



2020 Annual Report

National Institute for Mathematical and Biological Synthesis

Reporting Period September 2019 – August 2020

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NIMBioS Annual Project Report to NSF for Award 1300426, Year 12

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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 twelfth 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. The focus was on supporting a collection of Short-term Visits that would enhance prior and continuing efforts supported by NIMBioS, and there was heavy emphasis on support for domestic visitors. We encouraged international visitors only if there were very strong reasons for their unique contribution to a collaboration that could not be accommodated through remote participation. Additionally, we continued our support for education through the Undergraduate Research Conference and the Summer Research Experience program for undergraduates. Workshops and Tutorials were planned but several of these, as well as the visiting program, were impacted starting in March due to the pandemic. Thus the summer undergraduate program was held completely online and the in-person gatherings that were planned were postponed or moved to a virtual venue.

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 the analysis of complex spatial data, in modeling of complex biological systems and in development and analysis of models for complex social systems. These 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, 2019 through August 31, 2020, NIMBioS shifted focus from hosting larger Investigative Workshops and Tutorials and Working Groups to hosting smaller groups as Short-term Visits. No traditional Investigative Workshops or Tutorials were held as those that were planned for spring 2020 ended up being postponed due to COVID travel restrictions. There were 237 participants in NIMBioS-hosted activities during this period with five Postdoctoral Fellows in residence, 40 Short-term Visitors, and two Visiting Scholars.

Demographics data available for participants in events from September 1, 2019 through June 30, 2020 are presented in detail in the NIMBioS Evaluation Report

(see section Y12-1 of the addendum to this Annual Report) and summarized below. There were 237 participants through June 30, 2020 from four countries and 34 U.S. states as well as the District of Columbia and Puerto Rico, representing 87 different institutions. International participants amounted to 3% of all participants, arising from our emphasis on domestic visitors during this project year. Most participants were college or university faculty (39%) and undergraduates (46%) with post-doctoral researchers and college/university staff accounting for a smaller fraction (6% each). Across all events female representation was 37%, and minority representation was 13.5%. 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, 2019 through March 3, 2020 were from 34 different institutions and collaborated with NIMBioS post-doctoral fellows and faculty from six units at the University of Tennessee. In-person visits after March 3rd were postponed or canceled due to the pandemic.

Specific Objectives:

A goal of NIMBioS is to encourage research activities at the interface of mathematics and biology that facilitate development of interdisciplinary collaborations. During this period NIMBioS hosted 16 Short-term Visit groups. An additional 15 Short-term Visit groups were scheduled for spring/summer 2020 but had to be postponed due to COVID-19. Similarly, a Workshop and two Tutorials had to be postponed.

A specific objective of NIMBioS is to foster development of a cadre of scholars capable of effectively carrying out research at the interface of mathematics and biology. To meet this objective NIMBioS Outreach and Education supported activities for individuals at diverse levels of experience, from elementary school, middle school, high school (activities and workshops), and undergraduates (undergraduate math/biology research conference, visits to MSI partners, SRE program) to graduate students and the general science research and education population (through Tutorials, seminars, presentations).

2020 SRE for Undergraduates Program

The Summer Research Experience (SRE) for undergraduates helps participants gain the skills and make the connections between mathematics and biology that are a core component of the NIMBioS mission. Seventeen undergraduates participated in the 2020 NIMBioS SRE for undergraduates. Due to the COVID-19 pandemic, the normally eight-week program was shortened to six weeks and conducted entirely remotely. Four participants were University of Tennessee, Knoxville students; 13 were from 12 other institutions. Students worked in teams with NIMBioS postdocs and faculty to conduct research at the interface of mathematics and biology. Students also attended lectures on cross-cultural mentoring, responsible conduct of research and other seminars focused on professional development.

The projects this year were:

- Individual-based model to explain the co-evolutionary dynamics of quorum sensing and biofilms
- Agent-based simulation of *Caenorhabditis elegans*
- Influence of climate change velocity on future species distributions
- Modeling the effects of pathogenic bacteria on phytoplankton community mortality
- Modeling the individual and population effects of elevated incubation

temperatures of sea turtles

The summer program was initially scheduled to be held virtually for just the month of June, but by mid-June there was unanimous agreement from the participants (students and mentors) that the interactions were highly productive and would benefit from being extended. The program was therefore extended to July 10, and each of the projects presented their results to all participants on the final two days. A general indicator of the success of the NIMBioS SRE program is the progression of many former participants into graduate programs in STEM fields.

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

Undergraduate students engaged in research in biology and mathematics, their faculty mentors, and our Minority Serving Institution partners were invited to this eleventh annual conference. The URC included student talks and posters and two plenary speakers (Sadie Ryan, U. of Florida, and Christopher Strickland, U. of Tennessee). To help students' career planning, this URC also included an introductory technology session, a panel about perspectives on applying to graduate fellowships, breakout sessions for in depth research discussion and a graduate school showcase. Over 120 undergraduates and faculty from academic institutions across North America were in attendance. There were 66 undergraduate research talks and posters. (November 16-17, 2019)

NIMBioS Interdisciplinary Seminars

The NIMBioS Interdisciplinary Seminar Series was held during the fall and spring semesters. Prior to each seminar, NIMBioS hosts a reception to provide an opportunity for informal collaboration, discussion and networking among NIMBioS staff, visitors, faculty, and post-docs as well as faculty and students from across the UT community. Five in-person seminars were held, and in spring, we hosted an online seminar series with six seminars. This included a webinar series focused on modeling, especially related to modeling the COVID-19 outbreak, which has received over 4000 views of its posted videos.

A panel discussion on Preparing Proposals for NSF Graduate Research Fellowship Programs was hosted by NIMBioS. Students were invited to participate, and advice and perspectives on applying for fellowships was presented and discussed (September 4, 2019).

Joint Math Meetings

At the Joint Math Meetings 2020, NIMBioS Associate Director S. Lenhart spoke at a NExT panel about the UT-NIMBioS STEM Alliance activities for undergraduates with disabilities. Two undergraduate students, Vinny Jodoin from University of Tennessee and Margie Knight from Colorado College presented talks on their SRE 2019 projects, and Jodoin also presented a poster.

Tutorials and Workshops

The NIMBioS' tutorial on adaptive management was originally scheduled for April 1-3, 2020 but has been postponed until fall 2020 due to the COVID-19 pandemic. Adaptive management seeks to determine sound management strategies in the face of uncertainty concerning the behavior of the system being managed. This tutorial introduces participants to methods for modeling adaptive management, with an emphasis on case studies drawn from environmental and natural resource

management. Organizers: I. Chades (CSIRO), P. Fackler (NCSU), D. Kling (OSU), M. Springborn (UC-Davis), and S. Lenhart.

In February participants from across the southeastern US practiced their messaging and engagement skills in a day-long Communicating Science Workshop at NIMBioS. The workshop was co-hosted by the Ecology Society of America (ESA) Public Affairs Office, the ESA Southeastern Member Chapter, and NIMBioS.

NIMBioS hosted the first Network Meeting of the Quantitative Biology at Community Colleges Group (NSF RCN funded through Montgomery College in MD and BioQUEST) in February. This meeting began to form the network to bring together life science and math faculty from across the country to develop a collection of Open Educational Resources (OERs) focused on math/quantitative skills appropriate for community college biology courses, and provide the professional development and community support needed to incorporate quantitative/math skills in biology courses.

NIMBioS hosted the Expanding Your Horizons STEM Activity Day with 52 middle-school girls. Faculty and staff from the University of Tennessee developed activities focusing on botany, ecology, mathematics, and engineering. This workshop was held in cooperation with Expanding Your Horizons and the Knoxville branch of AAUW in November.

Dr. S. Lenhart participated in an External Advisory Committee meeting for the NSF-HBCU-UP Targeted Infusion Project on Infusion of Computational Biological content into Fisk University's UG STEM Curriculum in February. This meeting involved discussion and evaluation of their REU program and course development (Precalculus for Life Sciences and Tools for Bioinformatics with 4 computing modules).

The NIMBioS Graduate Award Program was designed to enhance student research and education. Most of the awardees used the support to attend professional conferences or for research expenses during this reporting period.

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 Fellows supported by other grants or awards, another assisting with a Spatial Analysis Lab project, and yet another who served as a mentor for the SRE program. An objective of NIMBioS is to enhance career opportunities for current and former Postdoctoral Fellows, and meetings on career development with the NIMBioS leadership were encouraged and a seminar on career development was held.

Significant Results:

NIMBioS relies upon participants to self-report products that were derived from their participation in NIMBioS activities. From January 2009 through June 2020 there have been 2,378 products reported, including 1,018 published peer-reviewed journal articles, 47 book chapters, 31 dissertations and theses, 959 presentations/posters, 102 grant requests, 65 educational aids or curricula, and 61 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 Y12-4 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,

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, Trends in Ecology and Evolution, Nature Communications, Nucleic Acids Research, Frontiers in Ecology and the Environment, Proceedings of the National Academy of Sciences, Ecology Letters, Current Biology, and others. [Table 1](#) in the supporting file included with this section provides details on NIMBioS-derived publications in certain high-impact journals.

Key outcomes or
Other achievements:

Metrics of success for NIMBioS include establishing new connections between researchers from diverse backgrounds leading to new interdisciplinary science. NIMBioS publications span 125 Web of Science discipline areas with 66% of journal articles having 2-5 authors and 25% having six or more co-authors. 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.

NIMBioS' **Spatial Analysis Laboratory** (SAL) continues to foster an interdisciplinary community of researchers (students and faculty) with interests and expertise in spatial analyses and technologies. Support is provided for proposal submissions, spatial analyses for funded projects, access to geospatial technology, and leveraging other spatial analysis capabilities available at UT. Operating under the auspices of NIMBioS as a UT recharge center, SAL offers consultation, drone flight, and terrestrial laser scanning (lidar) services.

SAL activities this period included (i) programming and server support for a global atlas of arbuscular mycorrhizal fungi, (ii) terrestrial lidar data collection for an internally funded project analyzing forest structural diversity at UT Arboretum, (iii) analysis of drone-collected multispectral data for another internally funded project mapping the vegetation health in the Knoxville Urban Wilderness, and (iv) support for proposals submitted to NASA and NSF. SAL coordinated two projects for the NIMBioS Summer Research Experience for Undergraduates program: (i) NIMBioS education and outreach coordinator G. Wiggins, SAL Director M. Papeş, and NIMBioS postdoc L. Carrasco-Tornero mentored a student group integrating velocity of climate change and ecological niche models in assessments of potential future distributions of pollinators and (ii) M. Papeş mentored a student investigating new processing workflows for terrestrial lidar data. A collaboration with Dr. Todd Schroeder from USFS Southern Research Station brought to NIMBioS a new postdoc, B. Branoff, who evaluated forest structure and biomass estimates derived from National Agriculture Imagery Program point cloud data with field measured tree heights collected by the USFS Forest Inventory Analysis program and with canopy height products developed from USGS 3DEP airborne lidar data. A tutorial on use of lidar data planned for spring 2020 was cancelled due to COVID.

The **Center for the Dynamics of Social Complexity** (DySoC; dysoc.org) operates under the auspices of NIMBioS and has arisen through the long-term efforts of S. Gavrillets, NIMBioS Associate Director for Scientific Activities, 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 members from numerous departments (Anthropology, Child and Family Studies, Classics, Ecology and Evolutionary Biology, Mathematics, Mechanical, Aerospace and Biomedical Engineering, Philosophy, Physics, Political Science, 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 at least 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 hosted six seminars at NIMBioS on topics including components of cooperation, cultural inheritance mechanics, public goods, biases in social learning strategies, evolution and spread of human agriculture, and political implications of ethnic inequality. A major DySoC activity this year, supported by the John Templeton Foundation, was to develop web-based educational materials with basic and applied lessons in the dynamics of cultural evolution for graduate students and postdoctoral researchers.

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. Two of the NIMBioS Graduate Award recipients used their awards to receive consulting support. Additionally, NIMBioS staff members collaborated with UTK faculty on research projects that required computational and modeling expertise that NIMBioS could provide.

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

NIMBioS carries out several training and professional development activities. We provide some highlights here, but see the detailed listing of activities during this reporting period in Section Y12-3 of the Annual Report Addendum.

Postdoctoral Fellows

Postdoctoral Fellows at NIMBioS have historically been independent researchers who develop their own proposed research activity and receive mentoring from both a mathematical sciences and a biological sciences faculty member. This reporting year all NIMBioS Postdoctoral Fellows were involved in collaborations with other projects either supported by internal UTK funding or by non-NSF external funding. 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, another assisting with a Spatial Analysis Lab project, and one who served as a mentor for the SRE program.

Postdoctoral Fellows at NIMBioS are encouraged to organize a Postdoctoral Professional Development Seminar series during the academic year, giving the Fellows additional opportunities to explore and discuss shared professional development issues with faculty and staff from around the University. These events are open to Fellows from other

departments. 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. Seminar topics 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. 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, and the majority of the awardees chose to use the funds in fiscal year 2020. 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.

A panel discussion on Preparing Proposals for NSF Graduate Research Fellowship Programs was hosted by NIMBioS. Students were invited to participate, and advice and perspectives on applying for fellowships was presented and discussed (September 4, 2019).

NIMBioS Tutorials provide training on specific research tools for all groups but are important for graduate student professional development. Unfortunately two Tutorials organized for spring 2020 were postponed due to COVID.

Five UT graduate students worked on projects related to NIMBioS during this period. T. Poppenwimer, a doctoral student in Ecology and Evolutionary Biology, collaborated with NIMBioS Director L. Gross and staff from the National Institute for STEM Evaluation and Research on analyses of extensive data on NIMBioS activities regarding the effectiveness of center-scale activities. This effort focused on the productivity of NIMBioS Working Groups, considered the impacts of diversity of discipline and backgrounds of working group participants on team productivity, and some results were presented at the (virtual) Annual Meeting of the Ecological Society of America in August 2020. A. Hyman and J. DeSalu, both graduate students in Ecology and Evolutionary Biology, provided support for faculty projects, and I. D. Dewi (a UT College of Veterinary Medicine student) and L. Santana-Souza (an Ecology and Evolutionary Biology graduate student) gained experience as mentors for the SRE program.

Undergraduates

The NIMBioS 2020 Summer Research Experiences for Undergraduates program provided training in research procedures, mathematical modeling, programming, and poster and oral and poster presentations. Students also attended lectures on cross-cultural mentoring, responsible conduct of research and other seminars focused on professional development.

The NIMBioS Undergraduate Research Conference at the Interface of Biology and Mathematics (November 2019) exposed more than 120 undergraduates and mentors to a variety of research topics, perspectives on applying to graduate fellowships, a graduate school showcase, and an introductory technology session.

*** How have the results been disseminated to communities of interest? If so, please provide details.**

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 2020, the website contained 1498 pages and 2066 pdf documents. Table 2 and Figure 1 (see [supporting figure and tables](#) at the end of this section) illustrate trends in the number of site visits over the current reporting period and over the full range of NIMBioS operation. The purpose of the website is to provide information about research at the interface of mathematics and biology and attract potential scientists, researchers and students to participate in the work and/or educational offerings of NIMBioS while also providing scientific information to a generalized audience. The audience for nimbios.org is multifaceted with a wide range of needs and interests, primarily consisting of scientists from academic institutions, state and federal government agencies and non-governmental organizations, 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,” including publications, presentations, proposals, scientific meetings generated by NIMBioS activities, educational products, and data and software. The site is updated with new content on a regular 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 2020, there were more than 9,700 subscribers, and the newsletter typically has an average click-through rate well above industry standards of about 30 percent.

NIMBioS regularly distributes e-blasts of announcements about upcoming research and educational and outreach opportunities as well as calls for support. The e-blast reaches individual email addresses and also goes to a variety of interdisciplinary listservs and websites for placement. NIMBioS also distributes a weekly, “NEXT@NIMBioS,” email to a more internal audience with a listing of the next week’s events and visiting scientists.

To reach a wider audience for the purposes of enhancing public understanding and increasing interest in learning about science, NIMBioS publicizes its extensive library of more than 581 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 1,900 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.

NIMBioS uses EurekAlert!, an online, global news service which reaches thousands of journalists, to disseminate press releases. The press releases are written for a non-specialized audience interested in science topics. NIMBioS also collaborates with the media office at the University of Tennessee, Knoxville, as well as the press offices of visiting scientists’ institutions, in order to increase dissemination of research results via press releases.

Over its existence, 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.

Finally, aside from NIMBioS' multimedia channels and communication activities, NIMBioS undertakes numerous outreach activities via the NIMBioS Education and Outreach office. These include presentations and exhibits about our activities at professional meetings, such as the Joint Mathematics Meeting, the Society for the Advancement of Chicanos and Native Americans in Science, and the National Science Teaching Association. It also includes outreach to the general public, such as the presentation of a special NIMBioS math and biology award at the regional science fair and coordinating activities for 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 section Y12-3 of the Addendum.

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

In comparison to efforts in previous reporting periods, NIMBioS activities were necessarily reduced in scope, due to the limited funding for participant support remaining as part of the no-additional-cost extension. This extension was initially established through August 2020, but due to the impact of the pandemic on forcing postponement of activities which had been scheduled for spring and summer 2020, the extension was approved through February 2021. 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. Due to COVID restrictions on travel, we anticipate that essentially all activities involving those not in the immediate NIMBioS region will be held virtually rather than in person.

NSF support will be utilized for the Undergraduate Research Conference at the Interface of Mathematics and Biology, a Tutorial on adaptive management, a collaborative (with Burroughs Welcome Fund) Workshop on graduate quantitative education for biologists, and a number of Short-term Visit groups.

Over the recent years, NIMBioS has developed Affiliated Centers that expand on its mission, and arise from efforts towards sustainability. Affiliated centers continuing to be organized under the auspices of NIMBioS 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 is expected 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 and will have affiliated projects supporting postdoctoral fellows. SAL serves as a local, regional and national resource and 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 are 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 collaborations with faculty whose research benefits from the modeling and

Supporting Files

Table 1. 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	46.49	99.30	4
Science	44.37	97.87	11
Cell	38.62	99.53	1
Trends in Ecology and Evolution	18.60	99.10	2
Nature Communications	13.61	92.25	3
Nucleic Acids Research	11.80	95.12	3
Frontiers in Ecology and the Environment	11.61	98.11	2
Proceedings of the National Academy of Sciences	10.62	89.43	21
Ecology Letters	10.56	96.73	13
Current Biology	10.17	92.45	1
PLoS Biology	8.88	91.40	3
New Phytologist	8.80	97.22	6
Systematic Biology	8.77	91.00	10
Methods in Ecology and Evolution	8.73	94.94	7
eLife	8.12	95.16	4
Philosophical Transactions of the Royal Society B	6.74	91.94	1
Ecography	6.13	95.05	8
Conservation Biology	6.10	89.39	5
Molecular Ecology	5.97	86.44	12

PLoS Genetics	5.86	85.59	2
Ecology	5.56	99.63	13
Functional Ecology	5.54	84.23	2
Proceedings of the Royal Society B	5.43	86.11	2
PLoS Computational Biology	5.26	89.82	10
Ecological Applications	5.05	80.78	3
Journal of Animal Ecology	4.91	91.96	7
Diversity and Distributions	4.82	85.41	4
Quarterly Review of Biology	4.62	84.41	1
Scientific Reports	4.58	76.76	7
Journal of the Royal Society Interface	4.25	73.94	5
PLoS Neglected Tropical Diseases	4.24	93.14	3
Heredity	4.10	68.74	2
Journal of Biogeography	4.10	78.23	3
American Naturalist	4.07	76.53	16
Evolution	3.98	73.21	18
Molecular Phylogenetics and Evolution	3.88	64.71	3
CBE - Life Sciences Education	3.75	74.40	1
Oikos	3.75	75.89	5
PLoS ONE	3.23	62.68	45
BMC Bioinformatics	3.21	72.73	3
Biological Invasions	3.14	78.41	2
Oecologia	3.10	65.77	6
Ecological Modelling	2.98	95.85	1

Animal Behaviour	2.97	78.13	11
Physical Review E	2.29	73.89	1
Journal of Theoretical Biology	2.12	65.32	32
Bulletin of Mathematical Biology	1.99	47.93	17
SIAM Journal on Control and Optimization	1.97	59.20	1
Journal of Mathematical Biology	1.89	52.32	6
Theoretical Ecology	1.53	21.13	11
Mathematical Methods in the Applied Sciences	1.47	74.42	3
Behaviour	1.45	23.98	11

*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 2020

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

Reporting year	Unique visitors	Visits
Sep 1, 2008 - Aug 31, 2009	9259	19951
Sep 1, 2009 - Aug 31, 2010	21278	41700
Sep 1, 2010 - Aug 31, 2011	33449	65208
Sep 1, 2011 - Aug 31, 2012	45084	88398
Sep 1, 2012 - Aug 31, 2013	74123	116473
Sep 1, 2013 - Aug 31, 2014	73906	116331
Sep 1, 2014 - Aug 31, 2015	78604	125992
Sep 1, 2015 – Aug 31, 2016	63800	99723
Sep 1, 2016 – Aug 31, 2017	50498	84553
Sep 1, 2017 - Aug 31, 2018	42912	67504

Sep 1, 2018 - Aug 31, 2019

37325

58681

Sep 1, 2019 - Jun 30, 2020*

29507

43185

*Partial year

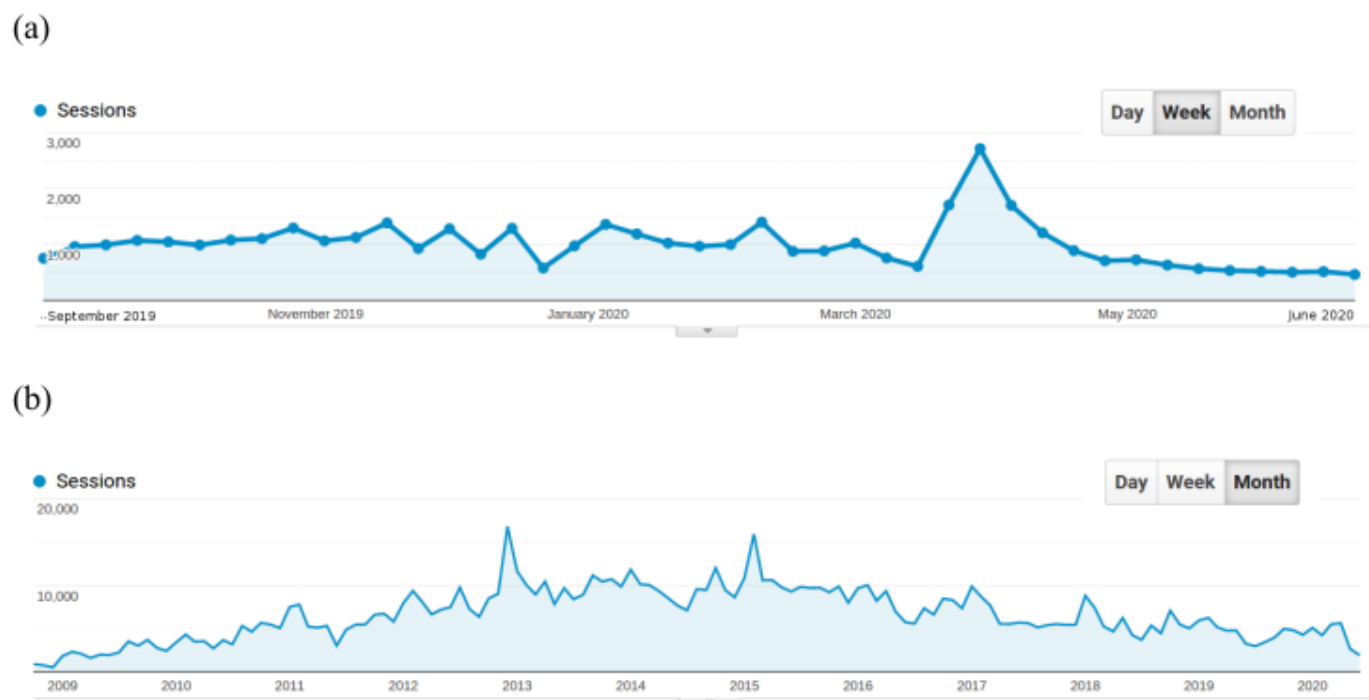


Figure 1. Number of nimbios.org website visits for (a) the 2020 reporting year (weekly, September 1, 2019 through June 30, 2020) and (b) monthly for the period October 1, 2008 through June 30, 2020. These figures show the impact of significant products on the number of website visits and document overall trends in visits since the inception of NIMBioS (site use data from Google Analytics).

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Educational aids or Curricula.

[EDU] Mayes R, Dauer J. 2017. Revised diagnostic assessment of quantitative modeling in undergraduate biology. Georgia Southern University.

Educational aids or Curricula.

[EDU] Mayes R, Dauer J. 2017. Revised diagnostic assessment of quantitative modeling in undergraduate biology. University of Nebraska.

Contributed Talk.

Carrasco, L.C., X. Giam, M. Papeš, K.S. Sheldon. LiDAR-derived 3D vegetation structural metrics reveal opposite effects of horizontal and vertical forest heterogeneity on bird richness. Ecological Society of America Annual Meeting. 16 August 2019, Louisville, KY, US. Contributed talk.

Grant Proposal.

Rinberg D, Koulakov A, Gerkin RC, Bozza T, Franks K, Mainland JB, Fleischmann A, Datta B. U19 (1U19NS112953), Cracking the Olfactory Code, Database, Website, Model Validation, Funded, \$15M, 2019-2024 2018.

Grant Proposal.

Demenou BB, Heuertz M. Beyond species limits: Genomic structure and evolutionary ecology in a complex of related tropical tree taxa in the Brazil nut family (Lecythidaceae). Postdoc grant, Idex program, University of Bordeaux. Not funded.

Grant Proposal.

Chang, C.H. 2018. National Science Foundation (NSF) Extreme Science and Engineering Discovery Environment (XSEDE) Start-Up Allocation. \$2,500. Accepted.

Grant Proposal.

Co-PI, NSF DRL "Exploratory: STEM ICE: Inspire, Communicate, Educate, ~\$356K, submitted on Sep 1, 2017.

Grant Proposal.

Collaborative Research: ABI Innovation: Quantifying biogeographic history: a novel model-based approach to integrating data from genes, fossils, specimens, and environments. 2017. NSF Advances in Biological Informatics. \$600,000. S Hoban, A Strand, J Robinson, A Smith, A Dawson. Submitted, in review

Grant Proposal.

Dauer J, Mayes R. 2017. Quantitative Biology Assessment of Model Reasoning (QBAM). Spencer Foundation. \$49,915. Pending.

Grant Proposal.

Gerkin RC, Mainland JB. 2018. Pyrfume: A Library for Mammalian Olfactory Psychophysics: \$450,000. Pending. NIDCD, PI, R01 (1R01DC018455). "CRCNS: Data Sharing: Pyrfume: A library for mammalian olfactory psychophysics", Funded, \$450K, 2019-2022

Grant Proposal.

Heuertz M, Lemes MR. Species boundaries and ecological genomics in the face of global change in the Brazil nut family (Lecythidaceae). 4th GUYAMAZON call. ~\$25,000. Accepted.

Grant Proposal.

Macfarlan SJ. 2019. Healing the warriors soul: Post-combat purification rituals in a cross-cultural perspective. University of Utah College of Social & Behavioral Sciences Research Incentive Seed Program. \$3,900. Accepted.

Grant Proposal.

Machine learning and mathematical modeling of pace of life in disease ecology STV Han B, Oâ€™Regan S, Drake J. 2017-2022. Global patterns, predictors, and their dynamical consequences in zoonotic diseases of mammals. National Science Foundation, Ecology and Evolution of Infectious Diseases Program. \$2M, Accepted

Grant Proposal.

Merchant N, Sahneh FD, Kobourov S, Papes M. (2018). TRIPODS+X:VIS: Data Science Pathways for a Vibrant TRIPODS Commons at Scale. NSF Division of Mathematical Sciences. \$199,859. Awarded 1 Oct 2018

Grant Proposal.

Munoz-Zanzi C. US-Mexico Planning Visits and Pilot Project on the Social-Ecology of Leptospirosis in an Urban-Rural Gradient. NSF - Catalyzing New International Collaborations. 2015-2016 \$75,000

Grant Proposal.

NSF CUE: Collaborative Research: Bridging diversity and curriculum gaps in computing through pedagogical innovation and cross-discipline education

Grant Proposal.

NSF Core Research: Assessment of Quantitative Modeling by Undergraduate Students (QM BUGS). \$495,445 (GSU subcontract \$243,316). PI Joe Dauer, University of Nebraska, Co-PIs Robert Mayes and Kent Rittschof. 3 year project. Submitted Summer 2017.

Grant Proposal.

NSF Core Research: Assessment of Quantitative Modeling by Undergraduate Students (QM BUGS). \$495,445 (GSU subcontract \$243,316). PI Joe Dauer, University of Nebraska, Co-PIs Robert Mayes and Kent Rittschof. 3 year project. Submitted Summer 2017.

Grant Proposal.

PI, NIH R01, Connecting emergent aspect of gene networks to cellular aging \$3.3M. submitted on October 7, 2016.

Grant Proposal.

PI, NIH R15, "Invasive Growth Response to DNA Repair Stress in *Saccharomyces cerevisiae* Biofilms", ~\$300K (\$92K subaward to UTC), lead-PI A. Marz, Norfolk State University, submitted on Oct 25, 2017.

Grant Proposal.

PI, NSF DBI â€œREU Site: ICompBio. Engaging Undergraduates in Interdisciplinary Computing for Biological Research. ~ \$359K. Submitted on August 23, 2017.

Grant Proposal.

PI, NSF EAGER, "Investigating the potential network modular configuration rule for system-level biological robustness with respect to intrinsic and extrinsic variations." CoPIs Hope Klug, Jennifer Boyd, Azad Hossain, Anthony Skjellum. Submitted on Feb 7, 2018.

Grant Proposal.

PI, NSF IIS, "Spokes: MEDIUM: SOUTH: Collaborative: Integrating Biological Big Data Research into Student Training and Education", ~\$550K, submitted on September 18, 2017. Pending.

Grant Proposal.

PI, NSF REU Site: IComputeB2 – Engaging undergraduates in interdisciplinary computing for biological and biomedical research. \$321K. Submitted in August 2016.

Grant Proposal.

Pound M, Sudakov I, Petrovskii S, Myers C. 2020. Modelling Past Climate Changes and Species Extinctions: the Neogene as a Case Study. The UK Natural Environment Research Council. Â£100,000. Submitted.

Grant Proposal.

Quantitatinsf.gov/awardsearch/showAward?AWD_ID=1919613&HistoricalAwards=falseve Biology in Community College Working Groups 1-3 \$499,858 NSF Quantitative Biology, Community College

Grant Proposal.

Research Coordination Network (RCN): Predicting vertebrate responses to a changing climate: modeling genomes to phenomes to populations (G2P2PoP) Funded \$500,000
National Science Foundation, Buck CL, Hindle A, Galic N. 2017

Grant Proposal.

S Hoban, A Strand, A Dawson, J Robinson, A Smith. 2018 NSF Advances in Biological Informatics, Funded, \$271,300 to Morton Arboretum (Grant total \$698,760) Award #1759759

Grant Proposal.

Sparks EE, Pradal C. 2018. Engineering aerial roots for plant stability. Thomas Jefferson Fund and the FACE Foundation. \$20,000. Funded.

Grant Proposal.

Strandburg-Peshkin A., Manser, M., Hirsch, B., Holekamp, K., Roch, M. Communication and the coordination of collective behavior across spatial scales in animal societies, \$1,350,000, accepted

Grant Proposal.

Talkachova & Otani, Collaborative research: Extending multi-scale ideas to the large-scale spatial-temporal control and dynamics of waves in excitable cardiac systems, NSF, 2017, pending

Grant Proposal.

Under review: Jenkins, K, Karpakakunjaram, Kiser, K. 2019. Building Faculty Collaborations to enhance Community College Quantitative Biology. Research Coordination Networks in Undergraduate Biology (RCN-UBE) National Science Foundation (NSF) 18-510 Under Review

Grant Proposal.

Vulinec, K. Maryland Department of Natural Resources, Lewes Wind Turbine Post-Construction Evaluation; â€œWind Turbine and Bat Interaction Study: The Lewes, Delaware Wind Turbine as a Case Study. 2013. \$30,000. Accepted

Grant Proposal.

Vulinec, K. University of Delaware/First State Wind LLC; â€œBat Mortality and Curtailment of the Wind Turbine at the University of Delaware Lewes Wind Turbine. 2013-2015. \$59,000. Accepted.

Grant Proposal.

Wiggins, G, and M. Papes. 2019. Modeling Habitat Suitability for Black Walnut and Walnut Twig Beetle in the Eastern U.S. USDA Forest Service, Forest Health Protection, \$24,994.00. Accepted

Interview.

Interview with Eli Chen, WDDE, Dover, DE: <https://soundcloud.com/eli-chen/dsu-researchers-test-a-new-method-to-protect-bats-from-wind-turbines> (This report took First Place - Prepared report (news, features, sports, or opinion) "Radio, Delaware Press Association, and Second place - Prepared report (news, features, sports, or opinion)" Radio National Federation of Press Women. 2015.

Interview.

ScienceNOW: Do Golf Courses Make Good Bat Habitats? By Yasmin Ogale 12 August 2011.
<http://news.sciencemag.org/sciencenow/2011/08/do-golf-courses-make-good-bat-ha.html>

Interview.

UnDisciplined: The Cultural Anthropologist and the Population Health Analyst [Interview]. Retrieved from: <https://www.upr.org/post/undisciplined-cultural-anthropologist-and-population-health-analyst>. January 11, 2019.

Media Coverage.

Obese woman are active for just one hour a YEAR, study finds. Dailymail (UK). February 24, 2014

Media Coverage.

Business Transformation and Transforming Wellbeing Theory

TEDxAUP x = independently organized TED event Media Talk show in Paris France Theme: So What?

<https://www.ted.com/tedx/events/30664>

Media Coverage.

Delaware State University News: 2010. DSU's Dr. Kevina Vulinec Named as Fulbright Scholar: <http://desu.edu/dsus-dr-kevina-vulinec-named-fulbright-scholar>

Media Coverage.

Novel Protocol Calculates Energy Needs, Physical Activity Ratio. HealthDay News. Feb. 20, 2014

Presentation.

Bohon, Stephanie A. and Ruben Ortiz "Structural Conditions of Police-Involved Killings in the United States. University of Tennessee Chapter of the American Statistical Association, Knoxville, TN. (March 2019)

Presentation.

Charles Sims. The burden of success: Who should manage species removed from the endangered species list? Southern Economic Association Annual Meeting: Washington, DC, November 19-21, 2016.

Presentation.

Childs, L. February 2020. Modeling malaria development in mosquitoes. How fast can mosquitoes pass on infection? Math Biology Seminar, Georgia Tech

Presentation.

Childs, L. January 2020. Modeling malaria development in mosquitoes. How fast can mosquitoes pass on infection?

Presentation.

February 17-20, 2020. National Laboratory for Scientific Computing (LNCC). Petropolis, RJ, Brazil. Brazilian MINISTRY OF SCIENCE, TECHNOLOGY, INNOVATION AND COMMUNICATIONS. 30 participants

Presentation.

Garcia Reyero Vinas, N. Mathews, T. Antczak P, Gergs, A. Murphy CA, Nisbet RM. Daphnia as a model to advance Adverse Outcome Pathways 2017 Minneapolis, MN

Presentation.

Hamelin, Allen, ..., Cunniffe. Coinfections by noninteracting pathogens are not independent and require new tests of interaction. Models in Evolutionary Biology, February 10-14, 2020, Marseille, France. (<https://conferences.cirm-math.fr/2302.html>)

Presentation.

Hamelin, F. M., Allen, L. J., Bokil, V. A., Gross, L. J., Hilker, F. M., Jeger, M. J., Manore, C.A., Power, A.G., Rua, M.A. & Cunniffe, N. J. (2019). Co-infections by non-interacting pathogens are not independent and require new tests of interaction. BioHasard 2019 International Conference on Stochastic Models for Biology, August 26-29, Rennes, France. coinfection, multiple pathogens, SIS epidemic, statistical independence, pathogen association

Presentation.

Holmes RM. November , 2019, Cultivating Ensembles Across Arts Humanities and STEM. Annual Research Luncheon, Youngstown State University.

Presentation.

Jiao, J. and N. Fefferman 2019. Host metapopulation, disease epidemiology and host evolution. Georgia Tech Biomath Seminar, Atlanta, Georgia

Presentation.

Jim Sanchirico. Political Economy of Renewable Resource Federalism. Association of Environmental and Resource Economists (AERE) Summer Conference: Incline Village, NV, May 30-31, 2019.

Presentation.

Lika, K, Murphy CA, Muller EB, Nacci DE, Nisbet RM, Remien CH, Schultz IR, Watanabe KH. Hormone-driven energy allocation for egg loading added to adynamic energy budget model to predict the effects of endocrine disruption.

Presentation.

Mike Neubert. Transboundary fisheries management: the effects of decentralization, dispersal, and interstate competition. ESA Meeting: Louisville, KY, August 11-16, 2019.

Presentation.

Morozov, A. February 2019. Long transients as a bugbear of ecological forecasting: ConceApts, models and data. DSABNS, Invited talk, Centro Congressi Federico II, Naples, Italy

Presentation.

Nisbet, RM, and Murphy, CA. Challenges in incorporating sub-organismal processes represented by quantitative AOPS

in dynamic energy budget models.

Presentation.

Ortiz, Ruben "Assessing the Relationship Between Minority-Threat and Police-Involved Killings Using Diffuse and Targeted Threat Effects. Society for the Study of Social Problems, New York City, NY. (August 10th, 2019)

Presentation.

Ortiz, Ruben "Clustering the Killing Fields: Developing a Taxonomy of Metropolitan Areas where Civilians are Killed by Police. The American Society of Criminology, San Francisco, CA. (November 12, 2019)

Presentation.

Ortiz, Ruben and Stephanie A. Bohon "Population Dynamics of People of Color and the Relationship to Police-Caused Deaths by Shooting in US Metropolitan Areas. Southern Demographic Association, New Orleans, LA (October 23, 2019)

Presentation.

Peace, A., Mayer GD. Modeling concurrent nutrient and toxicant stressors under dynamic energy budget theory

Presentation.

Presentation: Childs, L. October 2019. Modeling malaria development in mosquitoes. How fast can mosquitoes pass on infection? Applied Math Seminar, George Mason University.

Presentation.

S Hoban. March 2016. University of Chicago Department of Ecology and Evolution, invited seminar Species range shifts in a warming world

Presentation.

Schultheis, E.H. and M.K. Kjellvik (2017) Data Nuggets: Bringing authentic research and data into the classroom to unearth students' quantitative and inquiry skills. QUBES Faculty Mentoring Network (invited talk)

Presentation.

Sparks EE, Pradal C. February 2020. Phenotyping and modeling of plant anchorage and physiology. iCropM workshop, Montpellier, France. plant, functional structural plant models, biomechanics

Presentation.

Stevenson, LM, Muller, EB, Nacci DE, Whitehead A, Nisbet RM. Connecting suborganismal and organismal responses using dynamic energy budget modeling and the ecological model species *Fundulus heteroclitus*

Presentation.

Stibe, A., & Cugelman, B. (2019, September). Social Influence Scale for Technology Design and Transformation. In IFIP Conference on Human-Computer Interaction (pp. 561-577). Springer, Cham.

Presentation.

Sudakov, I. November 2019. Nonlinear analysis of species extinction in a population competing for resources. Dynamical Systems Seminar, Boston University.

Presentation.

Suzanne Lenhart. Informing local responses to disease outbreak and invasive spread, while still ensuring coordinated management. ESA Meeting: Louisville, KY, August 11-16, 2019.

Presentation.

Vulinec, K, Szewczak, J, AlpÁzar, P.. 2013. Bat capture and acoustic recording techniques. Association for Tropical Biology and Conservation Annual Meeting, Tirimbina Biological Station, Costa Rica. 7 Participants.

Presentation.

Vulinec, K.. 2011. Bat capture and acoustic recording techniques (In Portuguese). Biological Dynamics of Forest Fragments Project (BDFFP); Instituto Nacional de Pesquisas da AmazÃ´nia, Manaus, Brazil. 10 Participants.

Presentation.

World Congress of Environmental and Resource Economists 2018, Conservation, mathematical modeling, tropical biology, agroforestry, systematic conservation planning. Chang, CH, Gothenburg, Sweden

Presentation.

Xingli Giam. Shifting conservation priorities between states and the federal government for Appalachian species under climate change. ESA Meeting: Louisville, KY, August 11-16, 2019.

Other Publications

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

Kew Gardens blog (2018). *Coverage in the Royal Botanic Garden, Kew*. Science blog: Conserving genetic diversity of ash trees. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

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

Patent Applications

Technologies or Techniques

Thesis/Dissertations

Miyaoka TY.. *Spatiotemporal epidemiology with optimal control and application to Zika virus..* (2019). University of Campinas.. Acknowledgement of Federal Support = Yes

Websites or Other Internet Sites

[Back to the top](#)

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	1

Armsworth, Paul	Faculty	1
Bintz, Jason	Faculty	1
Bishop, Pam	Faculty	1
Eda, Shigetoshi	Faculty	1
Fefferman, Nina	Faculty	1
Ganusov, Vitaly	Faculty	1
Hong, Tian	Faculty	2
McCord, Rachel	Faculty	1
Miller, Debra	Faculty	1
Papes, Mona	Faculty	1
Strickland, Christopher	Faculty	1
Swenson, Michelle	Faculty	1
Talmy, David	Faculty	2
Von Arnim, Albrecht	Faculty	1
Wyneken, Jeanette	Faculty	1
Zhao, Xiaopeng	Faculty	1
Branoff, Benjamin	Postdoctoral (scholar, fellow or other postdoctoral position)	6
Carrasco Tornero, Luis	Postdoctoral (scholar, fellow or other postdoctoral position)	12
Carrignon, Simon	Postdoctoral (scholar, fellow or other postdoctoral position)	9
Harvey, Michael	Postdoctoral (scholar, fellow or other postdoctoral position)	3
Hinson, Audra	Postdoctoral (scholar, fellow or other postdoctoral position)	1

Jiao, Jing	Postdoctoral (scholar, fellow or other postdoctoral position)	12
Suarez, Gonzalo	Postdoctoral (scholar, fellow or other postdoctoral position)	1
Tverskoi, Denis	Postdoctoral (scholar, fellow or other postdoctoral position)	10
Udiani, Oyita	Postdoctoral (scholar, fellow or other postdoctoral position)	8
Young, Matthew	Postdoctoral (scholar, fellow or other postdoctoral position)	1
Zhu, Gengping	Postdoctoral (scholar, fellow or other postdoctoral position)	4
Carr, Eric	Other Professional	12
Comiskey, Jane	Other Professional	12
Dugger, Sherri	Other Professional	1
Eskridge, Chandra	Other Professional	1
Jackson, Heather	Other Professional	1
LoRe, Sondra	Other Professional	1
Minshall, Nichole	Other Professional	9
Murr, Louise	Other Professional	6
Peek, Mike	Other Professional	12
Spar, Jennifer	Other Professional	12
Wiggins, Greg	Other Professional	12
Crawley, Catherine	Staff Scientist (doctoral level)	8
Welsh, Chris	Staff Scientist (doctoral level)	12
DeSalu, Jeff	Graduate Student (research assistant)	2
Dian Dewi, Ida	Graduate Student (research assistant)	1

Hyman, Amanda	Graduate Student (research assistant)	3
Poppenwimer, Tyler	Graduate Student (research assistant)	11
Santana Souza, Lucas	Graduate Student (research assistant)	1
Balstad, Laurinne	Research Experience for Undergraduates (REU) Participant	1
Beckford, Charlotte	Research Experience for Undergraduates (REU) Participant	1
Catron, Spencer	Research Experience for Undergraduates (REU) Participant	1
Clark, Matthew	Research Experience for Undergraduates (REU) Participant	1
Folmar, Jackie	Research Experience for Undergraduates (REU) Participant	1
Joshi, Umang	Research Experience for Undergraduates (REU) Participant	1
Ledesma, Dakila	Research Experience for Undergraduates (REU) Participant	1
Lin, Michael	Research Experience for Undergraduates (REU) Participant	1
Roth, Sarah	Research Experience for Undergraduates (REU) Participant	1
Rumley, Savannah	Research Experience for Undergraduates (REU) Participant	1
Sallee, Abigail	Research Experience for Undergraduates (REU) Participant	1
Seggern, Chelsea	Research Experience for Undergraduates (REU) Participant	1
Smith, Elliott	Research Experience for Undergraduates (REU) Participant	1
Thomas, Anna	Research Experience for Undergraduates (REU) Participant	1

Tian, Amy	Research Experience for Undergraduates (REU) Participant	1
Westaway, Stephanie	Research Experience for Undergraduates (REU) Participant	1
Zumpano, Francesca	Research Experience for Undergraduates (REU) Participant	1

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 Director of NIMBioS and oversees all aspects of the Center.

Funding Support: University of Tennessee

International Collaboration: Yes, France, Germany, United Kingdom

International Travel: No

Sergey Gavrilets

Email: sergey@nimbios.org

Most Senior Project Role: Co-Investigator

Nearest Person Month Worked: 2

Contribution to the Project: Dr. Gavrilets is the NIMBioS Associate Director for Scientific Activities and member of the NIMBioS Leadership Team. He leads the assessment of requests for support in conjunction with the rest of the Leadership Team and is Director for the Center for the Dynamics of Social Complexity (DySoC) within NIMBioS.

Funding Support: University of Tennessee

International Collaboration: Yes, Canada, China, Finland, Germany, Italy, Netherlands, Norway, Spain, Switzerland, United Kingdom

International Travel: Yes, Israel - 0 years, 0 months, 7 days; Netherlands - 0 years, 0 months, 3 days; Switzerland - 0 years, 0 months, 4 days

Suzanne Lenhart

Email: lenhart@math.utk.edu

Most Senior Project Role: Co-Investigator

Nearest Person Month Worked: 1

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 2020 Summer Research Experience for Undergraduates.

Funding Support: University of Tennessee

International Collaboration: Yes, Germany, Spain, United Kingdom

International Travel: No

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. Paul is the lead for the Resources for the Future grant.

Funding Support: University of Tennessee**International Collaboration:** Yes, France, India**International Travel:** No**Jason Bintz****Email:** jbintz@johnsonu.edu**Most Senior Project Role:** Faculty**Nearest Person Month Worked:** 1

Contribution to the Project: Dr. Bintz, Director of Mathematics program at Johnson University, was a mentor for the 2020 Summer Research Experience for Undergraduates program.

Funding Support: University of Tennessee**International Collaboration:** No**International Travel:** No**Pam Bishop****Email:** pbaird@utk.edu**Most Senior Project Role:** Faculty**Nearest Person Month Worked:** 1

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 collaborates with NIMBioS to assess the success of individual activities and the Center as a whole.

Funding Support: University of Tennessee**International Collaboration:** No**International Travel:** No**Shigetoshi Eda****Email:** seda@utk.edu**Most Senior Project Role:** Faculty**Nearest Person Month Worked:** 1

Contribution to the Project: Dr. Eda, Professor in the Department of Forestry, Wildlife & Fisheries and Associate Director of the Center for Wildlife Health, was a mentor for the 2020 Summer Research Experience for Undergraduates program.

Funding Support: University of Tennessee**International Collaboration:** No**International Travel:** No**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 Postdoctoral Fellows Jing Jiao, Gonzalo Suarez, and Oyita Udiani.

Funding Support: University of Tennessee

International Collaboration: Yes, United Kingdom

International Travel: No

Vitaly Ganusov

Email: vitaly@utk.edu

Most Senior Project Role: Faculty

Nearest Person Month Worked: 1

Contribution to the Project: Dr. Ganusov 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, Portugal

International Travel: No

Tian Hong

Email: hongtian@utk.edu

Most Senior Project Role: Faculty

Nearest Person Month Worked: 2

Contribution to the Project: Dr. Hong is a mentor for the 2020 Summer Research Experience for Undergraduates program and works on Enhancing Quantitative & Data Science Education with Dr. Louis Gross

Funding Support: University of Tennessee

International Collaboration: Yes, Japan

International Travel: No

Rachel McCord

Email: rmccord@utk.edu

Most Senior Project Role: Faculty

Nearest Person Month Worked: 1

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

Debra Miller

Email: dmille42@utk.edu

Most Senior Project Role: Faculty

Nearest Person Month Worked: 1

Contribution to the Project: Dr. Miller, Director of the Center for Wildlife Health at the University of Tennessee, was a mentor for the 2020 Summer Research Experience for Undergraduates program.

Funding Support: University of Tennessee

International Collaboration: No

International Travel: No

Mona Papes

Email: mpapes@utk.edu

Most Senior Project Role: Faculty

Nearest Person Month Worked: 1

Contribution to the Project: Dr. Papes is a member of the NIMBioS leadership team, Director of the Spatial Analysis Lab, and is also a mentor for the 2020 Summer Research Experience for Undergraduates program.

Funding Support: University of Tennessee

International Collaboration: Yes, Benin, Brazil

International Travel: No

Christopher Strickland

Email: cstric12@utk.edu

Most Senior Project Role: Faculty

Nearest Person Month Worked: 1

Contribution to the Project: Dr. Strickland (Mathematics) is working on Enhancing Quantitative & Data Science Education with Dr. Louis Gross

Funding Support: University of Tennessee

International Collaboration: No

International Travel: No

Michelle D. Swenson

Email: mswenson@utk.edu

Most Senior Project Role: Faculty

Nearest Person Month Worked: 1

Contribution to the Project: Dr. Swenson, lecturer in the Department of Mathematics, was a mentor for the 2020 Summer Research Experience for Undergraduates program.

Funding Support: University of Tennessee

International Collaboration: No

International Travel: No

David Talmy

Email: dtalmy@utk.edu

Most Senior Project Role: Faculty

Nearest Person Month Worked: 2

Contribution to the Project: Dr. Talmy is a mentor for the 2020 Summer Research Experience for Undergraduates

program and is working on Enhancing Quantitative & Data Science Education with Dr. Louis Gross

Funding Support: University of Tennessee

International Collaboration: Yes, Denmark, Israel, Norway, United Kingdom

International Travel: No

Albrecht Von Arnim

Email: vonarnim@utk.edu

Most Senior Project Role: Faculty

Nearest Person Month Worked: 1

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

Jeanette Wyneken

Email: jwyneken@fau.edu

Most Senior Project Role: Faculty

Nearest Person Month Worked: 1

Contribution to the Project: Dr. Wyneken, Professor in Biological Sciences at Florida Atlantic University, was a mentor for the 2020 Summer Research Experience for Undergraduates program.

Funding Support: University of Tennessee

International Collaboration: No

International Travel: No

Xiaopeng Zhao

Email: xzhao9@utk.edu

Most Senior Project Role: Faculty

Nearest Person Month Worked: 1

Contribution to the Project: Dr. Zhao, Department of Mechanical, Aerospace and Biomedical Engineering, was a mentor for the 2020 Summer Research Experience for Undergraduates program.

Funding Support: University of Tennessee

International Collaboration: No

International Travel: No

Benjamin Branoff

Email: benjamin.branoff@gmail.com

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

Nearest Person Month Worked: 6

Contribution to the Project: Dr. Branoff was a Targeted Postdoctoral Fellow working with Dr. Mona Papes on a project to generate forest volume and biomass estimates from the National Agriculture Imagery Program digital surface model data for Tennessee and Virginia.

Funding Support: University of Tennessee

International Collaboration: No

International Travel: No

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 2020 Summer Research Experience for Undergraduates program.

Funding Support: University of Tennessee

International Collaboration: No

International Travel: No

Simon Carrignon

Email: simon@nimbios.org

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

Nearest Person Month Worked: 9

Contribution to the Project: Dr. Carrignon is a postdoctoral fellow in the Center for the Dynamics of Social Complexity (DySoC) working with DySoC faculty members Dr. Sergey Gavrilets, Dr. Alex Bentley, and Dr. Suzie Allard to explore and test the role of social learning strategies in human cooperation and cultural changes across the ages.

Funding Support: University of Tennessee

International Collaboration: Yes, Denmark, Spain, Taiwan, United Kingdom, Zimbabwe

International Travel: No

Michael Harvey

Email: mharve21@utk.edu

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

Nearest Person Month Worked: 3

Contribution to the Project: Dr. Harvey worked with Dr. Mona Papes and Dr. Liz Derryberry on projects related to the NIMBioS Spatial Analysis Laboratory.

Funding Support: University of Tennessee

International Collaboration: No

International Travel: No

Audra Hinson

Email: ahinson3@utk.edu

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

Nearest Person Month Worked: 1

Contribution to the Project: Dr. Hinson, Department of Microbiology, was a mentor for the 2020 Summer Research Experience for Undergraduates program.

Funding Support: University of Tennessee
International Collaboration: No
International Travel: No

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.

Funding Support: University of Tennessee

International Collaboration: No

International Travel: No

Gonzalo Suarez

Email: gsuarez1@utk.edu

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

Nearest Person Month Worked: 1

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

Denis Tverskoi

Email: dtversko@utk.edu

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

Nearest Person Month Worked: 10

Contribution to the Project: Dr. Tverskoi is a postdoctoral fellow in the Center for the Dynamics of Social Complexity (DySoC) working with Dr. Sergey Gavrilets and Dr. Suresh Babu on modeling the dynamics of social norms and social institutions.

Funding Support: University of Tennessee

International Collaboration: No

International Travel: No

Oyita Udiani

Email: oyita.udiani@nimbios.org

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

Nearest Person Month Worked: 8

Contribution to the Project: Dr. Udiani was a NIMBioS Targeted Postdoctoral Fellow working with Dr. Nina Fefferman.

Funding Support: University of Tennessee

International Collaboration: No

International Travel: No

Matthew J. Young

Email: m jy5068@psu.edu

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

Nearest Person Month Worked: 1

Contribution to the Project: Dr. Young is a Targeted Postdoctoral Fellow working with Dr. Nina Fefferman beginning August 1, 2020.

Funding Support: University of Tennessee

International Collaboration: No

International Travel: No

Gengping Zhu

Email: gzhu6@utk.edu

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

Nearest Person Month Worked: 4

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

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: University of Tennessee

International Collaboration: No

International Travel: No

Jane Comiskey

Email: ecomiske@nimbios.org

Most Senior Project Role: Other Professional

Nearest Person Month Worked: 12

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

Funding Support: University of Tennessee

International Collaboration: No

International Travel: No

Sherri Dugger

Email: sdugger@utk.edu

Most Senior Project Role: Other Professional

Nearest Person Month Worked: 1

Contribution to the Project: Sherri became the NIMBioS Business Manager effective July 27, 2020.

Funding Support: University of Tennessee

International Collaboration: No

International Travel: No

Chandra Eskridge

Email: ceskridge@nimbios.org

Most Senior Project Role: Other Professional

Nearest Person Month Worked: 1

Contribution to the Project: Chandra retired in early 2019 from her position as Executive and Business Assistant for NIMBioS, but she returned in November and December 2019 to provide support while another staff member was on maternity leave.

Funding Support: University of Tennessee

International Collaboration: No

International Travel: No

Heather Jackson

Email: hjacks15@utk.edu

Most Senior Project Role: Other Professional

Nearest Person Month Worked: 1

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

Sondra LoRe

Email: sondra@utk.edu

Most Senior Project Role: Other Professional

Nearest Person Month Worked: 1

Contribution to the Project: Sondra LoRe is an Evaluation Associate for the National Institute for STEM Evaluation and Research. She is working with Dr. Louis Gross on Enhancing Quantitative & Data Science Education.

Funding Support: University of Tennessee

International Collaboration: No

International Travel: No

Nichole Minshall**Email:** nminshal@utk.edu**Most Senior Project Role:** Other Professional**Nearest Person Month Worked:** 9**Contribution to the Project:** Nichole was the NIMBioS Business Manager through May 2020.**Funding Support:** University of Tennessee**International Collaboration:** No**International Travel:** No**Louise Murr****Email:** lmurr@utk.edu**Most Senior Project Role:** Other Professional**Nearest Person Month Worked:** 6**Contribution to the Project:** Louise is a member of the NIMBioS office staff primarily processing reimbursement requests for NIMBioS visitors, but she picked up substantial responsibilities in business management in June and July.**Funding Support:** University of Tennessee**International Collaboration:** No**International Travel:** No**Mike Peek****Email:** peek@nimbios.org**Most Senior Project Role:** Other Professional**Nearest Person Month Worked:** 12**Contribution to the Project:** Michael is the NIMBioS Information Technology (IT) Manager. He provides all IT support, basic hardware and connectivity, software and applications for collaborative services. He oversees the IT staff, which includes a computational data engineer and a senior analyst.**Funding Support:** University of Tennessee**International Collaboration:** No**International Travel:** No**Jennifer Spar****Email:** jthomas@nimbios.org**Most Senior Project Role:** Other Professional**Nearest Person Month Worked:** 12**Contribution to the Project:** Jennifer is the NIMBioS Event and Travel Coordinator. She handles all aspects of event management, contracting with hotels, planning catering, providing support for visitors, and arranging travel for all participants.**Funding Support:** University of Tennessee**International Collaboration:** No**International Travel:** No**Greg Wiggins**

Email: wiggybug@utk.edu

Most Senior Project Role: Other Professional

Nearest Person Month Worked: 12

Contribution to the Project: Greg is the NIMBioS Outreach and Education Coordinator. He works closely with Associate Director for Outreach and Education Lenhart to develop and manage all NIMBioS outreach and education activities. Dr. Wiggins is also a mentor for the 2020 Summer Research Experience for Undergraduates.

Funding Support: University of Tennessee

International Collaboration: No

International Travel: No

Catherine Crawley

Email: ccrawley@nimbios.org

Most Senior Project Role: Staff Scientist (doctoral level)

Nearest Person Month Worked: 8

Contribution to the Project: Dr. Crawley was the NIMBioS Communications Manager through March 2020. She was the main point of administrative contact for media, wrote press releases on NIMBioS activities, conducted interviews with visiting scientists, produced print and video pieces highlighting NIMBioS activities and research, and consulted with other staff on strategies to increase awareness of NIMBioS opportunities worldwide.

Funding Support: University of Tennessee

International Collaboration: No

International Travel: No

Chris Welsh

Email: cwelsh@nimbios.org

Most Senior Project Role: Staff Scientist (doctoral level)

Nearest Person Month Worked: 12

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

Funding Support: University of Tennessee

International Collaboration: No

International Travel: No

Jeff DeSalu

Email: jdesalu@vols.utk.edu

Most Senior Project Role: Graduate Student (research assistant)

Nearest Person Month Worked: 2

Contribution to the Project: Jeff is a graduate student in the Department of Ecology and Evolutionary Biology at the University of Tennessee. He works with Dr. Nina Fefferman.

Funding Support: University of Tennessee

International Collaboration: No

International Travel: No

Ida Dian Dewi**Email:** idewi@vols.utk.edu**Most Senior Project Role:** Graduate Student (research assistant)**Nearest Person Month Worked:** 1

Contribution to the Project: Ida is in the Department of Biomedical and Diagnostic Services at the University of Tennessee College of Veterinary Medicine. She served as a mentor for the 2020 Summer Research Experience for Undergraduates program.

Funding Support: University of Tennessee**International Collaboration:** No**International Travel:** No**Amanda Hyman****Email:** ahyman2@vols.utk.edu**Most Senior Project Role:** Graduate Student (research assistant)**Nearest Person Month Worked:** 3

Contribution to the Project: Amanda is a doctoral student in the Department of Ecology & Evolutionary Biology working with Dr. Paul Armsworth.

Funding Support: University of Tennessee**International Collaboration:** No**International Travel:** No**Tyler L. Poppenwimer****Email:** tpoppenw@vols.utk.edu**Most Senior Project Role:** Graduate Student (research assistant)**Nearest Person Month Worked:** 11

Contribution to the Project: Tyler is a doctoral student in the Department of Ecology & Evolutionary Biology. He is working with Dr. Louis Gross on analyses of data from NIMBioS activities regarding the effectiveness of center-scale activities.

Funding Support: NSF**International Collaboration:** No**International Travel:** No**Lucas Santana Souza****Email:** lsantan3@vols.utk.edu**Most Senior Project Role:** Graduate Student (research assistant)**Nearest Person Month Worked:** 1

Contribution to the Project: Lucas is in the Department of Ecology and Evolutionary Biology at the University of Tennessee. He served as a mentor for the 2020 Summer Research Experience for Undergraduates program.

Funding Support: University of Tennessee**International Collaboration:** No**International Travel:** No**Laurinne Balstad**

Email: laurie.balstad@gmail.com

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

Nearest Person Month Worked: 1

Contribution to the Project: Participant in the NIMBioS' summer 2020 Summer Research Experience for undergraduate program.

Funding Support: NSF

International Collaboration: No

International Travel: No

Year of schooling completed: Junior

Home Institution: Saint Olaf College

Government fiscal year(s) was this REU participant supported: 2020

Charlotte Beckford

Email: cbeckford1@fordham.edu

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

Nearest Person Month Worked: 1

Contribution to the Project: Participant in the NIMBioS' summer 2020 Summer Research Experience for undergraduate program.

Funding Support: NSF

International Collaboration: No

International Travel: No

Year of schooling completed: Junior

Home Institution: Fordham University

Government fiscal year(s) was this REU participant supported: 2020

Spencer Catron

Email: scatron@vols.utk.edu

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

Nearest Person Month Worked: 1

Contribution to the Project: Participant in the NIMBioS' summer 2020 Summer Research Experience for undergraduate program.

Funding Support: NSF

International Collaboration: No

International Travel: No

Year of schooling completed: Freshman

Home Institution: University of Tennessee Knoxville

Government fiscal year(s) was this REU participant supported: 2020

Matthew Clark

Email: matthew.clark.dev@gmail.com

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

Nearest Person Month Worked: 1

Contribution to the Project: Participant in the NIMBioS' summer 2020 Summer Research Experience for undergraduate program.

Funding Support: NSF
International Collaboration: No
International Travel: No
Year of schooling completed: Junior
Home Institution: Fisk University
Government fiscal year(s) was this REU participant supported: 2020

Jackie Folmar

Email: jackie.folmar@yale.edu

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

Nearest Person Month Worked: 1

Contribution to the Project: Participant in the NIMBioS' summer 2020 Summer Research Experience for undergraduate program.

Funding Support: NSF

International Collaboration: No

International Travel: No

Year of schooling completed: Sophomore

Home Institution: Yale University

Government fiscal year(s) was this REU participant supported: 2020

Umang Joshi

Email: joshui@xavier.edu

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

Nearest Person Month Worked: 1

Contribution to the Project: Participant in the NIMBioS' summer 2020 Summer Research Experience for undergraduate program.

Funding Support: NSF

International Collaboration: No

International Travel: No

Year of schooling completed: Junior

Home Institution: Xavier University

Government fiscal year(s) was this REU participant supported: 2020

Dakila Ledesma

Email: dakilaledesma@gmail.com

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

Nearest Person Month Worked: 1

Contribution to the Project: Participant in the NIMBioS' summer 2020 Summer Research Experience for undergraduate program.

Funding Support: NSF

International Collaboration: No

International Travel: No

Year of schooling completed: Other

Home Institution: University of Tennessee Chattanooga

Government fiscal year(s) was this REU participant supported: 2020

Michael Lin

Email: mlin60@jhu.edu

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

Nearest Person Month Worked: 1

Contribution to the Project: Participant in the NIMBioS' summer 2020 Summer Research Experience for undergraduate program.

Funding Support: NSF

International Collaboration: No

International Travel: No

Year of schooling completed: Sophomore

Home Institution: Johns Hopkins University

Government fiscal year(s) was this REU participant supported: 2020

Sarah Roth

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

Nearest Person Month Worked: 1

Contribution to the Project: Participant in the NIMBioS' summer 2020 Summer Research Experience for undergraduate program.

Funding Support: NSF

International Collaboration: No

International Travel: No

Year of schooling completed: Sophomore

Home Institution: University of Tennessee Knoxville

Government fiscal year(s) was this REU participant supported: 2020

Savannah Rumley

Email: s.rumley.00@gmail.com

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

Nearest Person Month Worked: 1

Contribution to the Project: Participant in the NIMBioS' summer 2020 Summer Research Experience for undergraduate program.

Funding Support: NSF

International Collaboration: No

International Travel: No

Year of schooling completed: Sophomore

Home Institution: Fisk University

Government fiscal year(s) was this REU participant supported: 2020

Abigail Sallee

Email: asallee@vols.utk.edu

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

Nearest Person Month Worked: 1

Contribution to the Project: Participant in the NIMBioS' summer 2020 Summer Research Experience for

undergraduate program.

Funding Support: NSF

International Collaboration: No

International Travel: No

Year of schooling completed: Junior

Home Institution: University of Tennessee Knoxville

Government fiscal year(s) was this REU participant supported: 2020

Chelsea Seggern

Email: cseggern@vols.utk.edu

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

Nearest Person Month Worked: 1

Contribution to the Project: Participant in the NIMBioS' summer 2020 Summer Research Experience for undergraduate program.

Funding Support: NSF

International Collaboration: No

International Travel: No

Year of schooling completed: Other

Home Institution: University of Tennessee Knoxville

Government fiscal year(s) was this REU participant supported: 2020

Elliott Smith

Email: elliosmi@umich.edu

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

Nearest Person Month Worked: 1

Contribution to the Project: Participant in the NIMBioS' summer 2020 Summer Research Experience for undergraduate program.

Funding Support: NSF

International Collaboration: No

International Travel: No

Year of schooling completed: Sophomore

Home Institution: University of Michigan

Government fiscal year(s) was this REU participant supported: 2020

Anna Thomas

Email: akt221@lehigh.edu

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

Nearest Person Month Worked: 1

Contribution to the Project: Participant in the NIMBioS' summer 2020 Summer Research Experience for undergraduate program.

Funding Support: NSF

International Collaboration: No

International Travel: No

Year of schooling completed: Junior

Home Institution: Lehigh University

Government fiscal year(s) was this REU participant supported: 2020

Amy Tian

Email: amytian@uchicago.edu

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

Nearest Person Month Worked: 1

Contribution to the Project: Participant in the NIMBioS' summer 2020 Summer Research Experience for undergraduate program.

Funding Support: NSF

International Collaboration: No

International Travel: No

Year of schooling completed: Junior

Home Institution: University of Chicago

Government fiscal year(s) was this REU participant supported: 2020

Stephanie Westaway

Email: swestawa@samford.edu

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

Nearest Person Month Worked: 1

Contribution to the Project: Participant in the NIMBioS' summer 2020 Summer Research Experience for undergraduate program.

Funding Support: NSF

International Collaboration: No

International Travel: No

Year of schooling completed: Junior

Home Institution: Samford University

Government fiscal year(s) was this REU participant supported: 2020

Francesca Zumpano

Email: zumpanf1@tcnj.edu

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

Nearest Person Month Worked: 1

Contribution to the Project: Participant in the NIMBioS' summer 2020 Summer Research Experience for undergraduate program.

Funding Support: NSF

International Collaboration: No

International Travel: No

Year of schooling completed: Junior

Home Institution: College of New Jersey

Government fiscal year(s) was this REU participant supported: 2020

What other organizations have been involved as partners?

Name	Type of Partner Organization	Location
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AAAS-American Association for Advancement of Science	Academic Institution	Washington, D.C.
AAUW (American Association of University Women)	Other Nonprofits	Washington, D.C.
Center for Synthesis and Analysis of Biodiversity	Academic Institution	Aix-en-Provence, France
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
EDSIN (Environmental Data Science Inclusion Network)	Other Nonprofits	Columbus, Ohio
Ecological Society of America	Academic Institution	Washington, D.C.
FARO	Industrial or Commercial Firms	Lake Mary, FL
Fisk University	Academic Institution	Nashville, TN
Girls Achieving in Mathematics, Engineering, Science (GAMES)	Other Nonprofits	Knoxville, TN
AIBS-American Institute of Biological Sciences	Academic Institution	Reston, VA
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
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
John Templeton Foundation	Other Nonprofits	West Conshohocken, PA
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
AWM-Association for Women in Mathematics	Other Nonprofits	Fairfax, VA
Mathematical Association of America	Other Nonprofits	Washington, D.C.
Middle Tennessee State University	Academic Institution	Murfreesboro, TN
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
NISER (National Institute for STEM Evaluation and Research)	Academic Institution	Knoxville, TN
NSF Mathematical Sciences Institutes	Academic Institution	various
NSF-XSEDE Extreme Science and Engineering Environment	Academic Institution	various
NeuroNET	Other Organizations (foreign or domestic)	Knoxville, TN
Northern Arizona University	Academic Institution	Flagstaff, AZ
Auburn University	Academic Institution	Auburn, AL
Oak Ridge National Laboratory	Other Organizations (foreign or domestic)	Oak Ridge, TN
QBio@CC: RCN on Quantitative Biology at Community Colleges	Other Nonprofits	Rockville, MD
QUBES (Quantitative Undergraduate Biology Education and Synt	Academic Institution	Unity College, Unity, ME
SACNAS-Society for the Advancement of Chicanos and Native Am	Academic Institution	Santa Cruz, CA
SAMSI-Statistical and Applied Mathematical Sciences Institut	Academic Institution	Research Triangle Park, NC

SESYNC-National Social-Environmental Synthesis Center	Academic Institution	University of Maryland
SHADES-Sharing Adventures in Engineering & Science	Academic Institution	Knoxville, TN
SIAM-Society for Industrial and Applied Mathematics	Academic Institution	Philadelphia, PA
SMB-Society for Mathematical Biology	Academic Institution	international
SMILES	Other Nonprofits	El Paso, TX
BioQUEST Curriculum Consortium	Other Nonprofits	Madison, WI
South Big Data Spokes	Academic Institution	Spelman College
South-East Alliance for Persons with Disabilities	Academic Institution	Auburn, AL
Tennessee Ornithological Society	Other Nonprofits	Clarksville, TN
Tennessee State University	Academic Institution	Nashville, TN
Texas State University	Academic Institution	San Marcos, TX
U.S. Army Research Office	Other Organizations (foreign or domestic)	Research Triangle Park, NC
UC Davis HHMI Quantitative Biology Program	Academic Institution	Davis, CA
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
Burroughs Wellcome Fund	Other Organizations (foreign or domestic)	Research Triangle Park, NC
University of Tennessee - Biology in a Box	Academic Institution	Knoxville, TN
University of Tennessee - Chattanooga	Academic Institution	Chattanooga, TN
University of Texas El Paso	Academic Institution	El Paso, TX
Washington State University	Academic Institution	Pullman, WA

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

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.

AAUW (American Association of University Women)

Organization Type: Other Nonprofits

Organization Location: Washington, D.C.

Partner's Contribution to the Project:

Collaborative Research

More Detail on Partner and Contribution: NIMBioS held its Expanding Your Horizons STEM activity in November 2019 in cooperation with AAUW.

AIBS-American Institute of Biological Sciences

Organization Type: Academic Institution

Organization Location: Reston, VA

Partner's Contribution to the Project:

Collaborative Research

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

AWM-Association for Women in Mathematics

Organization Type: Other Nonprofits

Organization Location: Fairfax, VA

Partner's Contribution to the Project:

Collaborative Research

Personnel Exchanges

More Detail on Partner and Contribution: NIMBioS Associate Director Lenhart actively seeks collaboration on activities with this group 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. NIMBioS hosted the first meeting of the Quantitative Biology at Community Colleges network (Feb 2020).

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. NIMBioS organized a spring 2020 workshop on Quantitative Education in Life Science Graduate Programs that was postponed due to COVID.

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.

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.

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.

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. Gavrilets is collaborating with members of the Cultural Evolution Society on projects connected to the launch of NIMBioS' Center for the Dynamics of Social Complexity. A major project this reporting period, supported by the John Templeton Foundation, was development of online learning modules with basic and applied lessons in the dynamics of cultural evolution.

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.

EDSIN (Environmental Data Science Inclusion Network)

Organization Type: Other Nonprofits

Organization Location: Columbus, Ohio

Partner's Contribution to the Project:

Collaborative Research

More Detail on Partner and Contribution: NIMBioS is a contributor to the EDSIN network.

Ecological Society of America

Organization Type: Academic Institution

Organization Location: Washington, D.C.

Partner's Contribution to the Project:

Collaborative Research

Personnel Exchanges

More Detail on Partner and Contribution: NIMBioS Director and NIMBioS-affiliated faculty presented at the ESA annual meeting. NIMBioS hosted a day-long Communicating Science workshop in February 2020 along with ESA's Public Affairs Office and the ESA Southeastern Chapter.

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 participated on an external advisory committee for the NSF-HBCU-UP Targeted Infusion Project on Infusion of Computational Biological content into Fisk University's UG STEM Curriculum in February 2020. Fisk students participated in the NIMBioS SRE program in summer 2020.

Girls Achieving in Mathematics, Engineering, Science (GAMES)

Organization Type: Other Nonprofits

Organization Location: Knoxville, TN

Partner's Contribution to the Project:

Collaborative Research

More Detail on Partner and Contribution: Program at the University of Tennessee to promote girls' interest and self-efficacy in STEM using chess and other strategic games. NIMBioS is collaborating to carry out various activities to enhance STEM education in Tennessee.

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.

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 short-term visitors in fall 2020.

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. Dr. Talitha Washington is a former member of the NIMBioS Advisory Board.

Innovative Computing Laboratory

Organization Type: Academic Institution

Organization Location: Knoxville, TN

Partner's Contribution to the Project:

In-Kind Support

Facilities

Collaborative Research

More Detail on Partner and Contribution: The ICL is a large computer science research and development group

co-located with NIMBioS. NIMBioS and ICL staff communicate regularly to discuss possible joint activities.

JICS-Joint Institute for Computational Science

Organization Type: Academic Institution

Organization Location: University of Tennessee

Partner's Contribution to the Project:

Collaborative Research

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

John Templeton Foundation

Organization Type: Other Nonprofits

Organization Location: West Conshohocken, PA

Partner's Contribution to the Project:

Financial support

More Detail on Partner and Contribution: NIMBioS Associate Director S. Gavrilets is collaborating with members of the Cultural Evolution Society on projects connected NIMBioS' Center for the Dynamics of Social Complexity. A major project this reporting period was development of online learning modules with basic and applied lessons in the dynamics of cultural evolution. The Templeton Foundation provides support for this project.

Legacy Parks Foundation

Organization Type: Other Nonprofits

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.

MBI-Mathematical Biosciences Institute

Organization Type: Academic Institution

Organization Location: Ohio State University

Partner's Contribution to the Project:

Collaborative Research

More Detail on Partner and Contribution: The leadership teams of NIMBioS and MBI are in regular contact regarding potential collaborations on future workshops.

MSRI-Mathematical Sciences Research Institute

Organization Type: Academic Institution

Organization Location: Berkeley, CA

Partner's Contribution to the Project:

Collaborative Research

More Detail on Partner and Contribution: NIMBioS maintains open communications with MSRI and the other U.S.-based mathematics institutes to explore opportunities for joint activities.

Mathematical Association of America

Organization Type: Other Nonprofits

Organization Location: Washington, D.C.

Partner's Contribution to the Project:

Collaborative Research

More Detail on Partner and Contribution: NIMBioS is involved with the MAA Committee on the Undergraduate Program in Mathematics, helping develop recommendations to guide mathematics departments in designing curricula for their undergraduate students.

Middle Tennessee State University

Organization Type: Academic Institution

Organization Location: Murfreesboro, TN

Partner's Contribution to the Project:

Collaborative Research

Personnel Exchanges

More Detail on Partner and Contribution: Dr. J. Iriarte-Gross from MTSU assisted with the Expanding Your Horizons STEM activity at NIMBioS in November 2019. NIMBioS is collaborating with Dr. Iriarte-Gross on an Expanding Your Horizons STEM activity to be directed by MTSU in fall 2020.

NCEAS-National Center for Ecological Analysis and Synthesis

Organization Type: Academic Institution

Organization Location: University of California - Santa Barbara

Partner's Contribution to the Project:

Collaborative Research

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

NEON-National Ecological Observatory Network, Inc.

Organization Type: Academic Institution

Organization Location: Boulder, CO

Partner's Contribution to the Project:

Collaborative Research

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

NICS-National Institute for Computational Science

Organization Type: Academic Institution

Organization Location: Oak Ridge, TN

Partner's Contribution to the Project:

Collaborative Research

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

NISER (National Institute for STEM Evaluation and Research)

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 staff collaborate with NISER staff on research projects. NISER staff prepare the annual NIMBioS Evaluation Report.

NSF Mathematical Sciences Institutes

Organization Type: Academic Institution

Organization Location: various

Partner's Contribution to the Project:

Collaborative Research

More Detail on Partner and Contribution: NIMBioS Director and Associate Directors communicate regularly with their counterparts at the various math institutes to develop ideas for collaborative activities.

NSF-XSEDE Extreme Science and Engineering Environment

Organization Type: Academic Institution

Organization Location: various

Partner's Contribution to the Project:

Collaborative Research

More Detail on Partner and Contribution: The NSF-XSEDE program provides an HPC time allotment to NIMBioS,

and NIMBioS staff work with XSEDE staff to facilitate access for NIMBioS-associated researchers.

NeuroNET

Organization Type: Other Organizations (foreign or domestic)

Organization Location: Knoxville, TN

Partner's Contribution to the Project:

Collaborative Research

Personnel Exchanges

More Detail on Partner and Contribution: NIMBioS and NeuroNET (Neuroscience Network of East Tennessee) researchers discuss potential research collaborations.

Northern Arizona University

Organization Type: Academic Institution

Organization Location: Flagstaff, AZ

Partner's Contribution to the Project:

Collaborative Research

More Detail on Partner and Contribution: NIMBioS Director L. Gross collaborates with NAU faculty on potential projects.

Oak Ridge National Laboratory

Organization Type: Other Organizations (foreign or domestic)

Organization Location: Oak Ridge, TN

Partner's Contribution to the Project:

Collaborative Research

More Detail on Partner and Contribution: A number of ORNL scientists are NIMBioS senior personnel or collaborators, and NIMBioS leadership and affiliated faculty regularly interact with ORNL staff about possible collaborations.

QBio@CC: RCN on Quantitative Biology at Community Colleges

Organization Type: Other Nonprofits

Organization Location: Rockville, MD

Partner's Contribution to the Project:

Collaborative Research

Personnel Exchanges

More Detail on Partner and Contribution: NIMBioS Director L. Gross is on the QBio@CC Advisory Board. NIMBioS hosted the first meeting of the Quantitative Biology at Community Colleges Group (NSF RCN funded through Montgomery College in MD and Bioquest) in February 2020.

QUBES (Quantitative Undergraduate Biology Education and Synt

Organization Type: Academic Institution

Organization Location: Unity College, Unity, ME

Partner's Contribution to the Project:

Collaborative Research

Personnel Exchanges

More Detail on Partner and Contribution: NIMBioS collaborates with NISER on an ongoing project with the QUBES Consortium (Quantitative Undergraduate Biology Education and Synthesis) on methods for program evaluation.

SACNAS-Society for the Advancement of Chicanos and Native Am

Organization Type: Academic Institution

Organization Location: Santa Cruz, CA

Partner's Contribution to the Project:

Collaborative Research

More Detail on Partner and Contribution: NIMBioS maintains open communications with SACNAS to explore opportunities for joint activities.

SAMSI-Statistical and Applied Mathematical Sciences Institut

Organization Type: Academic Institution

Organization Location: Research Triangle Park, NC

Partner's Contribution to the Project:

Collaborative Research

More Detail on Partner and Contribution: NIMBioS maintains open communications with SAMSI to explore opportunities for joint activities.

SESYNC-National Social-Environmental Synthesis Center

Organization Type: Academic Institution

Organization Location: University of Maryland

Partner's Contribution to the Project:

Collaborative Research

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

SHADES-Sharing Adventures in Engineering & Science

Organization Type: Academic Institution

Organization Location: Knoxville, TN

Partner's Contribution to the Project:

Collaborative Research
Personnel Exchanges

More Detail on Partner and Contribution: NIMBioS staff are working with the SHADES program to encourage middle school girls' interest in math and science.

SIAM-Society for Industrial and Applied Mathematics

Organization Type: Academic Institution
Organization Location: Philadelphia, PA

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: NIMBioS and SIAM have discussed opportunities to continue collaborations on workshops and tutorials. Director Gross is on SIAM's Committee on Science Policy.

SMB-Society for Mathematical Biology

Organization Type: Academic Institution
Organization Location: international

Partner's Contribution to the Project:
Collaborative Research

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

SMILES

Organization Type: Other Nonprofits
Organization Location: El Paso, TX

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: SMILES = Student-made Interactive Learning with Educational Songs. NIMBioS Director Gross is on the SMILES Advisory Board.

South Big Data Spokes

Organization Type: Academic Institution
Organization Location: Spelman College

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: NIMBioS Director L. Gross is on the Advisory Board for the Big Data Spokes project.

South-East Alliance for Persons with Disabilities

Organization Type: Academic Institution

Organization Location: Auburn, AL

Partner's Contribution to the Project:

Collaborative Research

More Detail on Partner and Contribution: NIMBioS collaborated with the SEAPD-STEM program to encourage STEM students with disabilities and participated in the SEAPD-STEM conference.

Tennessee Ornithological Society

Organization Type: Other Nonprofits

Organization Location: Clarksville, TN

Partner's Contribution to the Project:

Collaborative Research

More Detail on Partner and Contribution: NIMBioS staff were part of the organizing committee for and designed math and biology activities for TOS' Discover Birds program. Deputy Director Welsh is Vice-President for East Tennessee, serves on the Education subcommittee of the Conservation and Research Funding committee, and is a State Director for the Knoxville Chapter.

Tennessee State University

Organization Type: Academic Institution

Organization Location: Nashville, TN

Partner's Contribution to the Project:

Collaborative Research

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

Texas State University

Organization Type: Academic Institution

Organization Location: San Marcos, TX

Partner's Contribution to the Project:

Collaborative Research

More Detail on Partner and Contribution: NIMBioS Director L. Gross and Associate Director S. Lenhart are collaborating with faculty from Texas State Univ. on potential NIFA capacity building projects.

U.S. Army Research Office

Organization Type: Other Organizations (foreign or domestic)

Organization Location: Research Triangle Park, NC

Partner's Contribution to the Project:

Collaborative Research

More Detail on Partner and Contribution: Army Research Office staff have visited and participated in activities at NIMBioS, and there are ongoing discussions of possible research initiatives.

UC Davis HHMI Quantitative Biology Program

Organization Type: Academic Institution

Organization Location: Davis, CA

Partner's Contribution to the Project:

Collaborative Research

More Detail on Partner and Contribution:

USDA - APHIS - WS - National Wildlife Research Center

Organization Type: Other Organizations (foreign or domestic)

Organization Location: Fort Collins, CO

Partner's Contribution to the Project:

Collaborative Research

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

UT Center for Wildlife Health

Organization Type: Academic Institution

Organization Location: Knoxville, TN

Partner's Contribution to the Project:

Collaborative Research

More Detail on Partner and Contribution: NIMBioS and CWH researchers have collaborated on efforts to support research experiences for undergraduates.

UT Health Sciences Center

Organization Type: Academic Institution

Organization Location: Memphis, TN

Partner's Contribution to the Project:

Collaborative Research

More Detail on Partner and Contribution: NIMBioS-affiliated faculty are collaborating with UTHSC faculty.

University of Tennessee - Biology in a Box

Organization Type: Academic Institution

Organization Location: Knoxville, TN

Partner's Contribution to the Project:

Collaborative Research

More Detail on Partner and Contribution: Biology in a Box is a fun and challenging way for entire schools to enhance their life sciences curriculum at all grade levels and to encourage student interest in STEM disciplines. NIMBioS interacts with Biology in a Box leaders and continues to advocate for use of the boxes in STEM education.

University of Tennessee - Chattanooga

Organization Type: Academic Institution

Organization Location: Chattanooga, TN

Partner's Contribution to the Project:

Collaborative Research

More Detail on Partner and Contribution: NIMBioS Director L. Gross collaborates with UT Chattanooga faculty on the Big Data Spokes project.

University of Texas El Paso

Organization Type: Academic Institution

Organization Location: El Paso, TX

Partner's Contribution to the Project:

Collaborative Research

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

Washington State University

Organization Type: Academic Institution

Organization Location: Pullman, WA

Partner's Contribution to the Project:

Collaborative Research

More Detail on Partner and Contribution: NIMBioS Director L. Gross collaborates with WSU faculty on potential projects.

Women in STEM Center

Organization Type: Academic Institution

Organization Location: Middle Tennessee State Univ.

Partner's Contribution to the Project:

Collaborative Research

More Detail on Partner and Contribution: S. Lenhart is working with Dr. J. Iriarte-Gross of MTSU to plan an

Expanding Your Horizons event for middle school girls.

sDiv

Organization Type: Other Nonprofits

Organization Location: Leipzig, Germany

Partner's Contribution to the Project:

Collaborative Research

More Detail on Partner and Contribution: sDiv is the synthesis center of iDiv, the German Centre for Integrative Biodiversity Research. NIMBioS staff are collaborating with sDiv staff on center and database management procedures.

What other collaborators or contacts have been involved?

University of Tennessee, Knoxville

S. Allard, School of Information Sciences

S. Babu, Mechanical, Aerospace, and Biomedical Engineering

A. Bentley, Anthropology

G. Burghardt, Psychology

J. Chen, Food Science

V. Dale, Ecology & Evolutionary Biology

E. Derryberry, Ecology & Evolutionary Biology

T. Freeberg, Psychology

C. Richards - Armsworth Lab, Ecology & Evolutionary Biology

D. Ruck, Anthropology

G. Shteynberg, Psychology

M. Thalos, Philosophy

H. S. Yoon, Ecology & Evolutionary Biology

Other Institutions

B. Beckage, Plant Biology & Computer Science, Univ. Vermont

I. Chades, CSIRO

P. Fackler, Agricultural & Resource Economics, North Carolina State Univ.

T. Franck, Climate Interactive

J. Iriarte-Gross, Chemistry, Middle Tennessee State University

D. Kling, Applied Economics, Oregon State Univ.

K. Lacasse, Psychology, Rhode Island College

X. Liu, Agricultural Sciences, Texas State Univ.

N. Merchant, Data Science Institute, Univ. Arizona

H. Qin, Computer Science and Engineering, Univ. Tennessee - Chattanooga

M. Springborn, Environmental Science and Policy, Univ. Calif. - Davis

E. Swartz, The Good Food Institute

Collaborators in the Cultural Evolution Online Learning Tutorials <http://www.dysoc.org/cesmodules/>

E. Akçay and M. Smolla, Biology, Univ. of Pennsylvania

M. Alfaro, Ecology & Evolutionary Biology, and J. Foster and B. Koch, Sociology, Univ. California, Los Angeles

L. Aplin, Max Planck Institute for Animal Behaviour, Germany

A. Bell, Anthropology, Univ. Utah

N. Claidière, CNRS, Aix-Marseille Univ., France

R. Genet, California Polytechnic State Univ.

E. Gjesfjeld, Archaeology Univ. Cambridge, UK

R. Kendal and J. Tehrani, Univ. Durham, UK

P. Richerson, Univ. California, Davis

D. Silvestro, Biological & Environmental Sciences, Univ. Gothenburg, Sweden

P. Smaldino, Cognitive and Information Sciences, Univ. California, Merced

O. Sobchuk, Max Planck Institute the Science of Human History, Jena, Germany

J. Stubbersfield, Psychology, Heriot-Watt Univ., Edinburgh, UK

A. Whiten, Univ. St Andrews, UK

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Impacts

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

Over the time period of this project, a number of publications resulting from NIMBioS activities have appeared in top national and international journals with high impact factors, including American Naturalist, Population Ecology, Proceedings of the Royal Society B, Humanities & Social Sciences, Journal of Theoretical Biology, Scientific Reports, Ecology Letters, Evolution and Human Behavior, and PLoS Computational Biology. [Table 1](#) in the supporting file included with this section provides details on NIMBioS-derived publications in high-impact factor journals since 2008.

Activities supported by NIMBioS have had a strong impact on a number of biological sub-disciplines. The following,

which were reported during this reporting period, provide some highlights grouped by the type of activity but are just samples of the activities in the subject areas.

Several participants in the *NIMBoS SRE program* and their mentor former NIMBioS postdoc Sara Flanagan have published a paper entitled "Space, density and extra-pair matings have opposing impacts on male and female reproductive success" in *Population Ecology* summarizing results of their summer project. Many territorial species have a mating system characterized by males establishing home ranges on the breeding grounds prior to arrival of females, resulting in males competing for territories and females choosing a mate upon their arrival. It remains unknown, however, how the outcomes of decisions surrounding territory establishment and mate choice are influenced by the spatial configuration of the breeding grounds. The authors used a spatially explicit, individual-based model to investigate the sex-specific effects of these decisions on reproductive success. In their model, males that arrive earlier obtain higher quality territories and improve their chances for extra-pair copulations. Females can choose their mate to maximize the quality of the male or to attempt to minimize the density of other females near their nesting site to avoid competition. Females therefore face a tradeoff between high-density regions around high-quality males and low-quality males in areas of low competition. Their model predicts a negative correlation between male and female reproductive success under a wide range of conditions when the majority of the territories are on the margins of the breeding area. Most notably, this sexual conflict arises as an edge effect suggesting that fragmentation of breeding habitats could impact the consequences of mate choice in many species with territorial breeding habits.

Former *NIMBioS postdoc* Caroline Farior published a paper entitled "Theory predicts plants grow roots to compete with only their closest neighbours" in *Proceedings of the Royal Society B*. The combination of individual-based selection with shared access to resources drives individuals to invest more than necessary in taking up their share of resources due to the threat of other individuals doing the same (competitive overinvestments). This evolutionary escalation of investment is common, from deer antlers and peacock feathers to tree height and plant roots. Because plant roots seem to be well intermingled below ground, the simplifying assumption that belowground resources are perfectly well mixed is often made in models—a condition that favors maximal fine-root overinvestments. Dr. Farior developed simple models to investigate the role of space in determining the overlap among individuals belowground and resulting fine-root biomass. Without costs of growing roots through space, evolutionary optimization leads individuals to intermingle their fine roots perfectly and to invest just as much in these roots, whether there are two individuals competing or many. However, if there are any costs of sending roots through soil, investment in fine roots is constrained in amount and spatial extent. Dominant individuals are those that keep their roots in the soil closest to their own stem and the stems of their closest neighbors. These results highlight the importance of space in determining individual strategies as well as competitive networks in below-ground systems.

Members of a *NIMBioS working group* on Theory of plant-soil feedback: Phenomenological, mechanistic and spatial models published a paper entitled "Pathogens and Mutualists as Joint Drivers of Host Species Coexistence and Turnover: Implications for Plant Competition and Succession" in the *American Naturalist*. The potential for either pathogens or mutualists to alter the outcome of interactions between host species has been clearly demonstrated experimentally, but our understanding of their joint influence remains limited. Individually, pathogens and mutualists can each stabilize (via negative feedback) or destabilize (via positive feedback) host-host interactions. When pathogens and mutualists are both present, the potential for simultaneous positive and negative feedbacks can generate a wide range of possible effects on host species coexistence and turnover. The authors explored the potential role of microbial mutualists and pathogens in plant species turnover during succession. They showed how a combination of positive and negative plant-microbe feedbacks can generate a coexistence state that is part of a set of alternative stable states. This result implies that the outcomes of coexistence from classical plant-soil feedback experiments may be susceptible to disturbances and that empirical investigations of microbially mediated coexistence would benefit from consideration of interactive effects of feedbacks generated from different distinct components of the plant microbiome.

Participants in the *NIMBioS Investigative Workshop* on Transients in Biological Systems: Implications and Detection, S. Ahn and L. L. Rubchinsky, have published a paper entitled "Temporal patterns of dispersal-induced synchronization in population dynamics" in the *Journal of Theoretical Biology*. The mechanisms and properties of synchronization of oscillating ecological populations attract attention because it is a fairly common phenomenon and because spatial synchrony may elevate risk of extinction or lead to other environmental impacts. The authors studied temporal patterning of intermittent synchronized dynamics in a system of two dispersal-coupled Rosenzweig-MacArthur predator-

prey oscillators. They consider the properties of the distributions of durations of desynchronized intervals and their dependence on the model parameters. The authors show that the temporal patterning of synchronous dynamics (an ecological network phenomenon) may depend on the properties of individual predator-prey patch (individual oscillator) and may vary independently of the strength of dispersal. They also show that if the predator dynamics are slow relative to the dynamics of the prey (a situation that may promote brief but large outbreaks), dispersal-coupled predator-prey oscillating populations exhibit numerous short desynchronizations (as opposed to few long desynchronizations) and may require weaker dispersal in order to reach strong synchrony.

What is the impact on other disciplines?

Education, History, Psychology, and Anthropology

Members of the NIMBioS Working Group on "Developing new solutions to improve student quantitative biology skills: A focus on community colleges" have published a paper in *Problems, Resources, and Issues in Mathematics Undergraduate Studies* entitled "A "Rule-of-Five" Framework for Models and Modeling to Unify Mathematicians and Biologists and Improve Student Learning". Despite widespread calls for the incorporation of mathematical modeling into the undergraduate biology curriculum, there is lack of a common understanding around the definition of modeling, which inhibits progress. In this paper, the authors extend the "Rule-of-Four," initially used in calculus reform efforts, to a "Rule-of-Five" framework for models and modeling that is inclusive of varying disciplinary definitions of each. This unifying framework allows building on strengths that each discipline and its students bring, but also identifying gaps in modeling activities practiced by each discipline. They also discuss benefits to student learning and interdisciplinary collaboration.

A short-term visitor Dr. Tom Currie and NIMBioS faculty Sergey Gavrilets have published a paper in *Humanities & Social Sciences* entitled "Duration of agriculture and distance from the steppe predict the evolution of large-scale human societies in Afro-Eurasia". Understanding why large, complex human societies have emerged and persisted more readily in certain regions of the world than others is an issue of long-standing debate. The authors systematically test different hypotheses involving the social and ecological factors that may ultimately promote or inhibit the formation of large, complex human societies. They employ spatially explicit statistical analyses using data on the geographical and temporal distribution of the largest human groups over a 3000-year period of history. The results support the predictions of two complementary hypotheses, indicating that large-scale societies developed more commonly in regions where (i) agriculture has been practiced for longer (thus providing more time for the norms and institutions that facilitate large-scale organization to emerge), and (ii) warfare was more intense (as proxied by distance from the Eurasian steppe), thus creating a stronger selection pressure for societies to scale up. The authors found no support for the influential idea that large-scale societies were more common in those regions naturally endowed with a higher potential for productive agriculture. Their study highlights how modern cultural evolutionary theory can be used to organize and synthesize alternative hypotheses and shed light on the ways ecological and social processes have interacted to shape the complex social world we live in today.

NIMBioS faculty member Sergey Gavrilets has published a paper in *Evolution and Human Behavior* entitled "Evolving institutions for collective action by selective imitation and self-interested design". Human behavior and collective actions are strongly affected by social institutions. A question of great theoretical and practical importance is how successful social institutions get established and spread across groups and societies. Using institutionalized punishment in small-scale societies as an example, the authors contrast two prominent mechanisms - selective imitation and self-interested design - with respect to their ability to converge to cooperative social institutions. While selective imitation has received a great deal of attention in studies of social and cultural evolution, the theoretical toolbox for studying self-interested design is limited. The authors introduced a novel approach, which they called foresight, generalizing standard myopic best response for the case of individuals with a bounded ability to anticipate actions of their group-mates and care about future payoffs. They consider groups composed of a number of regular members producing collective good and a leader monitoring and punishing free-riders. Their results show that foresight increases leaders' willingness to punish free-riders. This, in turn, leads to increased production and the emergence of an effective institution for collective action. Selective imitation by leaders (i.e. cultural group selection) outperforms self-interested design if leaders strongly discount the future. Foresight and selective imitation can interact synergistically leading to a faster convergence to an equilibrium.

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. The summer 2020 program included 17 undergraduates in math and biology fields, 11 of whom were female.

Our eleventh annual Undergraduate Research Conference at the Interface of Biology and Mathematics (November 2019), which attracted more than 120 participant students and faculty from academic institutions across North America, included more than 65 undergraduate research talks and posters and provided professional development opportunities for all participants. The Conference included an opportunity for students to discuss career plans with representatives from graduate programs at several institutions.

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. In 2019, 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, and the majority of awardees used these awards during this reporting period.

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/webinars. This allows access for 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 have been 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 hired ten faculty to enhance and expand expertise in areas related to the NIMBioS mission. The faculty hired who remain at UT have established laboratory groups which support many students and postdoctoral fellows. They have collaborated in a wide array of activities at NIMBioS, and they have collaborated with diverse groups of faculty to compose proposals and develop novel research projects.

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.

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.

Over its existence NIMBioS has supported numerous education and outreach activities throughout each 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 has posted through its website and linked resources a very large collection of videos and materials from webinars designed for a range of audiences, from students at all levels to researchers, to members of the public without extensive science background. As one example, during this reporting period NIMBioS hosted a series of live-streamed webinars on modeling disease to assist general audiences in understanding how models inform epidemiology particularly related to the ongoing pandemic. These webinars had an interactive component in which listeners could pose questions to the presenters. The recording of the webinars included the questions (and associated chat sessions), and these were posted publicly. Over 4000 views have occurred for these posted recordings, in addition to the over 1000 viewers who were part of the live-streaming.

NIMBioS has issued 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 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

The pandemic and associated constraints on visitors established by the University of Tennessee led NIMBioS to postpone or cancel several activities that had been planned to be held in the NIMBioS facilities during the spring and summer of this reporting period. Some of the activities planned were reconfigured to be held virtually (e.g. the Summer Research Experience for Undergraduates program) during the reporting period, and other activities are being planned to be held virtually during the Fall of 2020 as outlined in the plans for the no-additional cost extension that was put in place through February 2021. NIMBioS staff are collaborating extensively with the organizers of the various activities that had been planned to be held at NIMBioS, to arrange methods to assist in holding these activities virtually. Small groups of short-term visitors may still decide to visit NIMBioS in the Fall, which is allowable by University policy put in place as of August 2020. Decisions about such in-person visits are still in discussion with the organizers of these

potential visiting groups.

Changes that have a significant impact on expenditures

Due to the pandemic and constraints on visitors at the University, the planned expenditures of participant support funds for travel and housing for participants will not be feasible to be made. Rather, it will be appropriate to assist the variety of planned activities to host their activities virtually, which also provides certain novel opportunities to broaden participation beyond those who would have participated if the activities were held at NIMBioS. Therefore, we will be requesting a rebudgeting of the limited amount of participant support funding remaining to use our staff support to assist organizers in making the planned activities as beneficial as possible to a broad audience.

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.

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Addendum to NIMBioS Annual Report

Sep 1, 2019 – Aug 31, 2020

Y12-1. NIMBioS Evaluation Report

Y12-2. Participant List for NIMBioS Events and Activities

Y12-3. Description of Activities

Y12-4. Additional Products

Featured Articles

Websites

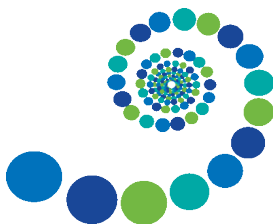
Media Coverage

**Y12-5. NSF Budget Office Reporting Requirement: Institutions, Partners,
Participants**

Addendum to NIMBioS Annual Report

Sep 1, 2019 - Aug 31, 2020

Y12-1. NIMBioS Evaluation Report



NIMBioS

National Institute for Mathematical
and Biological Synthesis

NIMBioS EVALUATION REPORT

REPORTING PERIOD TWELVE

SEPTEMBER 1, 2019 – JUNE 30, 2020

National Institute for Mathematical and Biological Synthesis

July 2020

National Institute for STEM Evaluation and Research

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

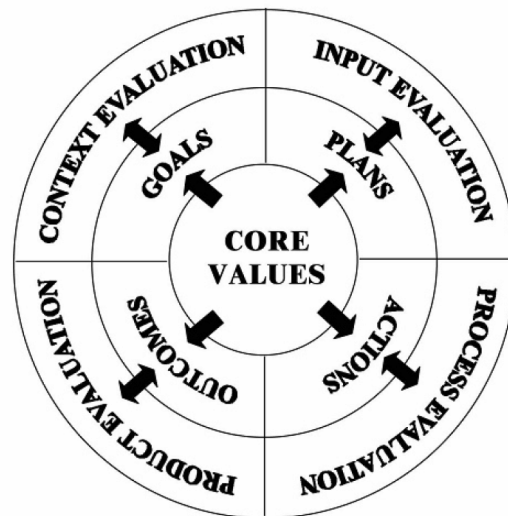
Product Evaluation assesses outcomes of the program.

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

INTRODUCTION

This is an evaluation summary of NIMBioS activities during the twelfth annual reporting period (RP 12) to the National Science Foundation. This report covers the period of September 1, 2019 through June 30, 2020. 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 12

Table 1. Research program activities

Activity	RP 12	All Years
Working Groups (# meetings hosted)	0	58 (184)
Investigative Workshops	0	53
Tutorials	0	27
Postdoctoral Fellows	5	52
Short-term visitors	40	439
Visiting graduate student fellows	0	8
Visiting Scholars	2	9
Sabbaticals	0	17

Education and Outreach (EO) program activity highlights (RP 12) include:

- NIMBioS Interdisciplinary Seminar Series
- Summer Research Experiences (SRE) Program
- Undergraduate Research Conference at the Interface of Biology and Mathematics

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 gender, 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.

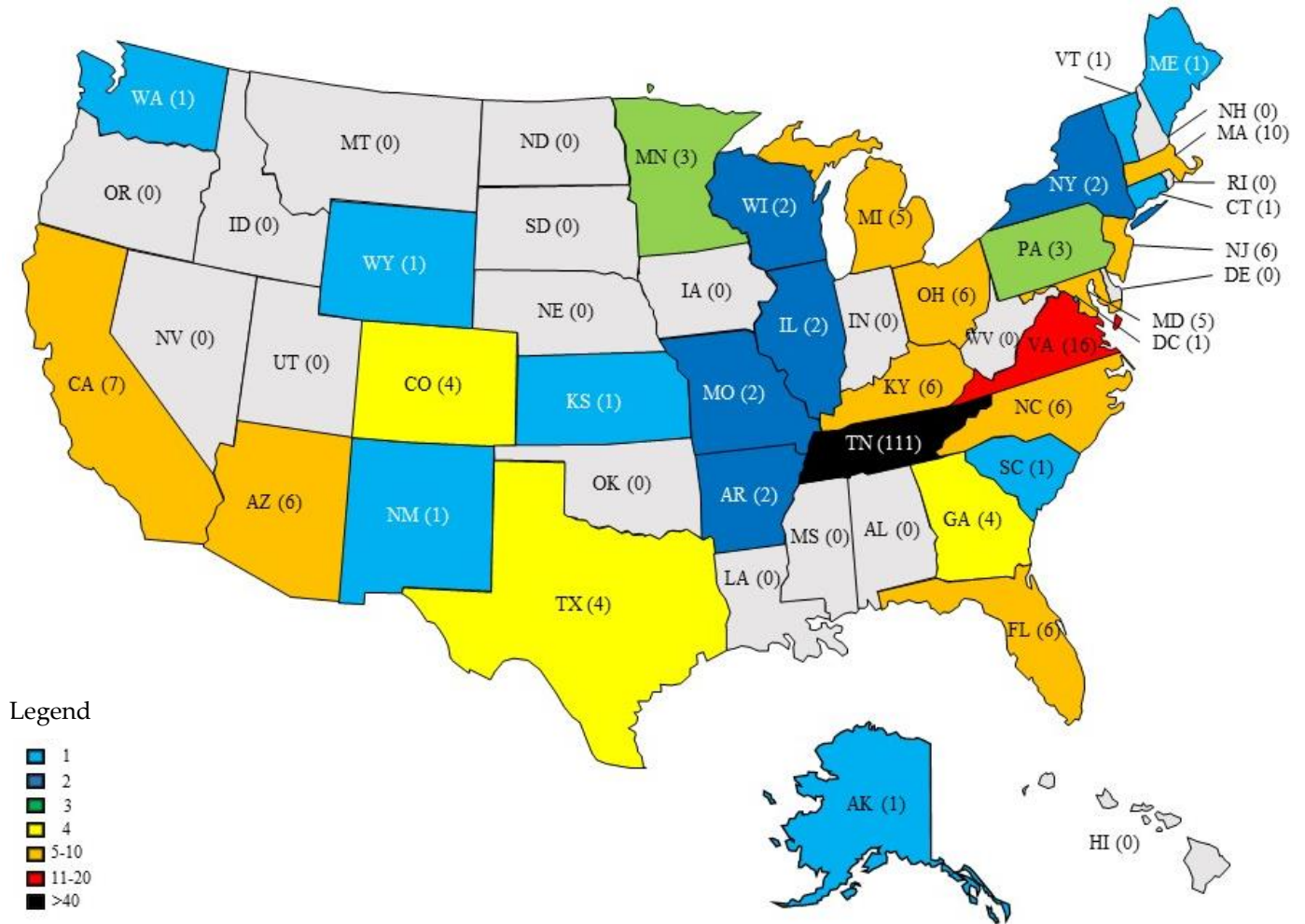
Geographic Diversity. During RP 12, 237 participants (212 unique individuals) from 4 countries participated in NIMBioS events. Most participants came from the United States (97%). Participants also came from Canada, Brazil and The United Kingdom (**Figure 2**).

Figure 2. NIMBioS RP 12 participants by country



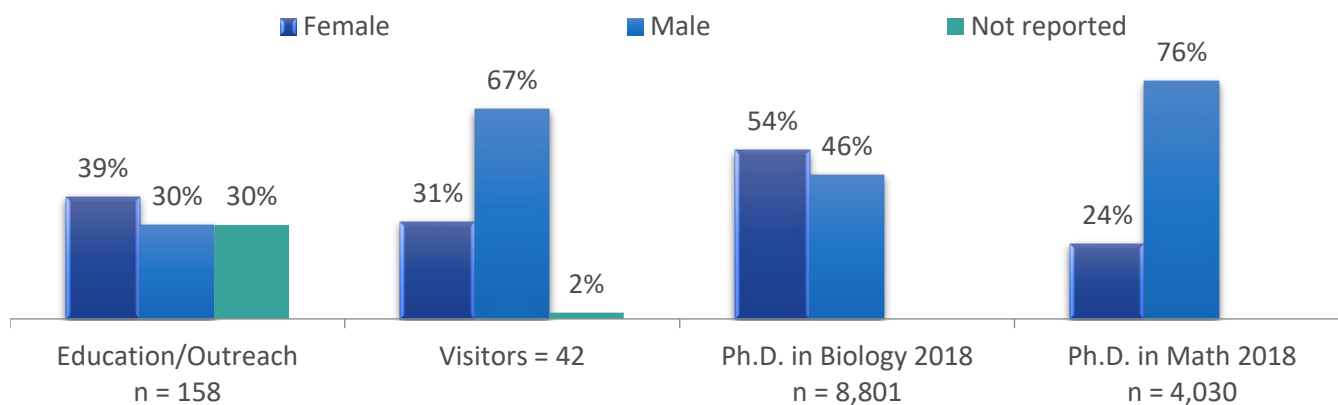
Within the United States., 34 different states, as well as the District of Columbia and Puerto Rico, were represented. The largest percentage of participants came from within Tennessee (48%), followed by Virginia (7%), Massachusetts (4%) and California (3%) (Figure 3).

Figure 3. NIMBioS RP 12 participants by U.S. state



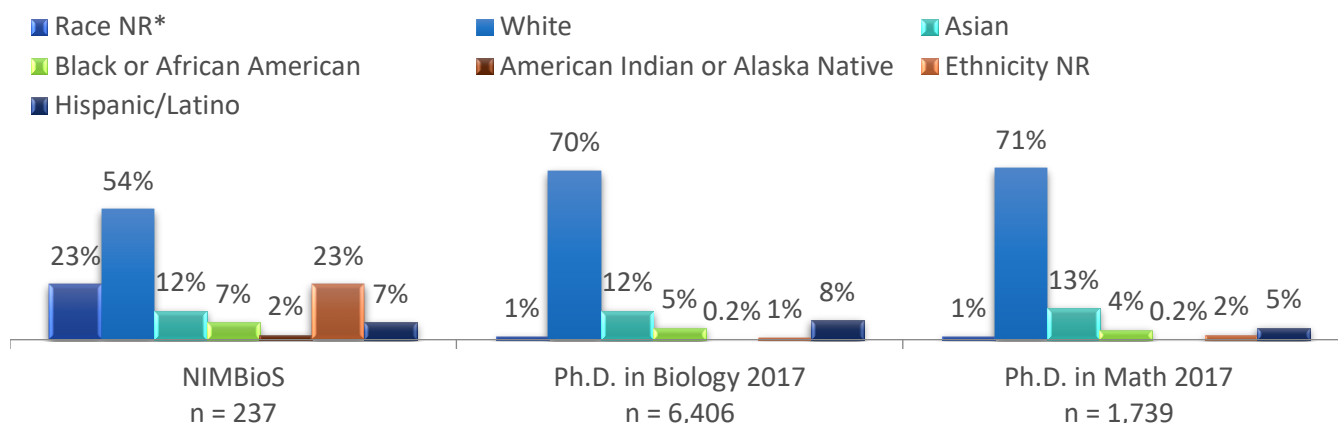
Gender, Racial, and Ethnic Diversity. Across all events during RP 12, female participation was 37% (21% of participants did not report gender identity). During RP 12, NIMBioS hosted Education/ Outreach events and Visitors (**Figure 4**). Comparison groups shown are all individuals receiving doctorates in biology and mathematics in the U.S. In 2018 (data from NSF Survey of Earned Doctorates). The overall distribution of females in NIMBioS activities was lower than the awarded Ph.D.'s in biology in the U.S. and was slightly higher than awarded Ph.D.'s in mathematics.

Figure 4. Gender composition of participants by event type



Overall minority representation across NIMBioS events during RP 12 was 13.5% (22.8% of participants did not report race/ethnicity status) and exceeds the numbers for doctoral recipients in the biological and mathematical sciences (**Figure 5**). Comparison groups shown are all U.S. citizens and permanent residents receiving doctorates in biology and mathematics in the U.S. in 2018. Minority representation varied among activities¹.

Figure 5. Minority representation of NIMBioS participants



*NR = not reported

¹ For the purposes of this report, “minority” refers to those who self-identify as American Indian or Alaska native, black or African American, and/or Hispanic or Latino (NSF Survey of Earned Doctorates, 2018 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 (note: no Working Groups or Investigative Workshops took place during RP 12). Benchmarks for diversity in participants at NIMBioS activities are provided in **Figures 6 to 11**.

BENCHMARKS FOR DIVERSITY IN ALL PARTICIPANTS

Figure 6. Proportion of female participants across all NIMBioS activities, Working Groups and Investigative Workshops by year

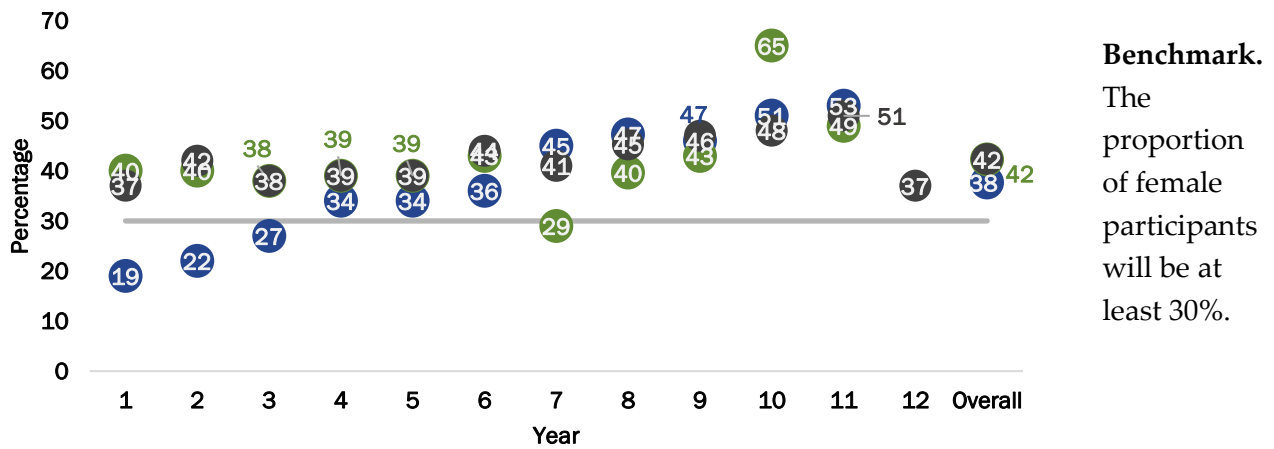


Figure 7. Proportion of international participants across all NIMBioS activities, Working Groups and Investigative Workshops by year

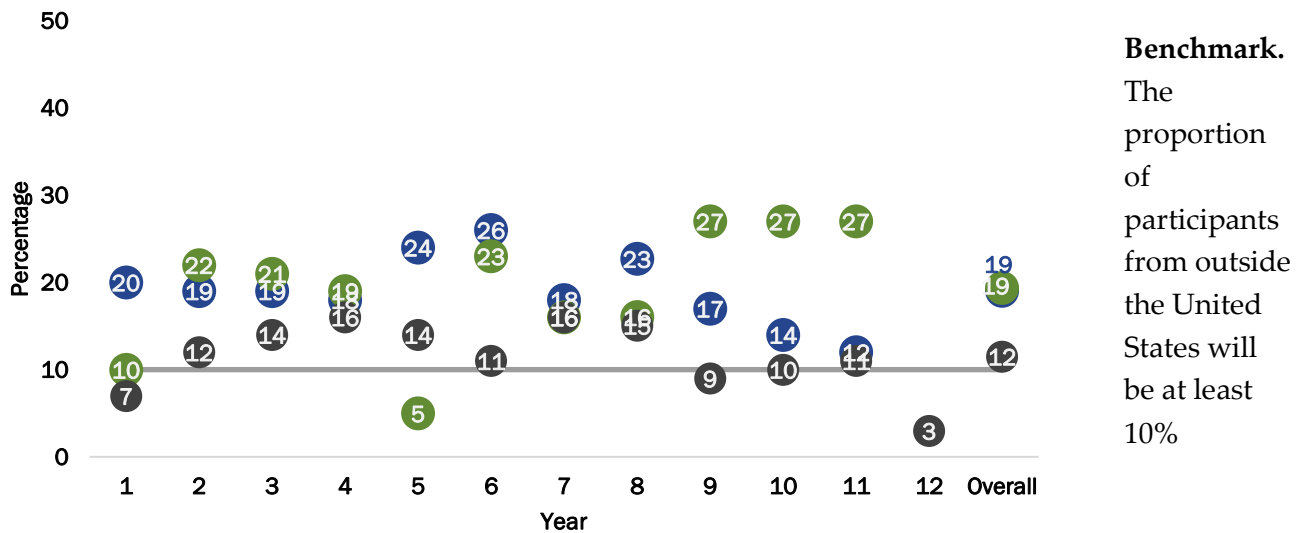
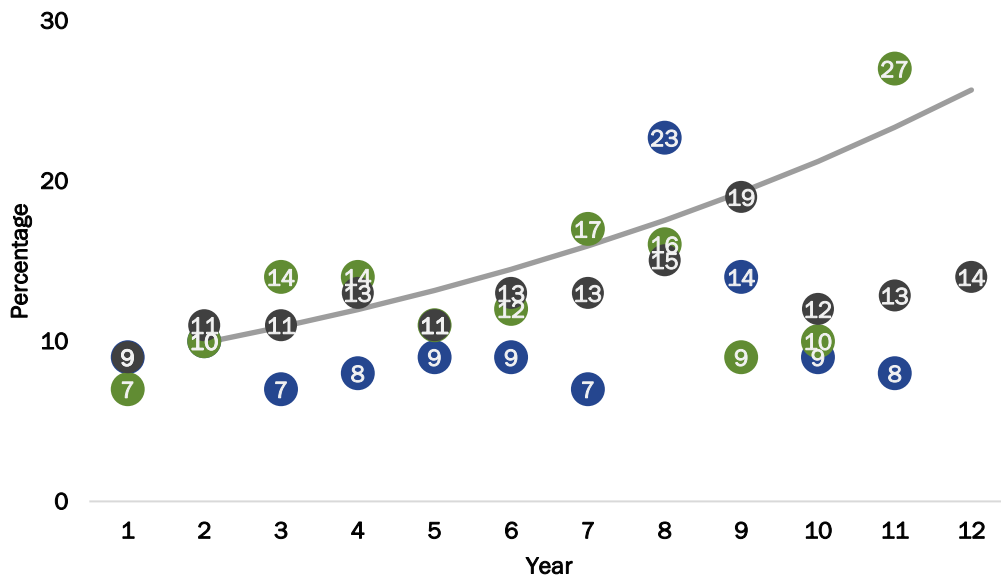


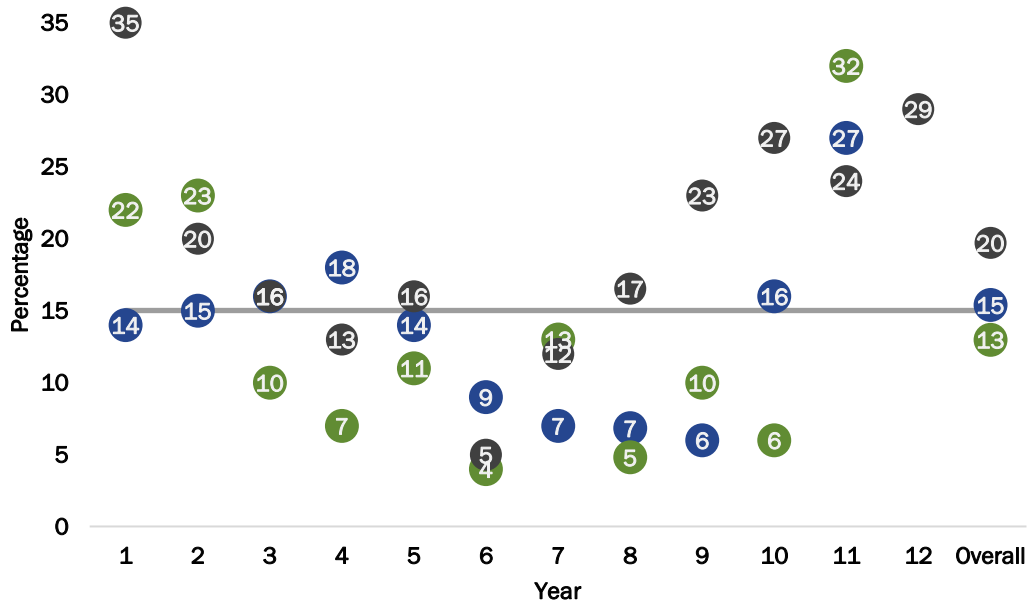
Figure 8. Proportion of participants from underrepresented groups across all NIMBioS activities, Working Groups and Investigative Workshops



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 9. 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 10. Proportion of female organizers across all NIMBioS activities, Working Groups and Investigative Workshops by year

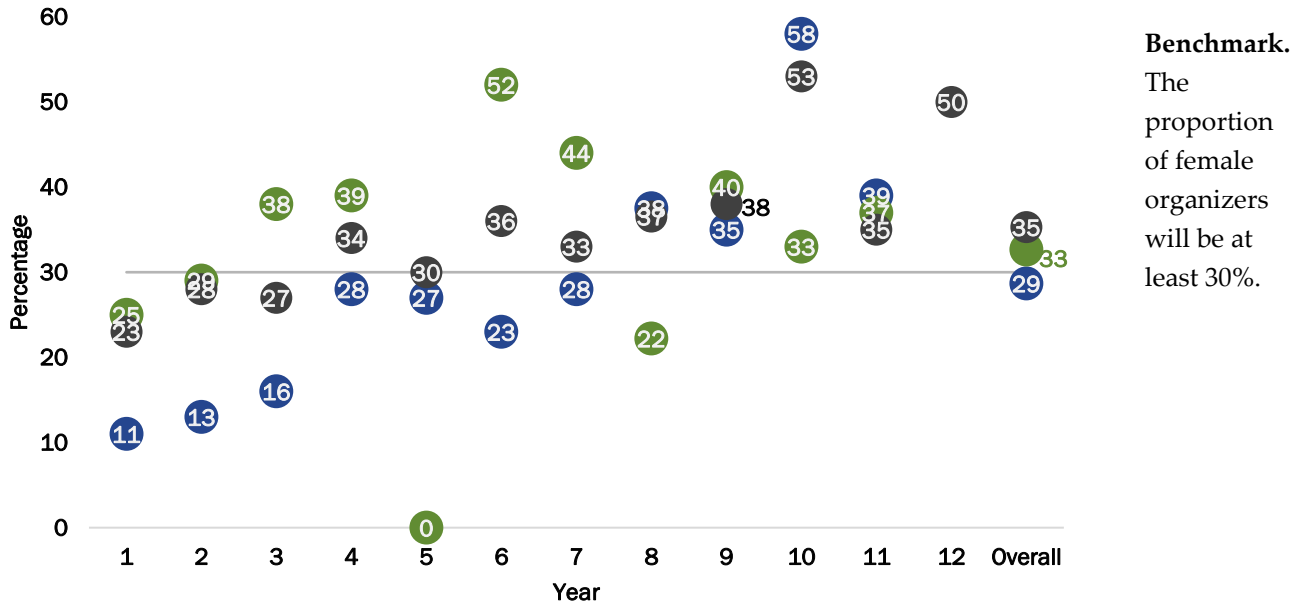
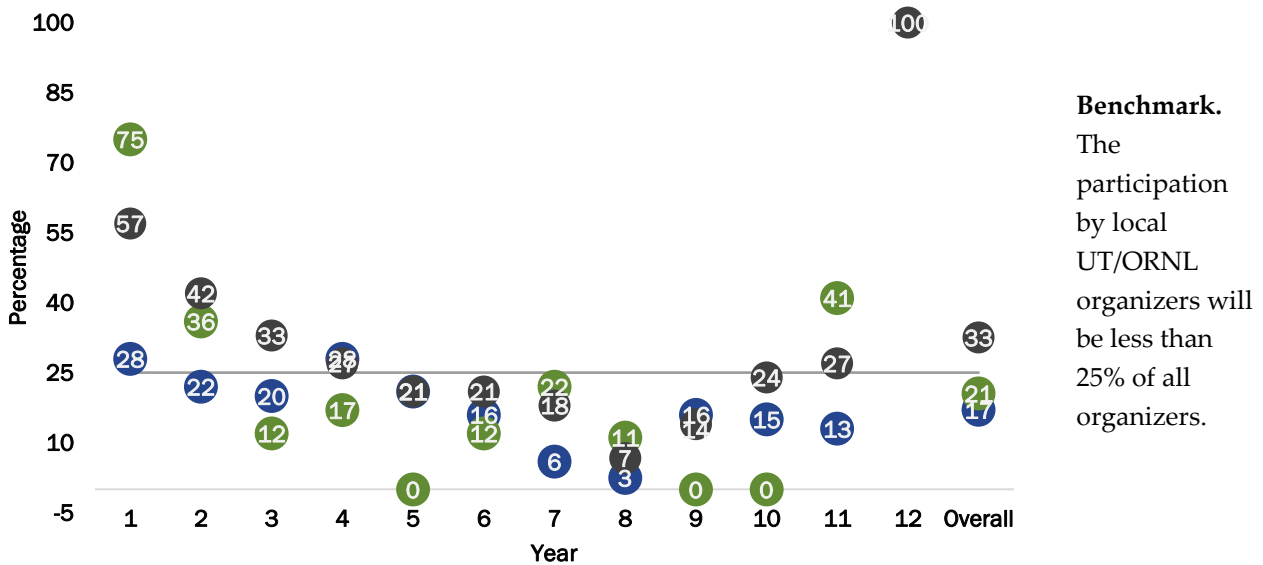


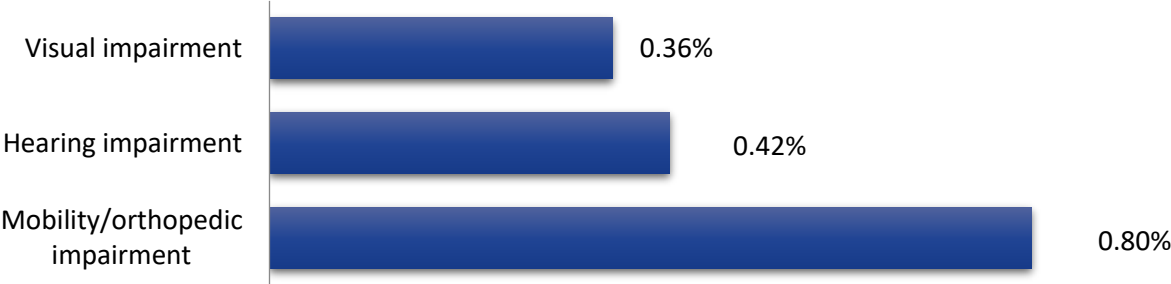
Figure 11. Proportion of local organizers across all NIMBioS activities, Working Groups and Investigative Workshops



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.

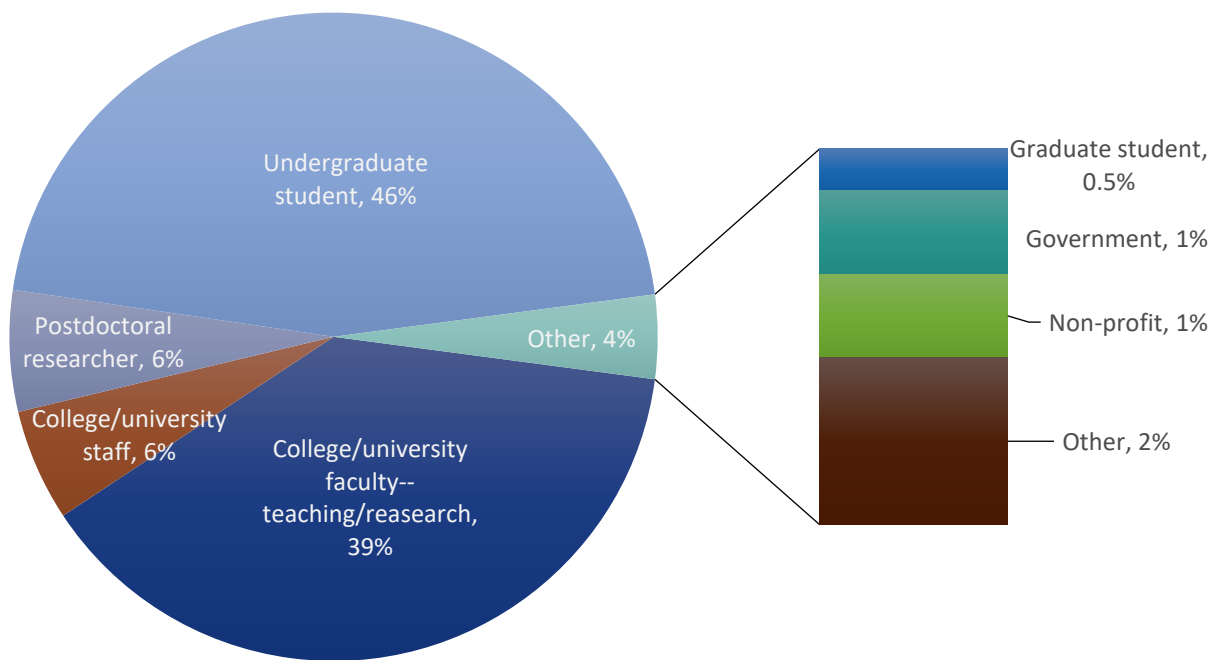
ABILITY DIVERSITY. Disclosure of disability status by participants to NIMBioS is optional. Around 2% overall indicated having some sort of disability during RP 12 (23% of participants did not report disability status) (**Figure 12**).

Figure 12. Disability status of participants (n = 237)



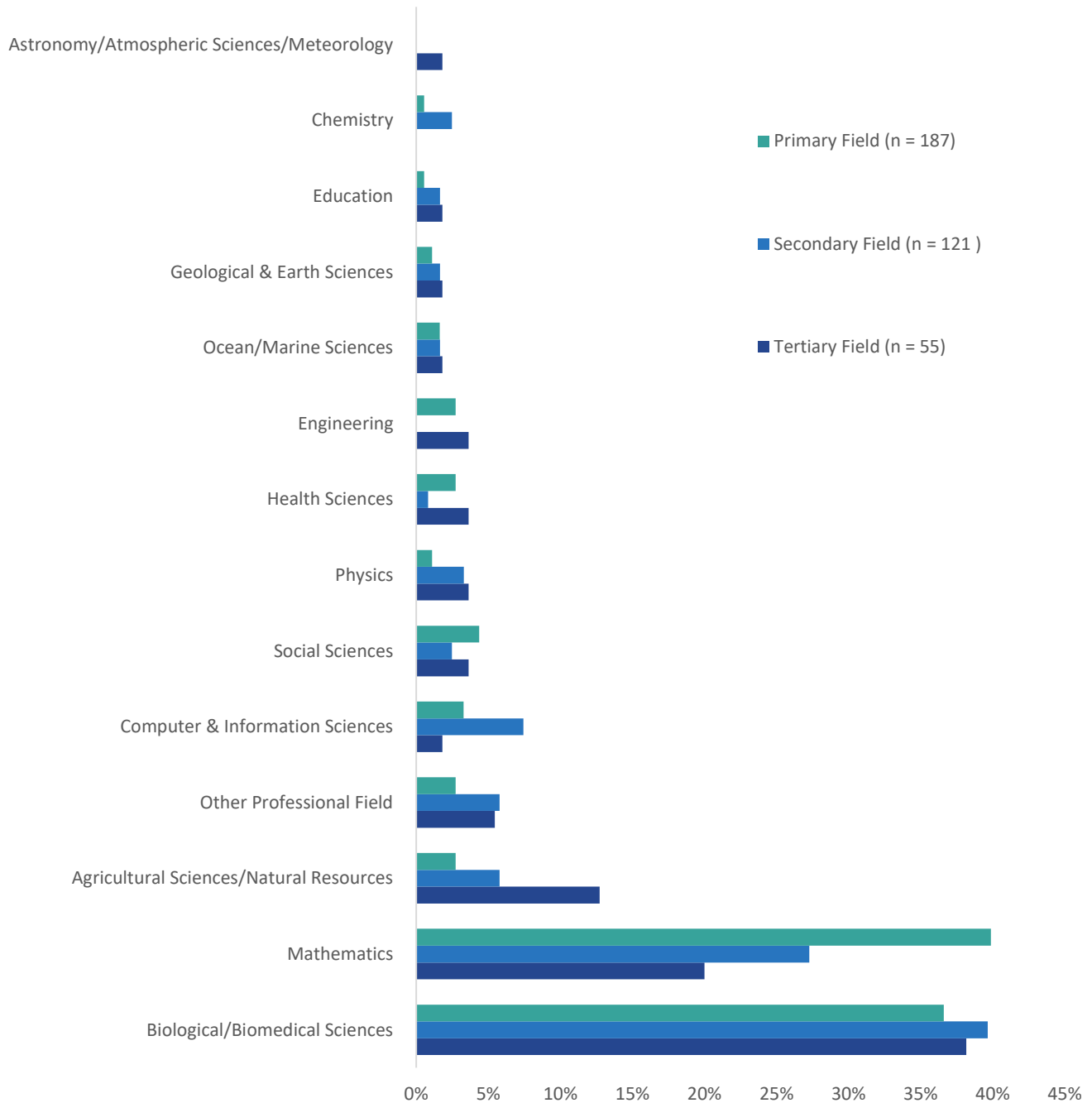
OCCUPATIONAL DIVERSITY. The majority of NIMBioS participants were undergraduate students, college/university faculty and staff, and postdoctoral researchers, however, participants came from government, industry, non-profit, and other positions as well (**Figure 13**). Twenty-two participants did not indicate their occupational status.

Figure 13. Employment status of participants (n = 215)



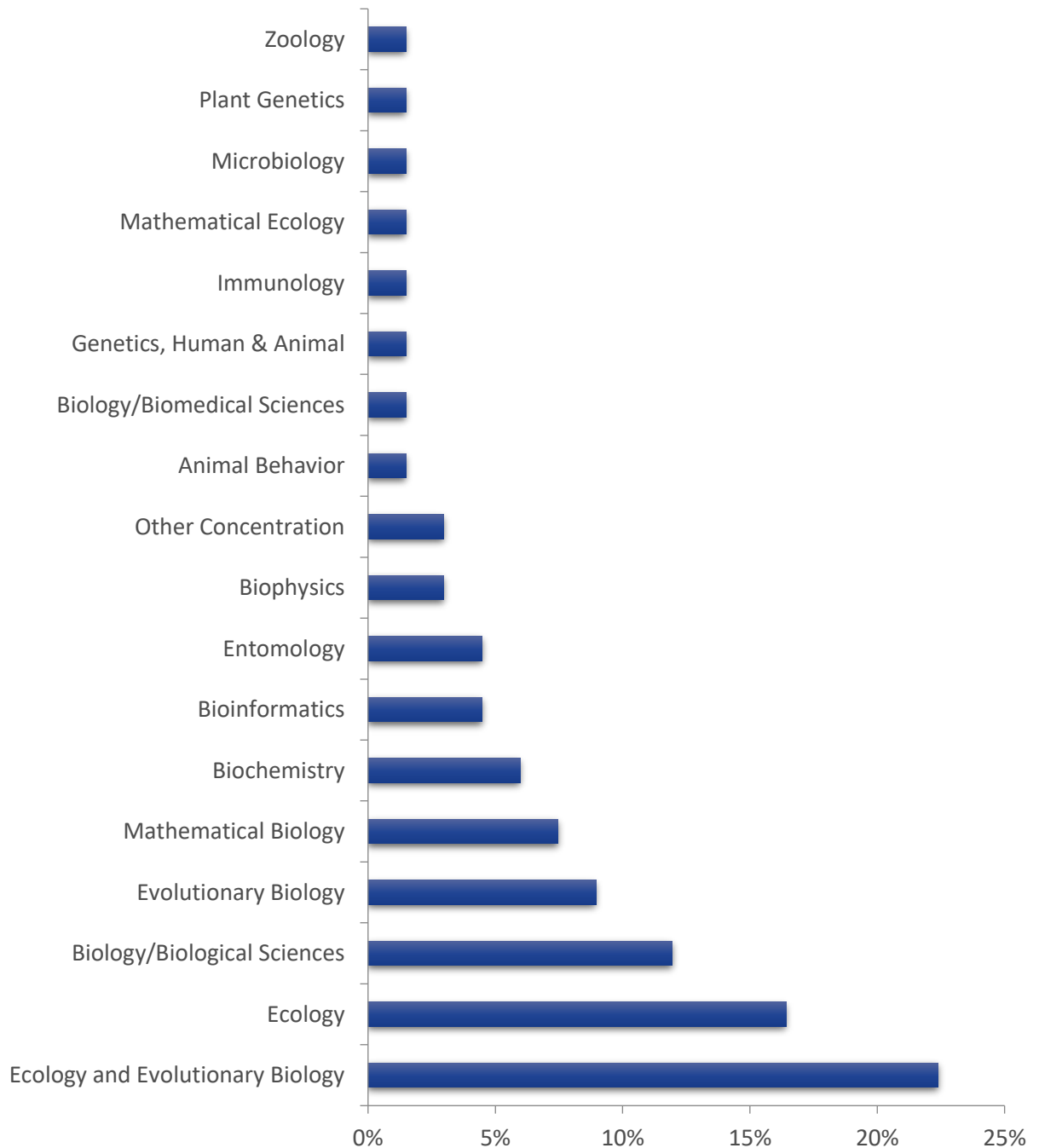
DISCIPLINARY DIVERSITY. Most participants at NIMBioS indicated their primary fields of study, as well as areas of concentration within those fields (54 participants did not indicate this information). Many indicated their secondary and tertiary fields of study as well. The most commonly reported fields of study included biological/biomedical sciences and mathematics although many other disciplines were represented (**Figure 14**).

Figure 14. Primary, secondary, and tertiary discipline areas of participants



The 67 participants indicating Biological/Biomedical Sciences as their primary field of study indicated 18 different areas of concentration within which they would classify their primary areas of research/expertise. The most commonly indicated area of concentration was ecology and evolutionary biology (22%), followed by ecology (16%), and general biological sciences (12%) (Figure 15).

Figure 15. Participant expertise area concentrations within biological/biomedical sciences field of study ($n = 67$)



INSTITUTIONAL DIVERSITY. Participants during RP 12 represented 87 different institutions, including colleges and universities, government institutions, high schools, industry, and non-profits (**Figure 16**). Of the 79 colleges/universities represented, 71 were classified as comprehensive (having undergraduate and graduate programs). **Figure 17** provides more information about institutional diversity.

Figure 16. Types of institutions represented ($n = 87$)

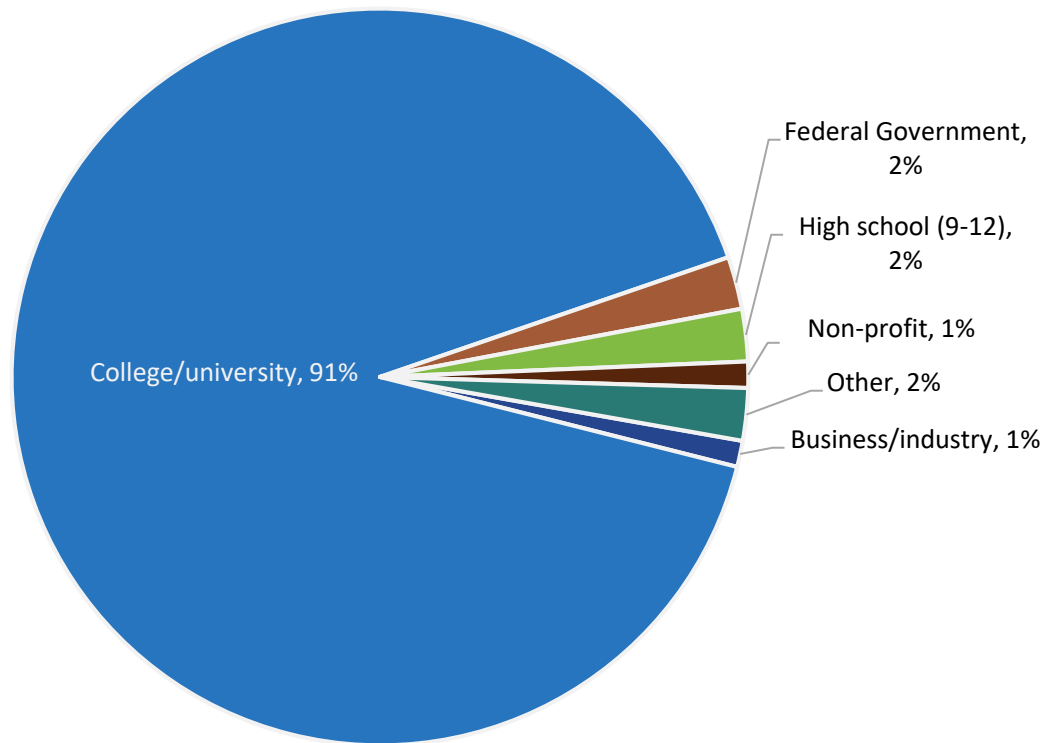
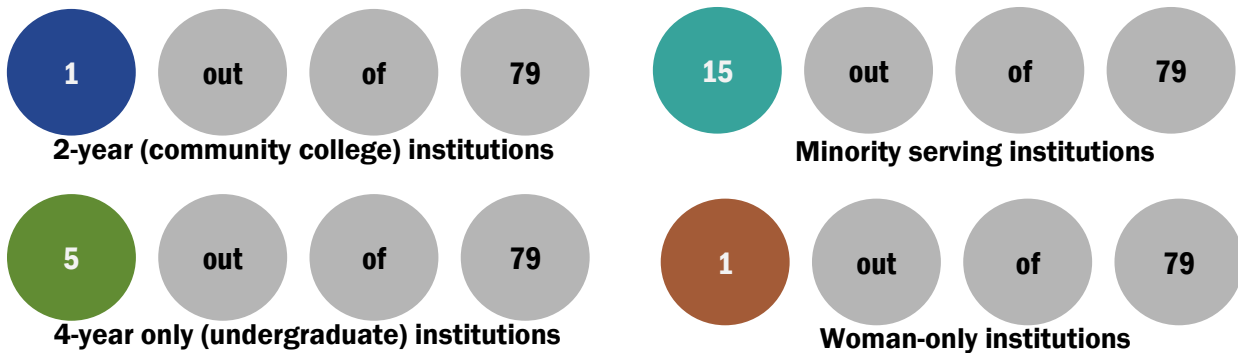


Figure 17. Characteristics of participants' colleges/universities ($n = 79$)



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 12.

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

Total Working Groups

58

Total Meetings

184

Total participants

2,123

Total unique participants

758

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. While no working groups took place during RP 12, NIMBioS has hosted 184 Working Group meetings (from 58 different groups) during the duration of the center. A total of 2,123 participants (758 unique) from 321 institutions took part in the Working Groups. Participants came together from 16 different major fields of study to focus on the respective scientific questions of their groups. Participants from 49 working groups completed a final feedback survey after the conclusion of their groups. Final surveys were not sent to the six working groups that only held one meeting at NIMBioS, or the QuantBio @ Community College Working Group, which had an independent evaluator.

Working Group Feedback

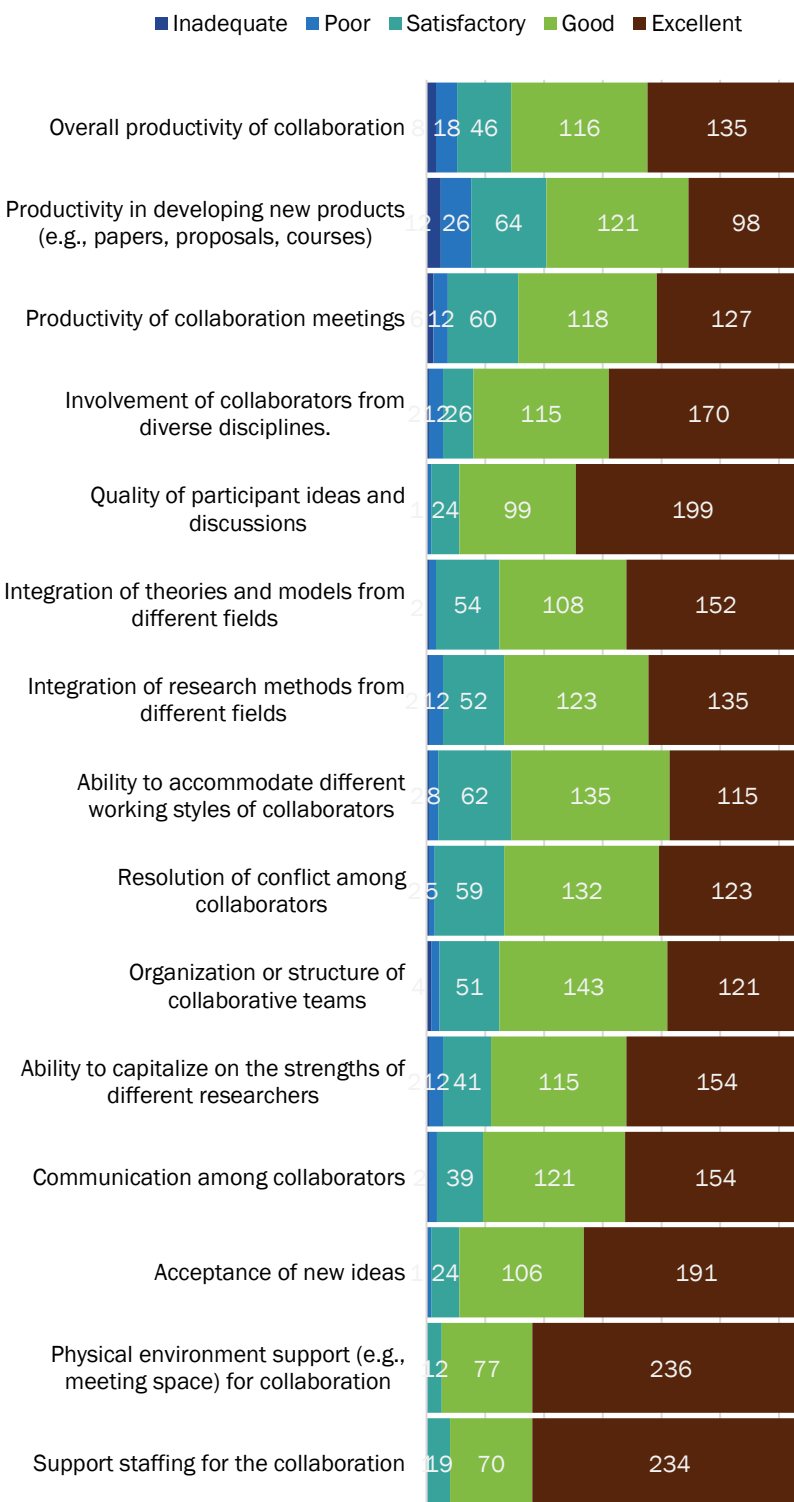
Number of Working Group past participants who have responded to the follow-up surveys
345

☞ Several of the group members brought perspectives that I had not been exposed to in my prior work. This was very rewarding for me.

☞ Though I have not specifically published any papers that directly address the topic of the working group, it improved my thinking with regard to much of the research I carry out. I anticipate working more directly in the area of this working group in the near future, and that work has benefitted from the experience of this working group. Overall, this was a very positive and important experience for me.

HIGHLIGHTS OF WORKING GROUP FOLLOW-UP EVALUATION RESPONSES (FIGURES 18 TO 20)

Figure 18. 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.

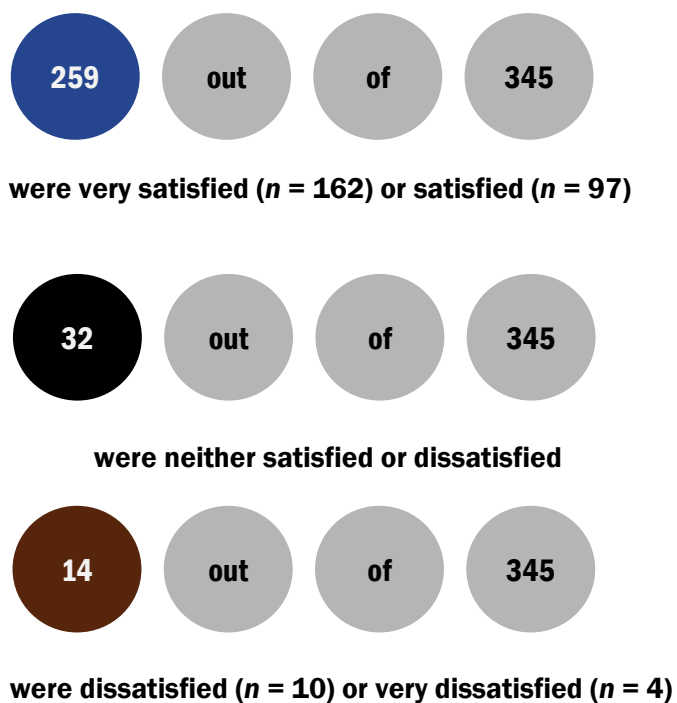
“ A very stimulating intellectual environment!

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

Figure 19. Evidence to support new insights and collaborations within the group



Figure 20. Overall satisfaction level of Working Group participants



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 2019 SRE Mentors were satisfied with the NIMBioS SRE program

EDUCATION AND OUTREACH PROGRAM ACTIVITIES

Summer Research Experience

The NIMBioS Summer Research Experience (SRE) program for undergraduates took place on the University of Tennessee (UT) Knoxville campus June 4-July 26, 2019. Eighteen undergraduates were chosen to participate in the program. (While this SRE program technically fell within the dates of reporting period eleven (RP 11), the SRE program for 2020 will have concluded right before the RP 12 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 six research projects for the 2019 program included: 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.

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.

SRE Student Feedback

☞ It helps others learn about how to work with other people in different fields. It also gives the opportunity for undergrads to work with professionals in the field of research. Lastly, if someone is thinking about grad school, this will help impact their decision.

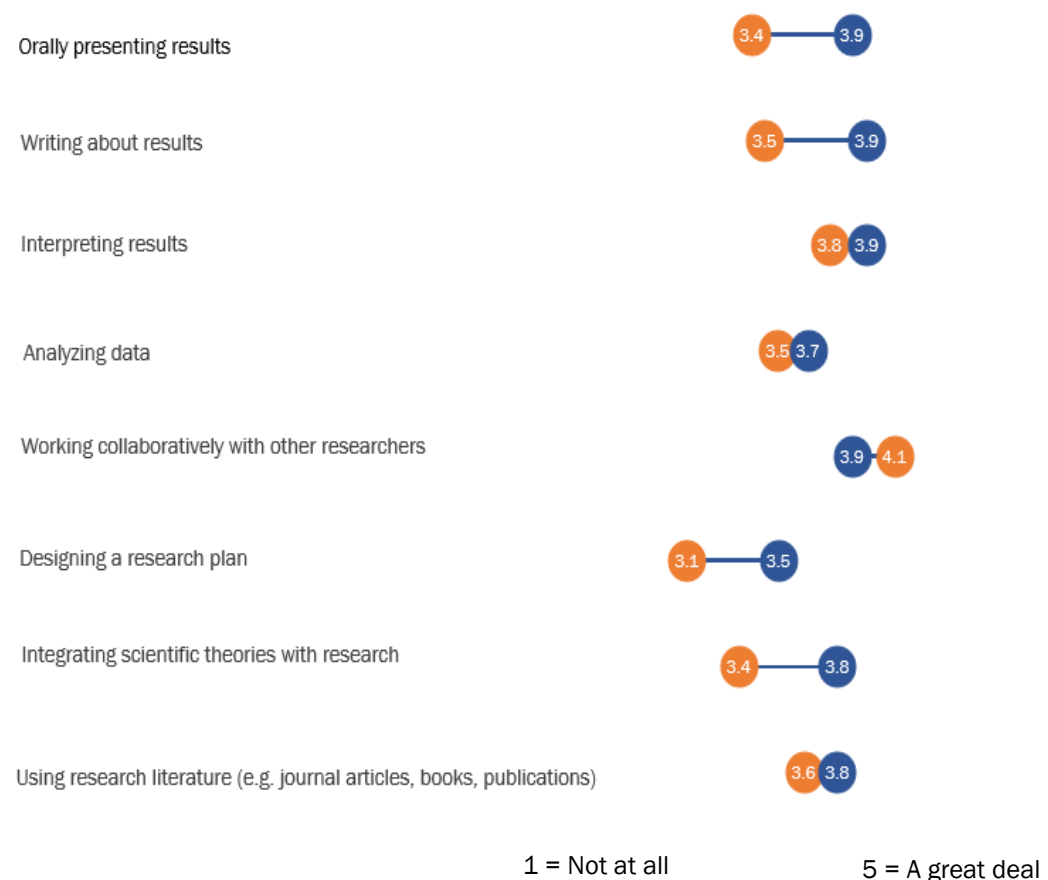
☞ While trying at times, this program taught me many valuable skills about how to work with academic professionals and provided me many valuable connections I wouldn't have otherwise made.

☞ I came to the program questioning grad school. Now that I've experienced some type of research, I'm thinking more seriously about grad school.

HIGHLIGHTS OF SRE EVALUATION RESPONSES (FIGURES 21 TO 23)

Overall increases were evident across research skills, except in the area of working collaboratively with other researchers. Participants rated their end of program skills in this area (3.9) lower than at the beginning of the program (4.1). Greatest gains were seen in their rating of skills using mathematical tools or models to describe a biological scenario which increased from 3.2 to 3.9 and in orally presenting results (3.4 to 3.9) (Figure 21).

Figure 21. Participant **pre-** and **post-**program skills as rated by SRE student participants.



URC Highlights

“ Everyone was friendly and open to talking about their work, and I had the opportunity to speak with other students and faculty from other areas.

“ It was all very helpful but the panel with the professors from various institutions was the most useful. Listening to experts in their field talk about their story as well as giving advice to undergraduates is super helpful. Moving forward as an undergraduate, I have some ideas of how I might best position myself to apply for graduate school.

“ I felt confident being able to present my research and get used to presenting research. It was also very helpful to see other undergraduates who were also presenting research so I could learn from their style. I also believe there was a good spread of majors at the conference all working on math and biology. This conference was effective at bringing a variety of research disciplines within math bio.

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

The NIMBioS 11th 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 November 16-17, 2019. 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 124 participants attended the 11th 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 81 participants took part in a feedback survey. Of those, 57 (70%) were undergraduate students and 24 (30%) 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 24-27)

Figure 24. Respondent agreement levels with statements about various aspects of the conference for undergraduate participants

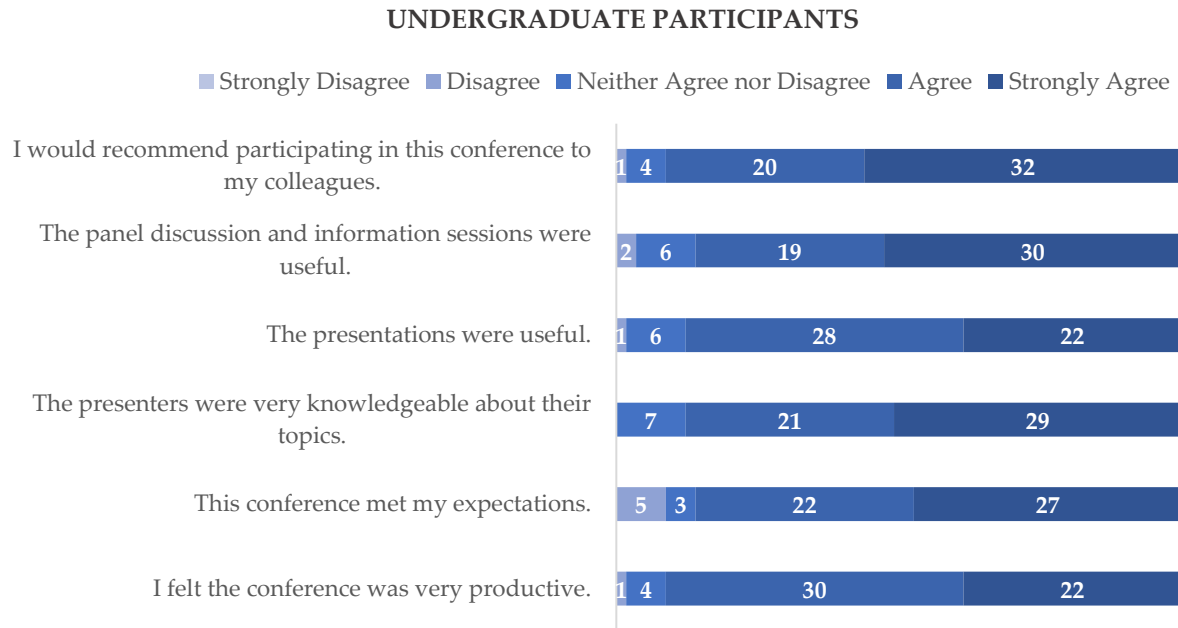


Figure 25. Respondent agreement levels with statements about various aspects of the conference for non-undergraduate participants

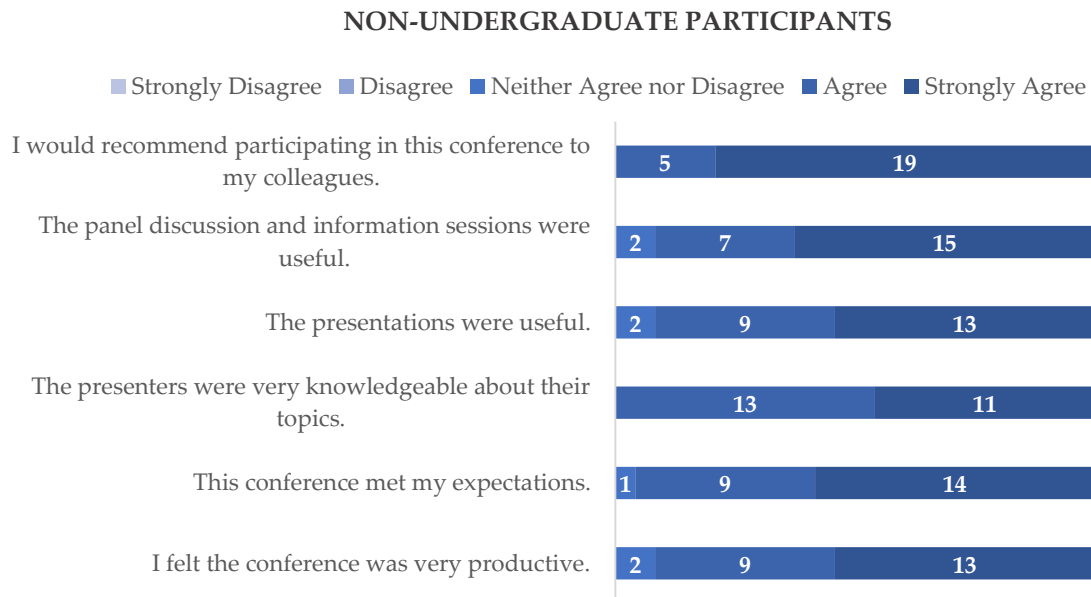


Figure 26. For undergraduate participants-- As a result of attending this conference, I have a better understanding of:

UNDERGRADUATE PARTICIPANTS

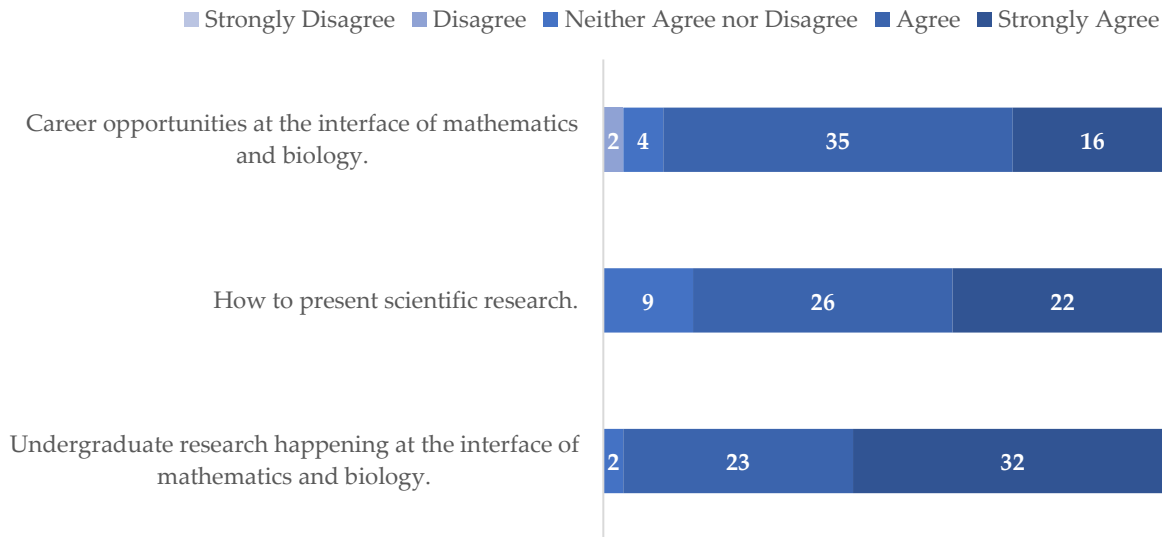
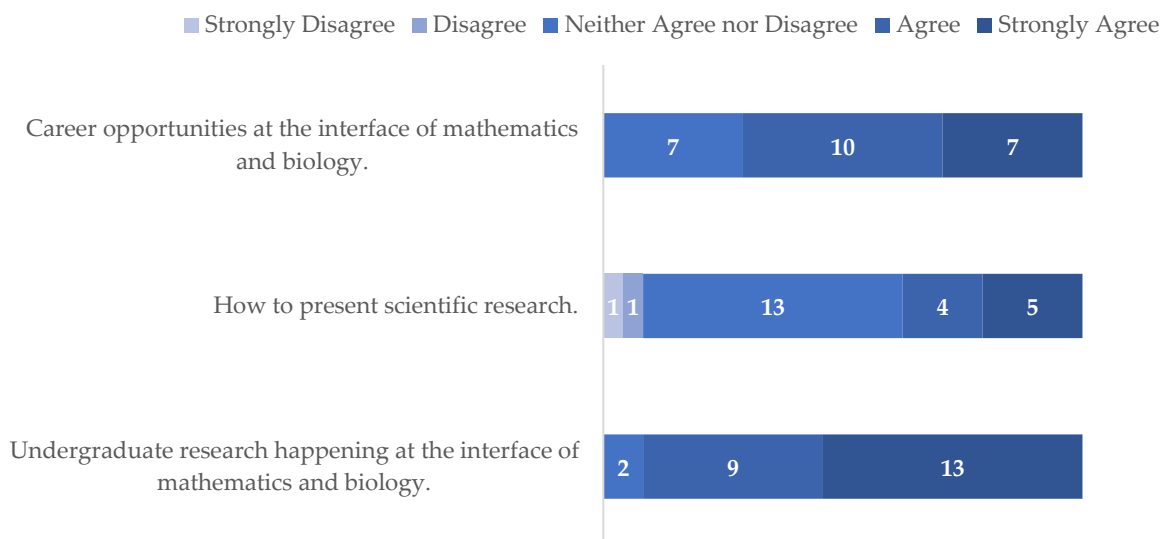


Figure 27. For non-undergraduate participants-- As a result of attending this conference, I have a better understanding of:

NON-UNDERGRADUATE PARTICIPANTS



Postdoctoral Fellow Overall Summary

Total Postdoctoral
Fellows
52

RP 12 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, 44 (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

☞ I greatly appreciated all of the faculty's efforts in our professional development workshops. It was invaluable to learn from them in the process of polishing our job statements. I also enjoyed the collegial community among the other postdocs. I was fortunate to have two great mentors who really facilitated my progress in my career.

☞ Some of the most useful aspects were: the professional development workshops (especially the ones related to job applications), interactions with top researchers in our fields, collegiality among post-docs, and the independence to work on our research projects and other professional endeavors. I very much benefitted from learning research, teaching, lab management, and other professional skills from not only seasoned faculty who know the tricks of the trade but also other postdocs who are emerging pioneers in their respective fields and able to provide fresh perspectives and cutting-edge techniques that could be applied to broad fields, including my own.

HIGHLIGHTS OF POSTDOCTORAL FELLOWSHIP PROGRAM RESPONSES (FIGURES 28-30)

Figure 28. Postdoctoral fellow satisfaction with program mentors

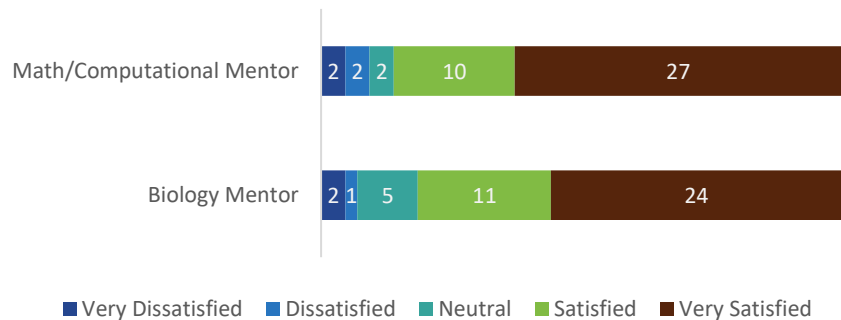
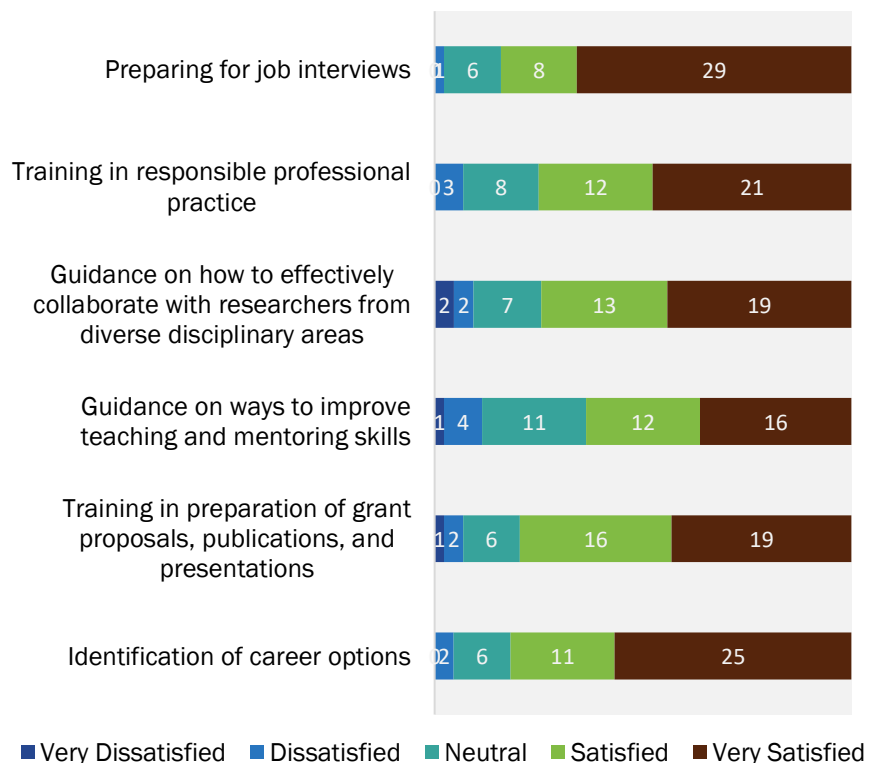


Figure 29. Postdoctoral fellow satisfaction with advice/assistance received from program mentors



Postdoc Feedback

☞ The degree of independence to explore research questions, and to largely manage my own workflow and time greatly helped me in my transition to a faculty position. In addition, the knowledgeable, sociable community of NIMBioS postdocs, and staff was a huge benefit of the position. The close proximity, and good relationship between NIMBioS and UT's EEB department was also very helpful.

☞ 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.

Figure 30. Postdoctoral fellow satisfaction with overall program experience

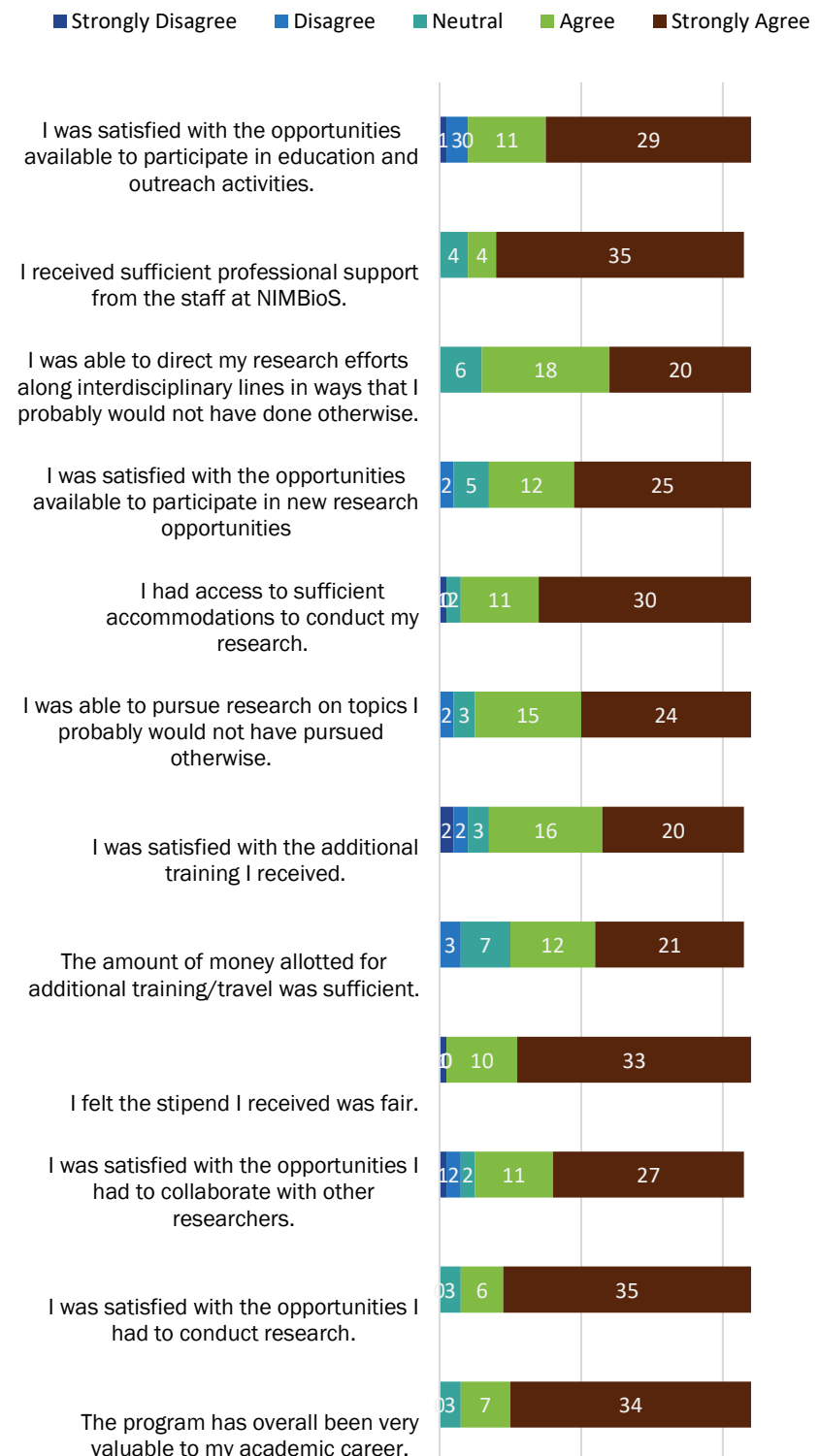
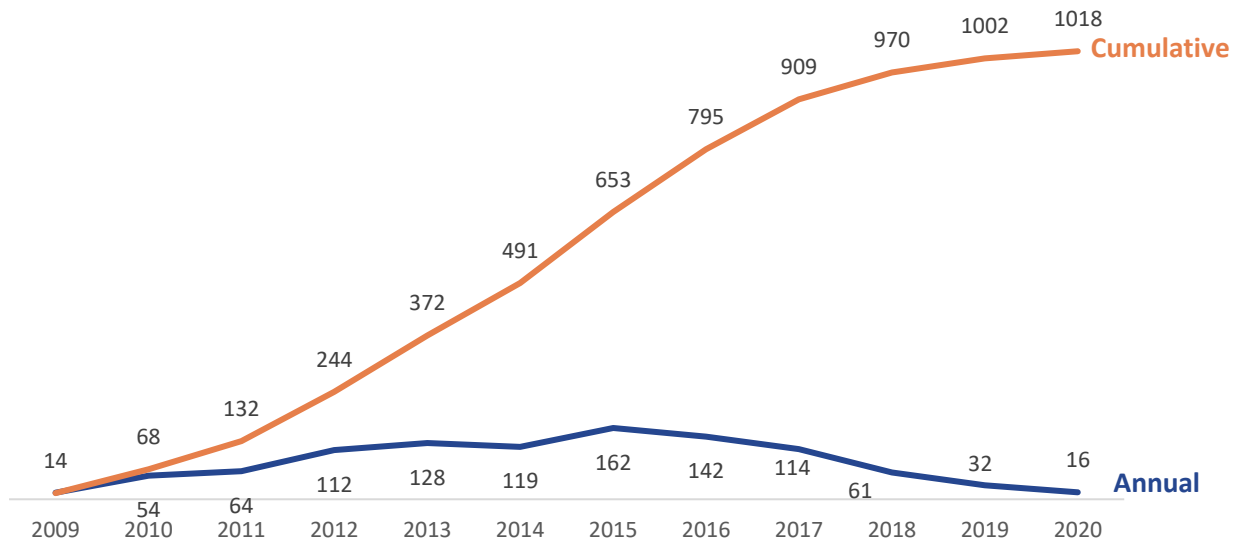


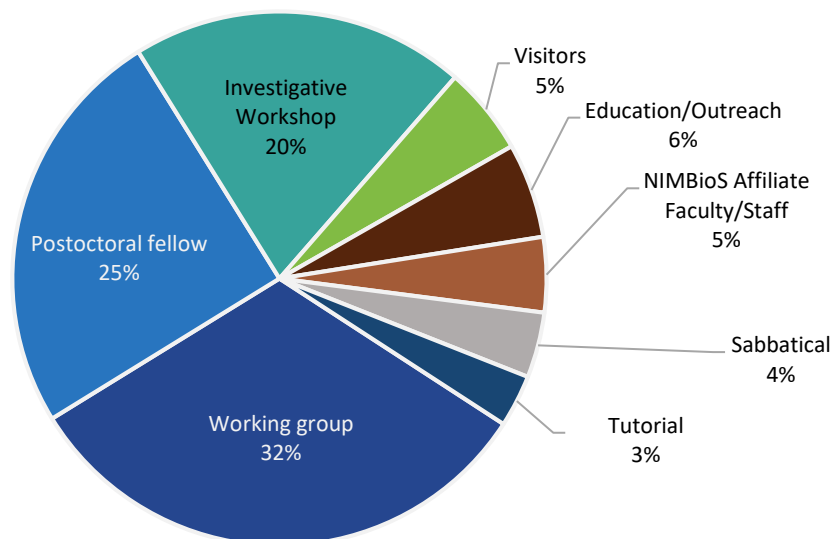
Figure 32. Number of **cumulative** and **annual** publications reported from NIMBioS activities since 2009, by publication year



Note. 2020 includes publications submitted by participants to NIMBioS through June 2020

NIMBioS publications come from a variety of activities, although Working Group participants tend to publish the largest portion of journal articles (32%), followed by NIMBioS Postdoctoral Fellows (25%) and Investigative Workshop participants (20%) (Figure 33).

Figure 33. 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	46.49	99.30	4
Science	44.37	97.87	11
Cell	38.62	99.53	1
Trends in Ecology and Evolution	18.60	99.10	2
Nature Communications	13.61	92.25	3
Nucleic Acids Research	11.80	95.12	3
Frontiers in Ecology and the Environment	11.61	98.11	2
Proceedings of the National Academy of Sciences	10.62	89.43	21
Ecology Letters	10.56	96.73	13
Current Biology	10.17	92.45	1
PLoS Biology	8.88	91.40	3
New Phytologist	8.80	97.22	6
Systematic Biology	8.77	91.00	10
Methods in Ecology and Evolution	8.73	94.94	7
eLife	8.12	95.16	4
Philosophical Transactions of the Royal Society B	6.74	91.94	1
Ecography	6.13	95.05	8
Conservation Biology	6.10	89.39	5
Molecular Ecology	5.97	86.44	12
PLoS Genetics	5.86	85.59	2
Ecology	5.56	99.63	13
Functional Ecology	5.54	84.23	2
Proceedings of the Royal Society B	5.43	86.11	2
PLoS Computational Biology	5.26	89.82	10
Ecological Applications	5.05	80.78	3

Table 2 (continued)

Journal Title	5-Year Impact Factor *	Average JIF Percentile	# of NIMBioS Publications**
Journal of Animal Ecology	4.91	91.96	7
Diversity and Distributions	4.82	85.41	4
Quarterly Review of Biology	4.62	84.41	1
Scientific Reports	4.58	76.76	7
Journal of the Royal Society Interface	4.25	73.94	5
PLoS Neglected Tropical Diseases	4.24	93.14	3
Heredity	4.10	68.74	2
Journal of Biogeography	4.10	78.23	3
American Naturalist	4.07	76.53	16
Evolution	3.98	73.21	18
Molecular Phylogenetics and Evolution	3.88	64.71	3
CBE - Life Sciences Education	3.75	74.40	1
Oikos	3.75	75.89	5
PLoS ONE	3.23	62.68	45
BMC Bioinformatics	3.21	72.73	3
Biological Invasions	3.14	78.41	2
Oecologia	3.10	65.77	6
Ecological Modelling	2.98	95.85	1
Animal Behaviour	2.97	78.13	11
Physical Review E	2.29	73.89	1
Journal of Theoretical Biology	2.12	65.32	32
Bulletin of Mathematical Biology	1.99	47.93	17
SIAM Journal on Control and Optimization	1.97	59.20	1
Journal of Mathematical Biology	1.89	52.32	6
Theoretical Ecology	1.53	21.13	11
Mathematical Methods in the Applied Sciences	1.47	74.42	3
Behaviour	1.45	23.98	11

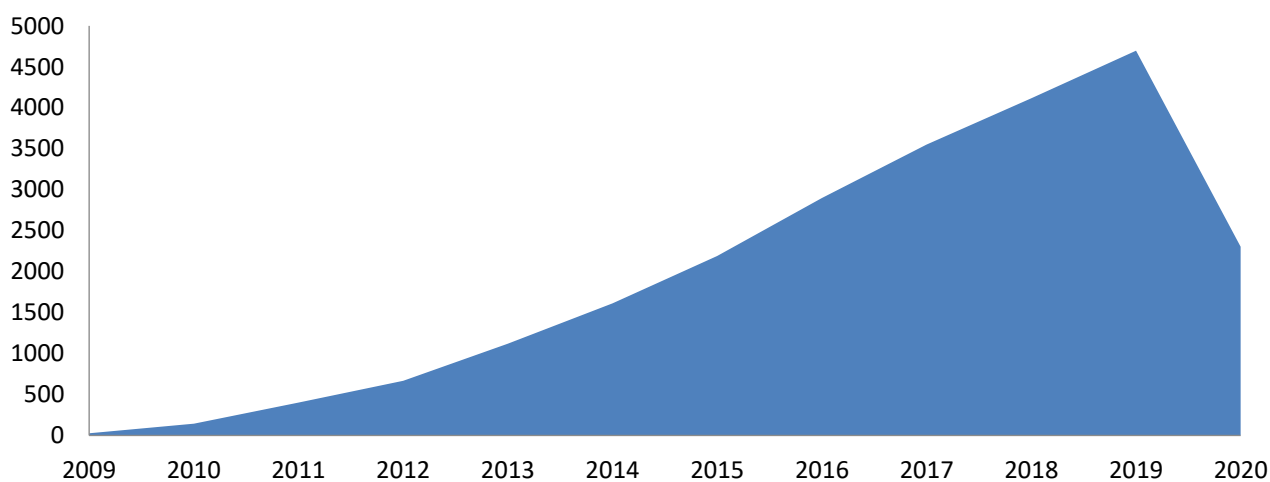
*Impact factor calculation: $\frac{\text{cites in year } n \text{ to articles published in year } (n-1 + n-2)}{\text{number of articles published in year } (n-1 + n-2)}$.

**September 2008 – June 2020

Bibliometric indicators

CITATION ANALYSIS OF PUBLICATIONS. Of the 1,018 journal articles reported by NIMBioS participants to date, 929 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 2,749 researchers from 1,084 unique institutions spanning 65 countries. These articles have appeared in 341 different journals, many of which are considered to have high-impact in the academic community. These articles have been collectively cited 23,707 times, with an average of 25.52 cites per article (**Figure 34**), and an h-index of 67. The cites per article count is greater than either of the two major research fields of the publications during the last 10 years; mathematics (4.67 citers/paper) and biology (17.27 citers/paper). One hundred sixteen participants have authored five or more papers each as a result of NIMBioS affiliated collaborations.

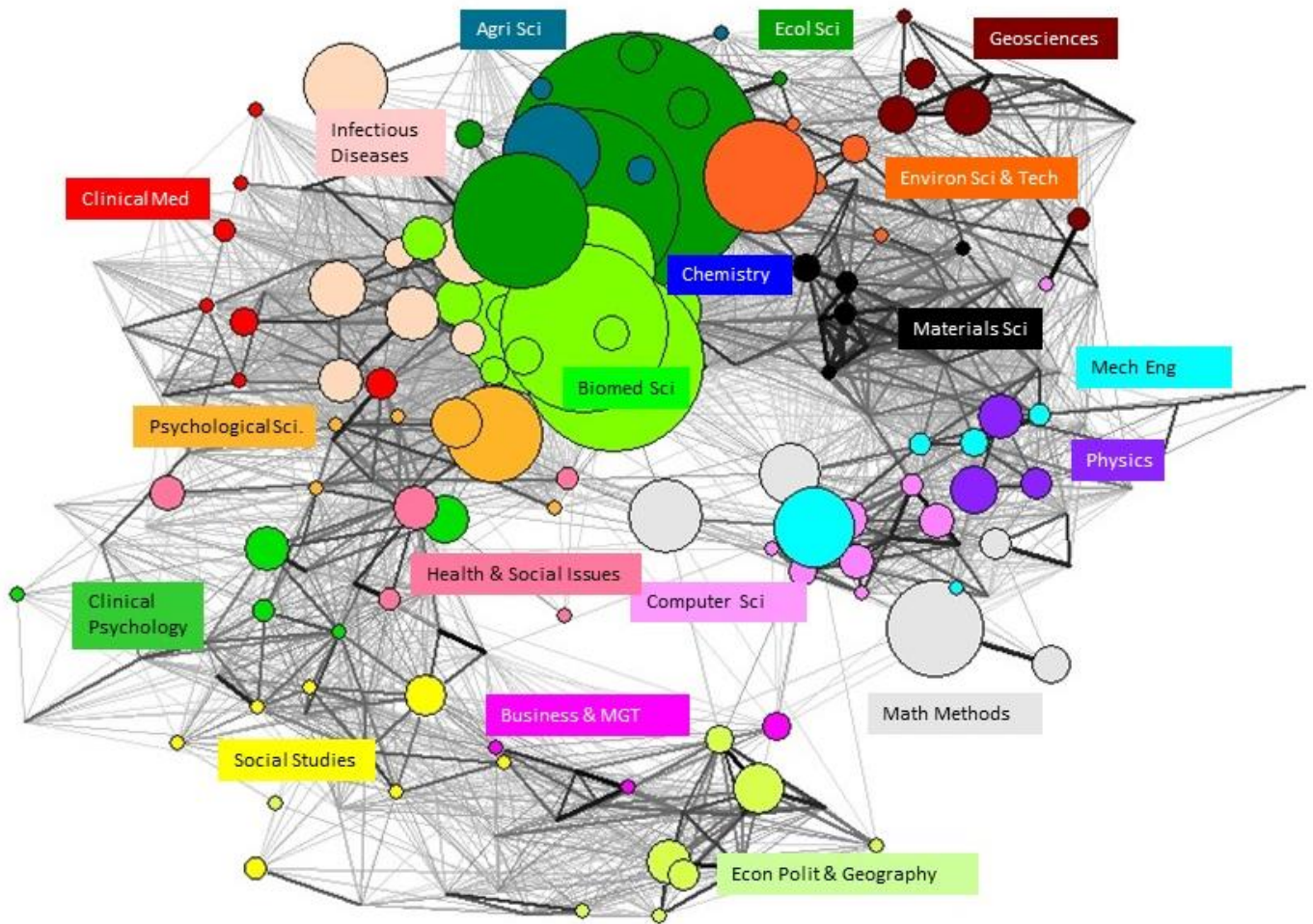
Figure 34. Citations per year for NIMBioS articles



DISCIPLINARY SPAN OF PUBLICATIONS. The 929 published articles indexed by WOS span 125 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.

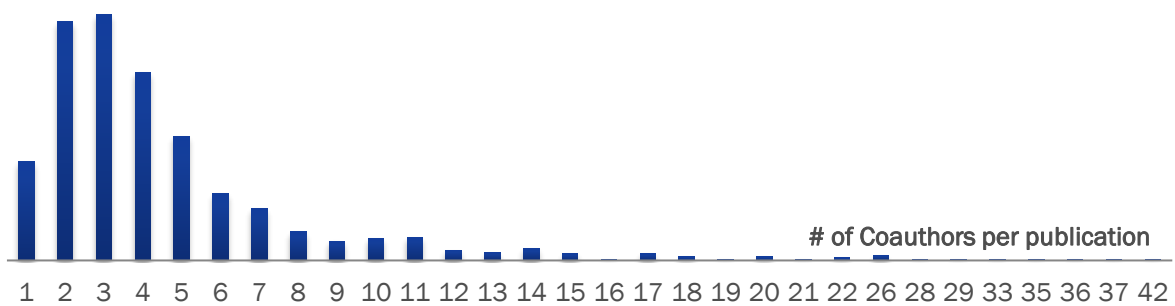
Figure 35 locates the subject categories of the 929 NIMBioS articles on a network map of the WC. The gray background intersections are the 225 WC, located based on cross-citation relationships among all WOS journals in 2014 (from Rafols, Porter, and Leydesdorff). The 19 labeled “macro-disciplines” are 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 (138), Mathematical & Computational Biology (127), Multidisciplinary Sciences (113), and Zoology (72).

Figure 35. Web of Science categories for 929 WOS journal articles to date



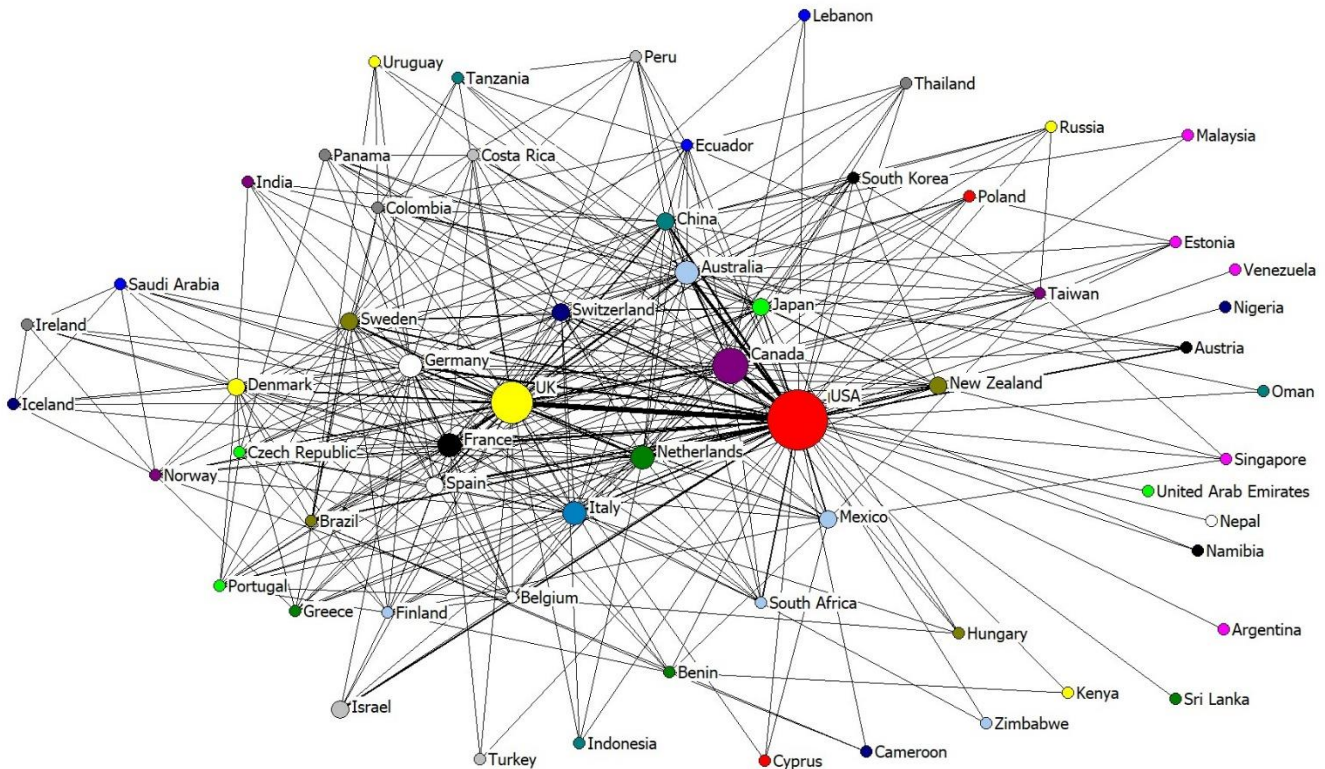
COAUTHORSHIP. One of the core values of NIMBioS is to take a collaborative approach to science and science education. NIMBioS is interested, therefore, in examining the number of co-authors on NIMBioS-related publications as one indicator of scientific collaboration. For the 929 publications reported thus far, the average number of co-authors per paper is 4.83 (Figure 36). Sixty-six percent of NIMBioS-related publications had 2-5 co-authors, while 25% had six or more co-authors.

Figure 36. 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 37).

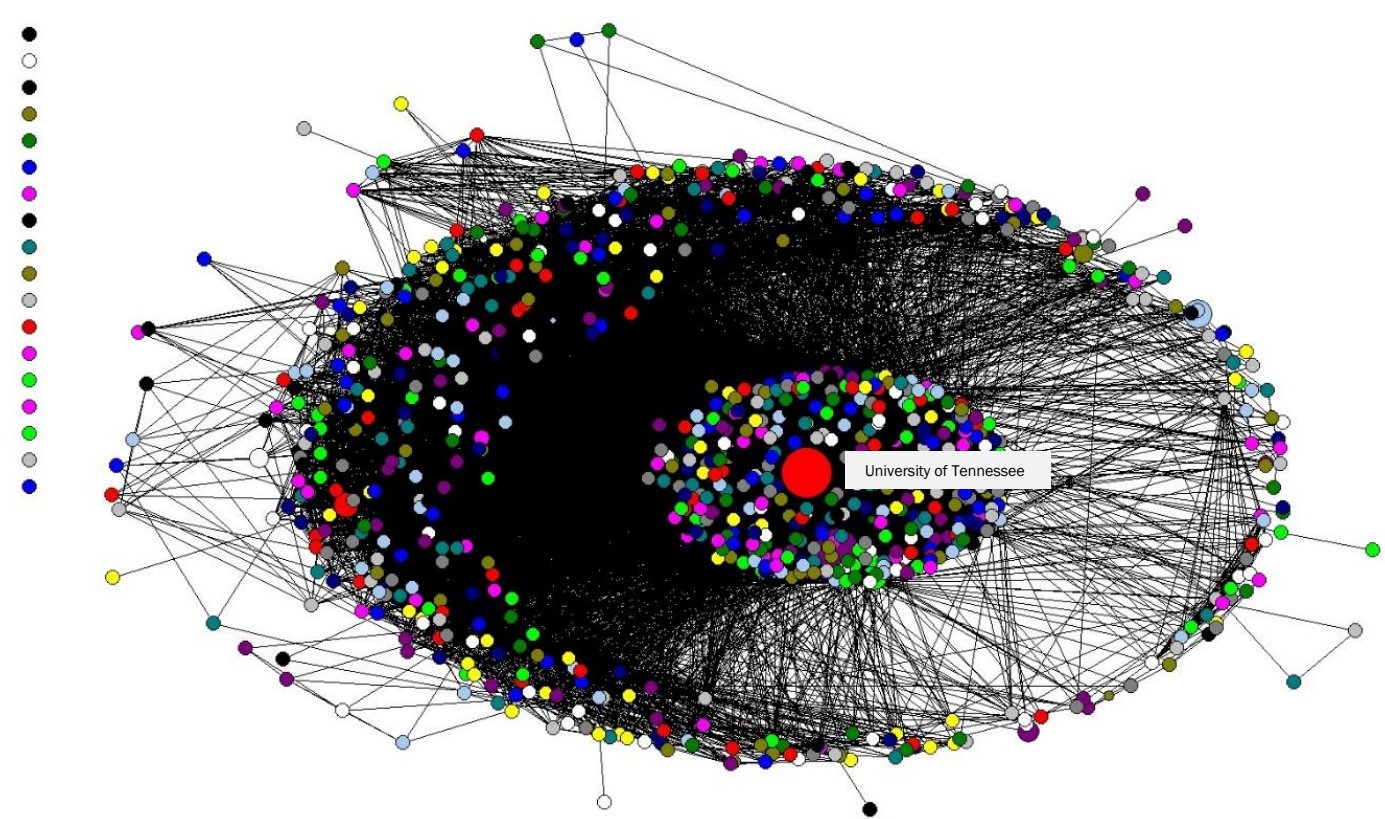
Figure 37. International collaboration on NIMBioS publications



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 1,084 unique institutions (**Figure 38**). The average number of institutions represented per paper was 3.6, with a range of 1-35 institutions per paper.

Figure 38. Cross-institutional collaboration on NIMBioS publications

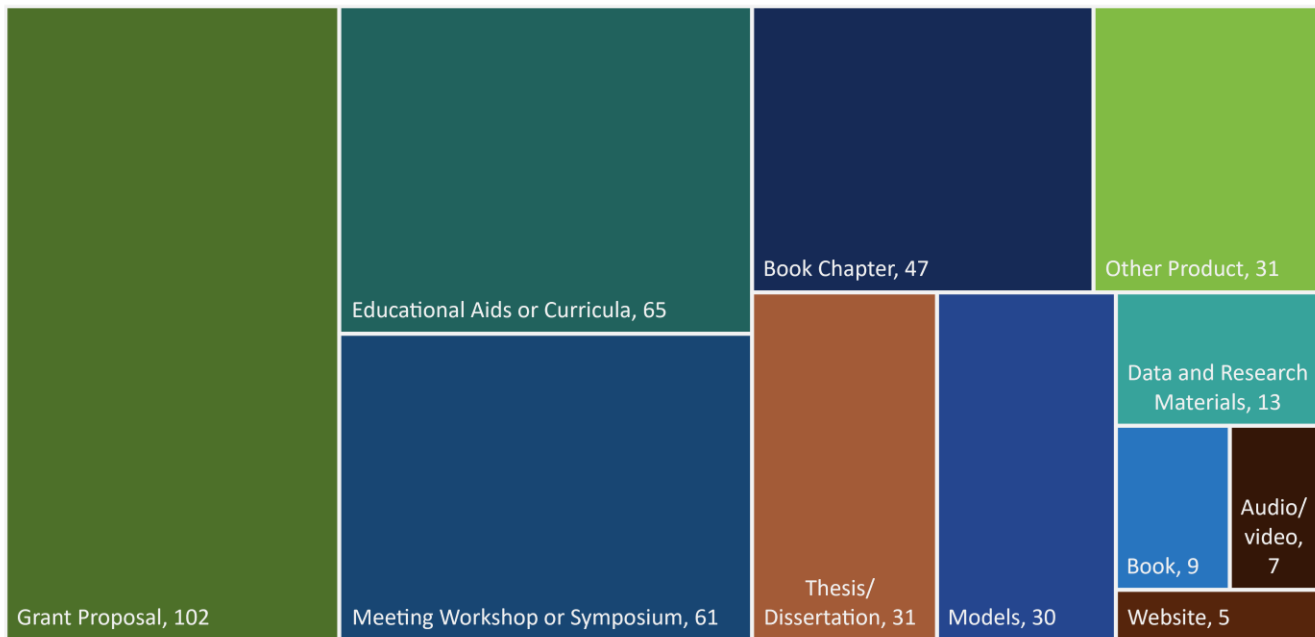


Note. Node radius represents the log scaled number of NIMBioS-affiliated papers from each institution, and line size represents the number of collaborations among institutions on these papers. Only 18 of the 1,084 institutions represented have published single-institution papers. The University of Tennessee 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 39** summarizes these types of products for the eleven-year period. In addition to the items listed in Figure 39, NIMBioS participants have reported 959 conference presentations related to NIMBioS affiliation.

Figure 39. Number of non-journal publication products arising from NIMBioS events



Addendum to NIMBioS Annual Report

Sep 1, 2019 - Aug 31, 2020

Y12-2. 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 Affiliate Faculty

Abel, Steven (Chemical & Biomolecular Engineering, UTK)
Armsworth, Paul (Ecology & Evolutionary Biology, UTK)
Berry, Michael (Electrical Engineering & Computer Science, UTK)
Bishop, Pam (National Institute for STEM Evaluation)
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)
Gaoue, 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

Fefferman, Nina (Univ. of Tennessee Knoxville)
Gavrilets, Sergey (Univ. of Tennessee Knoxville)
Gross, Louis (Univ. of Tennessee Knoxville)
Lenhart, Suzanne (Univ. of Tennessee Knoxville)
Papeş, Monica (Univ. of Tennessee Knoxville)
Welsh, Chris (Univ. of Tennessee Knoxville)

Postdoctoral Fellows

Branoff, Benjamin (Univ. of Tennessee Knoxville)
Carrasco Tornero, Luis (Univ. of Tennessee Knoxville)
Carrignon, Simon (Univ. of Tennessee Knoxville)
Jiao, Jing (Univ. of Tennessee Knoxville)
Tverskoi, Denis (Univ. of Tennessee Knoxville)
Udiani, Oyita (Univ. of Tennessee Knoxville)
Young, Matthew (Univ. of Tennessee Knoxville)
Zhu, Gengping (Univ. of Tennessee Knoxville)

Postdoctoral Fellow Mentors

Armsworth, Paul (Univ. of Tennessee Knoxville)
Bentley, Alex (Univ. of Tennessee, Knoxville)
Fefferman, Nina (Univ. of Tennessee Knoxville)
Gavrilets, Sergey (Univ. of Tennessee Knoxville)
Hong, Tian (Univ. of Tennessee Knoxville))
Papes, Mona (Univ. of Tennessee Knoxville)

NIMBioS Seminar Series

Childs, Lauren (Mathematics, Virginia Tech)
Levin, Simon (Ecology & Evolutionary Biology, Princeton Univ.)
Liebhold, Sandy (Research Entomologist, Northern Research Station, USDA Forest Service)

DySoC/NIMBioS Seminars

Botero, Carlos (Biology, Washington Univ., St. Louis)
Carrignon, Simon (DySoC/NIMBioS Postdoctoral Fellow)
Houle, Christian (Political Science, Michigan State Univ.)
Matthews, Luke J. (Behavioral and Social Scientist, RAND Corporation; Faculty, Pardee RAND Graduate School; Co-Director, RAND Center for Applied Network Analysis and System Science)

Van Cleve, Jeremy (Biology, Univ. of Kentucky)

NIMBioS/GAMES Webinars

Blanco, Carolina (Chess Master, Orthodontist, Entrepreneur)

Dale, Virginia (Ecology & Evolutionary Biology, University of Tennessee, Knoxville)

NIMBioS MathBio Webinars

Fefferman, Nina (Ecology and Evolutionary Biology and Mathematics, University of Tennessee)

Ganusov, Vitaly (Microbiology, University of Tennessee, Knoxville)

Gross, Louis (NIMBioS Director, Ecology and Evolutionary Biology and Mathematics, University of Tennessee)

Talmy, David (Microbiology, University of Tennessee, Knoxville)

Summer Research Experiences (SRE)

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

**Project mentors are denoted by an asterisk*

Balstad, Laurinne (Mathematics, Biology, Saint Olaf College)

Beckford, Charlotte (Mathematics, Fordham Univ.)

*Carrasco, Luis Tornero (NIMBioS and Ecology & Evolutionary Biology, Univ. of Tennessee)

Catron, Spencer (Mathematics, Physics, Univ. of Tennessee)

Clark, Matthew (Computer Science, Mathematics, Fisk Univ.)

*Dewi, Ida Dian (Biomedical and Diagnostic Sciences, UTCVM)

*Eda, Shigetoshi (Forestry, Wildlife & Fisheries, Univ. of Tennessee)

Folmar, Jackie (Ecology & Evolutionary Biology, Yale Univ.)

*Hinson, Audra (Microbiology, Univ. of Tennessee)

*Hong, Tian (Biochemistry & Cellular and Molecular Biology, Genome Science & Technology, Univ. of Tennessee)

Joshi, Umang (Biology, Computer Science, Xavier Univ.)

Ledesma, Dakila (Computer and Information Sciences, Univ. of Tennessee – Chattanooga)

*Lenhart, Suzanne (Mathematics, Univ. of Tennessee)

Lin, Michael (Biophysics, Johns Hopkins Univ.)

*Miller, Deb (Forestry, Wildlife and Fisheries; Veterinary Medicine; Director, Center for Wildlife Health, Univ. of Tennessee)

*Papeş, Mona (Ecology & Evolutionary Biology, Univ. of Tennessee)

*Rajakaruna, Harshana (Microbiology, Univ. of Tennessee)

Roth, Sarah (Ecology & Evolutionary Biology, Univ. of Tennessee)

Rumley, Savannah (Biochemistry, Molecular Biology, Fisk Univ.)

Sallee, Abigail (Biochemistry and Cellular & Molecular Biology, Univ. of Tennessee)

Santana-Souza, Lucas (Graduate student helper, Ecology & Evolutionary Biology, Univ. of Tennessee)

Seggern, Chelsea (Kinesiology, Univ. of Tennessee)

Smith, Elliott (Ecology & Evolutionary Biology, Univ. of Michigan)

*Swenson, Shel (Mathematics, Univ. of Tennessee)

*Talmy, David (Microbiology, Genome Science & Technology, Univ. of Tennessee)

Thomas, Anna (Mathematics, Computer Science, Lehigh Univ.)

Tian, Amy (Biology, Public Policy, Univ. of Chicago)

Westaway, Stephanie (Physics, Mathematics, Samford Univ.)

*Wiggins, Greg (NIMBioS Education and Outreach Coordinator)

*Wyneken, Jeanette (Biological Sciences, Florida Atlantic Univ.)

*Zhao, Xiaopeng (Mechanical, Aerospace and Biomedical Engineering, Univ. of Tennessee)

Zumpano, Francesca (Mathematics (Statistics), College of New Jersey)

Eleventh Annual Undergraduate Research Conference (URC) 2019 (2019/11/16 – 2019/11/17)

Adeunmi, Eniola	Hill, Emily	Pollack, Martin
Allen, Benjamin	Hodges, Samuel	Powers, Morgan
Ameneyro, Bernardo	Hong, Tian	Randall, Natalie
Arnold, Andrea	Hoover, Alexander	Rasuli, Zahra
Azeredo-Tseng, Cassandra	Howard, Victoria	Rawal, Nar
Bao, Lanjing	Huang, Gloria	Rivenbark, Kelly
Bechtel, Ambrose	Huff, Austin	Roach, Darien
Belcher, Michael	Jodoin, Vincent	Ruiz, Brandyn
Bhatt, Ghan	Jones, Mark	Ryan, Sadie
Bintz, Jason	Joyner, Michele	Sanwick, Alexis
Boggs, Kaeleen	Karig, Nicholas	Sauchuk, Rebecca
Bradley, Beth	Kilgore, Ana	Scheckelhoff, Kristen
Brown, Talia	Klitgaard, Kristen	Schmidt, Hannah
Cabezudo, Giovanni Colón	Lenhart, Suzanne	Schreiner, Courtney
Calip, Angelica Mercy	Liendo, Adam	Schugart, Richard
Campbell, Kayleigh	Liendo, Martha	Shao, Olivia
Carrasco, Luis	Lightfoot, Ben	Shapiro, Julia
Chau, Brian	Li, Qingxia	Sharda, Niharika
Chavis, Bryson	Liu, Ziyi	Shepherd, Liberty
Clark, Matthew	Lochner, Ellie	Simms, Jameson
Damrau, Zebedee	Lucero, Urbieta	Smith, Bonnie
DeAngeli, Kevin	Luo, Michael	Staugler, Laura
DeBrito, Marianne	Maddox, Trent	Strickland, Christopher
Dennis, Taylor	Magaña, Jerry	Sturgill, Jacob
Derouen, Zakary	Majetic, Gabrielle	Svetlik, Alexandra
DeRouis, Ethan	Mayor, Martin	Talmy, David
Ding, Wandu	McKinsey, Madison	Tolbert, Brionna
Dunlevy, Taylor	Melara, Luis	Tolone, Joe
Erovenko, Igor	Mitchell, Leah	Toumbacaris, Nicolas
Fay, Charles	Moeller, Holly	Vaughan, Laura
Ferguson, Jamie	Narayan, Akarsh	von Arnim, Albrecht
Gan, Alan	Nielsen, Brittany	Wagstaff, Peter
Gerber, Jacob	Okekenwa, Sonia	Washington, Alec
Giannantonio, Dominic	Owen, Matt	Watson, Tykeena
Gonzalez, Logan	Panchy, Nicholas	Weisgerber, Emma
Graham, Ian	Pan, Ze	Wiggins, Greg
Grandison, Brandon	Papes, Mona	Williams, Abigail
Gross, Louis	Pavkov, Ava	Wright, Kyle
Hampton, Griffin	Payne, Sheridan	Zaretzki, Iris
Hart, Kyle	Peterson, Miranda	Zumpano, Francesca
Haslam, Alanna	Pickle, Sam	
Heard, Valencia	Pighini, Jacob	

NIMBioS Staff

Carr, Eric (Univ. of Tennessee Knoxville)
Comiskey, Jane (Univ. of Tennessee Knoxville)
Crawley, Catherine (Univ. of Tennessee Knoxville)
Dugger, Sherri (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)

Visitors

Folashade Agosto (Ecology & Evolutionary Biology, Univ. of Kansas)
Carlos Botero (Biology, Washington Univ., Saint Louis, MO)
Colin Carlson (Biology, Georgetown Univ.)
Benito Chen-Charpentier (Mathematics, Univ. of Texas)
Lauren Childs (Mathematics, Virginia Tech)
Kim Cuddington (Biology, Univ. of Waterloo, ON)
Marinez Ferreira de Siqueira (Rio de Janeiro Botanical Garden Research Institute)
David Finnoff (Economics and Finance, Univ. Wyoming)
Tessa Francis (Puget Sound Institute, Univ. of Washington, Tacoma)
Kristine Grayson (Univ. of Richmond)
Alan Hastings (Environmental Science and Policy, Univ. of California, Davis)
Elizabeth Hobson (Bio Sciences, Univ. of Cincinnati)
Richard Horan (Agricultural, Food, and Resource Economics, Michigan State Univ.)
Christian Houle (Political Science, Michigan State Univ.)
Natali Hritonenko (Mathematics, Prairie View A&M Univ., TX)
David Kling (Applied Economics, Oregon State Univ., Corvallis)
Ying-Cheng Lai (School of Electrical, Computer and Energy Engineering, Arizona State Univ, Tempe)
Daniel Larremore (Computer Science, Univ. of Colorado Boulder)
Erik Larson (Macalester College)
Maria Leite (Mathematics and Statistics, Univ. of South Florida)
Simon Levin (Ecology and Evolutionary Biology, Princeton Univ., NJ)
Ellie Lochner (Univ. of Wisconsin, Eau Claire)
Karen Maguire (Economics, Oklahoma State Univ.)
Luke J. Matthews (Behavioral and Social Scientist, RAND Corporation; Faculty, Pardee RAND Graduate School; Co-Director, RAND Center for Applied Network Analysis and System Science)
Tom McAvoy (Quarantine Lab, Entomology, Virginia Tech)
Andrew Morozov (Mathematics, Univ. of Leicester, UK)
Mike Neubert (Woods Hole Oceanographic Inst.)
Paul Overvoorde (Macalester College)
Sergei Petrovskii (Mathematics, Univ. of Leicester, UK)
Noa Pinter-Wollman (Ecology and Evolutionary Biology, UCLA)
Michaela Puck Rombach (Math & Stats, Univ. of Vermont)
Brandyn Ruiz (Arizona State Univ.)
James Sanchirico (Environmental Science and Policy, Univ. of California, Davis)
Saray Shai (Comp Sci, Wesleyan Univ.)
Matthew Silk (Ecology and Conservation, Univ of Exeter)
Etotepe Aikpemi Sogbohossou (Univ. of Abomey-Calavi, Cotonou, Benin)
Liz Stanhope (Lewis & Clark College)
Ivan Sudakov (Physics, Univ. of Dayton)
David Swofford (Florida Museum of Natural History)
Jeremy Van Cleve (Biology, Univ. of Kentucky)
Abigail Williams (Salem College)
James D. Witts (Earth & Planetary Sciences, Univ. of New Mexico)
Mary Lou Zeeman (Mathematics, Bowdoin College, Brunswick, ME)
Andrew Zieffler (Univ. of Minnesota)

Graduate Student Workers

Jeff de Salu (University of Tennessee, Knoxville)

Amanda Hyman (University of Tennessee, Knoxville)

Tyler Poppenwimer (Univ. of Tennessee Knoxville)

Sustainment Activities

Quantitative Biology at Community Colleges, First Network Meeting, hosted by NIMBioS

Adams, Andrew

Adams, Jessica

Adler, Jennifer

Alford, Beth

Aryal, Pradip

Bissell, Ahrash

Buntz, Jennifer

Burlyn, Allison

Consani, Angela

des-Bordes, Emmanuel

Doyle, Duane

Esquibel, Joe

Fieber, Christina

Flanders, Vickie

Frazier, Adronisha

Huffman, Megan

Jaros, Adam

*Jenkins, Kristin

Jones, Dave

*Karpakakunjaram, Vedham

Latimer, Margaret

Lenahan, Melanie

Martin, Breonna

Miller, Mary

Mills, Michael

Handzlik, Brandi

Neuhauser, Claudia

Nieuwsma, Christianne

Phillips, Mary

Sarraj, Bara

Schinske, Jeff

Seitz, Heather

Simon, David

Starnes, John

Troyer, Amy

Vingochea, Luis

Williams, Brandy

Young, Karen

Cultural Evolution Online Learning Modules

Models of Social Dynamics: An Introductory Module

Paul E. Smaldino (Cognitive and Information Sciences, University of California, Merced)

Animal Cultures: Core Discoveries and New Horizons

Andy Whiten (University of St Andrews, UK)

Lucy Aplin (Max Planck Institute for Animal Behaviour, Germany)

Nicolas Claidière (CNRS, Aix-Marseille University, France)

Rachel Kendal (University of Durham, UK)

The Neverending Story: Cultural Evolution and Narratives

Joseph Stubbersfield (Psychology, Heriot-Watt University, Edinburgh, UK)

Jamie Tehrani (Anthropology, Durham University, Durham, UK)

Oleg Sobchuk (Max Planck Institute the Science of Human History, Jena, Germany)

Foundations of Cultural Evolution: A Question + Tools Approach

Adrian Bell (Anthropology, University of Utah)

Modeling the Dynamics of Cultural Diversification

Bernard Koch (Sociology, University of California, Los Angeles)

Erik Gjesfjeld (Archaeology University of Cambridge, UK)

Michael Alfaro (Ecology & Evolutionary Biology, University of California, Los Angeles)

Jacob Foster (Sociology, University of California, Los Angeles)

Daniele Silvestro (Biological & Environmental Sciences, University of Gothenburg, Sweden)

Participating NIMBioS staff: Eric Carr, Jane Comiskey, Catherine Crawley, and Michael Peek.

Addendum to NIMBioS Annual Report

Sep 1, 2019 - Aug 31, 2020

Y12-3. Description of Activities

Addendum-Description of Activities

DESCRIPTION OF MAJOR ACTIVITIES SEPTEMBER 1, 2019 – AUGUST 31, 2020

During the reporting period from September 1, 2019 through August 31, 2020, NIMBioS shifted focus from hosting larger Investigative Workshops and Tutorials and Working Groups to hosting smaller groups as Short-term Visits. There were no traditional Investigative Workshops or tutorials as those that were planned for spring 2020 ended up being postponed due to COVID travel restrictions. There were 237 participants in NIMBioS-hosted activities during this period with five Postdoctoral Fellows in residence, 40 Short-term Visitors, and two Visiting Scholars.

Demographics data available for participants in events from September 1, 2019 through June 30, 2020 are presented in detail in the NIMBioS Evaluation Report (see section Y12-1) and summarized below. There were 237 participants through June 30, 2020 from four countries and 34 U.S. states as well as the District of Columbia and Puerto Rico, representing 87 different institutions. International participants amounted to 3% of all participants. Most participants were college or university faculty (39%) and undergraduates (46%) with post-doctoral researchers and college/university staff accounting for a smaller fraction (6% each). Across all events female representation was 37%, and minority representation was 13.5%. 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, 2019 through March 3, 2020 were from 34 different institutions and collaborated with NIMBioS post-doctoral fellows and faculty from six units at the University of Tennessee. Visits after March 3rd were postponed due to COVID concerns.

Below is a short description of the activities held September 1, 2019 and planned through August 31, 2020 including 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

While no Working Groups had formal meeting during this reporting period, a Short-term Visit Group on Transients in Biological Systems was a follow up from previous Working Group activities.

INVESTIGATIVE WORKSHOPS

There were no full Investigative Workshops this year, but see Sustainment Activities for a description of workshops that were held or planned.

SUSTAINMENT ACTIVITIES

Quantitative Biology at Community Colleges, First Network Meeting, hosted by NIMBioS. The Quantitative Biology at Community Colleges (QB@CC) network brings together life science and math faculty from across the country to develop a collection of Open Educational Resources (OERs) focused on math/quantitative skills appropriate for community college biology courses, and provide the professional development and community support needed to incorporate quantitative/math skills in biology courses. NIMBioS hosted the First Network Meeting to launch this community. (Feb 27-29, 2020)

A NIMBioS/SCMB Investigative Workshop: Quantitative Education in Life Science Graduate Programs was planned for March 16-18, 2020, but was canceled due to COVID-19. The workshop aimed to bring together a diverse group of researchers and educators working at the interface of various areas of the life sciences and quantitative science (e.g. mathematics, statistics, computing, data science) to discuss educational aspects of graduate life science quantitative training, such as what topics to prioritize across the vast array of potential quantitative methods, how formal courses might be effectively mixed with online learning, seminars and lab group activities and the effectiveness of boot-camps and tutorials. The workshop was supported by funding from the Burroughs Wellcome Fund, from the National Science Foundation support for NIMBioS, with additional support from the University of Tennessee. The Workshop arises from a partnership between NIMBioS and the Southeast Center for Mathematics and Biology (SCMB).

Transdisciplinary Research in Principles of Data Science (TRIPODS): A meeting for the TRIPODS+X: VIS: Data science pathways for a vibrant TRIPODS commons at scale project with the NIMBioS Spatial Analysis Lab was postponed due to COVID.

VISITORS

Visiting Scholars

Etotépé Aïkpémi Sogbohossou (Univ. of Abomey-Calavi, Cotonou, Benin) visited to work with M. Papes and the NIMBioS Spatial Analysis Lab on niche modeling of species of concern in Benin (Sept 26, 2019-Dec 5, 2019)

Tony Jhwueng (Statistics, Feng-Chia Univ.) was scheduled to visit in July-August 2020 to continue his collaboration with B. O'Meara studying phylogenetic trait evolution through bridge processes. (Canceled due to COVID travel restrictions)

Short-term Visitors

Jeremy Van Cleve (Biology, Univ. of Kentucky) collaborated with S. Gavrillets and members of DySoC and presented the DySoC/NIMBioS Seminar: Components of cooperation: Synergy in structured populations and the evolution of guilt. (Sept 10, 2019)

Richard Horan (Agricultural, Food, and Resource Economics, Michigan State Univ.) and David Finnoff (Economics and Finance, Univ. Wyoming) visited C. Sims to discuss incorporating environmental and

demographic stochasticity into bioeconomic models of optimal renewable resource management. (Sept 24-26, 2019)

Tom McAvoy (Quarantine Lab, Entomology, Virginia Tech) worked on mathematical modeling of population dynamics and interactions among HWA and two predatory beetles with S. Lenhart, G. Wiggins, and H. Thompson. (Oct 8-9, 2019)

Ivan Sudakov (Physics, Univ. of Dayton); Sergei Petrovskii (Mathematics, Univ. of Leicester, UK); James D. Witts (Earth & Planetary Sciences, Univ. of New Mexico); and Colin Carlson (Biology, Georgetown Univ.) worked on Nonlinearity in past mass extinctions in collaboration with Colin D. Sumrall (Paleobiologist, Earth and Planetary Sciences). (Oct 10-11, 2019)

Luke J. Matthews (Behavioral and Social Scientist, RAND Corporation; Faculty, Pardee RAND Graduate School; Co-Director, RAND Center for Applied Network Analysis and System Science) visited to present a DySoC/NIMBioS Seminar: Cultural inheritance mechanics: Their affordances for evolutionary adaptation and applications to policy analysis. (Oct 15, 2019)

Liz Stanhope (Lewis & Clark College); Kristine Grayson (Univ. of Richmond); Erik Larson (Macalester College); Paul Overvoorde (Macalester College); and Andrew Zieffler (Univ. of Minnesota) worked on Assessing undergraduate quantitative biology skills in collaboration with Suzanne Lenhart and Louis Gross. (Oct 18-19, 2019)

Maria Leite (Mathematics and Statistics, Univ. of South Florida); Benito Chen-Charpentier (Mathematics, Univ. of Texas); Natali Hritonenko (Mathematics, Prairie View A&M Univ., TX); and Folashade Augusto (Ecology & Evolutionary Biology, Univ. of Kansas) worked on Plant sustainability under virus co-infection and harvesting in collaboration with Orou Gaoue. (Oct 18-21, 2019)

Noa Pinter-Wollman (Ecology and Evolutionary Biology, UCLA); Elizabeth Hobson (Bio Sciences, Univ. of Cincinnati); Daniel Larremore (Computer Science, Univ. of Colorado Boulder); Michaela Puck Rombach (Math & Stats, Univ. of Vermont); Saray Shai (Comp Sci, Wesleyan Univ.); and Matthew Silk (Ecology and Conservation, Univ of Exeter) worked on Null models in social behavior in collaboration with Nina Fefferman. (Oct 24-26, 2019)

Marinez Ferreira de Siqueira (Rio de Janeiro Botanical Garden Research Institute) worked on Scalable computational framework to assess climate change impacts and anthropogenic changes in Atlantic Rainforest biodiversity from a restoration perspective in collaboration with Mona Papeş. (Oct 27-29, 2019)

Karen Maguire (Economics, Oklahoma State Univ.) worked on Pecking order? Fracking boom and bird populations on the High Plains of Colorado in collaboration with Mona Papeş and the NIMBioS Spatial Analysis Lab. (Nov 20-27, 2019)

Kim Cuddington (Biology, Univ. of Waterloo, ON); Tessa Francis (Puget Sound Institute, Univ. of Washington, Tacoma); Alan Hastings (Environmental Science and Policy, Univ. of California, Davis); Ying-Cheng Lai (School of Electrical, Computer and Energy Engineering, Arizona State Univ, Tempe); Simon Levin (Ecology and Evolutionary Biology, Princeton Univ., NJ); Andrew Morozov (Mathematics, Univ. of Leicester, UK); Sergei Petrovskii (Mathematics, Univ. of Leicester, UK); and Mary Lou Zeeman

(Mathematics, Bowdoin College, Brunswick, ME) worked on Mismatched transients in the dynamics of social and ecological systems in collaboration with Sergey Gavrilets. (Nov 25-26, 2019)

David Kling (Applied Economics, Oregon State Univ., Corvallis); James Sanchirico (Environmental Science and Policy, Univ. of California, Davis); and Mike Neubert (Woods Hole Oceanographic Inst.) worked on Matching policy scope to ecosystem scale: Lessons from environmental federalism in collaboration with Charles Sims and Suzanne Lenhart. (Dec 4-6, 2019)

David Swofford (Florida Museum of Natural History) worked on Porting spatially explicit model of UCE sequence evolution SelON into PAUP in collaboration with Michael Gilchrist and Brian O'Meara. (Dec 9-13, 2019)

Ellie Lochner (Univ. of Wisconsin, Eau Claire); Abigail Williams (Salem College); and Brandyn Ruiz (Arizona State Univ.) worked on Impacts of climate change on environmental suitability of selected North American buzz pollinators in collaboration with Mona Papeş, Luis Carrasco Tornero and Greg Wiggins. (Jan 16-18, 2020)

Lauren Childs (Mathematics, Virginia Tech) visited to present a NIMBioS Seminar: Modeling malaria development in mosquitoes: How fast can mosquitoes pass on infection? (with Math Department) (Jan 28, 2020)

Carlos A. Botero (Biology, Washington Univ., Saint Louis, MO) visited to present a DySoC/NIMBioS Seminar. Ecological and evolutionary modeling shed light into the evolution and spread of human agriculture. (Feb 4, 2020)

Christian Houle (Political Science, Michigan State Univ.) visited to present a DySoC/NIMBioS Seminar: The political implications of ethnic inequality. (Mar 3, 2020)

Neil Johnson (Physics, The George Washington Univ., Washington D.C.) planned to visit to present a DySoC/NIMBioS Seminar: Online ecologies of distrust and hate. (Mar 10, 2020, postponed due to COVID-19)

David Kling (Applied Economics, Oregon State Univ., Corvallis); Ben Fitzpatrick (Mathematics, Loyola Marymount Univ., Los Angeles); and Julie Blackwood (Mathematics and Statistics, Williams College, Williamstown, MA) were due to collaborate with Suzanne Lenhart and Charles Sims on Using computational models of adaptive management to quantify the value of learning across levels of governance (Adaptive management with learning). (Mar 12-14, 2020, postponed due to COVID-19)

Sergei Petrovskii (Mathematics, Univ. of Leicester, UK); Ivan Sudakov (Physics, Univ. of Dayton); Corinne Myers (Earth and Planetary Sciences, Univ. of New Mexico); James D. Witts (Earth & Planetary Sciences, Univ. of New Mexico); and Daniel Rothman (Earth, Atmospheric, and Planetary Sciences, Massachusetts Inst. of Technology) were due to collaborate with Colin D. Sumrall (Paleobiologist, Earth and Planetary Sciences) on Transient dynamics of mass extinctions: Linking the past to the future. (Mar 16-18, 2020, postponed due to COVID-19)

(Joy) Ying Zhou (Mathematics, Lafayette College); Noelle Beckman (Biology and Ecology Center, Utah State Univ.); Sarah Bogen (Mathematics and Statistics, Utah State Univ.); James Bullock (Centre for Ecology and Hydrology, Crowmarsh Gifford, Oxfordshire); Mark Lewis (Mathematics and Statistical Sciences, Univ. of Alberta, Edmonton, Canada); and Michael Neubert (Biology, Woods Hole

Oceanographic Institution, Woods Hole, MA) were due to work on Biodiversity loss in the face of global change: Models & data. (Mar 23-26, 2020, postponed due to COVID-19)

Sandy Liebhold (Research Entomologist, Northern Research Station, USDA Forest Service) planned to visit to present a NIMBioS Seminar: Socioeconomic drivers of historical global insect invasions. His in-person visit was canceled due to COVID-19; he presented his seminar online instead. (Mar 24, 2020)

Charlotte Chang (Environmental Analysis & Biology, Pomona College) and Yuta Masuda (The Nature Conservancy) were due to collaborate with Paul Armsworth on Using environmental social media to combat issue polarization for common pool resources. (April 1-3, 2020, postponed due to COVID-19)

Jake Ferguson (Biology, Univ. of Hawaii at Manoa); Tiffany Knight (Spatial Interaction Ecology, German Centre for Integrative Biodiversity Research); Kapua Kawelo joining remotely (Natural Resources Manager, O'ahu Army Natural Resources Program); and Trevor Caughlin (Biology, Boise State Univ.) were due to collaborate with Lalasia Bialic-Murphy, Susan Kalisz, Paul Armsworth, Stephanie Kivlin, Robert McElderry (EEB, UTK) on Quantifying the effects of non-native invaders on the biodiversity of island ecosystems and developing biologically and economically efficient restoration strategies. (Apr 6-9, 2020, postponed due to COVID-19)

Michael Bailey (Research Scientist Manager, Facebook) planned to visit to present a DySoC/NIMBioS Seminar: The economic impact of social networks. (Apr 7, 2020, postponed due to COVID-19)

Carrie Manore (Los Alamos National Laboratory); Megan Rua (Wright State Univ.); Neil McRoberts (Univ. of California, Davis); and Alison Power (Cornell Univ.); Karen Garrett (Univ. of Florida) were due to collaborate with Louis Gross on Grower decisions and cooperation impact on crop disease spread. (May 5-8, 2020, postponed due to COVID-19)

Jane Molofsky (Plant Biology, Univ. of Vermont); Brian Beckage (Plant Biology & Computer Science, Univ. of Vermont); Cang Hui (Mathematics, Stellenbosch Univ., South Africa) were due to collaborate with Dan Simberloff (EEB) and David Talmy (Microbiology) on Exploring the edge of trait space with theoretical models. (May 11-15, 2020, postponed due to COVID-19)

Abdelaziz Lawani (Agriculture, Eastern Kentucky Univ.); Daniel Miller (Univ. of Illinois); Sonia Padonou (Univ. of Illinois) were due to collaborate with Amanda Hyman, Paul Armsworth, Orou Gaoue on Addressing conservation issues in Benin with innovative optimization models. (May 12-15, 2020, postponed due to COVID-19)

Andrew J. Bernoff (Harvey Mudd College); Michael Culshaw-Maurer (Univ. of California, Davis); Rebecca Everett (Haverford College); Maryann E. Hohn (Univ. of California, Santa Barbara); and Jasper Weinburd (Harvey Mudd College) were due to collaborate with Christopher Strickland on Foraging and social interaction in the formation of locust hopper bands. (May 18-22, 2020, postponed due to COVID-19)

Habacuc Flores-Moreno (Biological Sciences, George Washington Univ.); Luke McCormack (Morton Arboretum); Rich Phillips (Biology, Indiana Univ.); Ben Sikes (Ecology & Evolutionary Biology, Univ. of Kansas); Kathleen Treseder (Ecology & Evolutionary Biology, Univ. of California, Irvine); and Amy Zanne (Biology, George Washington Univ.) were due to collaborate with Stephanie Kivlin, Colleen Iversen and Camille Defrenne on Creating a framework to interpret and model plant and mycorrhizal fungal traits at the global scale. (May 27-30, 2020, postponed due to COVID-19)

Katie Storey (Mathematics, Univ. Michigan), Erik Amezcuita (Computational Mathematics, Science, and Engineering, Michigan State Univ.), Vladislav Bukshytynov (Mathematical Sciences, Florida Institute of Technology) and Hwayeon Ryu (Mathematics and Statistics, Elon Univ.) originally planned to visit August 10-14 to collaborate with V. Maroulas on Topological methods for identifying patterns in lung tumor gene expression data but are now looking to reschedule.

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, 2019 and August 31, 2020.

Undergraduate Research Conference at the Interface Between Biology and Mathematics

Undergraduate students engaged in research in biology and mathematics, their faculty mentors, and our Minority Serving Institution partners were invited to this eleventh annual conference. The conference included student talks and posters, two plenary speakers (Sadie Ryan, U. of Florida, and Christopher Strickland, U. of Tennessee). To help students to plan for their future careers, this conference also included an introductory technology session, a panel about perspectives on applying to graduate fellowships, breakout sessions for in depth research discussion and a graduate school showcase. Over 120 undergraduates and faculty from academic institutions across North America were in attendance. There were 66 undergraduate research talks and posters. (November 16-17, 2019)

Joint Math Meetings

At the Joint Math Meetings 2020, NIMBioS Associate Director S. Lenhart spoke at a NExT panel about the UT-NIMBioS STEM Alliance activities for undergraduates with disabilities. Two undergraduate students, Vinny Jodoin from University of Tennessee and Margie Knight from Colorado College presented talks on their SRE 2019 projects, and Jodoin also presented a poster.

2020 Summer Research Experience (SRE) for Undergraduates Program

Seventeen undergraduates participated in the 2020 NIMBioS Summer Research Experience (SRE) for undergraduates. Due to the COVID-19 pandemic, the normally eight-week program was shortened to six weeks and conducted entirely remotely. Of the 17 of the participants, four were students at the University of Tennessee, Knoxville (UT), and the other 13 were from 12 other institutions. These students worked in teams with NIMBioS postdocs and faculty to conduct research at the interface of mathematics and biology. Students also attended lectures on cross-cultural mentoring, responsible conduct of research and other seminars focused on professional development. Student support included a \$2,500 stipend. (June 1 through July 10, 2020). The projects this year were Individual-based models to explain the co-evolutionary dynamics of quorum sensing and biofilms; agent-based simulation of

Caenorhabditis elegans; influence of climate change velocity on future species distributions; modeling the effects of pathogenic bacteria on phytoplankton community mortality; and modeling the individual and population effects of elevated incubation temperatures of sea turtles. (June 1 – July 10, 2020)

A panel discussion on Preparing Proposals for NSF Graduate Research Fellowship Program was hosted by NIMBioS. Students were invited to participate, and advice and perspectives on applying for fellowships was presented and discussed (September 4, 2019).

Tutorials and similar events

NIMBioS' tutorial on adaptive management was originally scheduled for April 1-3, 2020 but was postponed until fall 2020 due to the COVID-19 pandemic. Adaptive management seeks to determine sound management strategies in the face of uncertainty concerning the behavior of the system being managed. Specifically it attempts to find strategies for managing dynamic systems while learning the behavior of the system. This tutorial introduces participants to methods for modeling adaptive management, with an emphasis on case studies drawn from environmental and natural resource management. Organizers: Iadine Chades (CSIRO), Paul Fackler (NCSU), David Kling (OSU), Michael Springborn (UC-Davis), and Suzanne Lenhart. Another tutorial on use of LiDAR technology for spatial analysis projects organized by M. Papes was also cancelled due to COVID.

Participants from across the southeastern US practiced their messaging and engagement skills in a day-long Communicating Science Workshop at the University of Tennessee, Knoxville. The workshop was co-hosted by the Ecology Society of America (ESA) Public Affairs Office, the ESA Southeastern Member Chapter, and the National Institute for Mathematical and Biological Synthesis. (February 3, 2020)

The first Network Meeting of the Quantitative Biology at Community Colleges Group (NSF RCN funded through Montgomery College in MD and BioQUEST) was hosted by NIMBioS. This meeting began to form the network to bring together life science and math faculty from across the country to develop a collection of Open Educational Resources (OERs) focused on math/quantitative skills appropriate for community college biology courses, and provide the professional development and community support needed to incorporate quantitative/math skills in biology courses. (February 27-29)

School Visits, Field Trips, Conferences and Meetings

Dr. S. Lenhart did outreach activities regularly at Bearden High School and the Phyllis Wheatly YWCA program (for Vine Middle School students). She helped with the Tennessee Mu Alpha State Convention on March 7, 2020.

NIMBioS hosted Expanding Your Horizons STEM Activity Day with a total of 52 middle-school girls at this event. Faculty and staff from the University of Tennessee developed activities focusing on botany, ecology, mathematics, and engineering. All participants were given t-shirts and gift bags with various educational items. This workshop was held in cooperation with Expanding Your Horizons (with assistance from Dr. Judith Iriarte-Gross, Middle Tennessee University) and the Knoxville branch of AAUW on November 9, 2019.

Dr. S. Lenhart gave seminars presenting ideas about NIMBioS Education and Outreach Activities at these locations: Inclusive Excellence Series at Louisiana State U. on September 26, 2019 and Western Kentucky University Undergraduate Mathematics Conference on November 22, 2019.

Dr. G. Wiggins, NIMBioS Outreach and Education Coordinator, served as a judge at the St. Joseph School Science Fair. (February 2020)

Dr. S. Lenhart participated in an External Advisory Committee meeting for the NSF-HBCU-UP Targeted Infusion Project on Infusion of Computational Biological content into Fisk University's UG STEM Curriculum on February 20, 2020. This meeting involved discussion and evaluation of their REU program and course development (Precalculus for Life Sciences and Tools for Bioinformatics with 4 computing modules).

The NIMBioS Graduate Award Program distributed twenty NIMBioS Graduate Awards in 2019. The awards were designed to supplement the funding available for UTK/UTIA graduate students to enhance their research and education. While some of the awards were used during the last reporting period, most of the awardees opted to use them in fiscal year 2020. Most awardees used the funding as support to attend professional conferences or for research expenses.

NIMBioS Interdisciplinary Seminars

The NIMBioS Interdisciplinary Seminar Series was held during the fall and spring semesters. 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. There were 5 seminars presented in person, and later in the spring, we hosted an online webinar series with six webinars. Several of the online webinars focused on modeling, especially related to modeling the COVID-19 outbreak.

DySoC/NIMBioS Seminar. Components of cooperation: Synergy in structured populations and the evolution of guilt, with Jeremy Van Cleve, Biology, Univ. of Kentucky. Sep 10, 2019

DySoC/NIMBioS Seminar. Cultural inheritance mechanics: Their affordances for evolutionary adaptation and applications to policy analysis, with Luke J. Matthews, Behavioral and Social Scientist, RAND Corporation; Faculty, Pardee RAND Graduate School; Co-Director, RAND Center for Applied Network Analysis and System Science. Oct 15, 2019

DySoC/NIMBioS Seminar. Public goods, from biofilms to societies, with Simon Levin, Ecology & Evolutionary Biology, Princeton Univ. Nov 25, 2019

DySoC/NIMBioS Seminar. Ecological and evolutionary modeling shed light into the evolution and spread of human agriculture, with Carlos A. Botero, Biology, Washington Univ., Saint Louis, MO. Feb 4, 2020

DySoC/NIMBioS Seminar. The political implications of ethnic inequality, with Christian Houle, Political Science, Michigan State Univ. Mar 3, 2020

Pre-workshop online Webinar for NIMBioS Investigative Workshop: Quantitative Education in Life Science Graduate Programs. Mar 3, 2020

DySoC/NIMBioS Seminar. Online ecologies of distrust and hate, with Neil Johnson, Physics, The George Washington Univ., Washington D.C. Mar 10, 2020 (postponed due to COVID-19)

NIMBioS/Math Biology Webinar. Socioeconomic drivers of historical global insect invasions, with Sandy Liebhold, Research Entomologist, Northern Research Station, USDA Forest Service. Mar 24, 2020

NIMBioS MathBio Webinar. The role of applied math in real-time pandemic response: How basic disease models work with Dr. Nina Fefferman, Mathematics, Ecology & Evolutionary Biology, Univ. of Tennessee. Mar 31, 2020

DySoC/NIMBioS Seminar. The economic impact of social networks, with Michael Bailey, Research Scientist Manager, Facebook. Apr 7, 2020 (postponed due to COVID-19)

NIMBioS MathBio Webinar. Costs and benefits of defending against viral infection: Lessons from natural ecosystems with Dr. David Talmy, Microbiology, Univ. of Tennessee. Apr 7, 2020

NIMBioS MathBio Webinar. Modeling for a globally connected world: What models are good for and how they work with Dr. Louis Gross, Mathematics and Ecology & Evolutionary Biology, Univ. of Tennessee. Apr 14, 2020

NIMBioS MathBio Webinar. Mathematical modeling of malaria transmission by mosquitoes, with Dr. Vitaly Ganusov, Assoc. Professor, Microbiology, Univ. of Tennessee. Apr 21, 2020

NIMBioS/GAMES Webinar. From suburbia to ski bum to succession, with Virginia Dale, Ecology & Evolutionary Biology, University of Tennessee; Corporate Fellow Emeritus, Oak Ridge National Laboratory. Jul 30, 2020

NIMBioS/GAMES Webinar. Making the right moves in chess and in life, with Carolina Blanco, Chess Master, Orthodontist, Entrepreneur. Aug 6, 2020

Addendum to NIMBioS Annual Report

Sep 1, 2019 – Aug 31, 2020

Y12-4. Additional Products

Featured Articles

Websites

Media Coverage

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

SEPTEMBER 1, 2019 – AUGUST 31, 2020

Feature Articles and Press Releases

(current reporting period)

September 10, 2019. Saving Amphibians, One Tadpole at a Time (blog post)

September 16, 2019. Top of Class: Quantitative Bioscience at UT (blog post)

September 23, 2019. Networking? New Software Studies the Ecological Kind (blog post)

November 12, 2019. Girls Dig STEM at NIMBioS (blog post)

November 13, 2019. Undergraduate Research Wins Award (blog post)

January 29, 2020. Filling the Research Gap: Mathematics of Gun Violence (blog post)

March 16, 2020. Bargain-hunting for biodiversity: New tool pinpoints conservation targets (press release/announcement)

March 17, 2020. Partnering for Success with Minority Serving Institutes: The Story of Fisk (blog post)

March 25, 2020. SRE Students Publish in Population Ecology (blog post)

May 8, 2020. 2020 SRE Students Selected (blog post)

June 16, 2020. New Online Tutorials: Dynamical Systems in Cultural Evolution (press release/announcement)

August 5. Predictive Modeling of the COVID-19 outbreak in Knox County (blog post)

Websites

Title: The NIMBioS Website

URL: www.nimbios.org

Short Description of the Website: This is the main website for NIMBioS. As of June 2020, the website contained 1498 pages and 2066 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

09/18/19, NISER Joins ORE, Develops New Evaluation Office, Tennessee Catalyst,

<https://research.utk.edu/niser-joins-ore-develops-new-evaluation-office/>

10/31/19, A new ranavirus threatens US amphibian diversity, EurekaAlert,

https://eurekaalert.org/pub_releases/2019-10/uoti-anr103119.php

11/12/19, Wanted: scientists trained in convergence science, Lasker Foundation Newsletter,

<http://www.laskerfoundation.org/new-noteworthy/articles/wanted-scientists-trained-convergence-research/>

11/15/19, Biological sciences "converge" on a new direction, Lasker Foundation Newsletter,

<http://www.laskerfoundation.org/new-noteworthy/articles/biological-sciences-converge-new-direction/>

12/06/19, Studying Relationships Between Forest Structure and Bird Biodiversity, NEON Observatory Blog, <https://www.neonscience.org/observatory/observatory-blog/studying-relationships-between-forest-structure-bird-biodiversity>

Addendum to NIMBioS Annual Report

Sep 1, 2019 -Aug 31, 2020

**Y12-5. 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 30th, 2020 for the current reporting period. The NIMBioS Annual Report is submitted before 8/31/2020, the end of the reporting period, so data for the current reporting period include only the period from 9/1/2019 through 6/30/2020; they do not include projections for activities occurring between 7/1/2020 and 8/31/2020. 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
9/1/2015 - 8/31/2016	232	51 ^a	917 (649 indiv.)
9/1/2016 - 8/31/2017	221	51 ^b	773 (650 indiv.)
9/1/2017 - 8/31/2018	147	28 ^c	444 (371 indiv.)
9/1/2018 - 8/31/2019	204	30 ^d	591 (461 indiv.)
9/1/2019 - 6/30/2020*	76	4 ^e	237 (212 indiv.)

* Numbers reported here include only the period from 9/1/2019-6/30/2020; they do not include projections for activities occurring between 7/1/2019-8/31/2020.

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

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

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

^d 4 business/industry, 10 federal, 16 non-profit

^e 1 business/industry, 0 federal, 1 non-profit, 2 other