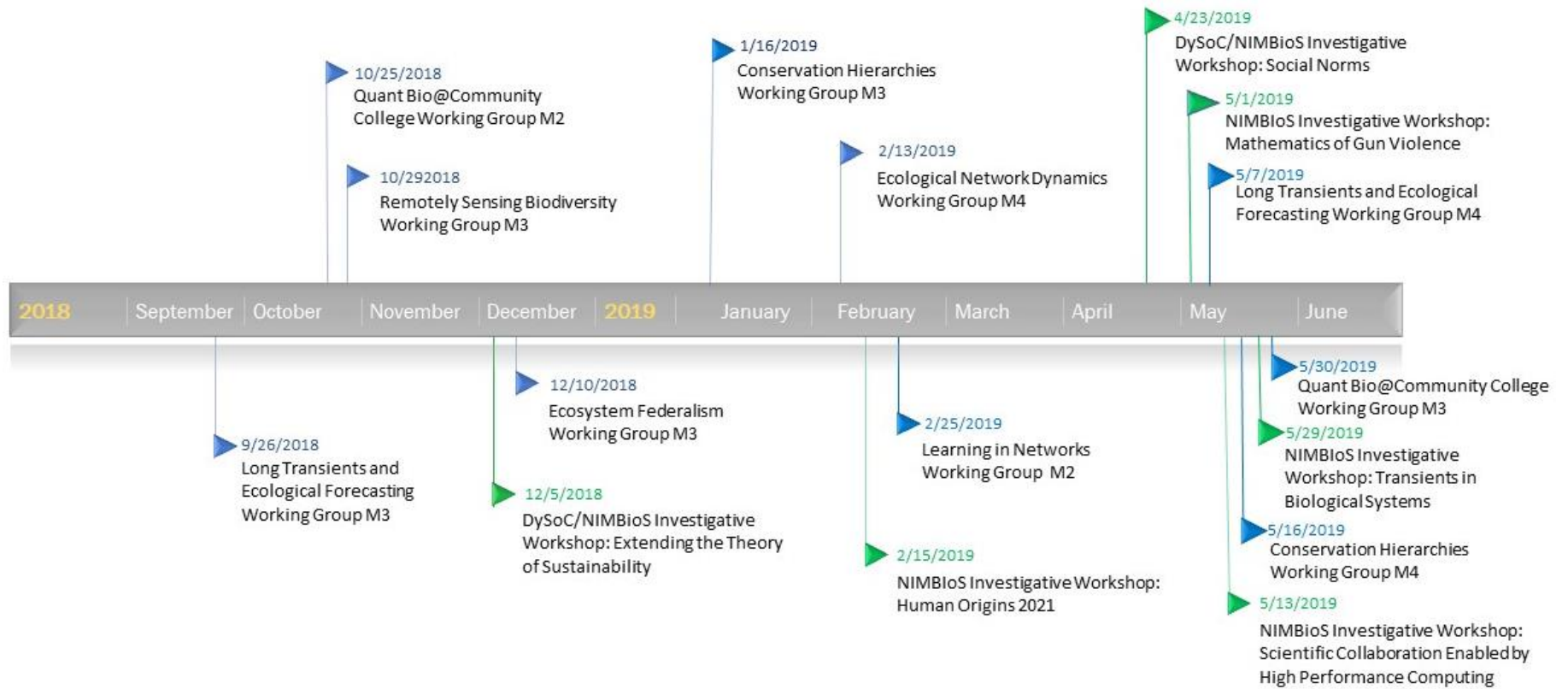
82

**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 addressed may be 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 postdoctoral fellows 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 11, NIMBioS hosted 10 Working Group meetings (from 7 different groups) – see **Figure 19**. A total of 118 participants (82 unique) from 76 institutions took part in the Working Groups. During RP 11, participants came together from nine different major fields of study to focus on the respective scientific questions of their groups.

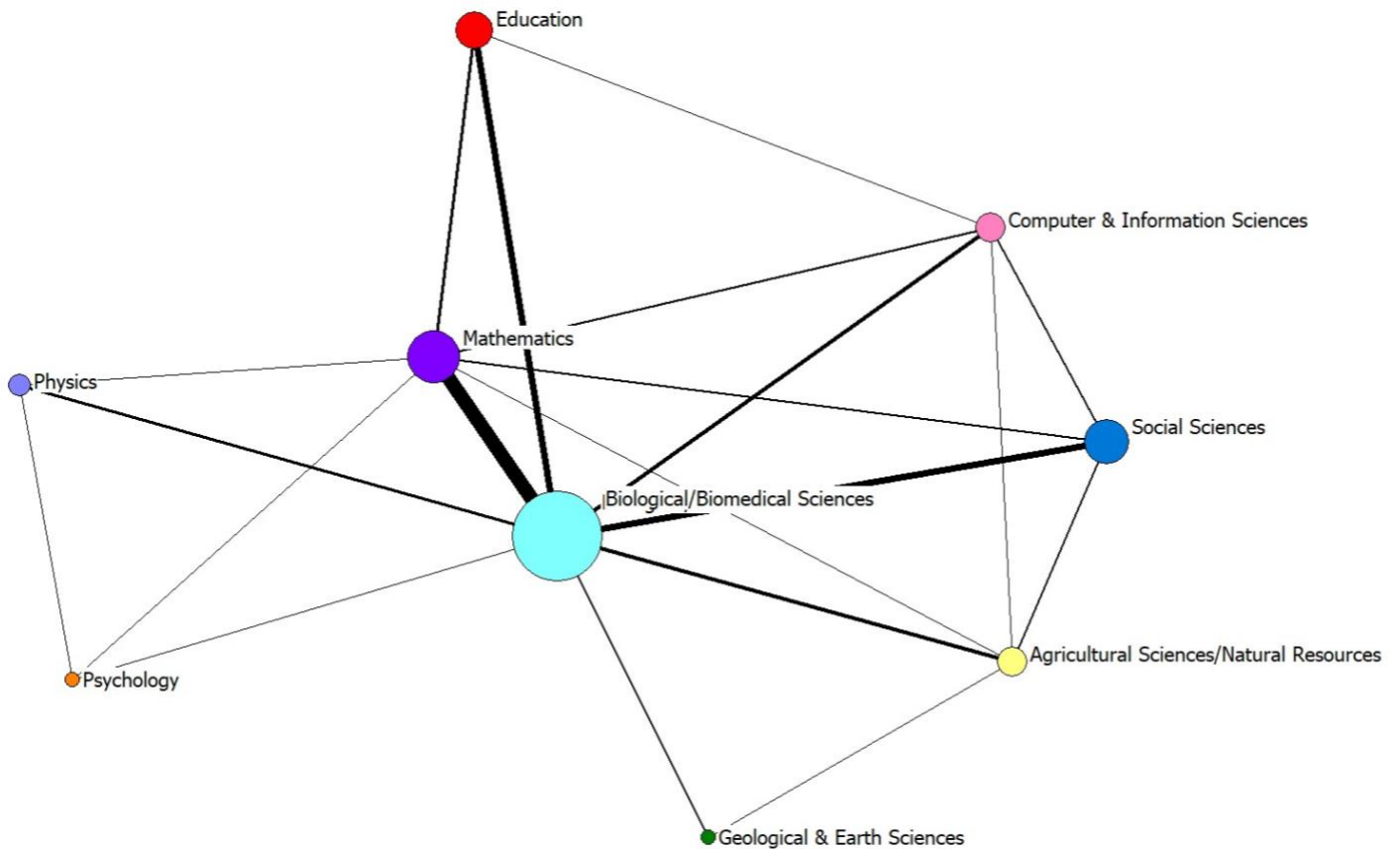
Figure 19 . Timeline of RP 11 Working Group and Investigative Workshop events





**Figure 20** shows the cross-disciplinary connections fostered among Working Group members through the meetings hosted at NIMBioS during RP 11. Node radius is representative of the log scaled number of participants identifying with 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? All organizer respondents ( $n = 27$ ) 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

“The Working Group is going really well. Various products are marching forward that are highly interdisciplinary, and each make clear modeling innovations in the relevant literature. NIMBioS support during this most recent meeting and throughout the Working Group meeting series has been excellent.

“It will, in the long run, be very productive. I have established new collaborations that I look forward to continuing.

“A perfect experience: a group of top-level academics have worked together very efficiently, now for the third meeting in a row, resulting in essential scientific products. Support from NIMBioS was crucial for this activity, and the NIMBioS staff have always been friendly and efficient, too.

From the organizers:

“It is nice to have someone else make travel arrangements. Meals and meeting space are all great.

“NIMBioS is amazing!!

### Working Group First Meetings

During RP 11, NIMBioS did not host first meetings of any groups due to the center being near the end of its funding cycle.

### Working Group Second, Third and Fourth Meetings

During RP 11 NIMBioS hosted the second meetings of two Working Groups with 26 participants, the third meeting of five Working Groups with 61 participants, and the fourth meeting of three groups with 32 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 (i.e. follow-up surveys after conclusion of the groups), rather than after every meeting, however, comments were solicited about the general feeling about the group's progress after each meeting.

### Concluded Working Groups

To date, total of 57 working groups have concluded with NIMBioS (the 58<sup>th</sup> and final group will conclude in August 2019). It is the policy of NIMBioS to send follow-up evaluation surveys to Working Group participants around six months after NIMBioS leadership has been informed that a group has concluded. A total of 345 participants responded to the final evaluation for their groups to date. Five groups will receive their final evaluation survey after the date of the current report.

## Working Group Feedback

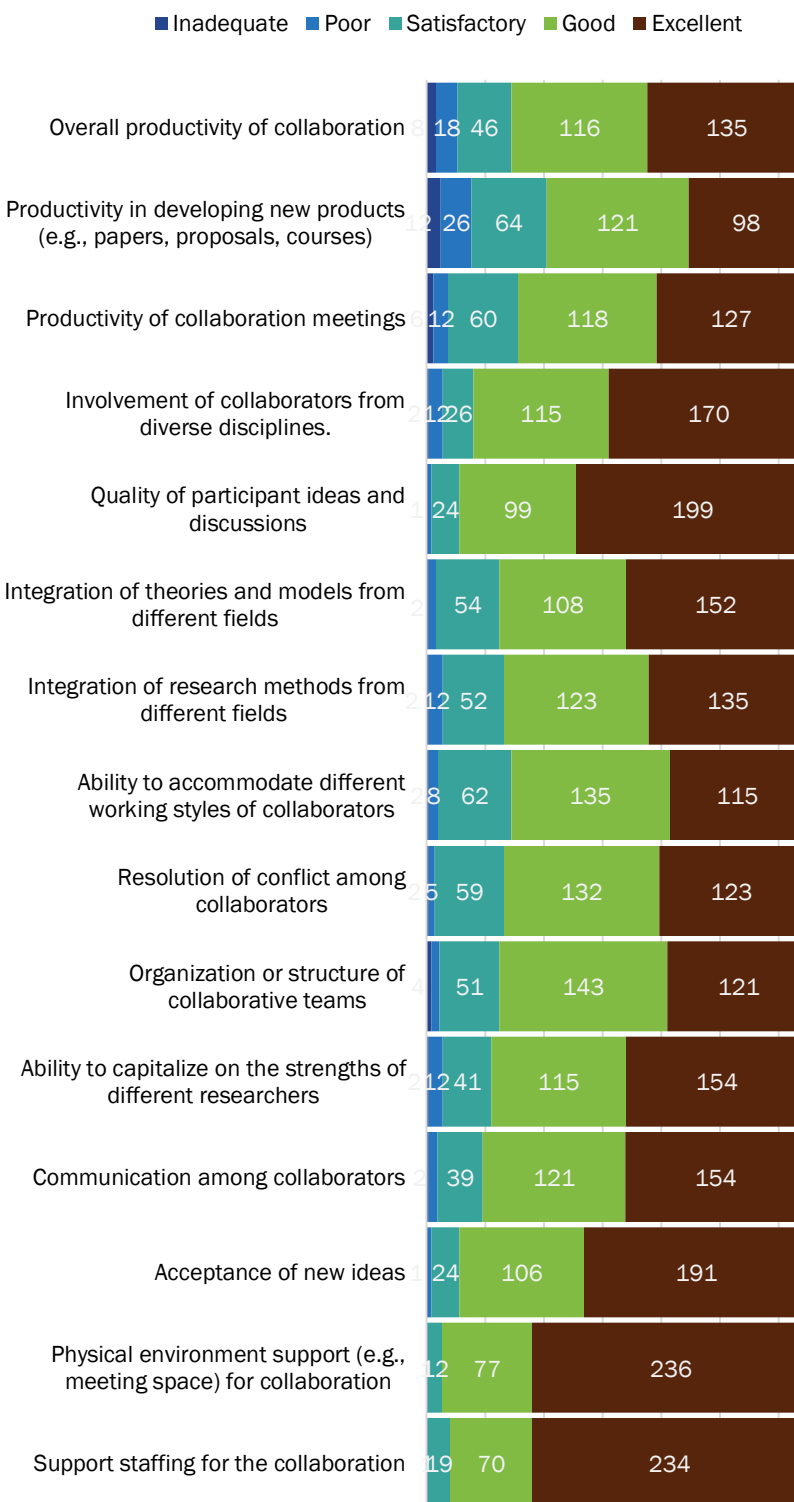
Number of Working Group past participants who have responded to the follow-up surveys  
**345**

“A strong collaboration was developed during the meetings and for the final product (manuscript).”

“A very high degree of cooperation and collaboration. Plus, the creation of social bonding and friendship with most of my co-workers!”

## HIGHLIGHTS OF WORKING GROUP FOLLOW-UP EVALUATION RESPONSES (FIGURES 21 TO 23)

Figure 21. Evaluation of various aspects of Working Groups



## Working Group Feedback

“...the Working Group members decided to continue their meetings beyond the Nimbios funding period (on their own expense). This is obviously a very strong indication of the appreciation of the meetings.

“A very stimulating intellectual environment!

“I could have done more with the subject if I were funded for it beyond the working group meetings.

Figure 22. Evidence to support new insights and collaborations within the group

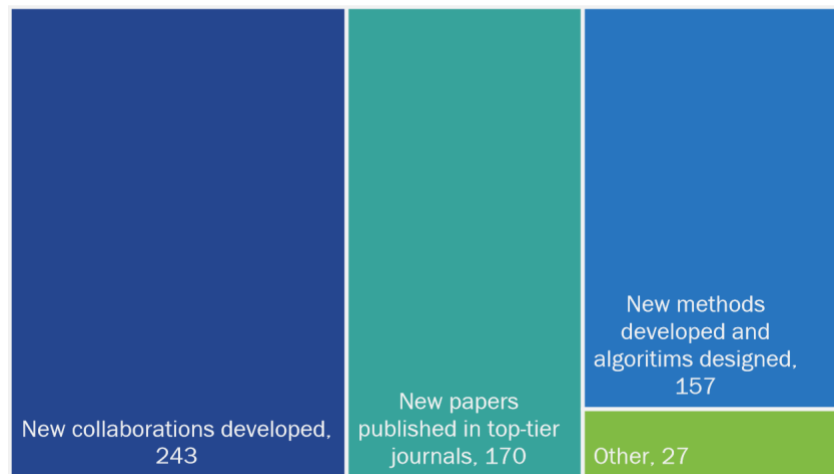
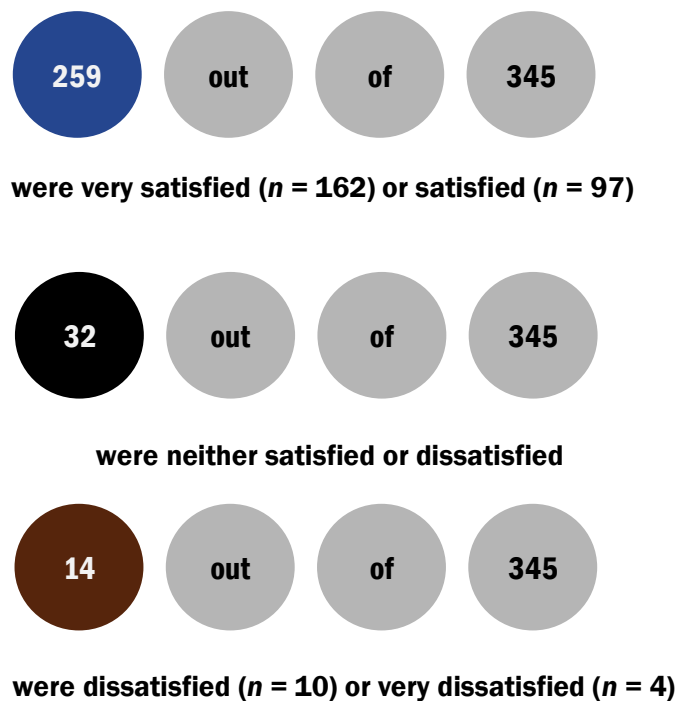


Figure 23. Overall satisfaction level of Working Group participants



# Investigative Workshops: RP 11 Summary

Number of Investigative Workshops supported by NIMBioS

6

Total participants

187

## INVESTIGATIVE WORKSHOPS

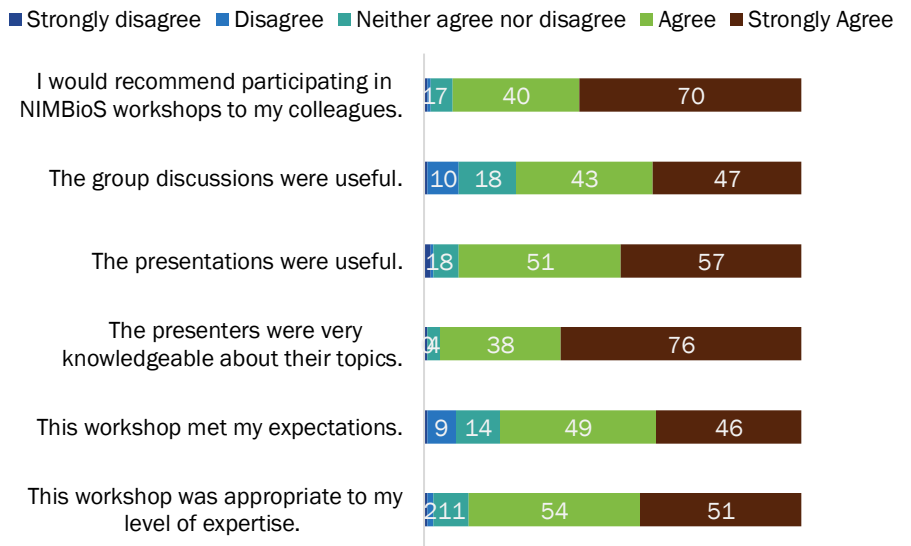
NIMBioS Investigative Workshops differ from Working Groups in that they focus on a broader topic or set of related topics at the interface of biology and mathematics and have relatively large size (30-40 participants). Workshops attempt to summarize/synthesize the state of the art and identify future 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 six Investigative Workshops during RP 11 with a total of 187 participants. Evaluation surveys were sent to all Workshop participants. A total of 133 participants took part in the evaluation of their Workshops (including 14 organizers who only answered questions about NIMBioS' handling of the event).


### HIGHLIGHTS OF WORKSHOP EVALUATION RESPONSES (FIGURES 24 TO FIGURE 26)


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


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



## Workshop Feedback

 Am already working on two collaborations with people I met at the workshop. Also, discussions from the workshop were directly relevant to my job interview at Cambridge the following week.

 I now feel better able to define social norms in a way understandable across disciplines and will use these definitions in future work.

 Excellent bunch of people, wonderful to meet them. The opportunities for mentorship (at many levels) was particularly appreciated.


 Participation in NIMBioS working groups and workshops has been formative in my career and continues to be a highlight of my job.

Figure 25. Most participants indicated “yes”, that participating in the workshop would influence their future research

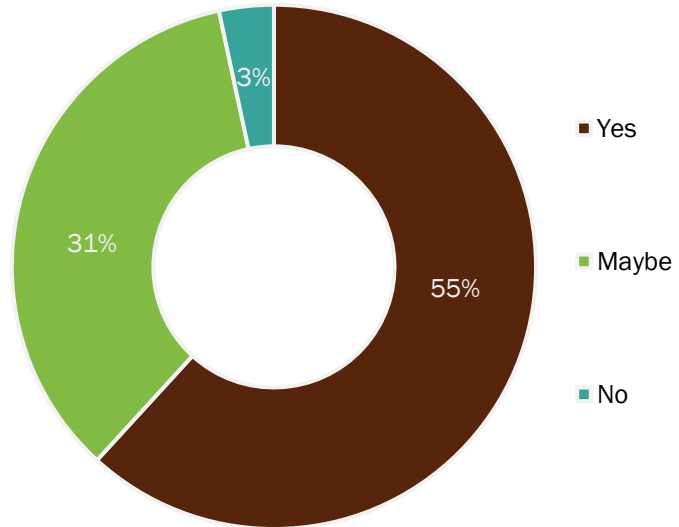
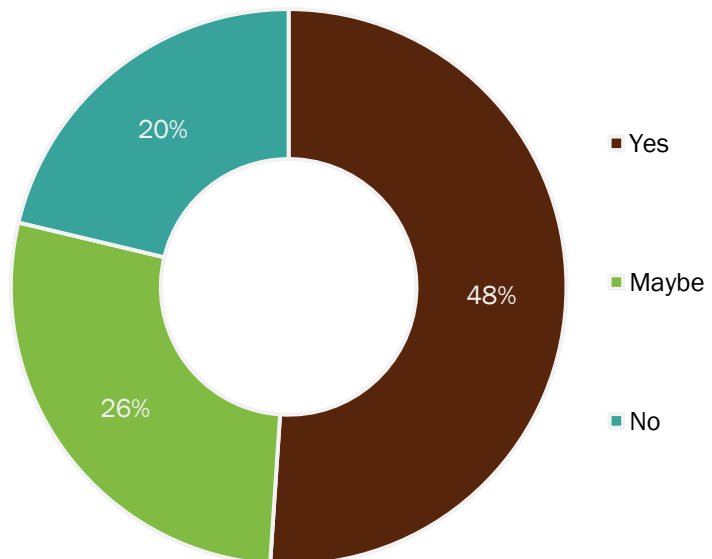


Figure 26. Many participants indicated “yes”, that they developed plans for collaborative research with other workshop participants with whom they had not previously collaborated



## Tutorials: RP 11 Summary

Number of Tutorials  
supported by NIMBioS

3

Total participants

98

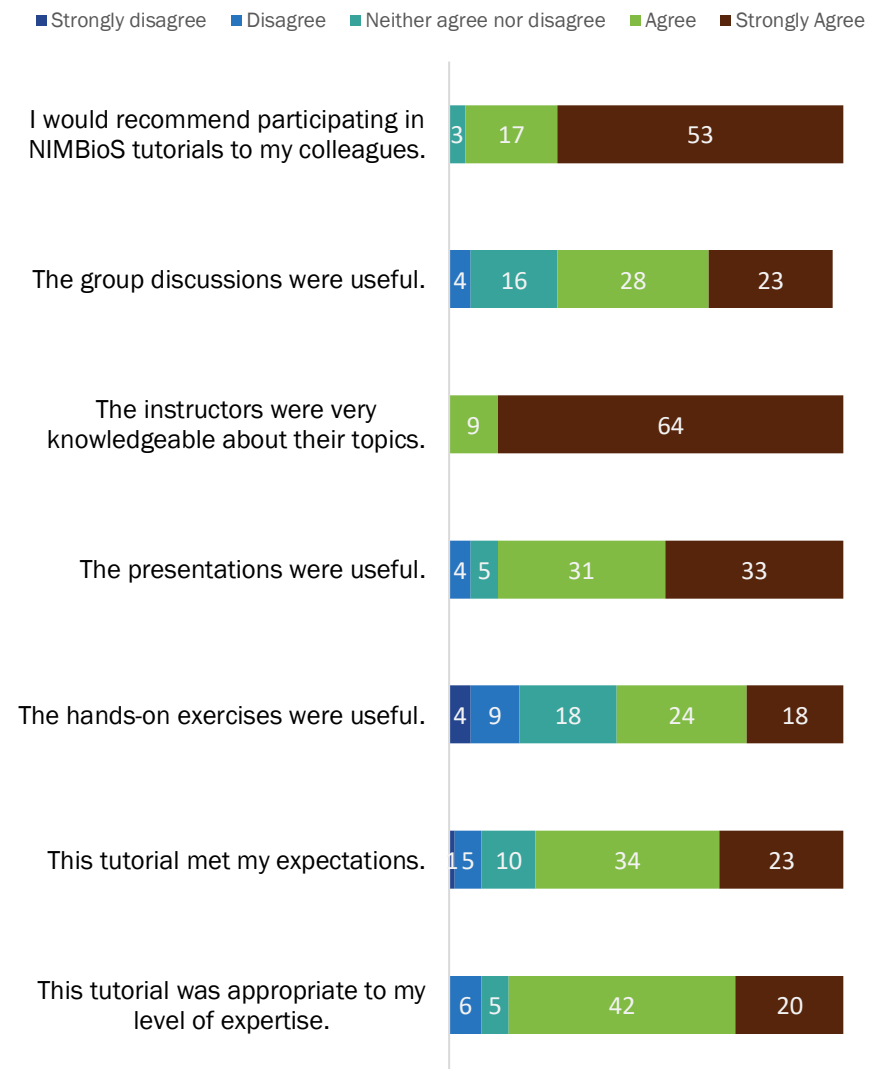
## EDUCATION AND OUTREACH PROGRAM ACTIVITIES

### Tutorials


NIMBioS Tutorials bring participants up to speed quickly on a variety of tools and topics. NIMBioS hosted three Tutorials during RP 11 with a total of 98 participants. Evaluation surveys were sent to all Tutorial participants. A total of 79 participants took part in the evaluation of the Tutorials (including five organizers who only answered questions about NIMBioS' handling of the event).


### HIGHLIGHTS OF TUTORIAL EVALUATION RESPONSES (FIGURES 27 AND 28)


**Figure 27. Participant overall satisfaction with the content and format of the Tutorial**



## Tutorial Feedback

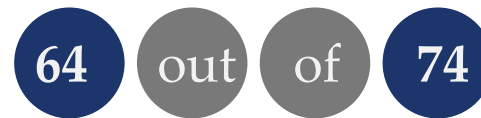
 I was very impressed with this tutorial. The material was of a very high content, and all the instructors were knowledgeable and approachable. I would say that putting the utility of the modelling into some kind of context could have been useful - it wasn't fully clear for which situations ecological niche modelling is best suited.

 I am really thankful for the tutorial opportunity, it was really helpful and interesting and you all make us feel very welcomed and happy! Thank you all!

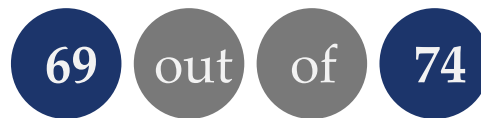
 Thank you! This was an exciting tutorial from organizers who were enthusiastic about the material and the subject. They were knowledgeable and open to questions.

**96%** OF PARTICIPANTS INDICATED THEY WOULD RECOMMEND PARTICIPATING IN NIMBIOS TUTORIALS TO THEIR COLLEAGUES

Figure 28. Overall participant satisfaction level with the Tutorial



**felt this was a very effective format for achieving their goals**



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



## SRE Highlights

**100%**

of SRE participants were very satisfied or satisfied with the research experience

**100%**

of SRE Participants would recommend the program to others

**100%**

of 2018 SRE Mentors were satisfied with the NIMBioS SRE program

### Summer Research Experience

The NIMBioS Summer Research Experience (SRE) program for undergraduates took place on the University of Tennessee (UT) Knoxville campus May 29-July 20, 2018. Fifteen undergraduates were chosen to participate in the program. (While this SRE program technically fell within the dates of reporting period ten (RP 10), the SRE program for 2019 will not conclude until after the RP 11 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 2018 program included: 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; The Spatial Interactions between Hunting and Plant Gathering in Tropical Forests; and Using Phylogenetics to Understand Cancer Tumor Evolution. Fourteen students responded to the evaluation pre and post surveys, which were situated in the following context.

#### 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 29 TO 31)

## SRE Feedback

I think the mentors were one of the greatest parts of this program. They were the best mentors I could have asked for. They did not just introduce me to research, but they also advise me on future graduate school opportunities. It has been really inspiring to work with them, and I can't wait to see them again in October during the Undergraduate Conference.

Something really awesome about everyone's topics here is how applicable it is to the real world. Like some people are doing cancer and diseases and invasive species and it's really cool to see how we can incorporate biology, math, economics, and just all of that together in a project-- it's pretty cool.

Figure 29. Participant pre-and post-program skills as rated by SRE student participants. (Lighter colors indicate pre-scores and darker colors indicate post-scores.)

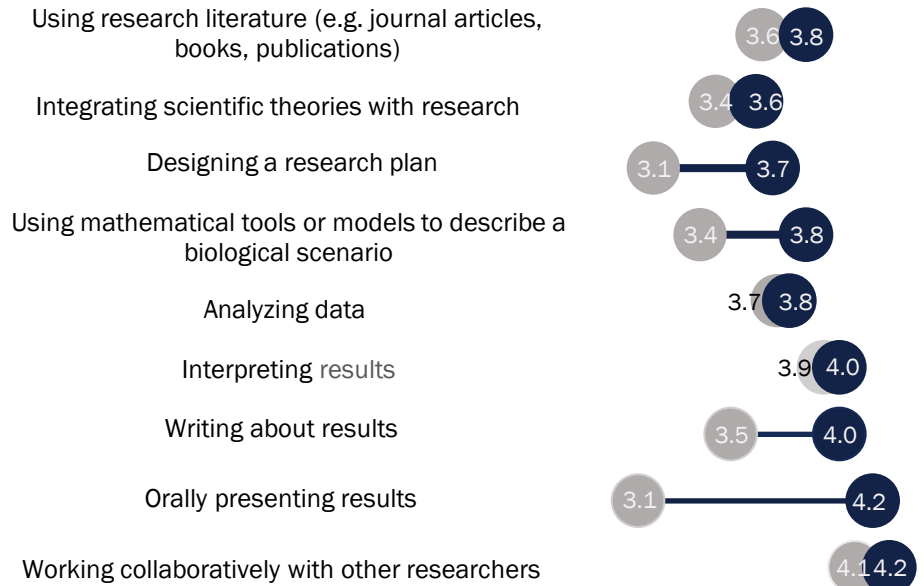
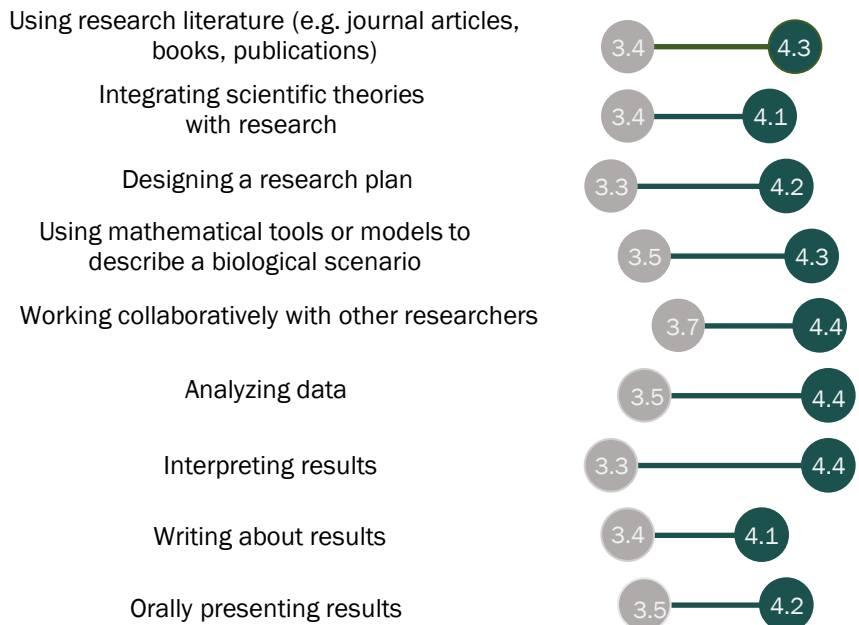


Figure 30. Participant pre-and post-program skills as rated by SRE Mentors. (Lighter colors indicate pre-scores and darker colors indicate post-scores.)



**Figure 31. SRE Student assessment of group mentors' skills and abilities in mentorship by group**



## URC Highlights

“ I was able to meet biology professors who also work with mathematicians. I previously have only worked with mathematicians, so this opportunity to see how closely the fields work together was enlightening.

“ At the conference, I was able to learn about the types of research that are going on in the intersection of mathematics and biology and I was able to meet and interact with the individuals who facilitate this research.

“ The Career Panel was the most useful aspect, because I like listening to the different opinions on certain aspects of Grad School and stories that these professors give about the way their career path was molded. Listening to this information helps me see things that I might not have seen had I not heard them or make me consider different ways of pursuing careers.

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

The NIMBioS 10th Annual Undergraduate Research Conference at the Interface of Biology and Mathematics took place at the University of Tennessee's Conference Center in downtown Knoxville on October 27-28, 2018. The event was organized by the NIMBioS Education and Outreach Associate Director for Education, Outreach, and Diversity, Suzanne Lenhart, and the Education and Outreach Coordinator Greg Wiggins.

A total of 62 participants attended the 10<sup>th</sup> 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, a graduate school showcase, and networking opportunities. Faculty and students were invited to attend, as well as high school teachers. Evaluation surveys were sent to all participants in the conference. A total of 62 participants took part in a feedback survey. Of those, 44 (71%) were undergraduate students and 18 (29%) were non-undergraduate students. Evaluation post surveys were situated in the following context.

#### CONTEXT

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

#### HIGHLIGHTS OF URC EVALUATION RESPONSES (FIGURES 32 TO 35)

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

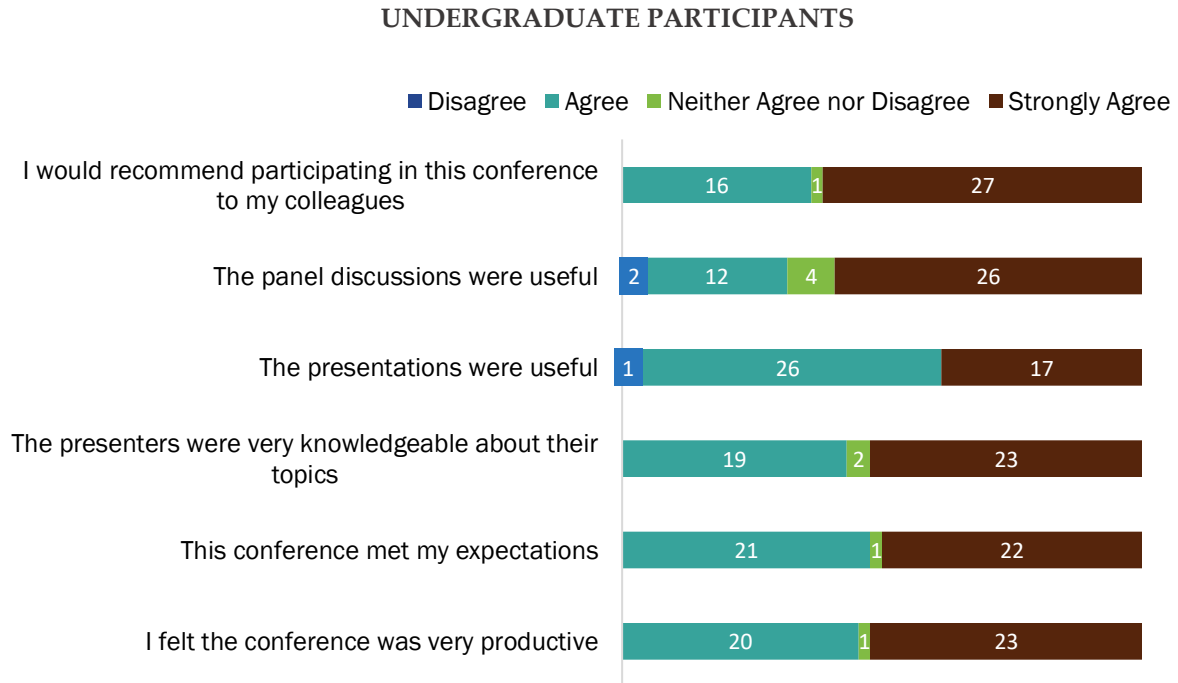


Figure 33. Respondent agreement levels with statements about various aspects of the conference for **non-undergraduate** participants

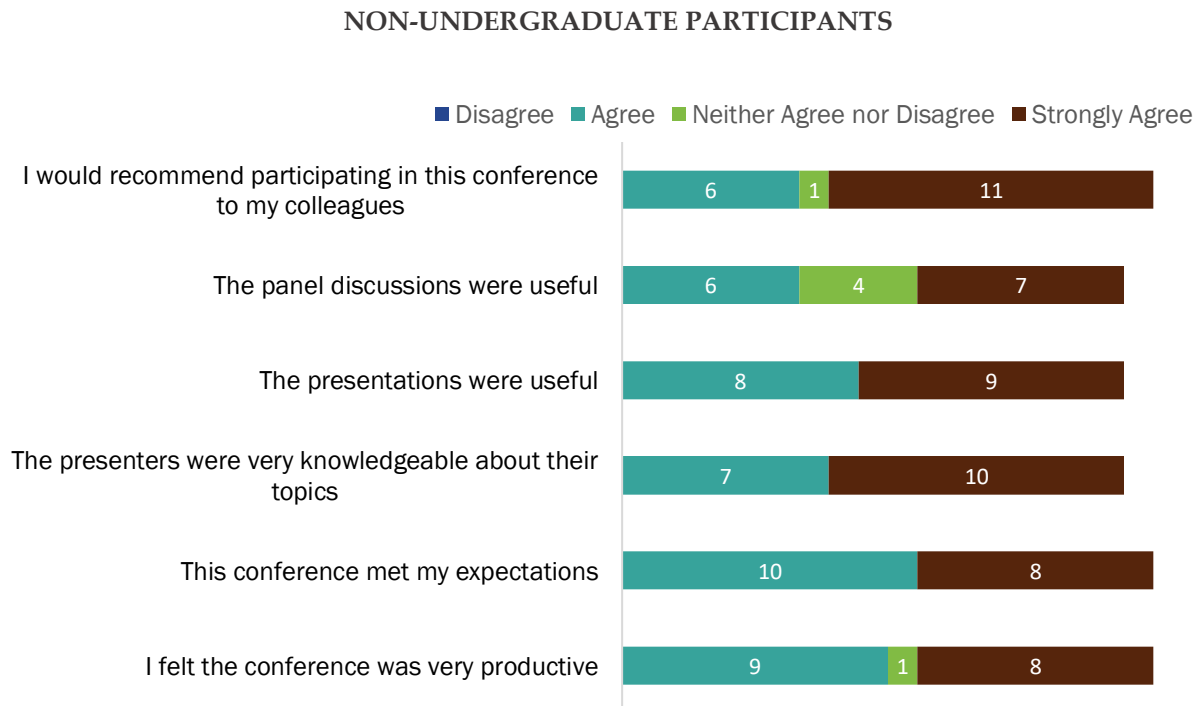


Figure 34. For **undergraduate** participants-- As a result of attending this conference, I have a better understanding of:

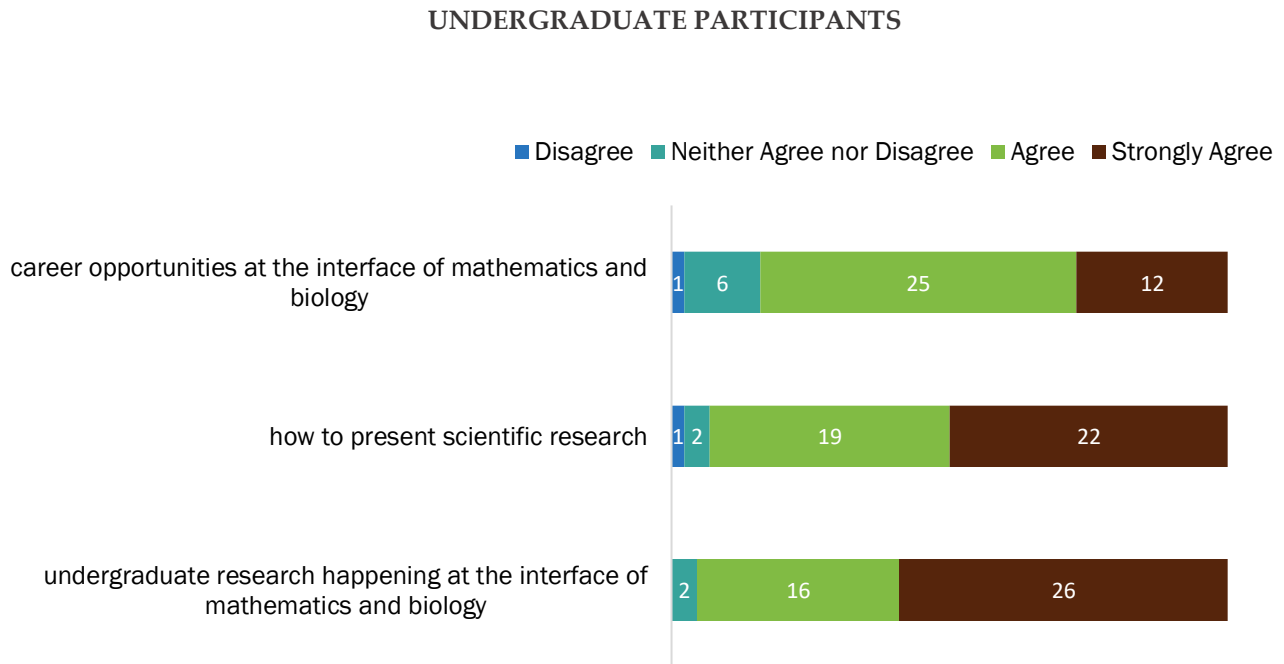
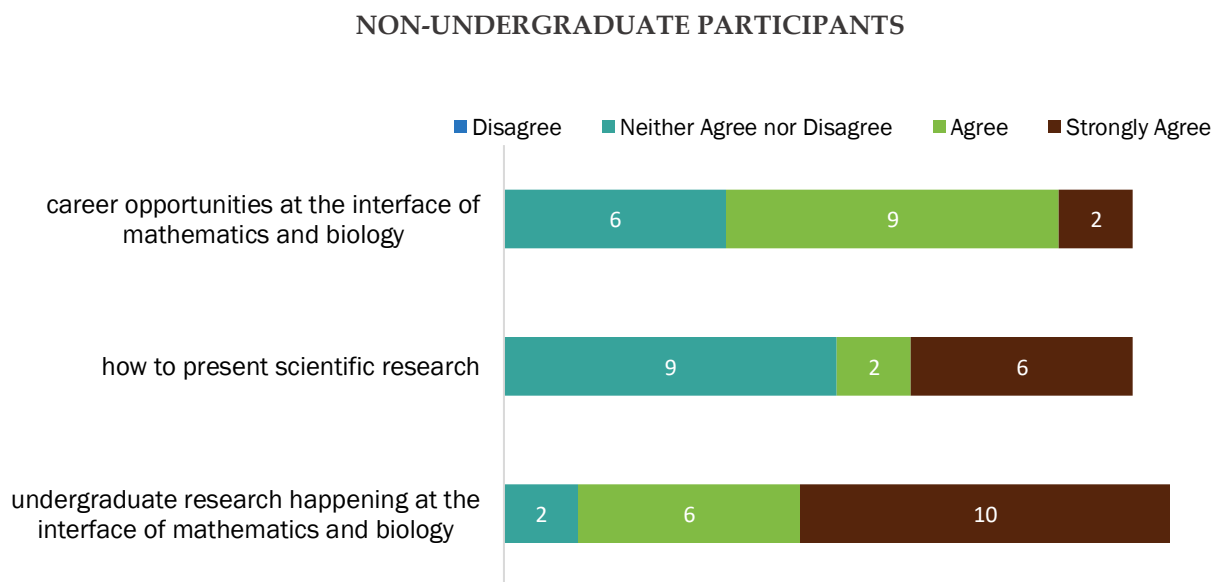


Figure 35. For **non-undergraduate** participants-- As a result of attending this conference, I have a better understanding of:



# Postdoctoral Fellow Overall Summary

Postdoctoral alumni  
**48**

RP 11 postdocs  
**5**

## **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 were welcomed 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 supported 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 Principal Investigators on grant proposals submitted through NIMBioS. Upon leaving the Postdoctoral Fellowship program at NIMBioS, program participants are asked to fill out a short exit evaluation form that examines several aspects of satisfaction with the program's operations. To date, 43 (88%) alumni from the program have filled out the form. The evaluation survey is situated in the following context.

### 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.

## Postdoctoral Fellow Feedback

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

 This fellowship gave me the opportunity to be a truly independent researcher. This meant that I was free to focus on projects that I found most promising and start collaborations with an unrestricted set of researchers. But with great independence comes great(er) responsibility. In particular, the responsibility to manage one's time, and decide whether a project merits investment of effort. I gained a lot of experience in managing my effort allocation while juggling several papers, job applications, etc. at the same time.

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

Figure 36. Postdoctoral fellow satisfaction with program mentors

■ Very Dissatisfied ■ Dissatisfied ■ Neutral ■ Satisfied ■ Very Satisfied

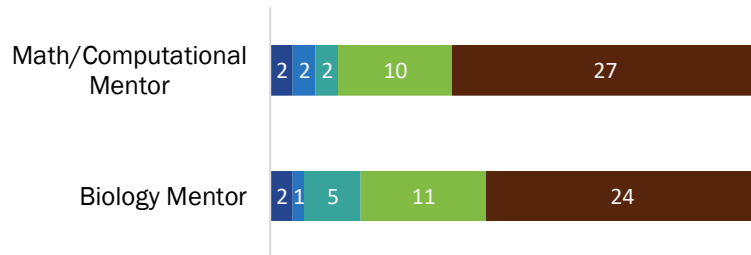


Figure 37. Postdoctoral fellow satisfaction with advice/assistance received from program mentors

■ Very Dissatisfied ■ Dissatisfied ■ Neutral ■ Satisfied ■ Very Satisfied





## Postdoc Feedback



Very

much appreciated support during and after maternity leave as well as after my fellowship has ended. NIMBioS really looks out for its postdocs and has extremely progressive policies for families.



This

is probably the best postdoctoral experience I have had. I enjoyed working with colleagues as well as sharing the experience of my mentors in terms of career planning, job search and interview. One of the great things about the 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.

**Figure 38. Postdoctoral fellow satisfaction with overall program experience**

■ Strongly Disagree ■ Disagree ■ Neutral ■ Agree ■ Strongly Agree

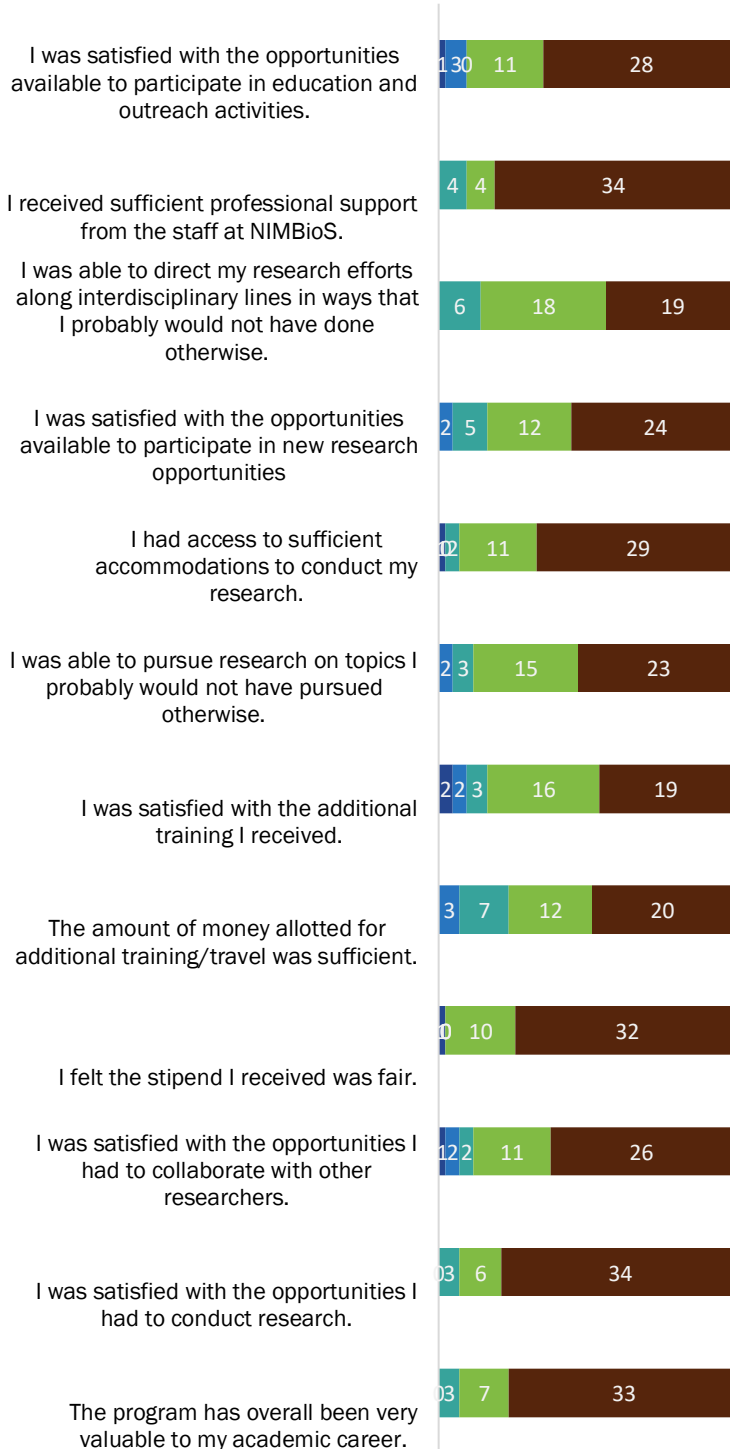
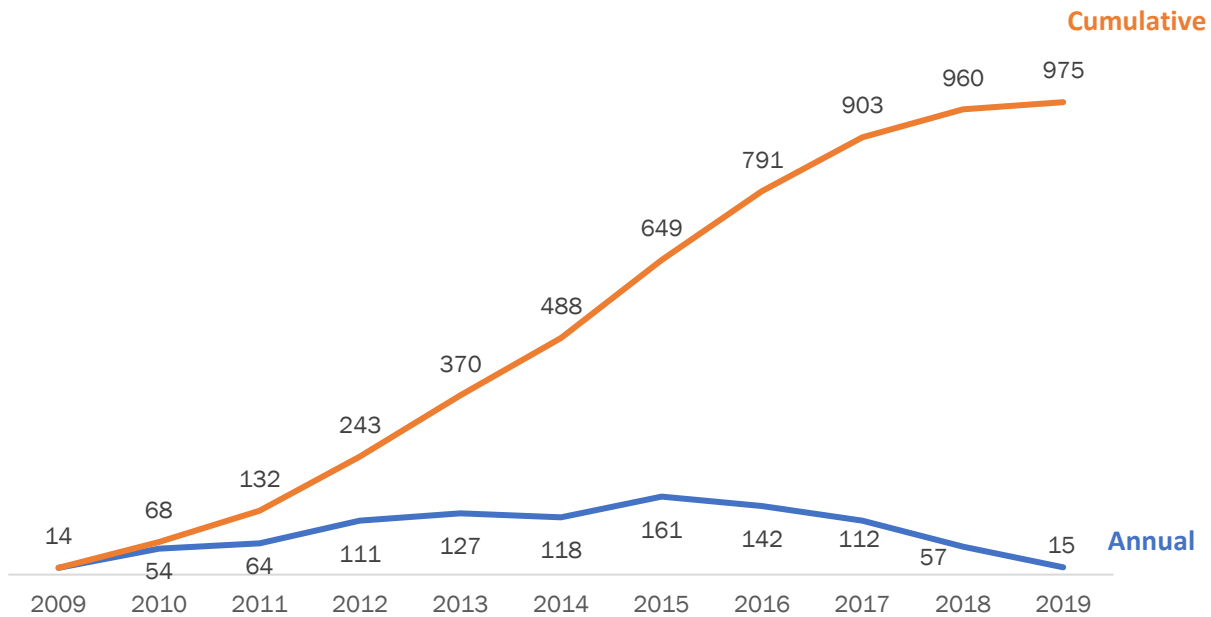




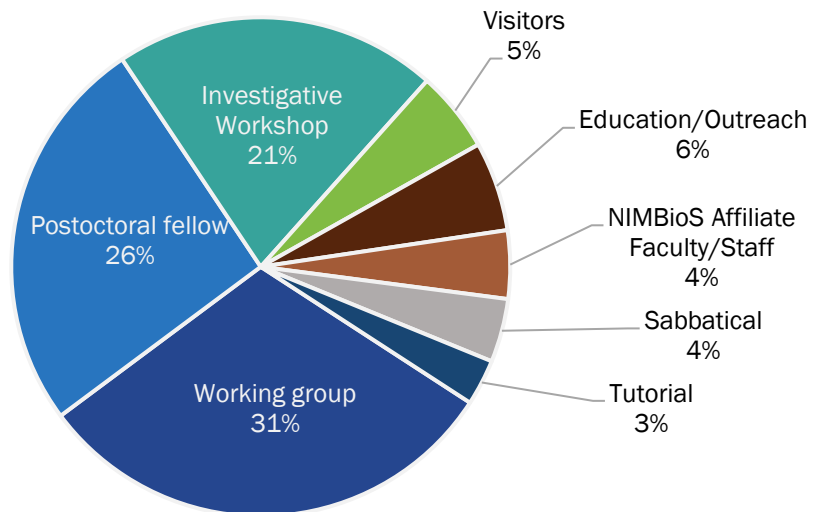
Figure 40. Number of **cumulative** and **annual** publications reported from NIMBioS activities since 2009, by publication year



Note. 2019 includes publications submitted by participants to NIMBioS through June 2019

NIMBioS publications come from a variety of activities, although Working Group participants tend to publish the largest portion of journal articles (31%), followed by NIMBioS Postdoctoral Fellows (26%) and Investigative Workshop participants (21%) (Figure 41).

Figure 41. Distribution of journal publications submitted to NIMBioS by participant type



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. 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. Because impact factors can range widely based on subject area, the Average Journal Impact Factor Percentile metric from Journal Citation Reports is also provided. This metric calculates the average Journal Impact Factor Percentile (JIF Percentile) scores from each field in which a journal is indexed and locates the current impact factor for a given journal within that range. Prominent high impact journals include Nature, Science, Cell, Trends in Ecology and Evolution, Nature Communications, Frontiers in Ecology and Evolution, and Ecology Letters.

**Table 2. Number of NIMBioS articles published in a selection of high-impact journals since NIMBioS’ inception, sorted by journal 5-Year Impact Factor**

Journal Title	5-Year Impact Factor*	Average JIF Percentile	# of NIMBioS Publications**
Nature	45.82	99.3%	3
Science	43.64	92.7%	8
Cell	36.43	99.5%	1
Trends in Ecology and Evolution	18.96	99.1%	7
Nature Communications	13.81	94.5%	2
Frontiers in Ecology and the Environment	11.96	98.7%	1
Ecology Letters	11.58	96.0%	10
Nucleic Acids Research	10.73	95.5%	3
Proceedings of the National Academy of Sciences	10.60	90.6%	18
Systematic Biology	10.48	91.0%	7
Current Biology	10.09	91.9%	1
Methods in Ecology and Evolution	9.54	94.8%	6
PLoS Biology	9.31	94.6%	3
eLife	8.52	96.0%	1
New Phytologist	8.34	96.7%	4
Philosophical Transactions of the Royal Society B	7.21	92.5%	6
Ecography	6.69	93.5%	5
Molecular Ecology	6.61	88.0%	11
PLoS Genetics	6.28	87.1%	2
Conservation Biology	6.11	94.0%	2
Functional Ecology	5.83	88.1%	1
Ecology	5.46	83.8%	6
Proceedings of the Royal Society B	5.39	83.8%	12
PLoS Computational Biology	5.04	90.8%	8
Journal of Animal Ecology	5.02	92.1%	4

**Table 2 (continued)**

Journal Title	5-Year Impact Factor *	Average JIF Percentile	# of NIMBioS Publications**
Ecological Applications	5.00	83.4%	3
PLOS Neglected Tropical Diseases	4.72	93.9%	1
Journal of Biogeography	4.64	78.3%	1
Quarterly Review of Biology	4.55	82.2%	1
Scientific Reports	4.53	79.0%	4
Diversity and Distributions	4.50	84.5%	3
Molecular Phylogenetics and Evolution	4.38	74.7%	1
Evolution	4.09	71.1%	17
American Naturalist	4.06	77.0%	2
Journal of the Royal Society Interface	4.04	77.5%	5
Oikos	3.77	74.7%	4
Heredity	3.68	66.1%	2
PLoS One	3.34	65.9%	35
Oecologia	3.32	68.6%	6
Animal Behaviour	3.10	79.8%	9
Biological Invasions	2.91	74.8%	1
Ecological Modeling	2.85	61.9%	9
BMC Bioinformatics	2.51	63.6%	2
SIAM Journal on Control and Optimization	2.39	64.4%	1
CBE - Life Sciences Education	2.38	74.4%	1
Physical Review E	2.38	73.0%	1
Journal of Theoretical Biology	2.04	57.1%	22
Theoretical Ecology	2.01	43.6%	6
Journal of Mathematical Biology	1.89	59.7%	3
Bulletin of Mathematical Biology	1.64	47.7%	1
Behaviour	1.40	35.8%	10
Mathematical Methods in the Applied Sciences	1.35	72.6%	2

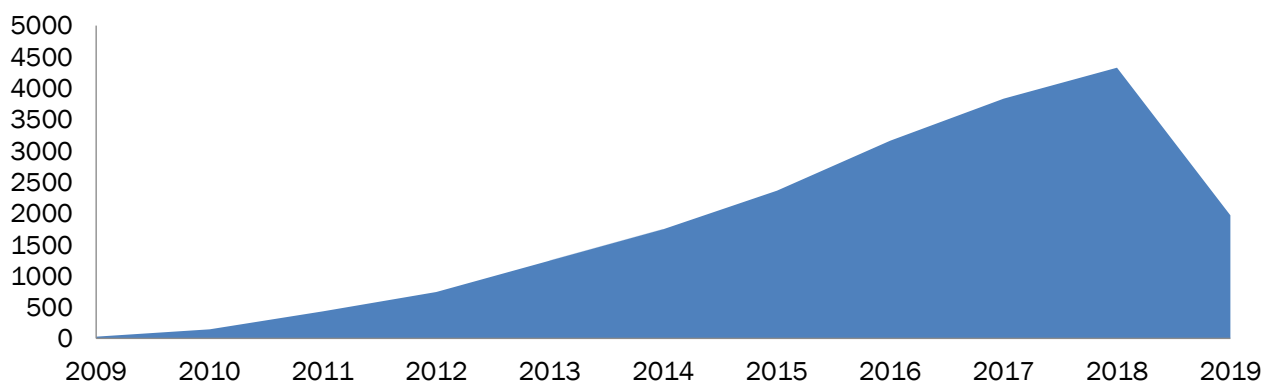
\*Impact factor calculation:  $\frac{\text{cites in year } n \text{ to articles published in year } (n-1 + n-2)}{\text{number of articles published in year } (n-1 + n-2)}$ .

\*\*September 2008 – June 2019

## Bibliometric indicators

**CITATION ANALYSIS OF PUBLICATIONS.** Of the 975 journal articles reported by NIMBioS participants to date, 911 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 2,714 researchers from 1,032 unique institutions spanning 65 countries. These articles have appeared in 324 different journals, many of which are considered to have high-impact in the academic community. These articles have been collectively cited 19,988 times, with an average of 21.82 cites per article (**Figure 42**), and an h-index of 62. The cites per article count is greater than either of the two major research fields of the publications during the last 10 years; mathematics (4.30 citers/paper) and biology (16.46 citers/paper). One hundred fourteen participants have authored five or more papers each as a result of NIMBioS affiliated collaborations.

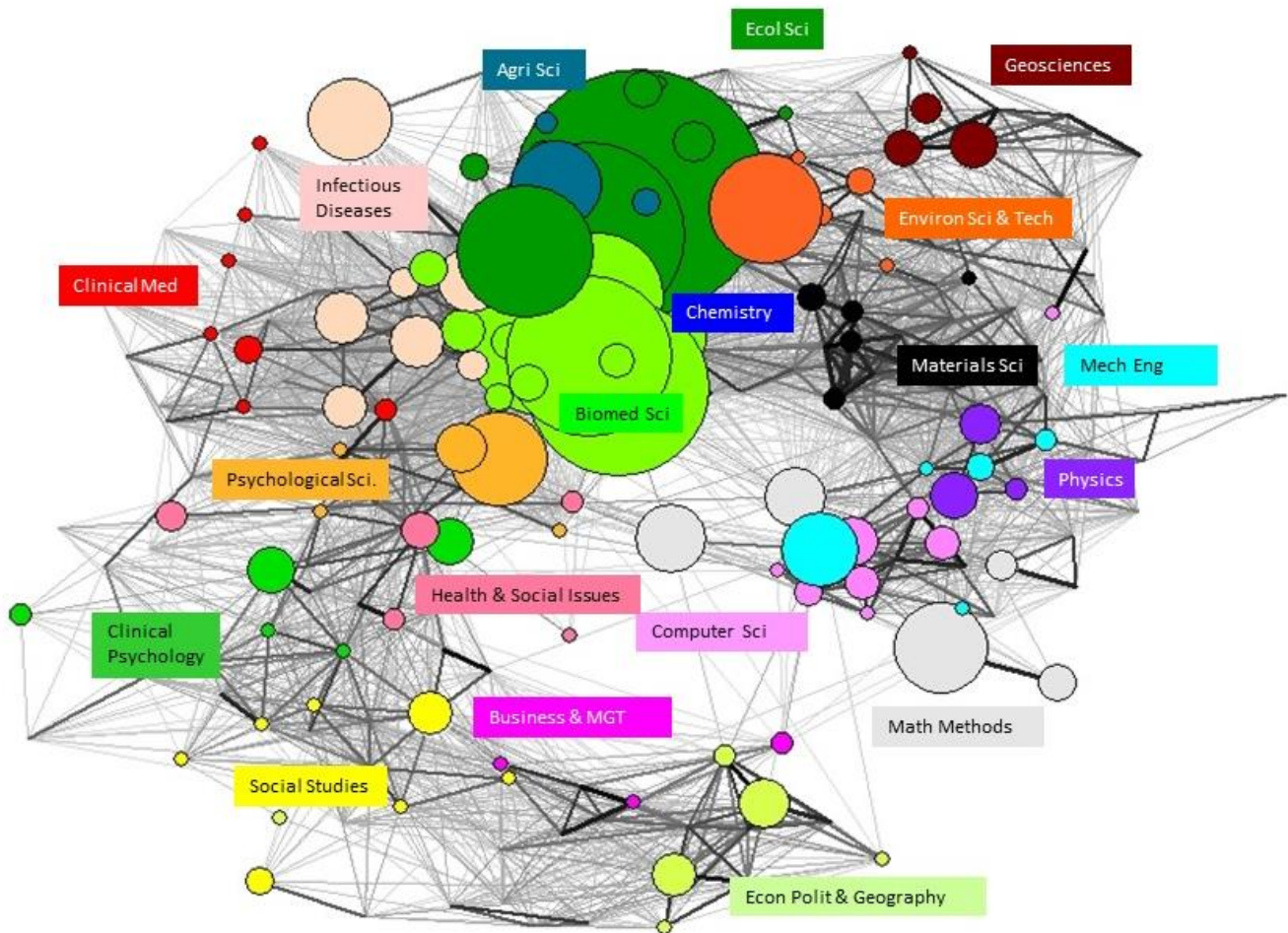
**Figure 42. Citations per year for NIMBioS articles**



**DISCIPLINARY SPAN OF PUBLICATIONS.** The 911 published articles indexed by WOS span 122 discipline areas, as designated by the WOS Subject Categories (WC). Categories are assigned at the journal level based upon a combination of citation patterns and editorial judgment. Subject categories are used in bibliometric research as a representation of the research areas in which scientists work.

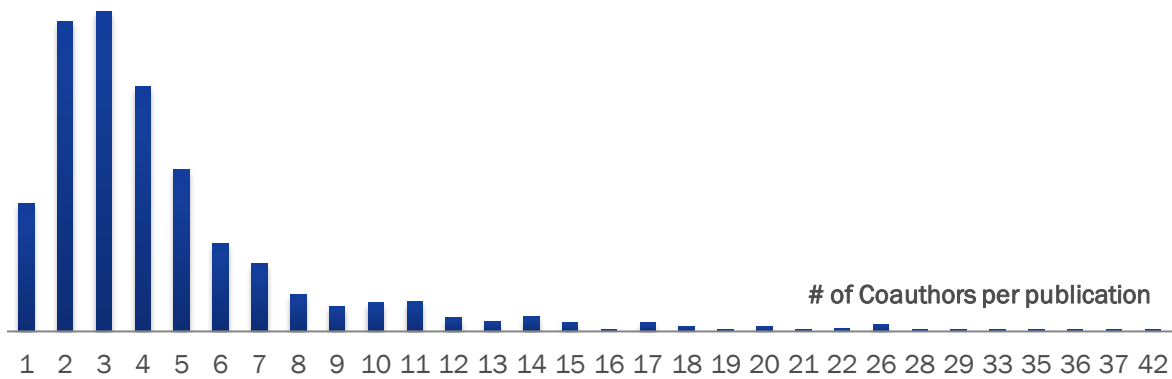
**Figure 43** locates the subject categories of the 911 NIMBioS articles on a network map of the WC. The gray background intersections are the 225 WC, located based on cross-citation relationships among all WOS journals in 2014 (from Rafols, Porter, and Leydesdorff). The 19 labeled “macro-disciplines” 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 (252), followed by Evolutionary Biology (145), Biology (125), Mathematical & Computational Biology (123), Multidisciplinary Sciences (113), and Zoology (72).

Figure 43. Web of Science categories for 911 WOS journal articles to date



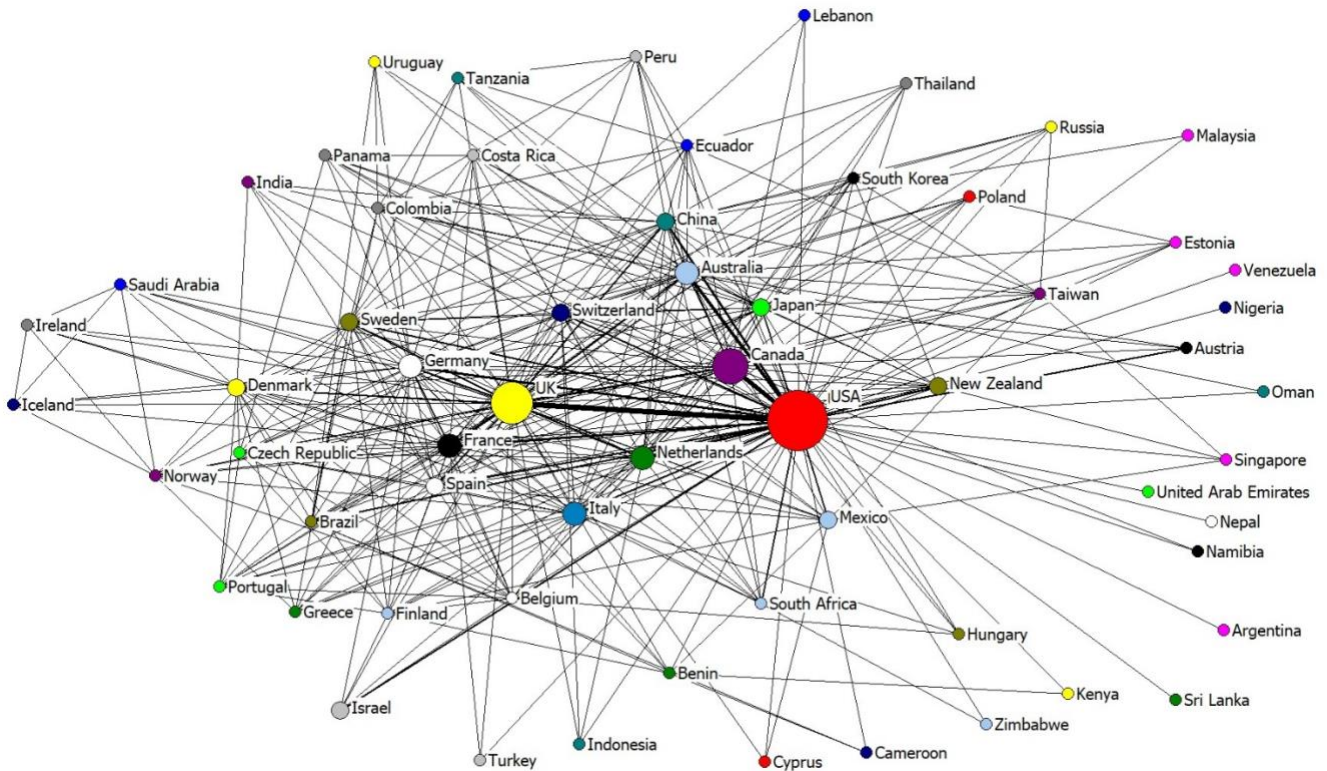
COAUTHORSHIP. One of the core values of NIMBioS is to take a collaborative approach to science and science education. NIMBioS is interested, therefore, in examining the number of co-authors on NIMBioS-related publications as one indicator of scientific collaboration. For the 911 publications reported thus far, the average number of co-authors per paper is 4.8 (Figure 44). Sixty-eight percent of NIMBioS-related publications had 2-5 co-authors, while 32% had six or more co-authors.

**Figure 44. Coauthorship frequency for NIMBioS publications**



**INTERNATIONAL COAUTHORSHIP.** NIMBioS also fosters international collaboration among researchers. While 65 different countries have been represented by NIMBioS coauthorship through the current reporting period, the average number of countries of coauthors per paper is 1.8, with a range of 1-12 countries represented per paper (**Figure 45**).

**Figure 45. International collaboration on NIMBioS publications**

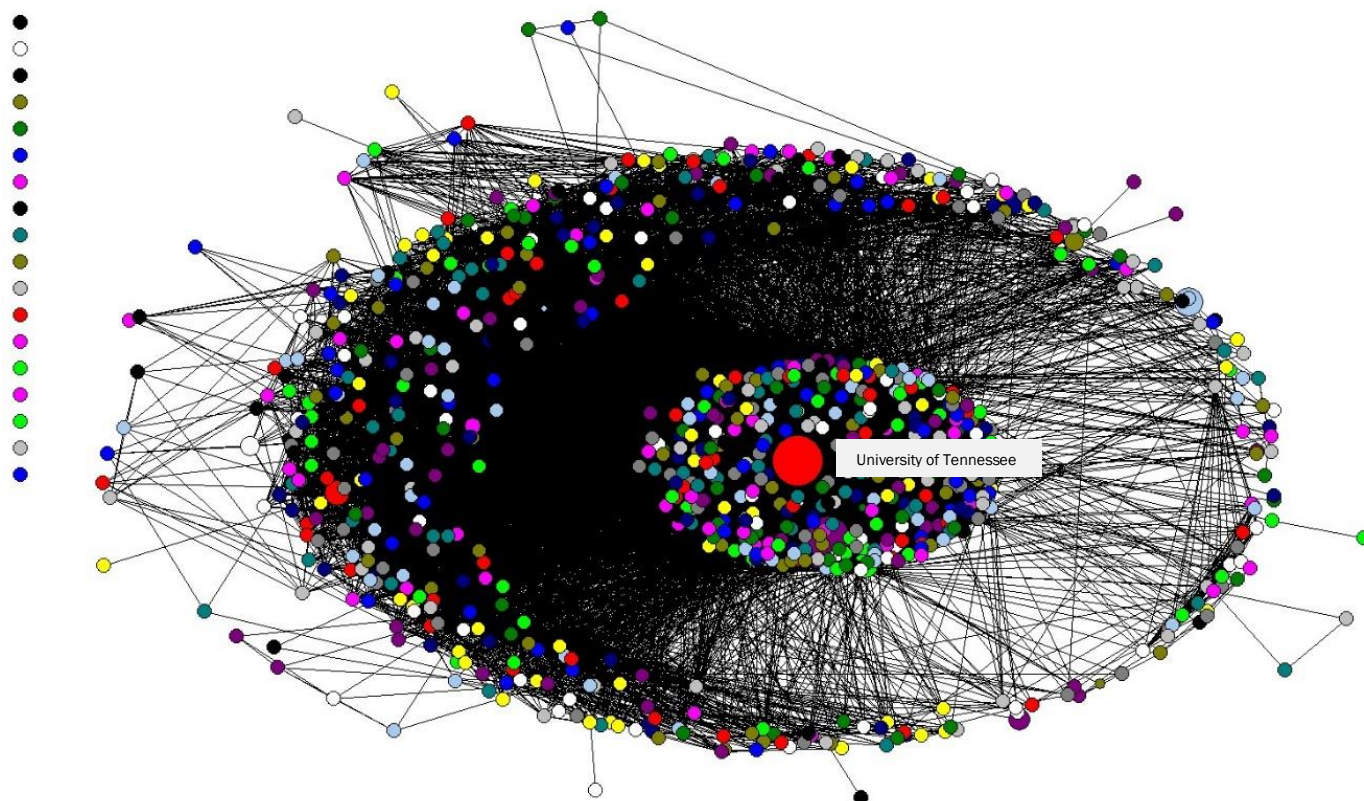


*Note.* Node radius represents the log scaled number of NIMBioS-affiliated papers from each country, and line size represents the number of collaborations among countries on these papers.



**CROSS-INSTITUTIONAL COAUTHORSHIP.** Coauthors of NIMBioS publications through the current reporting period came from 1,045 unique institutions (**Figure 46**). The average number of institutions represented per paper was 3.6, with a range of 1-35 institutions per paper.

**Figure 46. Cross-institutional collaboration on NIMBioS publications**

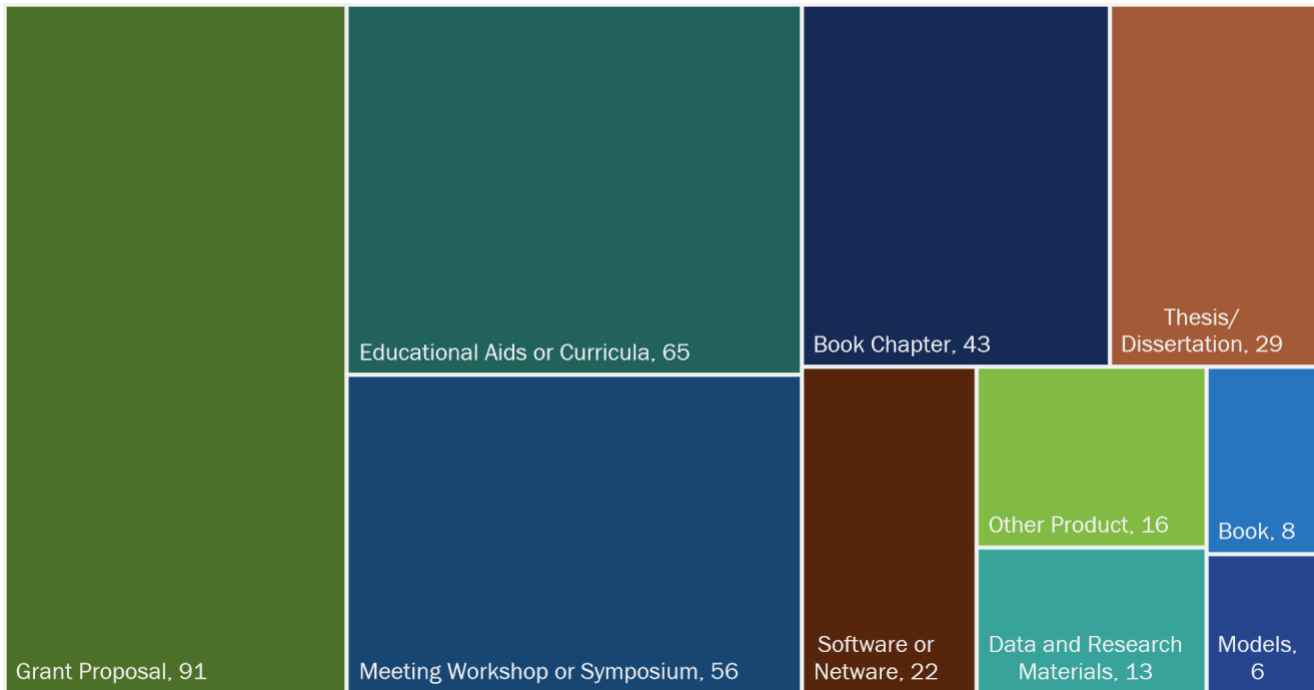


*Note.* Node radius represents the log scaled number of NIMBioS-affiliated papers from each institution, and line size represents the number of collaborations among institutions on these papers. Only 18 of the 1,045 institutions represented have published single-institution papers. The University of Tennessee is at the center of the figure.

## 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 eleven-year period. In addition to the items listed in Figure 47, NIMBioS participants have reported 938 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, 2018 – Aug 31, 2019**

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### **Y11-2. 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.

### NIMBioS Working Group: Long Transients and Ecological Forecasting Mtg 3 (Sep 26-28, 2018)

Abbott, Karen (Biology, Case Western Reserve Univ.)  
\*Cuddington, Kim (Biology, Univ. of Waterloo, Canada)  
Gellner, Gabriel (Empirical Ecology, Univ. of California, Davis)  
\*Hastings, Alan (Environmental Science and Policy, Univ. of California, Davis)  
Lai, Ying-Cheng (Electrical, Computer and Energy Engineering, Arizona State Univ., Tempe)  
\*Morozov, Andrew (Mathematics, Univ. of Leicester, UK)  
\*Petrovskii, Sergei (Mathematics, Univ. of Leicester, UK)  
Scranton, Katherine (Ecology and Evolutionary Biology, Yale Univ.)  
Zeeman, Mary Lou (Mathematics, Bowdoin College, Brunswick)

### NIMBioS Working Group: Quant Bio@Community College Mtg 2 (Oct 25-27, 2018)

Aikens, Melissa (Biology, Univ. of New Hampshire)  
\*Bissell, Ahrash (The NROC Project, Monterey Inst. for Technology and Education)  
Corwin, Lisa (Ecology and Evolutionary Biology, Colorado Univ., Boulder)  
Grisham, Linda (Director, Center for Teaching and Learning, Massachusetts Bay Community College)  
Gross, Louis (Ecology & Evolutionary Biology and Mathematics, Univ. of Tennessee; NIMBioS)  
\*Jenkins, Kristin (Director, BioQUEST)  
Karpakakunjaram, Vedham (Biology, Montgomery College, Rockville)  
\*Kiser, Stacey (Biology, Science Division, Lane Community College)  
Lenhart, Suzanne (NIMBioS Education and Outreach; Mathematics, Univ. of Tennessee)  
LoRe, Sondra (NISER, Univ. of Tennessee)  
\*Miller, Jillian (Mathematics, Roane State Community College)  
Neuhauser, Claudia (Division of Research and Mathematics, Univ. of Houston)  
Nieuwsma, Christianne (Mathematics, South Mountain Community College)  
Weisstein, Anton (Biology, Truman State Univ.)  
Wiggins, Greg (NIMBioS Education and Outreach)

### NIMBioS Working Group: Remotely Sensing Biodiversity Mtg 3 (Oct 29-31, 2018)

Asner, Greg (Global Ecology, Carnegie Institute for Science, Stanford CA)  
Carnaval, Ana Carolina (Biology, CUNY)  
\*Cavender-Bares, Jeannine (Ecology, Evolution and Behavior, Univ. of Minnesota)  
Fernandez, Nestor (German Centre for Integrative Biodiversity Research (iDiv))  
Gamon, John (Univ. of Alberta)  
Green, Robert (Science & Technology, NASA)  
Hestir, Erin (Environmental Engineering, UC Merced)  
Lausch, Angela (Helmholtz Centre for Environmental Research)  
Madritch, Michael (Biology, Appalachian State Univ.)  
Martin, Roberta (Global Ecology, Carnegie Institute for Science, Stanford CA)  
\*Meireles, Jose (Ecology, Evolution and Behavior, Univ. of Minnesota)  
Morsdorf, Felix (Geography, Univ. Zurich)  
\*O'Meara, Brian (Ecology and Evolutionary Biology, Univ. of Tennessee)  
Pereira, Henrique (German Centre for Integrative Biodiversity Research (iDiv))

Pontius, Jennifer (Environment and Natural Resources, Univ. Vermont)  
Record, Sydne (Biology, Bryn Mawr College)  
Schimel, David (Carbon Cycle and Ecosystems, NASA)  
Schrodt, Franziska (Pharmacy and Biomolecular Sciences, Univ. of Brighton)  
Schweiger, Anna (Ecology, Evolution and Behavior, Univ. of Minnesota)  
Serbin, Shawn (Environmental and Climate Sciences, Brookhaven National Laboratory)  
\*Townsend, Phil (Forest and Wildlife Ecology, Univ. of Wisconsin)  
Ustin, Susan (Plant Biology, Univ. of California, Davis)

### **NIMBioS Working Group: Ecosystem Federalism Mtg 3 (Dec 10-12, 2018)**

\*Armsworth, Paul (NIMBioS, Ecology and Evolutionary Biology, Univ. of Tennessee, Knoxville)  
\*Blackwood, Julie (Mathematics and Statistics, Williams College, Williamstown, MA)  
Dilkina, Bistra (Computer Science, Georgia Tech)  
Fitzpatrick, Ben (Mathematics, Loyola Marymount Univ.)  
Kling, David (Agricultural and Resource Economics, Oregon State)  
Lenhart, Suzanne (Mathematics, Univ. of Tennessee)  
Neubert, Michael (Applied Mathematics, Woods Hole Oceanographic Inst.)  
Papes, Monica (Ecology & Evolutionary Biology, Univ. of Tennessee)  
Sanchirico, Jim (Agricultural and Resource Economics, Univ. of California, Davis)  
Shea, Katriona (Theoretical Population Ecology, Pennsylvania State Univ.)  
\*Sims, Charles (Economics, Univ. of Tennessee; Howard H. Baker Jr. Center for Public Policy, Knoxville)  
Springborn, Michael (Environmental Science and Management, Univ. of California, Davis)  
Yakubu, Abdul-Aziz (Applied Mathematics, Howard Univ.)

### **NIMBioS Working Group: Hierarchies in Conservation Mtg 3 (Jan 16-18, 2019)**

Albers, Heidi Jo (Conservation economics, Univ. of Wyoming)  
\*Armsworth, Paul (Ecology & Evolutionary Biology, Univ. of Tennessee)  
Chang, Charlotte (NIMBioS)  
Dilkina, Bistra (Computational Science & Engineering, Georgia Inst. of Technology)  
Fovargue, Rachel (Ecology and Evolutionary Biology, Univ. of Tennessee)  
Helmstedt, Kate (Mathematical Sciences, Queensland Univ. of Technology, Australia)  
\*Kroetz, Kailin (Resources for the Future)  
\*Nolte, Christoph (Earth and the Environment, Boston Univ.)  
Ochoa-Ochoa, Leticia (Evolutionary Biology, Universidad Nacional Autónoma de México.)  
Papes, Mona (Ecology and Evolutionary Biology, Univ. of Tennessee, Knoxville)  
Sims, Charles (Baker Center for Public Policy; Economics, Univ. of Tennessee, Knoxville)

### **NIMBioS Working Group: Ecological Network Dynamics Mtg 4 (Feb 13-15, 2019)**

Aguiar, Marcus de (Physics, Univ. Estadual de Campinas)  
Besson, Mathilde (Univ. de Montréal)  
Burkle, Laura (Ecology, Montana State Univ.)  
Castelazo, Cecilia Diaz (Instituto de Ecología, Xalapa)  
\*Hembry, David (Ecology and Evolutionary Biology, Univ. of Arizona)  
Mueller, Ulrich (Integrative Biology, Univ. of Texas)  
Newman, Erica (Energy and Resources Group, UC Berkeley)  
\*O'Donnell, James (School of Marine and Environmental Affairs, Univ. of Washington, Seattle)  
Pires, Mathias (Ecology, Univ. de Sao Paulo)  
Yeakel, Justin (Quantitative EcoDynamics Group, Univ. of California, Merced)

## **NIMBioS Working Group: Learning in Networks Mtg 2 (Feb 25-26, 2019)**

\*Bassett, Danielle S. (Bioengineering (BE), Electrical and Systems Engineering (ESE), Univ. of Pennsylvania)  
Brooks, Heather (Mathematics, UCLA)  
Colas, Jaron (Computation Neural Systems, California Institute of Technology)  
Gerraty, Raphael Thomas (Psychology, Columbia Univ.)  
Gold, Joshua (Neuroscience, University of Pennsylvania)  
\*Grafton, Scott T. (Neuroscience, Inst. of Collaborative Biotechnologies, Univ. of California, Santa Barbara)  
Hartley, Catherine (Psychology, New York University)  
Ju, Harang (Complex Systems, Bioengineering, Univ. of Pennsylvania)  
O'Doherty, John (Humanities and Social Science, California Institute of Technology)  
Porter, Mason (Mathematics, University of California, Los Angeles)  
Shohamy, Daphna (Psychology, Columbia Univ.)

## **NIMBioS Working Group: Long Transients and Ecological Forecasting Mtg 4 (May 7-9, 2019)**

Abbott, Karen (Biology, Case Western Reserve Univ.)  
\*Cuddington, Kim (Biology, Univ. of Waterloo, Canada)  
Francis, Tessa (Lead Ecosystem Ecologist, Tacoma Puget Sound Institute, Univ. of Washington)  
Gavrilets, Sergey (DySoc/NIMBioS; Ecology & Evolutionary Biology and Mathematics, Univ. of Tennessee)  
Gellner, Gabriel (Empirical Ecology, Univ. of California, Davis)  
\*Hastings, Alan (Environmental Science and Policy, Univ. of California, Davis)  
\*Morozov, Andrew (Mathematics, Univ. of Leicester, UK)  
\*Petrovskii, Sergei (Mathematics, Univ. of Leicester, UK)  
Zeeman, Mary Lou (Mathematics, Bowdoin College, Brunswick)

## **NIMBioS Working Group: Hierarchies in Conservation Mtg 4 (May 16-19, 2019)**

Albers, Heidi Jo (Conservation economics, Univ. of Wyoming)  
\*Armsworth, Paul (Ecology & Evolutionary Biology, Univ. of Tennessee)  
Chang, Charlotte (NIMBioS)  
Dilkina, Bistra (Computational Science & Engineering, Georgia Inst. of Technology)  
Dissanayake, Sahan T.M. (Economics, Colby College, Portland State Univ.)  
Fovargue, Rachel (Ecology and Evolutionary Biology, Univ. of Tennessee)  
Giam, Xingli (Ecology and Evolutionary Biology, Univ. of Tennessee, Knoxville)  
\*Kroetz, Kailin (Resources for the Future)  
\*Nolte, Christoph (Earth and the Environment, Boston Univ.)  
Papes, Mona (Ecology and Evolutionary Biology, Univ. of Tennessee, Knoxville)  
Sims, Charles (Baker Center for Public Policy; Economics, Univ. of Tennessee, Knoxville)

## **NIMBioS Working Group: Quant Bio@Community College Mtg 3 (May 30-Jun 1, 2019)**

Aikens, Melissa (Biology, Univ. of New Hampshire)  
\*Bissell, Ahrash (The NROC Project, Monterey Inst. for Technology and Education)  
Corwin, Lisa (Ecology and Evolutionary Biology, Colorado Univ., Boulder)  
Donavan, Samuel (Biological Sciences, Univ. of Pittsburgh)  
Gross, Louis (Ecology & Evolutionary Biology and Mathematics, Univ. of Tennessee; NIMBioS)  
\*Jenkins, Kristin (Director, BioQUEST)  
Karpakakunjaram, Vedham (Biology, Montgomery College, Rockville)

Kirkpatrick, Yolanda (UTK VolsTeach)

\*Kiser, Stacey (Biology, Science Division, Lane Community College)

Lenhart, Suzanne (NIMBioS Education and Outreach; Mathematics, Univ. of Tennessee)

LoRe, Sondra (NISER, Univ. of Tennessee)

\*Miller, Jillian (Mathematics, Roane State Community College)

Neuhauser, Claudia (Division of Research and Mathematics, Univ. of Houston)

Nieuwsma, Christianne (Mathematics, South Mountain Community College)

Wiggins, Greg (NIMBioS Education and Outreach)

## **NIMBioS Working Group: Optimal Control of NTDs Mtg 2 (Jul 15-16, 2019)**

Casagrandi, Renato (Electronics, Information Science and Bioengineering, Politecnico di Milano (Italy))

\*Leo, Giulio De (Biology, Hopkins Marine Station, Woods Institute for the Environment, Stanford Univ.)

Hoover, Christopher (Univ. of California, Berkeley School of Public Health)

Lenhart, Suzanne (NIMBioS; Mathematics, Univ. of Tennessee)

\*Ngonghala, Calistus (Mathematics and Emerging Pathogens Inst., Univ. of Florida, Gainesville)

\*Remais, Justin (School of Public Health, Univ. of California, Berkeley)

Sanchirico, Jim (Environmental Science & Policy, Univ. of California, Davis)

Siewe, Nourridine (Univ. of British Columbia)

Sokolow, Suzanne H. (Biology, Hopkins Marine Station; Center for Innovation in Global Health, Stanford Univ.)

## **NIMBioS Working Group: Multiscale Vectored Plant Viruses Mtg 5 (Aug 7-9, 2019) (expected)**

\*Allen, Linda (Mathematics and Statistics, Texas Tech Univ., Lubbock)

\*Bokil, Vrushali (Mathematics, Oregon State Univ., Corvallis)

Cunniffe, Nick (Plant Sciences, Univ. of Cambridge)

Garrett, Karen (Kansas State Univ.)

Gross, Louis (EEB and Mathematics, Univ. Tennessee)

Hamelin, Frederic (Mathematics, Agrocampus Ouest France)

Hilker, Frank (Germany/Institute of Applied Systems, Osnabruck Univ.)

Manore, Carrie (Center for Computational Science Mathematics, Tulane Univ.)

McRoberts, Neil (Plant Pathology, Univ. of California, Davis)

\*Power, Alison (EEB, Cornell Univ.)

Rúa, Megan (NIMBioS)

## **DySoC/NIMBioS Investigative Workshop: Extending the Theory of Sustainability (Dec 5-7, 2018)**

Abbott, Joshua (Life Sciences, Arizona State Univ.)

Agarwala, Matthew (Environmental Economics, London School of Economics)

Armsworth, Paul (Ecology & Evolutionary Biology, Univ. of Tennessee Knoxville)

Blackwood, Julie C. (Mathematics and Statistics, Williams College)

Brooks, Jeremy (School of Environment and Natural Resources, The Ohio State Univ.)

Chang, Charlotte (NIMBioS, Univ. of Tennessee Knoxville)

Clark, William C. (Sustainability Science Program, Harvard Univ.)

Dietz, Thomas (Center for Systems Integration and Sustainability, Michigan State Univ.)

Elser, James (Life Sciences, Arizona State Univ.)

\*Fenichel, Eli (Forestry and Environmental Studies, Yale Univ.)

Fleurbaey, Marc (Woodrow Wilson School of Public and International Affairs, Princeton Univ.)

Frank, David (Philosophy and Ecology & Evolutionary Biology, Univ. of Tennessee Knoxville)

Fried, Stephanie (Business, Arizona State Univ.)

\*Gavrilets, Sergey (DySoC/NIMBioS; Ecology and Evolutionary Biology and Mathematics, Univ. of Tennessee)

Gopalakrishnan, Sathya (Agricultural, Environmental, and Development Economics, The Ohio State Univ.)  
Granco, Gabriel (Geography, Kansas State Univ.)  
Hastings, Alan (Environmental Science and Policy, Univ. of California, Davis)  
Hastings-Simon, Sara -Simon (Alberta clean economy program, Pembina Institute)  
Irwin, Elena (Agricultural, Environmental, and Development Economics, The Ohio State Univ.)  
Kaiser, Brooks (Management and Economics of Resources and the Environment, Sociology, Environmental and Business Economics, Univ. of Southern Denmark)  
Keeler, Bonnie (Institute on the Environment, Univ. of Minnesota)  
Lange, Glenn-Marie (Resources Global Practice, The World Bank)  
Leite, Maria (Biological Sciences, Univ. of South Florida Saint Petersburg)  
Lemoine, Derek (Economics, Univ. of Arizona)  
Leppanen, Christy (Ecology & Evolutionary Biology, Univ. of Tennessee Knoxville)  
Millinski, Manfred (Max Planck Institute for Evolutionary Biology, Ploen)  
Nkuiya, Bruno (Economics, Univ. of Alberta)  
Platt, Lisa (SSIE, Binghamton Univ.)  
\*Richerson, Peter (Environmental Science and Policy, Univ. of California, Davis)  
Santos, Maria J. (Geography, Univ. of Zurich)  
Schlüter, Maja (Stockholm Resilience Centre, Stockholm Univ.)  
Sims, Charles (Baker Center for Public Policy; Economics, Univ. of Tennessee, Knoxville)  
Thayer, Anastasia (Agricultural Economics, Texas A&M Univ. College Station)  
Waring, Tim (Economics, Univ. of Maine)  
Wing, Ian Sue (Earth & Environment, Boston Univ.)  
Yamaguchi, Rintaro (National Institute for Environmental Studies (NIES))

### **DySoC/NIMBioS Investigative Workshop: Human Origins 2021 (Feb 15-16, 2019)**

Andrews, Kristin (Philosophy, York Univ.)  
Brooks, Alison (Anthropology, George Washington Univ.)  
Buss, David (Psychology, Univ. of Texas at Austin)  
\*Waal, Frans de (Psychology, Emory Univ., Atlanta, Georgia)  
\*Gavrilets, Sergey (DySoC/NIMBioS; Ecology & Evolutionary Biology and Mathematics, Univ. of Tennessee, Knoxville)  
Gopnik, Alison (Psychology, Univ. California Berkeley)  
Henrich, Joe (Human Evolutionary Biology, Harvard Univ.)  
Herculano-Houzel, Suzana (Psychology, Vanderbilt Univ.)  
Pusey, Anne (Environmental Anthropology, Duke Univ.)  
\*Richerson, Peter (Environmental Science and Policy, Univ. of California, Davis)  
Seabright, Paul (Inst. for Advanced Sciences in Toulouse, Toulouse School of Economics)  
Wason, Paul (John Templeton Foundation)  
Wiessner, Polly (Anthropology, Univ. of Utah)  
Wrangham, Richard (Human Evolutionary Biology, Harvard Univ.)

### **DySoC/NIMBioS Investigative Workshop: Social Norms (Apr 23-25, 2019)**

Andrighetto, Giulia (Institute of Cognitive Science and Technologies, National Research Council (CNR); Malardalens Univ., Sweden)  
Boyd, Robert (Human Evolution and Social Change, Arizona State Univ.)  
Brinkman, Baba (Rap artist and playwright)  
Bunce, John (Human Behavior, Ecology, and Culture, Max Planck Institute for Evolutionary Anthropology)  
Centola, Damon (Annenberg School for Communication, Univ. of Pennsylvania)  
Constantino, Sara (Science, Technology and Environmental Policy, Princeton Univ.)  
Creanza, Nicole (Biological Sciences, Vanderbilt Univ.)



Demeritt, Allison (Univ. of Washington)  
\*Gavrilets, Sergey (DySoC/NIMBioS; Ecology & Evolutionary Biology and Mathematics, Univ. of Tennessee)  
\*Gelfand, Michele (Psychology, Univ. of Maryland)  
Ginges, Jeremy (Psychology, New School of Social Research)  
Giuliano, Paola (Anderson School of Management, UCLA)  
Henrich, Joseph (Human Evolutionary Biology, Harvard Univ.)  
Hoff, Karla (Development Research Group, The World Bank)  
Jakiela, Pamela (Center for Global Development)  
Bar-On, Kati Kish (Philosophy, Tel Aviv Univ.)  
Lapinski, Maria (Communication, Michigan State Univ.)  
Liu, Rain (School of Communication, Bellarmine Univ.)  
Lowes, Sara (Economics, Bocconi Univ.)  
Michalopoulos, Stelios (Economics, Brown Univ.)  
Mironova, Vera (Belfer Center for Science & International Affairs, Harvard Kennedy School)  
\*Nunn, Nathan (Economics, Harvard Univ.)  
Pan, Xinyue (Psychology, Univ. of Maryland)  
Perry, Logan (Mathematics, Univ. of Tennessee, Knoxville)  
Rodríguez, Pablo Lozano (Mathematics, Universidad Carlos III de Madrid (UC3M))  
Sanchez, Angel (Anxo) (Applied Mathematics, Universidad Carlos III de Madrid (UC3M))  
Sanfey, Alan (Behavioural Science Institute, Radboud Univ.)  
Santos, Fernando (Ecology and Evolutionary Biology, Princeton Univ.)  
Sapienza, Paola (Kellogg School of Management, Northwestern Univ.)  
Shteynberg, Garry (Psychology, Univ. of Tennessee, Knoxville)  
Singh, Manvir (Human Evolutionary Biology, Harvard Univ.)  
Stibe, Agnis (Media Lab, Massachusetts Institute of Technology)  
Traulsen, Arne (Evolutionary Theory, Max Planck Institute for Evolutionary Biology, Plön, Germany)  
Troyer, Lisa (Department of Defense)  
Vostroknutov, Alexander (Economics, Maastricht Univ.; Learning and Decision Making, Univ. of Trento)

### **NIMBioS/DySoC Investigative Workshop: Mathematics of Gun Violence (May 1-3, 2019)**

Akers, Tim (Research Innovation and Advocacy, Morgan State Univ.)  
Auerbach, Jeremy (Environmental & Radiological Health Sciences, Colorado State Univ.)  
Block, Richard (Sociology, Loyola Univ. Chicago)  
Brooks, Heather (Mathematics, Univ. of California, Los Angeles)  
Buggs, Shani (Univ. of California, Davis)  
Crifasi, Cassandra (Johns Hopkins Center for Gun Policy and Research, Johns Hopkins Bloomberg School of Public Health)  
Drawve, Grant (Sociology, Univ. of Arkansas)  
Eubank, Stephen (Virginia Biocomplexity Institute & Initiative, Univ. of Virginia)  
Fefferman, Nina (Mathematics and Ecology & Evolutionary Biology, Univ. of Tennessee, Knoxville)  
Goldstick, Jason stick (Emergency Medicine, Univ. of Michigan; Dir., Statistics & Methods Section, Research Core, UM Injury Prevention Center)  
\*Gross, Louis J. (Mathematics and Ecology & Evolutionary Biology; NIMBioS, Univ. of Tennessee, Knoxville)  
Hipple, Natalie (Criminal Justice, Indiana Univ. Bloomington)  
Jay, Jonathan (FACTS Consortium, Public Health, Harvard Univ.)  
Loeffler, Charles (Criminology, Univ. of Pennsylvania)  
Mills, Brianna (Harborview Injury Prevention and Research Center, Univ. of Washington)  
Mohler, George (Computer and Information Science, Indiana Univ., Purdue University Indianapolis)  
Myers, Kellen (Ecology and Evolutionary Biology, Univ. of Tennessee, Knoxville)  
Pear, Veronica (Violence Prevention Research Program, Univ. of California, Berkeley)  
Rodríguez, Nancy (Applied Mathematics, Univ. of Colorado, Boulder)

Saunders, Jessica (Policy, RAND Corporation)  
\*Scott, Shelby M. (Ecology & Evolutionary Biology, Univ. of Tennessee, Knoxville)  
Slutkin, Gary (Public Health, Univ. of Illinois at Chicago)  
Smart, Rosanna (Policy, RAND Corporation)  
Strickland, Christopher (Mathematics, Univ. of Tennessee, Knoxville)  
Taxman, Jeffrey (Psychiatry, Medical College of Wisconsin)  
Thalos, Mariam (Philosophy, Univ. of Tennessee, Knoxville)  
Tita, George (Criminology, Law and Society, Univ. of California, Irvine (School of Social Ecology))  
Towers, Sherry (Biosocial Complexity Initiative, Arizona State Univ.)  
Tracy, Melissa (Epidemiology, Biostatistics, State Univ. of New York (SUNY), Albany (School of Public Health))  
Volkening, Alexandria (Mathematical Biosciences Institute, The Ohio State Univ.)

## **NIMBioS Investigative Workshop: Scientific Collaboration Enabled by High Performance Computing** **(May 13-15, 2019)**

Aluru, Srinivas (Computational Science and Engineering, Georgia Institute of Technology)  
Barajas, Carlos (Mathematics and Statistics, Univ. of Maryland, Baltimore County)  
Bhowmick, Sanjukta (Computer Science and Engineering, Univ. of North Texas)  
Bording, Ralph (EE & CS, Alabama A&M Univ.)  
Chandrasekaran, Sunita (Univ. of Delaware)  
Danalis, Anthony (Innovative Computing Laboratory, Univ. of Tennessee)  
Dongarra, Jack (Computer Science, Univ. of Tennessee, Knoxville)  
Edholm, Christina (Mathematics, Univ. of Tennessee)  
\*Evans, Katherine (Computational Earth Sciences Group, Oak Ridge National Laboratory)  
Gainaru, Ana (Vanderbilt Univ.)  
Gao, Lani (Mathematics, Univ. of Tennessee, Chattanooga)  
Ge, Rong (Clemson Univ.)  
Giabbanelli, Philippe (Computer Science, Furman Univ.)  
Gobbert, Matthias (Mathematics and Statistics, Univ. of Maryland, Baltimore County)  
Goldberg, Arthur berg (Genetics and Genomic Sciences, Mount Sinai School of Medicine)  
Hinson, Audra (Univ. of Tennessee, Knoxville)  
Islam, Tanzima (Computer Science, Western Washington Univ.)  
Leeser, Miriam (Electrical and Computer Engineering, Northeastern Univ.)  
\*Lenhart, Suzanne (NIMBioS and Mathematics, Univ. of Tennessee)  
Moore, Shirley (Oak Ridge National Laboratory)  
Myers, Kellen (Univ. of Tennessee, Knoxville)  
Nam, Hai Ah (Los Alamos National Laboratory)  
Nzekwe, Chinedu (Applied Mathematics, North Carolina A&T State Univ.)  
Pathiravasan, Chathurangi (Mathematics, Southern Illinois Univ., Carbondale)  
Qian, Lei (Fisk Univ.)  
Queisser, Gillian (Mathematics, Temple Univ.)  
\*Randles, Amanda (Biomedical Engineering, Duke Univ.)  
Ruck, Damian (Univ. of Tennessee, Knoxville)  
Schlum, Katrina (Life Sciences, Univ. of Tennessee, Knoxville)  
\*Swenson, Michelle (Mathematics, Univ. of Tennessee)  
\*Taufert, Michela (Electrical Engineering and Computer Science, Univ. of Tennessee)  
Tchoua, Roselyne (Univ. of Chicago)  
Tomov, Stanimire (Stan) (Univ. of Tennessee, Knoxville)  
Holguin, Valerie Valerio (Agricultural and Biological Engineering, Univ. of Florida)  
Vardhan, Madhurima (Biomedical engineering, Duke Univ.)  
Warnow, Tandy (Computer Science, Engineering and Computer Science, Univ. of Illinois)  
\*Wiggins, Greg (NIMBioS, Univ. of Tennessee, Knoxville)

Wong, Kwai Lam (Kwai) (Univ. of Tennessee, Knoxville)  
Wu, Cathy (Univ. of Delaware)  
Xu, Ling (Mathematics, North Carolina A&T State Univ.)  
Yue, Ma (Univ. of Tennessee, Knoxville)  
Zhao, Xiaopeng (Biomedical Engineering, Univ. of Tennessee, Knoxville)

## **NIMBioS Investigative Workshop: Transients in Biological Systems (May 29-31, 2019)**

Abbott, Karen (Biology, Case Western Reserve Univ.)  
Esquivel, Jorge Arroyo (Mathematics, UC Davis)  
Artzy-Randrup, Yael (Theoretical Ecology (IBED) & Institute of Advanced Study, Univ. of Amsterdam)  
\*Boettiger, Carl (Environmental Science, Policy, and Management, Univ. of California, Berkeley)  
Burton, Danielle (Mathematics, Univ. of Tennessee, Knoxville)  
Cazelles, Bernard (Institut de Biologie de l'Ecole Normale Supérieure, Ecole Normale Supérieure)  
Chang, Charlotte (NIMBioS, Univ. of Tennessee)  
\*Cuddington, Kim (Biology, Univ. of Waterloo, Canada)  
Earn, David (McMaster Univ.)  
Erickson, Kelley (Missouri Botanical Garden)  
Fortin, Marie Josée (Ecology & Evolutionary Biology, Univ. of Toronto)  
Gaoue, Orou ue (Ecology and Evolutionary Biology, Univ. of Tennessee)  
Greenwood, Priscilla (Cindy) wood (Mathematics, Univ. of British Columbia)  
\*Hastings, Alan (Environmental Science and Policy, Univ. of California, Davis)  
Jiang, Junjie (Arizona State Univ.)  
Kuang, Yang (Mathematics, Arizona State Univ.)  
Lai, Ying-Cheng (Electrical, Computer and Energy Engineering, Arizona State Univ., Tempe)  
Laubmeier, Amanda (Mathematics, Univ. of Nebraska, Lincoln)  
\*Morozov, Andrew (Mathematics, Univ. of Leicester, UK)  
Neubert, Michael (Woods Hole Oceanographic Inst.)  
Ogle, Kiona (Informatics, Computing, and Cyber Systems, Northern Arizona Univ.)  
\*Petrovskii, Sergei (Mathematics, Univ. of Leicester, UK)  
Reimer, Jody (Mathematical and Statistical Sciences & Biological Sciences, Univ. of Alberta)  
Rubchinsky, Leonid (Mathematical Sciences and Stark Neurosciences Research Inst., Indiana Univ./Purdue Univ., Indianapolis)  
Rubin, Jonathan (Mathematics, Univ. of Pittsburgh)  
Scharf, Henry (Statistics, Colorado State Univ.)  
Strickland, Christopher (Mathematics, Univ. of Tennessee)  
Tao, Yun (Ecology, Evolution, and Marine Biology, Univ. of California, Santa Barbara)  
Vortkamp, Irina (mathematics & Computer Science, Osnabruck Univ.)  
Wikle, Chris (Statistics, Univ. of Missouri)  
Wolkovich, Elizabeth (Biodiversity Research Center, Forest & Conservation Sciences, Univ. of British Columbia)  
Zhang, Bo (Biology, Univ. of California, Davis)  
Zhu, Kai (Environmental Studies, Univ. of California, Santa Cruz)  
Zipkin, Elise (Integrative Biology, Michigan State Univ.)

## **NIMBioS Tutorial: Applications of Spatial Data: Ecological Niche Modeling (Dec 3-5, 2018)**

Atauchi-Rojas, Pavel (Museo de Historia Natural, Universidad Nacional de San Antonio Abad del Cusco (Peru))  
Bubb, Ilan (Nicholas School of the Environment (Marine Lab), Duke Univ.)  
Chaiyes, Aingorn (Forest and Environmental Management, Sukhothai Thammathirat Open Univ., Thailand)  
Clark, Joe (Ecology & Evolutionary Biology, Univ. of Tennessee, Knoxville)

Colon, Melanie (Renewable Natural Resources, Louisiana State Univ., Baton Rouge)  
Costanza, Anna (Research Intensive Pedagogical Training for Interdisciplinary Estuarine Scientists, San Francisco State Univ.)  
Donohue, Kathleen (Biology, Duke Univ.)  
Escobar, Luis (Fish and Wildlife Conservation, Virginia Tech)  
Feng, Xiao (Institute of the Environment, Univ. of Arizona, Tucson)  
Frey Mueller, Nicholas (Biology, Univ. of New Mexico)  
Amirkhiz, Reza Goljani (Biology, Univ. of South Dakota)  
Gorris, Morgan (Earth System Science, Univ. of California, Irvine)  
Levy, Benjamin (Mathematics, Fitchburg State Univ.)  
Liang, Wanwan (Entomology & Plant Pathology, Univ. of Tennessee)  
Lonsinger, Robert (Natural Resource Management, South Dakota State Univ.)  
Lyon, Lauren (Ecology and Evolutionary Biology, Univ. of Tennessee, Knoxville)  
Machado, Gustavo (Population Health and Pathobiology, North Carolina State Univ.)  
Lopez, Oscar Martinez (El Colegio de la Frontera Sur)  
Meneses, Nashelly (Applied Conservation Lab, Northern Arizona Univ.)  
Moutouama, Jacob (Ecology and Evolutionary Biology, Univ. of Tennessee, Knoxville)  
Mundis, Stephanie (Geography, Univ. of Florida)  
Nhleko, Zoliswa (Wildlife Ecology and Conservation, Univ. of Florida)  
\*Papeş, Mona (Ecology & Evolutionary Biology and Spatial Analysis Lab at NIMBioS, Univ. of Tennessee, Knoxville)  
Peterson, Town (Ecology & Evolutionary Biology and Biodiversity Institute, Univ. of Kansas, Lawrence)  
Tomas, Leon (Public Health, Environmental Health Sciences, Univ. of California, Berkeley)  
Tomkins, Melissa (Computational and Systems Biology, John Innes Centre)  
Voight, Carly (Tropical Conservation and Development, Ya'axche Conservation Trust)  
Vulinec, Kevina (Agriculture, Delaware State Univ., Dover)  
\*Wiggins, Greg (NIMBioS)  
Zhu, Gengping (NIMBioS, EEB, Univ. of Tennessee)

## NIMBioS Tutorial: Network Modeling (Feb 4-6, 2019)

Achenie, Luke (Chemical Engineering, Virginia Polytechnic Institute and State Univ. (Virginia Tech))  
Agusto, Folashade (Ecology and Evolutionary Biology, Univ. of Kansas)  
Boroomand, Amin (Quantitative and systems biology, Univ. of California Merced)  
Chang, Charlotte (NIMBioS, Univ. of Tennessee, Knoxville)  
Cañizares, Jessica (Biology, Tufts Univ.)  
Chick, Ruby (Mathematics, Oregon State Univ.)  
Eda, Shigetoshi (Forestry, Wildlife, and Fisheries, Univ. of Tennessee, Knoxville)  
Edoh, Kossi (Mathematics, North Carolina A&T State Univ.)  
Eichenwald, Adam (Biology, Tufts Univ.)  
Erovenko, Igor (Univ. of North Carolina, Greensboro)  
Fadikar, Arindam (Statistics, Virginia Polytechnic Institute and State Univ. (Virginia Tech))  
Fay, Charles (Physics, Emory and Henry College)  
\*Fefferman, Nina (Ecology & Evolutionary Biology, Univ. of Tennessee)  
\*Gallos, Lazaros (DIMACS, Rutgers Univ.)  
Gaoue, Orou ue (Ecology and Evolutionary Biology, Univ. of Tennessee, Knoxville)  
Gorospe, Kelvin (Fisheries, Animal, and Veterinary Sciences, Univ. of Rhode Island)  
Grosklos, Guen (Utah State Univ.)  
Grossman, Alex man (Microbiology, Univ. of Tennessee, Knoxville)  
Iboi, Enahoro (School of Mathematical and Statistical Sciences, Arizona State Univ.)  
Kivlin, Stephanie (Univ. of Tennessee, Knoxville)  
Lenhart, Suzanne (Mathematics, Univ. of Tennessee, Knoxville)  
Massad, Tara (Organization for Tropical Studies)

McCombs, Audrey (Ecology, Evolution and Organismal Biology, Iowa State Univ.)  
Garcia, Pablo Moreno (School of Natural Resources and Environment, Univ. of Florida)  
Pathiravasan, Chathurangi (Mathematics, Southern Illinois Univ., Carbondale)  
Qu, Zhuolin (Mathematics, Tulane Univ.)  
Souza, Lucas Santana (Ecology & Evolutionary Biology, Univ. of Tennessee, Knoxville)  
Schweitzer, Jennifer (Ecology & Evolutionary Biology, Univ. of Tennessee, Knoxville)  
Spanbauer, Trisha (Integrative Biology, Univ. of Texas Austin)  
Strickland, Christopher (Mathematics, Univ. of Tennessee, Knoxville)  
\*Suarez, Gonzalo (Ecology & Evolutionary Biology, Univ. of Tennessee)  
Sy, Karla Therese (Boston Univ.)  
Holguin, Valerie Valerio (Agricultural and Biological Engineering, Univ. of Florida)  
Wang, Xueying (Washington State Univ., Pullman)  
Xu, Bin (Applied and Computational Mathematics and Statistics, Univ. of Notre Dame)  
Zhao, Lihong (Center for Modeling Complex Interactions, Univ. of Idaho)

## NIMBioS Tutorial: The Search for Selection

(Jun 3-7, 2019)

Assis, Ana Paula (Ecology, Universidade de Sao Paulo)  
Bertola, Laura (Biology, City Univ. of New York)  
Browne, Luke (Ecology & Evolutionary Biology, Univ. of California, Los Angeles)  
Chapman, Joanne (Molecular Biosciences, Univ. of Kansas)  
Conklin, Emily (Biology, Univ. of Hawaii, Manoa)  
Donihue, Colin (Biology, Washington Univ. of Saint Louis)  
Duckett, Drew (Evolution, Ecology, & Organismal Biology, The Ohio State Univ.)  
Faillace, Cara (Station d'Ecologie Theorique et Experimentale UMR5321, Centre National de la Recherche Scientifique (CNRS))  
Friedel, Anna el (Martin Luther Univ. of Halle-Wittenberg (MLU))  
Gao, Xiangxi (Scientific Computing Group, Emory Univ.)  
Gering, Eben ring (Integrative Biology, Michigan State Univ.)  
Greene, Austin e (Zoology, Univ. of Hawaii, Manoa)  
Guyton II, Karl (Biology, Howard Univ.)  
Lou, Nicolas (Natural Resources, Cornell Univ.)  
Luria, Victor (Systems Biology, Harvard Univ.)  
Miller, John (Univ. of Tennessee, Knoxville)  
Moler, Ehren (Biological Sciences, Northern Arizona Univ.)  
Nzekwe, Chinedu (Applied Mathematics, North Carolina A&T State Univ.)  
Phong, Connie (Chemical and Systems Biology, Stanford Univ.)  
Piatkowski, Bryan (Biology, Duke Univ.)  
Prado-Irwin, Sofia (Organismic & Evolutionary Biology, Harvard Univ.)  
Ulate, Natalie Sanchez (Biological Sciences, Univ. of Alberta)  
Souza, Lucas Santana (Ecology & Evolutionary Biology, Univ. of Tennessee, Knoxville)  
Summers, Anne (Microbiology, Univ. of Georgia, Athens)  
Swenson, Jared (Biological Sciences, Northern Arizona Univ.)  
Teferedegn, Eden (Molecular Biology, Ege Univ.)  
Teitel, Zachary (Integrative Biology, Univ. of Guelph)  
Torres-Sanchez, Maria (Voss Lab, Univ. of Kentucky)  
\*Walsh, J. Bruce (Ecology & Evolutionary Biology, Univ. of Arizona)  
Weber, Jessica (Genetics, Harvard Univ.)  
Werneck, Fernanda (Scientific Collections, Harvard Univ.)  
Zarri, Liam (Ecology & Evolutionary Biology, Cornell Univ.)

## **NIMBioS Affiliate Faculty**

Abel, Steven (Chemical & Biomolecular Engineering, UTK)  
Armsworth, Paul (Ecology & Evolutionary Biology, UTK)  
Berry, Michael (Electrical Engineering & Computer Science, UTK)  
Brothers, Ernest (Assoc. Dean, The Graduate School, UTK)  
Bruce, Barry (BCMB, UTK) Brothers, Ernest (Assoc. Dean, The Graduate School, UTK)  
Buchan, Alison (Microbiology, UTK)  
Dale, Virginia (ORNL; EEB,UTK)  
Day, Judy (Mathematics; Electrical Engineering & Computer Science, UTK)  
Eda, Shigetoshi (Forestry, Wildlife & Fisheries, UTK)  
Emrich, Scott (Electrical Engineering & Computer Science, UTK)  
Feng, Xiaobing (Mathematics, UTK)  
Fordyce, James (Ecology & Evolutionary Biology, UTK)  
Ganusov, Vitaly (Microbiology, Mathematics, UTK)  
Gao, Orou (Ecology & Evolutionary Biology, UTK)  
Giam, Xingli (Ecology & Evolutionary Biology, UTK)  
Gilchrist, Michael (Ecology & Evolutionary Biology, UTK)  
Goodrich-Blair, Heidi (Microbiology, UTK)  
Hickling, Graham (Forestry, Wildlife, & Fisheries, 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)  
O'Meara, Brian (Ecology & Evolutionary Biology, UTK)  
Prosper, Olivia (Mathematics, 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 Leadership Team**

Bishop, Pamela (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)  
Welsh, Chris (Univ. of Tennessee Knoxville)

### **Postdoctoral Fellow**

Carrasco Tornero, Luis (Univ. of Tennessee Knoxville)  
Chang, Charlotte (Univ. of Tennessee Knoxville)  
Jiao, Jing (Univ. of Tennessee Knoxville)  
Myers, Kellen (Univ. of Tennessee, Knoxville)  
Panchy, Nicholas (Univ. of Tennessee Knoxville)  
Smith-Ramesh, Lauren (Univ. of Tennessee Knoxville)  
Zhu, Gengping (Univ. of Tennessee Knoxville)

### **Postdoctoral Fellow Mentor**

Armsworth, Paul (Univ. of Tennessee Knoxville)  
Fefferman, Nina (Univ. of Tennessee Knoxville)  
Hong, Tian (Univ. of Tennessee Knoxville)  
Kalisz, Susan (Univ. of Tennessee Knoxville)  
Papes, Mona (Univ. of Tennessee Knoxville)  
Simberloff, Dan (Univ. of Tennessee Knoxville)

### **NIMBioS Seminar Series**

Henson, Shandelle (Mathematics, Biology, Andrews Univ., Berrien Springs, MI)  
Jungck, John (Biological Sciences, Univ. of Delaware)  
Karanth, Krithi (Centre for Wildlife Studies, Bangalore; Assoc. Conservation Scientist, Wildlife Conservation Society, New York; Adjunct Asst. Professor, Duke Univ.)  
Melara, Luis (Mathematics, Shippensburg Univ.; Visiting Scholar, NIMBioS and Mathematics, Univ. of Tennessee, Knoxville)  
Prosper, Olivia (Mathematics, Univ. of Kentucky)  
Zhao, Xiaopeng (Mechanical, Aerospace and Biomedical Engineering, Univ. of Tennessee, Knoxville)

## DySoC/NIMBioS Seminars

Bohon, Stephanie (Assoc. Director of the Center for the Study of Social Justice; Sociology, Univ. of Tennessee  
de Waal, Frans B. M. (Living Links, Yerkes National Primate Research Center, Emory Univ., Atlanta, USA, and Utrecht Univ., the Netherlands)  
Doyen, Luc (Director of Research CNRS, GREThA, Univ. of Bordeaux, France)  
Freeberg, Todd (Psychology, EEB, Univ. of Tennessee, Knoxville; DySoC)  
Gavrilets, Sergey (EEB, Mathematics, NIMBioS, UTK; Anthropology, Oxford Univ.; DySoC)  
Gelfand, Michele (Psychology, Univ. of Maryland)  
Manaev, Oleg (Political Science, Univ. of Tennessee, Knoxville)  
Ruck, Damian (Anthropology, Univ. of Tennessee, Knoxville; DySoC)  
Van de Moortel, Aleydis (Classics, Univ. of Tennessee, Knoxville; DySoC)

## SAL/NIMBioS Seminars

Buban, Michael (Air Resources Laboratory, Atmospheric Turbulence & Diffusion Division, NOAA)  
Li, Shuai (Civil and Environmental Engineering, Univ. of Tennessee, Knoxville)  
Li, Yingkui (Geography, Univ. of Tennessee, Knoxville)

## Summer Research Experiences (SRE)

**(2019/06/04-2019/07/26)**

Adewunmi, Eniola (Univ. of Tennessee)  
Alexiades, Vasilios (Univ. of Tennessee)  
Azeredo-Tseng, Cassandra (New College of Florida)  
Bechtel, Ambrose (Univ. of Tennessee)  
Cabezudo, Giovanni (Univ. of Puerto Rico)  
Carrasco, Luis (NIMBioS, Shippensburg Univ.)  
Cho, Priscilla (Emory Univ.)  
Collins, Charles (Univ. of Tennessee)  
Fefferman, Nina (NIMBioS, Univ. of Tennessee)  
Fiet, Lucas (Univ. of Tennessee)  
Grandison, Brandon (Univ. of Florida)  
Hinson, Audra (Microbiology, Univ. of Tennessee)  
Hong, Tian (Univ. of Tennessee)  
Jiao, Jing (NIMBioS, Univ. of Tennessee)  
Jodoin, Vincent (Univ. of Tennessee)  
Kilgore, Ana (Colorado College)  
Knight, Margaret (Colorado College)  
Lenhart, Suzanne (NIMBioS, Univ. of Tennessee)  
Lochner, Ellie (Univ. of Wisconsin)  
Luo, Michael (College of New Jersey)  
Panchy, Nick (NIMBioS, Univ. of Tennessee)  
Papeş, Mona (Univ. of Tennessee)  
Payne, Sheridan (Bellarmine Univ.)  
Randall, Natalie (Austin College)  
Ruiz, Brandyn (Arizona State Univ.)  
Strickland, Christopher (Univ. of Tennessee)  
Talmy, David (Univ. of Tennessee)  
Todd, Meagan (Virginia Tech)  
Wiggins, Greg (NIMBioS, Univ. of Tennessee)  
Williams, Abigail (Salem College)  
Yin, Hannah (Tufts Univ.)



## **Undergraduate Research Conference (URC) 2018 (2018/10/27 – 2018/10/28)**

Abbasi, Eeman (Mount Holyoke College)  
Alred, Brianna (Univ. of Tennessee Knoxville)  
Andrade, Amber (Arizona State Univ.)  
Andrews, Leah (Saint Olaf College)  
Ateyeh, Abdullah (Western Kentucky Univ.)  
Brittney, Nelson (Murray State Univ.)  
Brock, Sarah (Univ. of Tennessee Knoxville)  
Brozak, Samantha (Arizona State Univ.)  
Butler, Cole (Univ. of Maine)  
Castedo Pena, Diego (North Carolina State Univ.)  
Chidambaran, Sadhana (Rutgers Univ. New Brunswick/Piscataway)  
Collins, Reagan (Texas Tech Univ.)  
Dai, Yi (The Ohio State Univ.)  
De Angeli, Kevin (Texas A&M Univ. Kingsville)  
Erovenko, Igor (Univ. of North Carolina Greensboro)  
Eversman, Kimberlyn (Truman State Univ.)  
Fay, Charles (Emory and Henry College)  
Gaff, Holly (Old Dominion Univ.)  
Gan, Alan (Univ. of Tennessee Knoxville)  
Gasper, Rebecca (Creighton Univ.)  
Gort Freitas, Nicolas (Santa Fe Institute)  
Hoard, Emily (Murray State Univ.)  
Kwarta, Brielle (Houghton College)  
Lanz, Aprillya (Grand Canyon Univ.)  
Lenhart, Suzanne (Univ. of Tennessee Knoxville)  
Li, Qiuyun (Rose-Hulman Institute of Technology)  
Li, Qingxia (Fisk Univ.)  
Machado, Jonathan (Univ. of North Carolina Greensboro)  
Mariano, Aloiso (Loyola Marymount Univ.)  
Mattamira, Chiara (Converse College)  
Melara, Luis (Shippensburg Univ. of Pennsylvania)  
Mora-Mercado, Laura (Univ. of Puerto Rico Mayaguez)  
Naik, Sparshee (Arizona State Univ.)  
Pellett, Jordan (Univ. of Wisconsin La Crosse)  
Pentecost, Abigail (Arizona State Univ.)  
Penumadu, Rachel (Univ. of Tennessee Knoxville)  
Petroski, Alyssa (Univ. of the Sciences)  
Reber, Ben (Houghton College)  
Riehl, Manda (Rose-Hulman Institute of Technology)  
Rogers, Daija (Grand Canyon Univ.)  
Rosensteel, Grant (Georgetown Univ.)  
Savinov, Mariya (Univ. of Pittsburgh)  
Schenck, Benjamin (College of William and Mary)  
Schugart, Richard (Western Kentucky Univ.)  
Shortreed, Brielle (Univ. of Wisconsin Milwaukee)  
Smith, Shelby (Creighton Univ.)  
Spell, Katherine (Appalachian State Univ.)  
Statum, Garrett (Univ. of Tennessee Knoxville)  
Susswein, Zachary (Georgetown Univ.)  
Tanaka, Shari (Creighton Univ.)

Torsey, Allison (Buffalo State College)  
Turner, Alena (Anderson Univ.)  
Vasquez-Perez, Pedro (Univ. of Puerto Rico Mayaguez)  
Vaughan, Laura (King Univ.)  
Wallace, Kourtney (Howard Univ.)  
Werbick, Meghan (Arizona State Univ.)  
White, Zakar (Virginia Polytechnic Institute and State Univ.)  
Wiggins, Greg (Univ. of Tennessee Knoxville)  
Yang, Jerry (Univ. of California Berkeley)  
Zhu, Junchun (Pennsylvania State Univ. University Park)

## **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)  
Minshall, Nichole (Univ. of Tennessee Knoxville)  
Murr, Louise (Univ. of Tennessee Knoxville)  
Peek, Michael (Univ. of Tennessee Knoxville)  
Spar, Jennifer (Univ. of Tennessee Knoxville)  
Wiggins, Greg (Univ. of Tennessee Knoxville)

## **Visitor**

Agusto, Folashade (Univ. of Kansas)  
Bintz, Jason (Univ. of Tennessee Knoxville)  
Brinkman, Baba (Rap artist and playwright)  
Chen, Benito Chen (Univ. of Texas Arlington)  
Childs, Lauren (Mathematics, Virginia Tech)  
Doyen, Luc (Universite de Bordeaux)  
Iriarte-Gross, Judith (Middle Tennessee State Univ.)  
Henson, Shandelle (Andrews Univ., Berrien Springs, MI)  
Jhwueng, Tony (Feng-Chia Univ.)  
Jordan, Heather (Mississippi State Univ.)  
Jungck, John (Univ. of Delaware)  
Karanth, Krithi (Centre for Wildlife Studies, Bangalore; Assoc. Conservation Scientist, Wildlife Conservation Society, New York; Duke Univ.)  
Kwarta, Brielle (Mathematics, Univ. of Washington)  
Leite, Maria Leite (Univ. of South Florida)  
Liu, Xiangping (Univ. of Tennessee)  
Magombedze, Gesham (Center for Infectious Diseases Research and Experimental Therapeutics, Baylor Health Care)  
Martinez, Oscar (El Colegio de la Frontera Sur)  
Melara, Luis (Shippensburg Univ. of Pennsylvania)  
Morozov, Andrew (Leicester Univ.)  
Numfor, Eric (Agusta College)  
Panchy, Nicholas (Univ. of Tennessee Knoxville)  
Petrovskii, Sergei (Univ. of Leicester)  
Pinter Wollman, Noa (Univ. of California Los Angeles)  
Prosper, Olivia (Univ. of Tennessee Knoxville)  
Seraphin, Sally (Univ. of Tennessee Knoxville)  
Smith-Ramesh, Lauren (Univ. of Tennessee Knoxville)  
Small, Pamela (Univ. of Tennessee Knoxville)

Stabel, Judith (USDA, Infectious Bacterial Diseases Research: Ames, IA)  
Udiani, Oyita (Univ. of Tennessee Knoxville)  
Vortkamp, Irina (Osnabruck Univ.)

### **Expected**

An, Gary An (Division of Acute Care Surgery, Univ. of Vermont Larner College of Medicine)  
Brooks, Heather (Mathematics, UCLA)  
Hohn, Maryann (Statistics and Applied Probability, UC Santa Barbara)  
Price, Candice (Mathematics, Univ. of San Diego)  
Radunskaya, Ami (Mathematics, Pomona College)  
Sindi, Suzanne (Mathematics, UC Merced)  
Williams, Nakeya (U.S. Military Academy, West Point)  
Wilson, Shelby (Mathematics, Morehouse College)

### **Undergraduate and Graduate Student Worker**

Musgrove, Matt (Univ. of Tennessee Knoxville)  
Yopp, Stephanie (Univ. of Tennessee Knoxville)

## **Sustainment Activities**

### **NISER Evaluation Associate**

Echols, Erica  
LoRe, Sondra  
York, Meredith

### **NIMBioS Tutorial: Risk Assessment Calculator Training (March 5-7, 2019)**

Alexander, Shanna (Earthcon Consultants, Marietta, GA)  
Chen, Valerie (Stantec, Bellevue, WA)  
Dawson, Jana (Legacy Radchem Consulting, LLC, Niceville, FL)  
Dec, Adam (AECOM, Germantown, MD)  
\*Dolislager, Fred (The Institute for Environmental Modeling, UTK and ORNL)  
Flynn, Robert (Purdue Univ., W. Lafayette, IN)  
Garner, LeAnne (Four Rivers Nuclear Partnership, Kevil, KY)  
\*Galloway, Leslie (The Institute for Environmental Modeling, UTK and ORNL)  
Kucera, Steve (RSI Entech, LLC, Oak Ridge, TN)  
\*Manning, Karessa (The Institute for Environmental Modeling, UTK and ORNL)  
McGee-Solomon, Morgan (Delaware DNREC, New Castle, DE)  
Miller, Thomas (Zmassociates Environ. Corp., Portland, OR)  
Offenberger, Stephanie (Arcadis US, Inc., Durham, NC)  
Olson, Genna (Hart & Hickman, PC, Raleigh, NC)  
Price, Morgan (Delaware DNREC, New Castle, DE)  
Ryer-Powder, Jill (Environmental Health Decisions, Ladera Ranch, CA)  
Smith, Jeanine (Arcadis US, Inc., Knoxville, TN)  
\*Stewart, Debra (The Institute for Environmental Modeling, UTK and ORNL)  
Wright-Walters, Maxine (Environmental Data Validation Inc., Pittsburgh, PA)

# **Addendum to NIMBioS Annual Report**

## **Sep 1, 2018 – Aug 31, 2019**

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### **Y11-3. Description of Activities**

## **Addendum-Description of Activities**

### **DESCRIPTION OF MAJOR ACTIVITIES SEPTEMBER 1, 2018 – AUGUST 31, 2019**

During September 1, 2018 through August 31, 2019 reporting period, NIMBioS hosted (or will host this summer) 12 meetings of nine different Working Groups, six Investigative Workshops, three Tutorials, monthly XSEDE HPC workshops, and many Outreach and Education activities.

There are projected to be more than 592 participants in NIMBioS-hosted activities during this period with 5 Postdoctoral Fellows in residence, and 30 Short-term Visitors, and five Visiting Scholars.

Demographics data on all participants are available for events from September 1, 2018 through June 30, 2019 and are presented in detail in the NIMBioS Evaluation Report (see Section Y11-2 of the attached addendum to this Annual Report) and summarized below. There were 558 participants through June 30, 2019, from 19 countries and 44 U.S. states as well as the District of Columbia and Puerto Rico representing 223 different institutions. International participants amounted to 11% of all participants. Most participants were college or university faculty (50%), but undergraduates (12%), post-doctoral researchers (14%), and graduate students (12%) accounted for a significant fraction of participants. Across all events female representation was 51%. Overall minority representation across NIMBioS events was 13%, which exceeds the number of doctoral recipients in the biological and mathematical sciences. Thirty short-term visitors from September 1, 2018 through August 31, 2019 represented 25 different institutions and collaborated with NIMBioS post-doctoral fellows and faculty from three University of Tennessee departments.

Below is a short description of each of the Working Groups, Investigative Workshops, and Tutorials held September 1, 2018 and planned through August 31, 2019 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 Y11-3 of this addendum.

#### **WORKING GROUPS**

Working Group: Long Transients and Ecological Forecasting

[http://www.nimbios.org/workinggroups/WG\\_ltt](http://www.nimbios.org/workinggroups/WG_ltt)

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: Sept 26-28, 2018; May 7-9, 2019

Working Group: Quant Bio@Community College

[http://www.nimbios.org/workinggroups/WG\\_quantbio-cc](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: Oct 25-27, 2018; May 30-Jun 1, 2019

Working Group: Remotely Sensing Biodiversity

[http://www.nimbios.org/workinggroups/WG\\_biodiversity](http://www.nimbios.org/workinggroups/WG_biodiversity)

Jeannine Cavender-Bares (Ecology, Evolution and Behavior, Univ. of Minnesota), Phil Townsend (Forest and Wildlife Ecology, Univ. of Wisconsin), Brian O'Meara (Ecology and Evolutionary Biology, Univ. of Tennessee), and Jose Meireles (Ecology, Evolution and Behavior, Univ. of Minnesota)

Remote sensing of biodiversity is critical at a time when the Earth's biodiversity loss due to human activities is accelerating at an unprecedented rate. Functional plant diversity is highly associated with plant biodiversity, and recent technological and computational advances allow the detection of plant functional traits and trait diversity from spectral data that can be remotely sensed. Although biodiversity itself cannot practically be observed everywhere, if functional traits and trait diversity can be remotely sensed using spectral data, the potential exists to at least globally inventory the diversity of traits associated with terrestrial biodiversity. Moreover, spectral data and the functional traits they predict can be linked to phylogenetic data as a means to estimate changes in biodiversity patterns globally.

However, the mathematical models and computational approaches to integrate multiple complex multidimensional datasets are underdeveloped. We bring together biological and computational experts from three disciplines—remote sensing and leaf optics, plant functional biology and systematics—to develop a framework and set of computational tools for linking spectral data, functional traits, and phylogenetics. Our goal is to transform the ability of humanity to detect and interpret the changing functional biodiversity of Planet Earth.

Meeting dates: Oct 29-31, 2018

Working Group: Ecosystem Federalism

[http://www.nimbios.org/workinggroups/WG\\_ecofed](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: Dec 10-12, 2018

Working Group: Conservation Hierarchies

[http://www.nimbios.org/workinggroups/WG\\_conservation](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: Jan 16-18, 2019; May 16-19, 2019

Working Group: Ecological Network Dynamics

[http://www.nimbios.org/workinggroups/WG\\_econetworks](http://www.nimbios.org/workinggroups/WG_econetworks)

Organizers: David Hembry (Molecular and Cell Biology, Univ. of California, Berkeley), Dominique Gravel (Biology, Univ. of Quebec, Rimouski, Canada), Paulo Guimaraes Jr. (Ecology, Univ. of Sao Paulo (USP), Brazil) and James O'Donnell (School of Marine and Environmental Affairs, Univ. of Washington, Seattle)

The rapidly advancing field of spatial ecology has demonstrated that processes operating over spatial and temporal scales have strong effects on ecosystems and their constituent organisms. However, research in either field seldom incorporates information from the other. In part, this endeavor has been hindered by the limited availability of datasets spanning suitably large spatial or temporal scales. More problematic is the lack of a theoretical framework and the analytical tools needed to interpret the spatio-temporal dynamics of ecological networks. This working group brings together a diverse group of scientists whose expertise spans both fields, including field biologists along with theoreticians and computational biologists. This group will develop working hypotheses for factors driving network dynamics based on empirical patterns; explore one or more case studies of variation across space or time in ecological networks; and develop a new model of network dynamics based on the theory of island biogeography, incorporating biogeography, coevolution, and community ecology, to be used in interpreting empirical patterns.

Meetings dates: Feb 13-15, 2019

Working Group: Learning in Networks

[http://www.nimbios.org/workinggroups/WG\\_learning](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 25-26, 2019

Working Group: Optimal Control of Neglected Tropical Diseases

Organizers: Giulio De Leo, Biology (Hopkins Marine Station, Stanford Univ.); Calistus Ngonghala (Mathematics and Emerging Pathogens Inst., Univ. of Florida, Gainesville); and Justin Remais (School of Public Health, Univ. of California, Berkeley)

Neglected Tropical Diseases (NTDs) such as amebiasis, Chagas disease, hookworm, leishmaniasis, and schistosomiasis affect more than 1.4 billion people worldwide. Their impacts—expressed as mortality, morbidity, reduced educational and employment opportunities, or social stigma—tend to be greatest among the global rural poor. Controlling NTDs is particularly challenging because of a lack of vaccines that can provide life-long immunity, and the existence of important environmental reservoirs where pathogens persist even as populations are successfully treated for their infections. After mass drug administrations (MDA) of the population at risk, treated people are commonly re-exposed to the parasite or pathogen in the environment, resulting in an endless cycle of treatment and reinfection. Two and a half billion dollars are currently disbursed yearly in tropical and subtropical regions in efforts to control NTDs. Such funding and control efforts are directed mainly toward MDA, with little theoretical understanding of the dynamics of elimination, nor of the conditions for optimal, cost-effective intervention. This Working Group investigates cost-effective NTD control and elimination measures through the application of optimal control theory and through the use of cutting-edge computational techniques applied to a range of mathematical transmission models exhibiting increasing levels of complexity. The group will assess the cost-effectiveness of alternative strategies for NTD elimination in addition to MDA, as well as innovative and creative ecological solutions aimed at interrupting environmental transmission through water, sanitation and hygiene interventions and biological control of free-living stages of pathogens and/or intermediate hosts.

Meeting dates: Jul 15-16, 2019

Working Group: Multiscale Vectored Plant Viruses

[http://www.nimbios.org/workinggroups/WG\\_plantviruses](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: Aug 7-9, 2019

## **INVESTIGATIVE WORKSHOPS**

DySoC/NIMBioS Investigative Workshop: Extending the Theory of Sustainability

[http://www.nimbios.org/workshops/WS\\_sustainability](http://www.nimbios.org/workshops/WS_sustainability)

Organizers: Peter Richerson (Environmental Science & Policy, Univ. of California, Davis); Eli Fenichel (Forestry and Environmental Studies, Yale Univ.); and Sergey Gavrilets (Center for the Dynamics of Social Complexity (Center for the Dynamics of Social Complexity/NIMBioS; Ecology & Evolutionary Biology and Mathematics, Univ. of Tennessee)

This workshop reviewed the state of sustainability theory. Major themes of the workshop included the role of cultural evolution, the role of evolving technology and R&D investments, diffusion of technology, uncertainty in ecosystem management, models of institutional change, and non-autonomous dynamics of important socio-environmental processes, e.g. climate change. We convened 36 participants drawn from a broad range of active scholars from the fields of economics, socio-political evolution, the natural sciences and mathematics to present the latest developments in their fields. Based on these presentations, the participants discussed where the most promising areas for new research lie. We looked for gaps in the modeling enterprise, particularly ones opened up by disciplinary divergences and new empirical findings.

Meeting dates: Dec 5-7, 2018

DySoC/NIMBioS Investigative Workshop: Human Origins 2021

[http://www.nimbios.org/workshops/WS\\_humanorigins](http://www.nimbios.org/workshops/WS_humanorigins)

Organizers: Sergey Gavrilets (Center for the Dynamics of Social Complexity/NIMBioS; Ecology & Evolutionary Biology and Mathematics, Univ. of Tennessee, Knoxville); Frans de Waal (Psychology, Emory Univ., Atlanta, Georgia); and Peter Richerson (Environmental Science and Policy, Univ. of California, Davis)

The year 2021 will be the 150th anniversary of the publication of Darwin's second book "The Descent of Man" (1871). The aim of this workshop was to develop strategies for preparing the scientific community for the widespread celebration of the achievements of life science in understanding human origins (including continuities and discontinuities with other species) that will accompany this anniversary. Our overall goal was to leverage this oncoming anniversary 1) to advance scientific research focusing on the evolutionary forces and mechanisms that drove the origins of the human species and on implications of our evolutionary past for modern humans and 2) to promote public understanding of the significance of this research across various segments of society, including educators, politicians, business leaders, and medical doctors. A specific goal was to build momentum and stimulate collaborative research networks across various scientific disciplines (such as evolutionary biology, primatology, anthropology, neurobiology, psychology, economics and other social sciences) with the aim of establishing a major new synthesis center analogous to the highly successful previous NSF-funded centers (NCEAS, NESCent, NIMBioS, and SESYNC) which have already revolutionized the way research is done across a range of life

sciences.

Meeting dates: Feb 15-16, 2019

DySoC/NIMBioS Investigative Workshop: Social Norms: Emergence, Persistence, and Effects

[http://www.nimbios.org/workshops/WS\\_socialnorms](http://www.nimbios.org/workshops/WS_socialnorms)

Organizers: Michele Gelfand (Psychology, Univ. of Maryland); Nathan Nunn (Economics, Harvard Univ.); and Sergey Gavrilets (Center for the Dynamics of Social Complexity/NIMBioS; Ecology & Evolutionary Biology and Mathematics, Univ. of Tennessee)

Human social behavior is controlled by many interacting factors including material cost-benefit considerations, genetically-informed social instincts, personality, and culturally transmitted norms, values, and institutions. A social norm is a behavior that one is expected to follow and expects others to follow in a given social situation. Humans learn norms from parents, through educational and religious practices, and from friends and acquaintances, books, and media. The adherence to norms is socially reinforced by the approval of, and rewards to, individuals who follow them and punishment of norm violators. Certain norms are internalized, that is, acting according to a norm becomes an end in itself rather than merely a tool in achieving certain goals or avoiding social sanctions. For individuals who have strongly internalized a norm, violating it is psychologically painful even if the direct material benefits for the violation are positive. Many individuals and groups are willing to pay extremely high costs to enact, defend, or promulgate norms that they consider important. At the same time, virtually all norms can be violated by individuals under some conditions (e.g. if the costs of compliance are too high). A society's values are transmitted through the internalization of norms, with some societies being more successful than others due to their norms and institutions. Society's norms are affected by historical and environmental factors. Some norms are very stable while others can change rapidly. Understanding the emergence, persistence, and effects of social norms is crucial for developing better policies affecting the life of the society as a whole and of its individual members. The workshop brought together active scholars interested in various aspect of social norms with the aim of stimulating new synergies, insights, and collaborations. The meeting was a transdisciplinary gathering of researchers from diverse disciplines including sociology, anthropology, psychology, economics, evolutionary biology, cultural evolution, neurobiology, political science, history, and experts on extremism, marketing, communications, as well as policy scholars and practitioners.

Meeting dates: Apr 23-25, 2019

NIMBioS/DySoC Investigative Workshop: Mathematics of Gun Violence

[http://www.nimbios.org/workshops/WS\\_gunviolence](http://www.nimbios.org/workshops/WS_gunviolence)

Organizers: Andrea L. Bertozzi (Mathematics and Mechanical and Aerospace Engineering, UCLA); Louis J. Gross (Mathematics and Ecology & Evolutionary Biology, NIMBioS, Univ. of Tennessee, Knoxville); Andrew V. Papachristos (Sociology, Institute for Policy Research, Northwestern Univ.); Shelby M. Scott (Ecology & Evolutionary Biology, Univ. of Tennessee, Knoxville); and Martin B. Short (Mathematics, Georgia Tech)

Gun violence is a central public concern in the United States, annually leading to the deaths of 31,000 individuals and the non-fatal injuries of 78,000 others. It has been called an epidemic and a public health crisis. For infectious disease epidemics and associated public health planning (including recent Zika and

Ebola outbreaks), officials relied on mathematical models to evaluate immediate responses and develop preventative policies. The construction of policies to curb the spread of gun violence could benefit from the development of mathematical models linked with available data. This workshop brought together researchers from diverse disciplinary backgrounds to (i) review the existing approaches on the mathematics and modeling of gun violence, (ii) identify and prioritize areas in the field that require further research, (iii) develop cross-disciplinary collaborations to gain new perspectives, and (iv) suggest research and data-collection that could assist evidence-based policy recommendations. A direct outcome from this workshop: a comprehensive review of existing models on this topic with suggestions for further effort. It is expected that collaborations arising from the workshop will result in novel efforts to enhance the quantitative underpinnings of the science of gun violence.

Meeting dates: May 1-3, 2019

NIMBioS Investigative Workshop: Scientific Collaboration Enabled by High Performance Computing

[http://www.nimbios.org/workshops/WS\\_hpc](http://www.nimbios.org/workshops/WS_hpc)

Organizers: Suzanne Lenhart (NIMBioS and Mathematics, Univ. of Tennessee); Katherine Evans (Computational Earth Sciences Group, Oak Ridge National Laboratory); Amanda Randles (Biomedical Engineering, Duke Univ.); Michelle Swenson (Mathematics, Univ. of Tennessee); Michela Taufer (Electrical Engineering and Computer Science, Univ. of Tennessee); and Greg Wiggins (NIMBioS, Univ. of Tennessee)

This workshop showcased important scientific research using big data and high performance computing and featured new developments in high performance computing. A main goal of the workshop was to facilitate new collaborations. The workshop included several invited research talks, a poster session, breakout discussion sessions and a panel discussion. The breakout discussions fostered conversations about computing needs for specific scientific projects. Participants came from a variety of scientific areas, ranging from biology to climate and to biomedical engineering, including faculty, postdocs and advanced graduate students.

Meeting dates: May 13-15, 2019

NIMBioS Investigative Workshop: Transients in Biological Systems

[http://www.nimbios.org/workshops/WS\\_transients](http://www.nimbios.org/workshops/WS_transients)

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

Transients, or non-asymptotic dynamics, cover a wide range of possibilities, from biology to ecology and beyond. A full understanding of transients and their implications for biology requires mathematical and statistical developments as well as attention to biological detail. Transient dynamics have also played a central role in both empirical observations and in models in neuroscience. Yet interaction between ecologists and neuroscientists on this topic has been limited. Although epidemiology could be considered part of population biology, there is also less cross-talk between epidemiology and other areas of population biology than desirable. Transients clearly play a role in disease dynamics. Areas such as immune response require attention to transients as well. Goals for the workshop: To spur further

research into transients, both from a mathematical standpoint and as a way to understand and analyze biological systems; to develop appropriate statistical questions related to the analysis of biological systems using ideas from transient dynamics; and to prepare one or more synthetic documents on the role of transients across biological systems. Ideas for this workshop benefited from discussions at meetings of the NIMBioS Working Group on Long Transients and Ecological Forecasting.

Meeting dates: May 29-31, 2019

## **SUSTAINMENT ACTIVITIES**

Risk Assessment Calculator Training: US EPA and RAIS Screening Level Calculator Training for Chemical and Radionuclide Risk Analysis

[http://www.nimbios.org/tutorials/TT\\_risk](http://www.nimbios.org/tutorials/TT_risk)

Organizers: Fred Dolislager, Leslie Galloway, Debra Stewart, and Karessa Manning from the Institute for Environmental Modeling, Univ. of Tenn. and Oak Ridge National Laboratory

The Institute for Environmental Modeling (TIEM) team has been publishing online "risk" (cancer risk and hazard index) calculators for over twenty years; this training provided participants with operational knowledge of all TIEM calculators. The instruction also delved into the ability of the calculators to address site-specific exposures, unique toxicity assessments, and complex risk characterizations.

Meeting dates: Mar 5-7, 2019

A Tasting Menu of Mathematical Models: What Can They Do and How They Might Help in Your Research

<http://www.nimbios.org/mathmod4u>

For graduate students, post-docs and faculty, the event included a presentation about types of models, a question and answer session about how modeling might fit into grant proposals, research, and teaching, and collaborative break-out sessions to discuss areas of research with potential for modeling.

Meeting dates: Oct 16 and Oct 22, 2018

XSEDE HPC Monthly Workshops at NIMBioS

[http://www.nimbios.org/workshops/ws\\_xsede](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: 2018: Sept 5-6, Oct 2-3, Nov 6, Dec 4-5 and 2019: Feb 12-13, June 3-7, Aug 6-7

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: Sept 14, 2018; Oct 19, 2018; Nov 2, 2018; Feb 1, 2019

## VISITORS

### Visiting Scholars:

Oyita Udiani (NSF Postdoctoral Fellow) visited on a fellowship with N. Fefferman to develop learning in models of animal behavior. (Sept 1, 2018-Aug 31, 2019)

Jason Bintz (Mathematics, Johnson Univ., Tennessee), who is a former NIMBioS Graduate Research Assistant, collaborated on two projects with S. Lenhart, a project using optimal control theory for resource allocation in population models with spatial and temporal features and a project to develop a model for the infectious disease, *Clostridioides difficile*. (Dec 20-21, 2018 and May 29-June 3, 2019)

Sally Seraphin (Behavioral Neuroscience, Centre College) collaborated with N. Fefferman to study accelerated developmental maturation and ageing associated with early adversity. (May 1-31, 2019)

Brielle Kwartia (Mathematics, Univ. of Washington), who participated in the 2018 NIMBioS Summer Research Experiences for Undergraduates program, collaborated with C. Sims and S. Lenhart to extending the SRE project on economic modeling of free-roaming cats in Knox County. (May 1-June 30, 2019)

Tony Jhwueng (Statistics, Feng-Shia Univ.) collaborated with B. O'Meara to create a novel method for trait evolution modeling using Bridge processes. (July 15-Aug 2, 2019)

### Short-term Visitors:

Guihong Fan (Mathematics, Columbus State Univ.) collaborated with S. Lenhart to develop a model of West Nile Virus in mosquitoes, humans and birds with an emphasis on dynamics driven by temperature. (Aug 3-7, 2018) [Not included in previous year's annual report because visit was approved after submission of the report.]

Luis Melara (Mathematics, Shippensburg Univ.) collaborated on a project with S. Lenhart to develop optimal control models for treatment of Retinitis Pigmentosa. (Aug 17-Dec 16, 2018)

Olivia Prosper (Mathematics, Univ. of Kentucky) collaborated on a project with S. Lenhart to develop epidemiological models that incorporate heterogeneity to study malaria and the opioid crisis. (Aug 22-Dec 16, 2018)

Shandelle M. Henson (Mathematics, Biology, Andrews Univ., MI) gave a seminar titled 'Climate change and tipping points for seabird colonies in the Pacific Northwest.' (Sept 4, 2018)

Luc Doyen (Director of Research CNRS, GREThA, Univ. of Bordeaux, France) gave a seminar titled 'Tragedy of open ecosystems.' (Sept 16-21, 2018)

Heather Jordan (Biological Sciences, Mississippi State Univ.) and Pamela Small (Microbiology [Emeritus], Univ. of Tennessee) collaborated with S. Lenhart and C. Edholm on a project to model Buruli Ulcer Disease. (Sept 23-27, 2018)

John Jungck (Biological Sciences, Univ. of Delaware) and Raina Robeva (Mathematics, Sweet Briar College) collaborated with L. Gross on projects related to quantitative education in biology. Jungck also gave a seminar. (Oct 1-3, 2018)

Maria Leite (Mathematics and Statistics, Univ. of South Florida), Benito Chen (Mathematics, Univ. of Texas Arlington) and Folashade Agosto (Ecology & Evolutionary Biology, Univ. of Kansas) collaborated with O. Gaoue on a project to develop a mathematical framework for the sustainability of harvesting non-timber forest products in a fragmented landscape. (Feb 8-11, 2019)

Krithi K. Karanth (Executive Director, Centre for Wildlife Studies, Bangalore; Assoc. Conservation Scientist, Wildlife Conservation Society, New York; Adjunct Asst. Professor, Duke Univ.) collaborated with C. Chang on a project to apply innovative social-ecological solutions to resolve human-wildlife conflict, and also gave a seminar on "Living with Wildlife: Insights from conservation research, technology and education programs in India." (April 10-14, 2019)

Baba Brinkman, a New York-based rap artist and playwright performed the world premiere of his Rap Guide to Culture and also attended the DySoC/NIMBioS Investigative Workshop on Social Norms in order to perform a "rap-up" of each day's discussions. (April 23-24, 2019)

Noa Pinter-Wollman (Ecology & Evolutionary Biology, Univ. of California, Los Angeles) collaborated with N. Fefferman on a project to develop a topological model for multiscale feedback in collaborative behavioral systems. (May 6-9, 2019)

Andrew Morozov (Mathematics, Univ. of Leicester, UK) and Sergei Petrovskii (Mathematics, Univ. of Leicester, UK) collaborated with S. Gavrillets on a project stemming from the Long Transients Working Group meeting, which occurred prior to the visit. (May 10-17, 2019)

Irina Vortkamp (Mathematics & Computer Science, Osnabrück Univ.) collaborated with S. Lenhart on a project to investigate optimization methods for discrete time models in agricultural land use. (May 28-31, 2019)

Oscar Martinez (Mathematics, El Colegio de la Frontera Sur) collaborated with M. Papes and L. Carrasoc Tornero on a project using spatial ecology tools to assess the conservation status of Mesoamerican bees. (July 14-31, 2019)

Gesham Magombedze (Center for Infectious Diseases Research and Experimental Therapeutics, Baylor Health Care) and Judith Stabel (USDA, Infectious Bacterial Diseases Research: Ames, IA) collaborated with S. Eda on a project to model John's disease immunology. (July 16-18, 2019)

Eric Numfor (Mathematics, Augusta College) collaborated with S. Lenhart on a project to build a cell-to-cell model of the human immunodeficiency virus. (July 21-26, 2019)

Lauren Childs (Mathematics, Virginia Tech) collaborated with N. Fefferman on a project to model malaria parasite diversity. (July 29-Aug 3, 2019).

Gary An (Division of Acute Care Surgery, Univ. of Vermont Larner College of Medicine) collaborated with J. Day on a project to research control discovery techniques applied to mathematical models for critical care medicine. (Aug 5-9, 2019)

Heather Brooks (Mathematics, UCLA); Candice Price (Mathematics, Univ. of San Diego); Maryann Hohn (Statistics and Applied Probability, UC Santa Barbara); Shelby Wilson (Mathematics, Morehouse College); Ami Radunskaya (Mathematics, Pomona College); Suzanne Sindi (Mathematics, UC Merced); and Nakeya Williams (U.S. Military Academy, West Point) collaborated with N. Fefferman on a project to research parasite risks and the evolution of social behaviors and emergent population organization. (Aug 25-31, 2019)

### **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, 2018 and August 31, 2019.

#### 2019 Summer Research Experience (SRE) for Undergraduates Program

Eighteen undergraduates participated in the 2019 NIMBioS Summer Research Experience (SRE) for undergraduates and note that seven of these students were supported by a grant to NIMBioS from the National Security Agency. During the eight-week program, 16 of the participants lived on campus at the University of Tennessee, Knoxville (UT) and worked in teams with NIMBioS postdocs and UT faculty to conduct research at the interface of mathematics and biology. The student support included a \$4,500 stipend, housing and some travel support. Two local students chose not to live in provided housing (June 3 through July 27, 2019). The projects this year were biochemical pathways for aerotaxis in motile bacteria; climate change as a driver of change in human-wildlife interactions; investigating viral infection rates of marine phytoplankton; modeling cell differentiation; modeling networking and the opioid epidemic; and the impact of shifting climate on co-evolution in vector-borne diseases.

#### Minority-Serving Institution Partner Visits

Visits were arranged for NIMBioS researchers to visit our minority-serving institution partners:

N. Panchy presented a talk for the Department of Mathematics Colloquium and visited with mathematics faculty at Howard University on Oct 18-19, 2018.



S. 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 Mar 22, 2019.

### 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. At the Joint Math Meetings 2019, Lenhart spoke in a special session about Zika epidemic modeling, and one of her collaborators was a student long-term visitor, partially supported by NIMBioS. SRE 2018 participant B. Reber from Houghton College presented a poster on his SRE project.

### 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 tenth annual conference. The conference included student talks and posters, two guest plenary speakers (H. Gaff and N. Fefferman), 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 attended. There were 60 undergraduate research talks and posters. (Oct 27-28, 2018)

### 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 2018 and Spring 2019)

### Teaching Workshops

S. Lenhart, G. Wiggins, Shel Swenson (UT math lecturer) and Vincent Jodoin (UT math student, working on secondary education) presented activities showing mathematical modeling for a teacher professional development workshop (Modeling with Math) at NIMBioS in cooperation with Knox County STEM-Hub and UT Center for Enhancing Education in Math and Science (CEEMS). Ten high school teachers attended. (June 2019)

S. Lenhart presented at a STEM teacher workshop in Palapye, Botswana, to 50 middle and high school teachers. (Nov 2018)

### Adventures in STEM Camp

NIMBioS collaborated with CURENT (a UT Engineering Center funded by NSF) to offer a week-long summer day camp for rising 7th and 8th grade girls on STEM (Science, Technology, Engineering, Mathematics). S. Lenhart, G. Wiggins, N. Panchy, and M. Peek presented. (June 2019)

### Tutorials

Lenhart and Wiggins helped to organize the following three tutorials:

Tutorial: The Search for Selection

<http://www.nimbios.org/tutorials/selection2>

This successful tutorial from June 2018 was repeated again in 2019.

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 3-7, 2019

Tutorial: Network Modeling

[http://www.nimbios.org/tutorials/TT\\_networks](http://www.nimbios.org/tutorials/TT_networks)

Organizers: Nina Fefferman (Ecology & Evolutionary Biology, Univ. of Tennessee); Lazaros Gallos (DIMACS, Rutgers Univ.) and Gonzalo Suarez (Ecology & Evolutionary Biology, Univ. of Tennessee)

This tutorial introduced students and interested faculty to the topic of complex networks. The field has grown tremendously over the last 20 years and network science has found numerous applications to fields such as biology, ecology, social sciences, physical sciences, computer science, technology, and urban planning. The tutorial reviewed in detail the main ideas and methods in network science with emphasis on both conceptual aspects and real-world applications. Hands-on activities helped the audience familiarize themselves with practical ways to potentially incorporate network analysis in their own research.

Meeting dates: Feb 4-6, 2019

Tutorial: Applications of Spatial Data: Ecological Niche Modeling

[http://www.nimbios.org/tutorials/TT\\_SpatialData2](http://www.nimbios.org/tutorials/TT_SpatialData2)

This successful tutorial from May 2018 was repeated again in 2019.

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); and Luis

Escobar (Fish and Wildlife Conservation, Virginia Tech)

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: Dec 3-5, 2018

#### School Visits, Field Trips, Conferences and Meetings

S. Lenhart visited Bearden High School once a week during the school year for math club enrichment activities.

S. Lenhart visited several times a middle school math group at the Phyllis Wheatly YWCA during the spring semester 2019.

S. Lenhart and G/ Wiggins presented career information at a STEM open house at Lonsdale Elementary School on May 9, 2019.

Students from North Middle School visited NIMBioS on May 6-7, 2019; we organized activities for 180 students among NIMBioS, UT Library, and CURENT.

Twenty students from Seymour Middle School visited on May 28, 2019.

Ten high schools from a summer CURENT visited on July 18, 2019. Activities about quantifying biodiversity were presented.

S. Lenhart and G. Wiggins presented math biology activities during a Chess Competition for young girls at UT on Mar 30, 2019.

G. Wiggins attended and presented research resulting from a 2018 SRE project at the Joint Meeting of the Entomological Society of America, Entomological Society of Canada, and the Entomological Society of British Columbia, Vancouver, BC, Canada, Nov 11-15, 2018.

S. Lenhart gave seminars about NIMBioS at these locations: Mathematics of Planet Earth SIAM conference, Philadelphia, September 2018; Mathematics in the City Beautiful, Orlando, December 2018;

Computational and Mathematical Population Dynamics, Fort Lauderdale, May 2019; and Invited Colloquium Talk at University of N. Carolina, Greensboro, June 2019.

G. Wiggins served as a judge at the St. Joseph School Science Fair. (Feb 2019)

#### 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 2019. All NIMBioS SRE students presented posters, and a total of 50 posters from eight undergraduate research programs were presented. (July 2019)

#### South East Alliance for Persons with Disabilities in STEM

During fall 2018, six undergraduate students participated in the UT-NIMBioS STEM Alliance, which aims to improve the 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. Students from this group participated in outreach programs to high school students with disabilities. In spring 2019, some of the students helped with two other outreach activities.

S. Lenhart was named Diversity Champion by UT's Student Disability Services in spring 2019.

# **Addendum to NIMBioS Annual Report**

## **Sep 1, 2018 – Aug 31, 2019**

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### **Y11-4. Additional Products**

**Featured Articles**

**Websites**

**Media Coverage**

## **Addenda -- Additional Products (featured articles, websites, media coverage)**

**SEPTEMBER 1, 2018 – AUGUST 31, 2019**

### **Feature Articles and Press Releases**

(current reporting period)

July 1, 2019. STEM adventures for middle school girls (blog post)

May 21, 2019. Learning from failures: Lemon Labs, NIMBioS partner (blog post)

May 7, 2019. In their own words: Spotlight on graduate research (blog post)

May 2, 2019. Spring kudos to Dr. Lenhart (blog post)

April 30, 2019. Undergrads ready for summer research (blog post)

April 24, 2019. Baba Brinkman's different kind of beatbox (blog post)

April 3, 2019. NIMBioS awards \$50,000 to UT graduate students (blog post)

March 27, 2019. Conservation champ to visit NIMBioS (blog post)

March 25, 2019. Baba promises to drop knowledge via rap (blog post)

February 20, 2019. Baba Brinkman returns! (blog post)

January 15, 2019. DySoC welcomes renowned primatologist Frans de Waal (blog post)

December 13, 2018. Special issue dedicated to Lenhart (blog post)

November 29, 2018. Southern African mathematics teachers train at the interface (blog post)

November 9, 2018. STEM group broadens participation for students with disabilities (blog post)

November 8, 2018. Templeton Foundation funds project to advance study of cultural evolution (press release)

October 8, 2018. New quantitative skills curriculum wins funding (press release)

October 4, 2018. Bag a job, bag your prey: Search theory used to manage threats from overhunting (press release)

October 3, 2018. Modeling with math for teachers (blog post)

September 24, 2018. NIMBioS extracurriculars and the mathematics of dance (blog post)

September 13, 2018. New in Science: Working group takes on transient dynamics (blog post)

September 6, 2018. Happy birthday to a great mentor (blog post)

August 16, 2018. Major accomplishments: The 10<sup>th</sup> annual report from NIMBioS (blog post)

August 14, 2018. Save the salamander: Epidemiological modeling deployed to halt killer fungus (blog post)

August 14, 2018. How will species adapt to climate change? g2p2pop seeks answers (blog post)

August 1, 2018. Team science at NIMBioS produces top paper (blog post)

### **Websites**

Title: The NIMBioS Website

URL: [www.nimbios.org](http://www.nimbios.org)

Short Description of the Website: This is the main website for NIMBioS. As of June 2019, the website contained 1320 pages and 1882 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: NIMBioS Tutorial: The Search for Selection II

URL: <http://www.nimbios.org/wordpress-training/selection2/>

Title: NIMBioS Investigative Workshop: Scientific Collaboration Enabled by High Performance Computing

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

Title: NIMBioS/DySoC Investigative Workshop: Mathematics of Gun Violence

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

Title: DySoC/NIMBioS Investigative Workshop: Social Norms

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

Title: DySoC/NIMBioS Investigative Workshop: Extending the Theory of Sustainability

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

Title: NIMBioS Investigative Workshop: Bio-acoustic Structure

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

Title: NIMBioS Tutorial: The Search for Selection I

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/eqg3/>

Title: NIMBioS Tutorial: Evolutionary Quantitative Genetics 2015

URL: <http://www.nimbios.org/wordpress-training/eqg2/>

Title: NIMBioS Tutorial: Evolutionary Quantitative Genetics 2014

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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



Title: NIMBioS Investigative Workshop: Predictive Models for ERA

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

Title: NIMBioS Tutorial: Computing in the Cloud

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

Title: NIMBioS Investigative Workshop: Vectored Plant Viruses

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

Title: NIMBioS Investigative Workshop: Interface Disease Models

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

Title: NIMBioS Investigative Workshop: Modeling Contamination of Fresh Produce

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

Title: NIMBioS Investigative Workshop: Animal Social Networks

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

Title: NIMBioS Investigative Workshop: Insect Pest Resistance Evolution

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

Title: NIMBioS Investigative Workshop: Analyzing Animal Vocal Communication Sequences

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

Title: NIMBioS Investigative Workshop: Modeling Blood Cell Interactions

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

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

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

Title: NIMBioS 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

4/23/19 Lecture: How tight and loose cultures wire our world, Tennessee Today,  
<https://t.e2ma.net/message/0fjh4g/4igorfb>

4/19/19 AIDS-immunocompromised populations see more antibiotic-resistant infections, Science & Technology Research News, <https://www.scienceandtechnologyresearchnews.com/aids-immunocompromised-populations-see-more-antibiotic-resistant-infections/>

4/15/19, UT to host workshop to study gun violence through mathematical analysis, UT Media Relations, <https://news.utk.edu/2019/04/15/ut-to-host-workshop-to-study-gun-violence-through-mathematical-analysis/>

4/16/19, Baba Brinkman to present Rap Guide to Culture, Tennessee Today,  
<https://t.e2ma.net/message/8hyw2g/4ikro9>

4/12/17, UT, NIMBioS partner to improve success of students with disabilities in STEM, Tennessee Today, <http://tntoday.utk.edu/2017/04/12/ut-nimbios-create-organization-improve-success-students-disabilities-stem/>

4/3/19, 20 graduate students awarded a cumulative \$50,000 from NIMBioS, UT's Catalyst,  
<https://research.utk.edu/recognitions-april-3>

3/19/19, Biology in a Box brings bones, fun to K-12 students, Tennessee Today,  
<https://news.utk.edu/2019/03/18/biology-in-a-box-brings-bones-fun-to-k-12-students/>

3/16/19, NIMBioS graduate awards, UT's Catalyst, <https://t.e2ma.net/message/rhbumb/r16jfv>

2/7/19 UT to host world-renowned primatologist, Tennessee Today,  
<https://t.e2ma.net/message/oumcmg/4ikro9>

2/2/19 Scientists strategize for better conservation plans: New research estimates species' niche by treating above, below taxonomic levels, ScienceDaily,  
<https://www.sciencedaily.com/releases/2019/02/190202171836.htm>

2/1/19, Scientists strategize for better conservation plans, Phys.org, <https://phys.org/news/2019-02-scientists-strategize.html>

11/4/18, Graduate spotlight: Shelby Scott, UT Office of Research Catalyst E-newsletter,  
<https://research.utk.edu/graduate-student-spotlight-shelby-scott/>

10/9/18, Join NIMBioS for a 'Tasting Menu' of Mathematical Models, Tennessee Today,  
<https://t.e2ma.net/message/ggmsgg/4igorfb>

10/9/18, New quantitative skills curriculum wins funding, UT Office of Research Catalyst E-newsletter,  
<https://t.e2ma.net/message/f4kndb/r16jfv>

10/5/18, Bag a job, bag your prey: Search theory used to manage threats from overhunting, Science Daily, <https://www.sciencedaily.com/releases/2018/10/181005111439.htm>



# **Addendum to NIMBioS Annual Report**

**Sep 1, 2018 -Aug 31, 2019**

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**Y11-5. 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 30<sup>th</sup>, 2019 for the current reporting period. The NIMBioS Annual Report is submitted before 8/31/2019, the end of the reporting period, so data for the current reporting period include only the period from 9/1/2018 through 6/30/2019; they do not include projections for activities occurring between 7/1/2019 and 8/31/2019. 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
9/1/2014 - 8/31/2015	239	69 <sup>a</sup>	944 (751 indiv.)
9/1/2015 - 8/31/2016	232	51 <sup>b</sup>	917 (649 indiv.)
9/1/2016 - 8/31/2017	221	51 <sup>c</sup>	773 (650 indiv.)
9/1/2017 - 8/31/2018	147	28 <sup>d</sup>	444 (371 indiv.)
9/1/2018 - 6/30/2019 <sup>*</sup>	194	29 <sup>e</sup>	558 (449 indiv.)

\* Numbers reported here include only the period from 9/1/2018-6/30/2019; they do not include projections for activities occurring between 7/1/2019-8/31/2019.

<sup>a</sup> 16 business/industry, 28 federal, 24 non-profit, 1 state

<sup>b</sup> 10 business/industry, 27 federal, 9 non-profit, 5 other

<sup>c</sup> 7 business/industry, 28 federal, 14 non-profit, 1 state, 1 other

<sup>d</sup> 5 business/industry, 15 federal, 6 non-profit, 2 other

<sup>e</sup> 4 business/industry, 9 federal, 16 non-profit