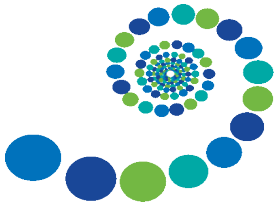

NIMBioS

National Institute for Mathematical and Biological Synthesis

NIMBioS EVALUATION REPORT

REPORTING PERIOD NINE

SEPTEMBER 1, 2016 – MARCH 31, 2017

National Institute for Mathematical and Biological Synthesis

May 2017

National Institute for STEM Evaluation and Research

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CIPP Model

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

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

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

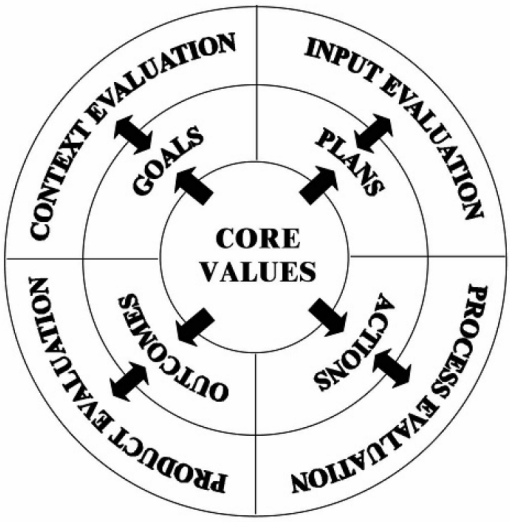
Product Evaluation assesses outcomes of the program.

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

INTRODUCTION

This is an evaluation summary of NIMBioS activities during the ninth annual reporting period (RP 9) to the National Science Foundation. This report covers the period of September 1, 2016 through March 31, 2017. The NIMBioS evaluation program follows the CIPP systems approach, which considers not only the outcomes of the center, but how the outcomes are achieved. The evaluation addresses four main interconnected evaluation phases as seen in Figure 1:

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



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

CONTEXT EVALUATION

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

INPUT EVALUATION

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

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

PROCESS EVALUATION

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

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

PRODUCT EVALUATION

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

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

ACTIVITIES – REPORTING PERIOD 9

Research program activities:

Activity	AR9	Overall
Working Group meetings	15	**53**
Investigative Workshop	1	**42**
Tutorials	0	**20**
Postdoctoral Fellows	8	**46**
Short-term visitors	23	**344**
Visiting graduate student fellow	0	**7**
Sabbatical	0	**17**

Education and Outreach (EO) program activity highlights:

NIMBioS Interdisciplinary Seminar Series
Biology in a Box Program
Summer Research Experiences (SRE) Program
Undergraduate Research Conference at the Interface of Biology and Mathematics
UT STEM REU Symposium
Joint MBI-CAMBAM-NIMBioS Summer Graduate Workshop
Blackwell-Tapia Conference and Award Ceremony
Uncertainty Quantification Tutorial
RevBayes Tutorial
Modern Math Workshop at SACNAS meeting

Other events: 2 Virtual Advisory Board Meetings

DIVERSITY OF RESEARCH ACTIVITIES

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

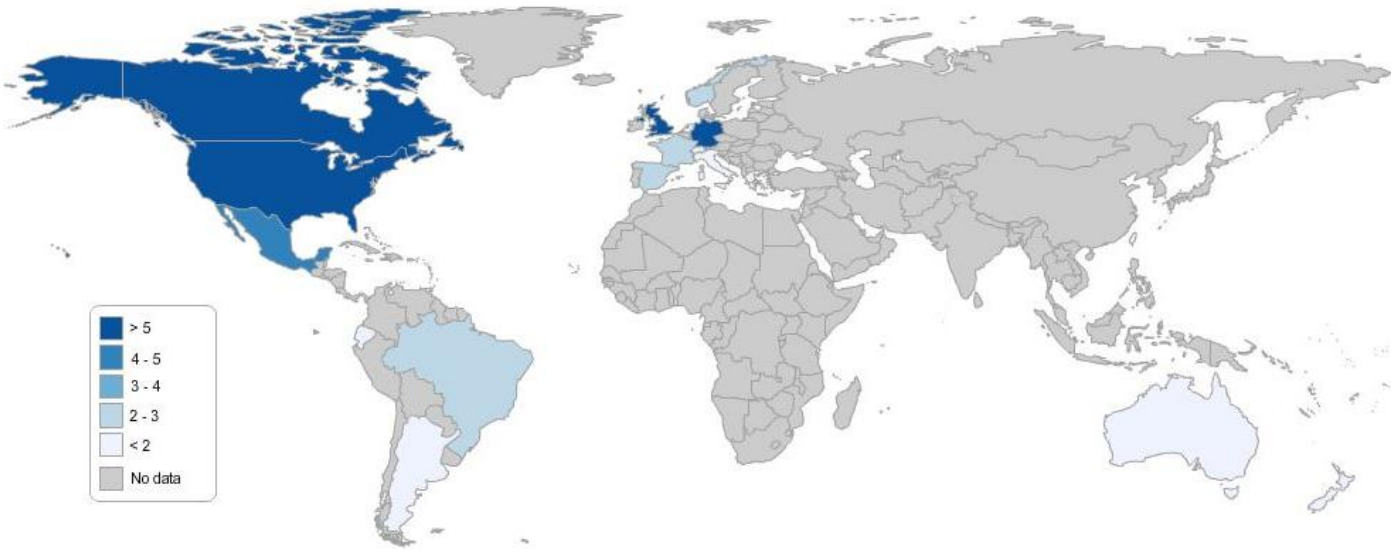
DIVERSITY OF PARTICIPANTS

One of the core values of NIMBioS is to increase the diversity of researchers and educators at the interface of mathematics and biology. NIMBioS collects voluntary demographic data from event applicants to gauge whether our program is fairly reaching and benefitting everyone regardless of demographic category and to ensure that those in under-represented groups have the same knowledge of and access to programs and other research and educational opportunities, and to assess involvement of international participants in the program. Electronic submission of demographic variables aligned to the reporting requirements of the National Science Foundation is requested of participants before participation in any NIMBioS event.

Demographic questions regarding gender, race, ethnicity, and disability status were optional. When feasible, the evaluation staff supplied missing demographic data from other sources (e.g. institution, primary field of study). The evaluation staff did not assume race, ethnicity, or disability status for any participant who did not report this information. All demographic information is confidential, and results are reported only in the aggregate.

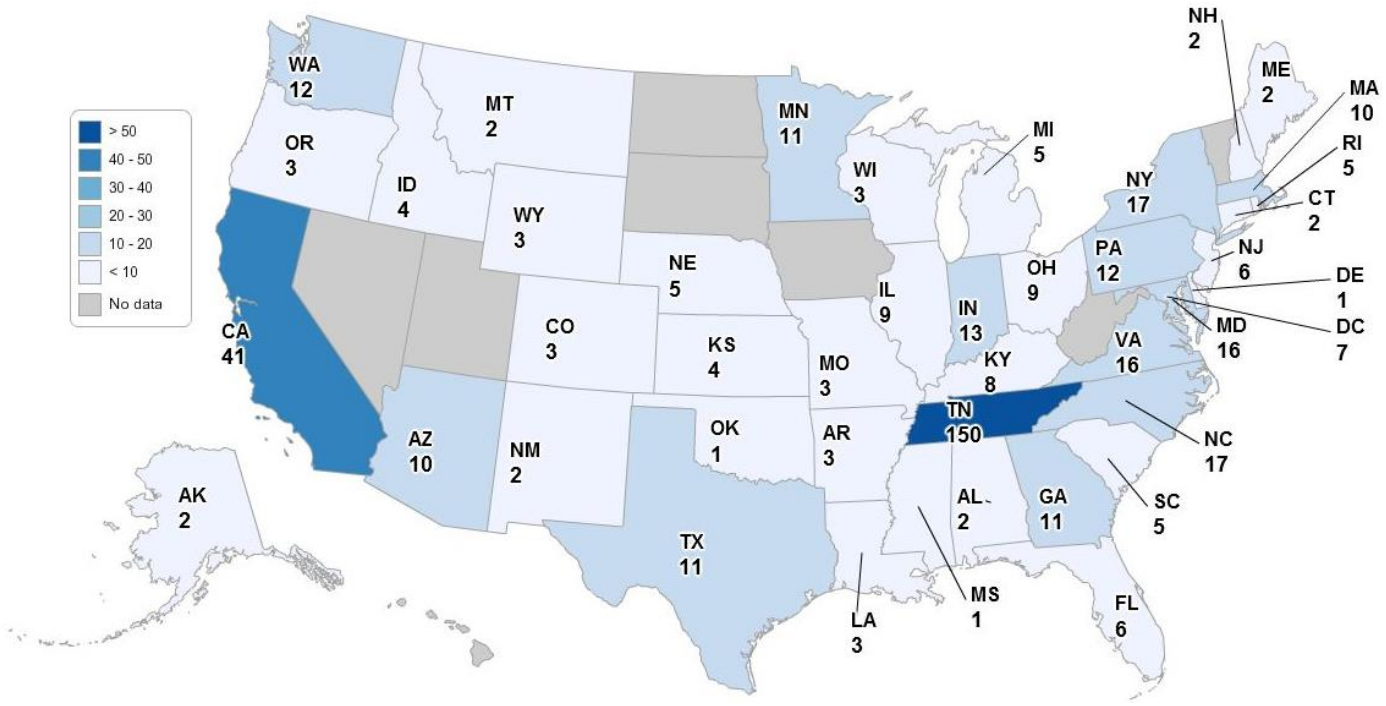
Geographic Diversity. During RP 9, 589 participants (479 unique individuals) from 19 countries participated in NIMBioS events. Most participants came from the United States (88.8%), followed by Canada (2.7%) and The United Kingdom (2.4%) (Figure 2). Roughly 1.4% of participants did not indicate country.

Figure 2. NIMBioS RP 9 participants by country



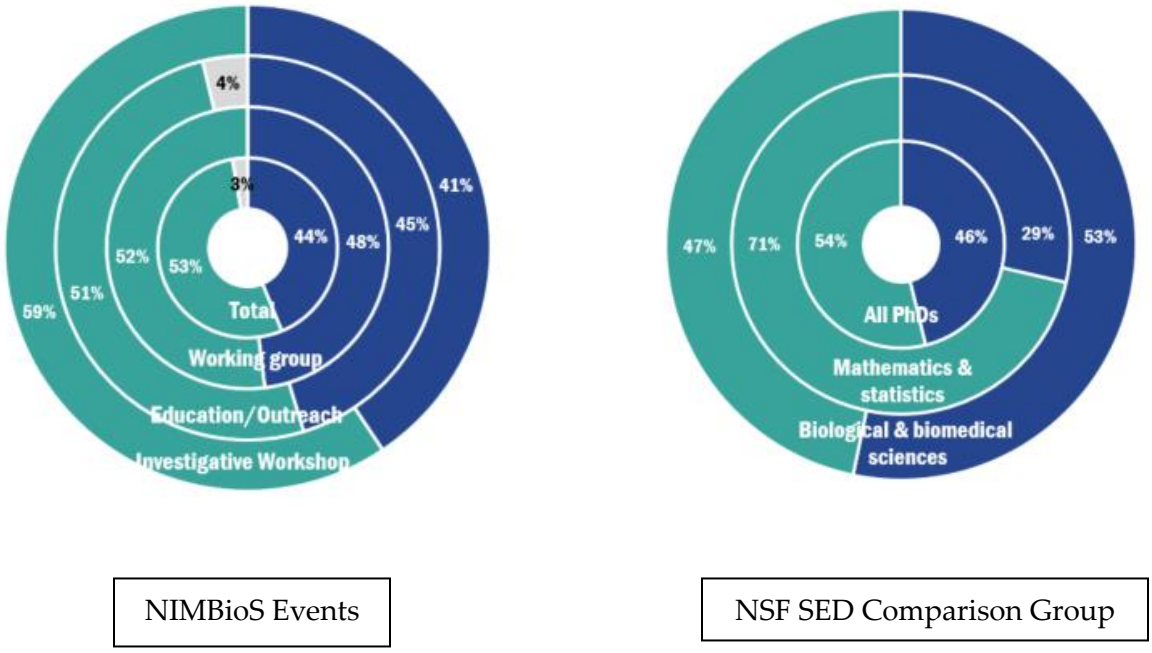
Within the U.S., 42 different states, as well as the District of Columbia and Puerto Rico, were represented. The largest percentage of participants came from within Tennessee (28.7%), followed by California (7.8%), North Carolina (3.2%), New York (3.2%), Virginia (3.1%), and Maryland (3.1%) (Figure 3).

Figure 3. NIMBioS RP 9 participants by U.S. state



Gender, Racial, and Ethnic Diversity. Across all events during RP 9, female participation was 43.8% (no gender data for 2.7%). Within specific activity types, the gender ratio varied slightly, from 48% in Working Groups to 41% in Investigative Workshops (**Figure 5**). Comparison groups shown are all individuals receiving doctorates, and all individuals receiving doctorates in biology and mathematics in the U.S. In 2015 (data from NSF Survey of Earned Doctorates). The overall distribution of females in NIMBioS activities falls within the range of practicing Ph.D.'s in biology and mathematics in the U.S.

Figure 4. Composition of participants by event type and earned doctorates for females, males, and not Reported.



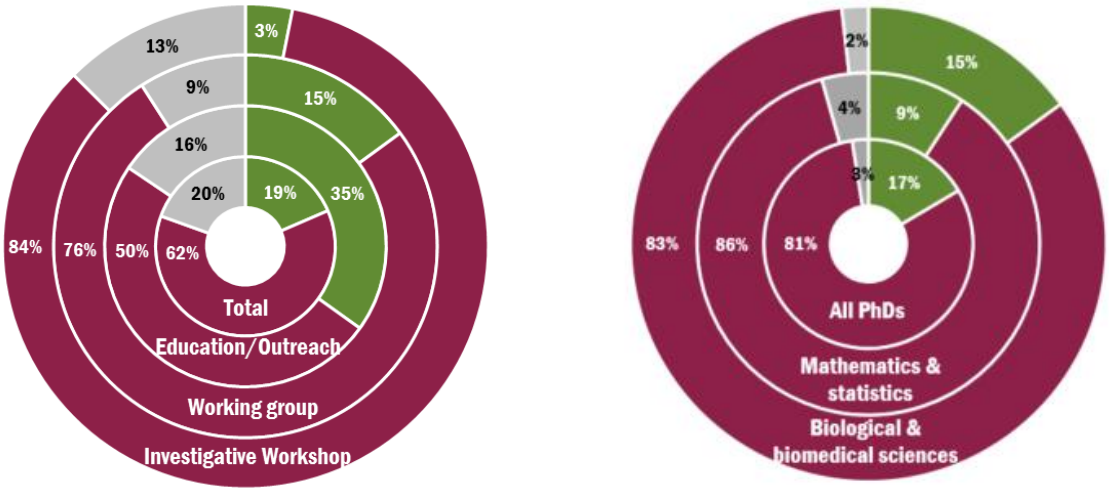
NIMBioS Events

NSF SED Comparison Group

Overall minority representation across NIMBioS events during RP 9 was 18.5%, and falls within ranges for doctoral recipients in the biological and mathematical sciences (Figure 5). Comparison groups shown are all U.S. citizen and permanent residents receiving doctorates, and receiving doctorates in biology and mathematics in the U.S. in 2015[1]. Minority representation varied among programs.

[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, 2015)

Figure 5. Minority representation of NIMBioS participants for underrepresented minority participants, not underrepresented and not reported.

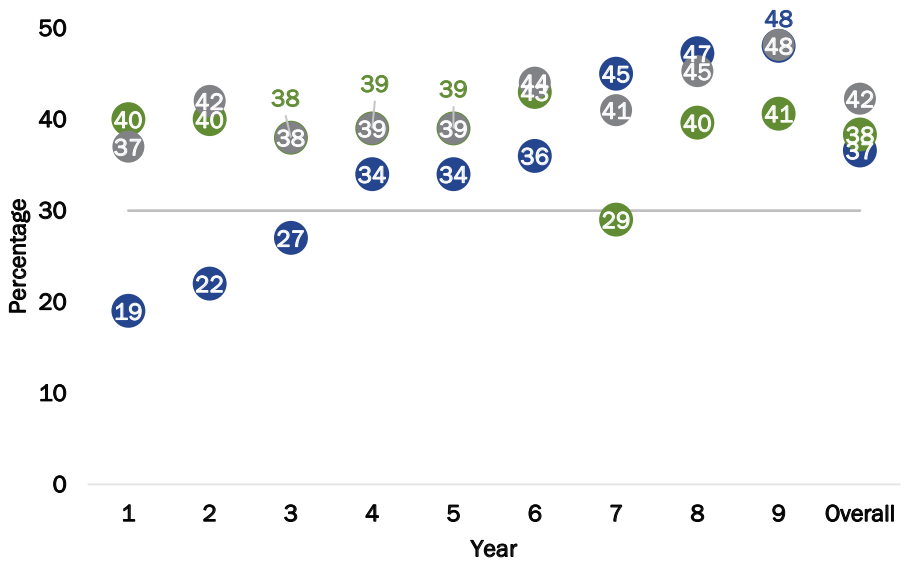


NIMBioS Events

NSF SED Comparison Group

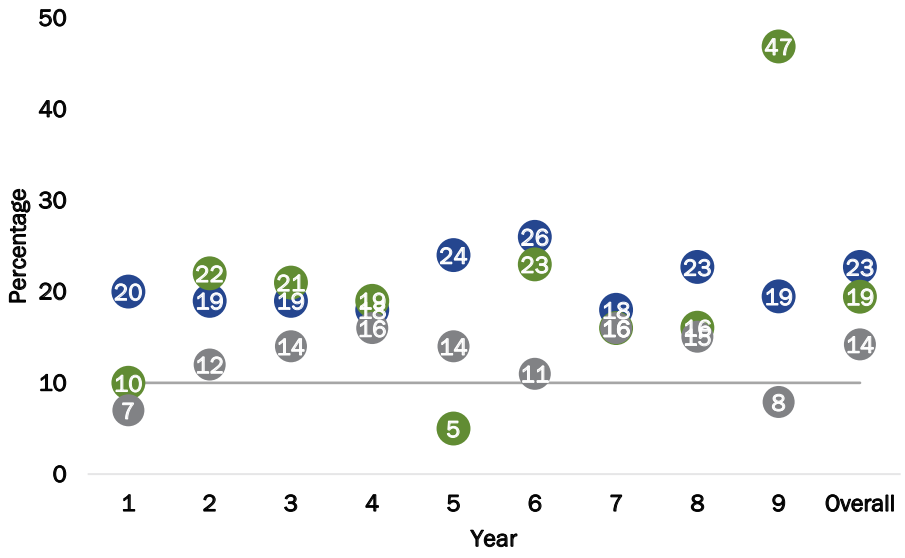
Diversity Benchmarks. Per the suggestion of the site review carried out at NIMBioS in June 2010, the NIMBioS leadership team has consulted with the NIMBioS advisory board in response to the recommendation by the site review committee that we establish a variety of benchmarks for our programs. The site review committee particularly recommended that benchmarks be developed on participation in Working Groups and Investigative Workshops relative to gender and under-represented groups, and on geographical diversity of participants. Benchmarks for diversity in participants at NIMBioS activities are provided in Figures 6 to 11:

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



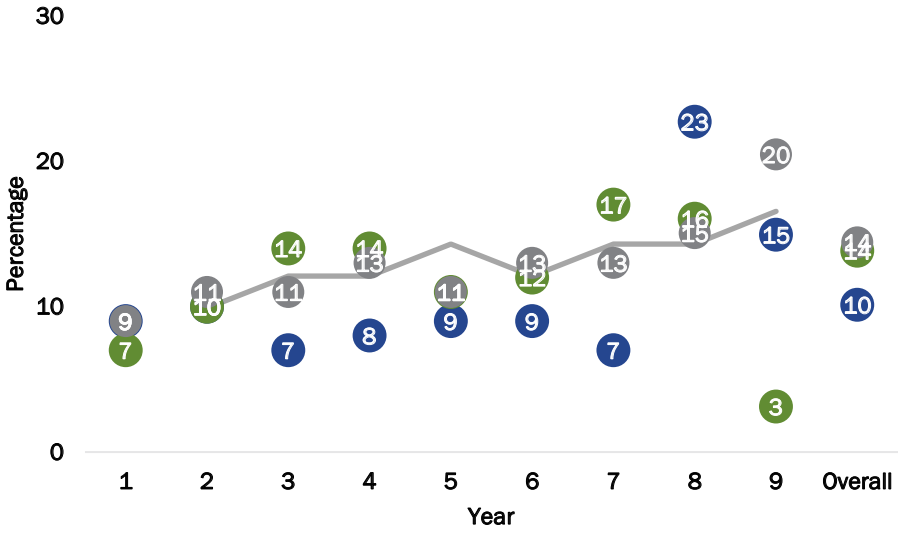
Benchmark. The proportion of female participants will be at least 30%.

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



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

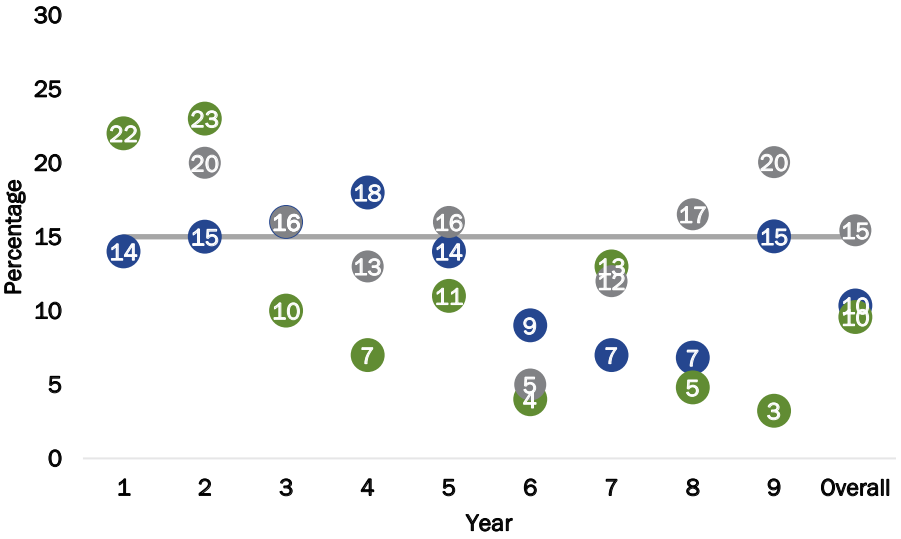
Figure 8. Proportion of participants from under-represented groups across all NIMBioS activities, Working Groups and Investigative Workshops



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

Note. F(t+1) = 1.1F(t) where F(t) is the proportion of total participants from underrepresented groups in Year t, and F(t+1) is the proportion of total participants from underrepresented groups in Year (t=1).

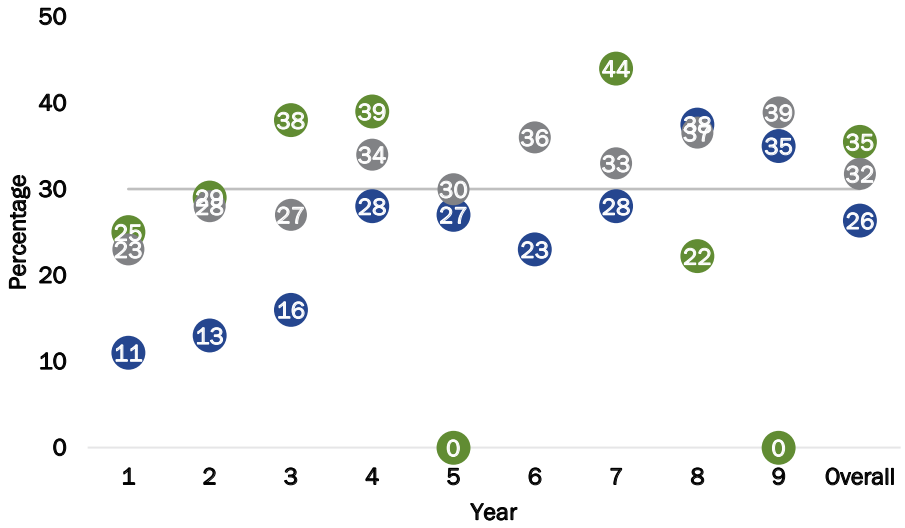
Figure 9. Proportion of local participants across all NIMBioS activities, Working Groups and Investigative Workshops



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:

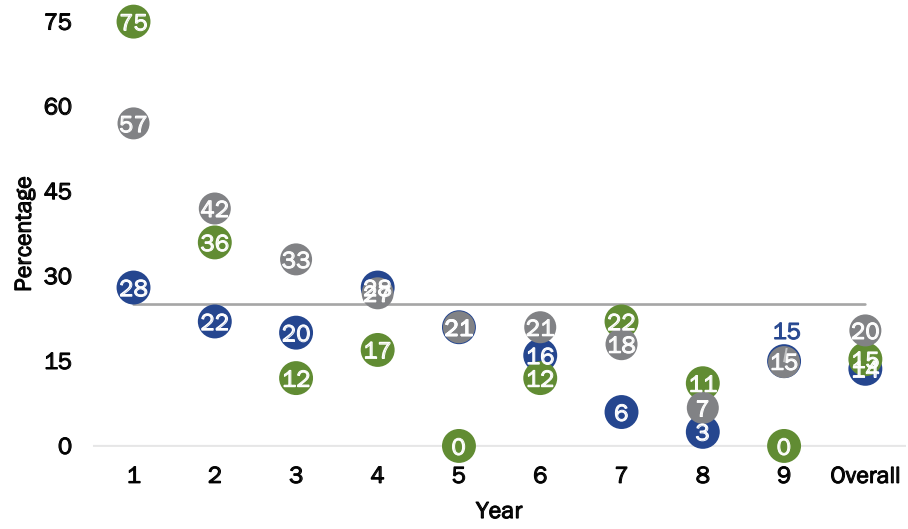
Figure 10. Proportion of female organizers across all Working Groups and Investigative Workshops by year



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

Note. Only participants who attend events are included in counts – for AR9, a female organizer for the Next Generation Genetic Monitoring workshop was unable to attend the event and therefore, is not represented in the benchmark numbers above. She was one of four organizers for the event, which would have made the percentatge for year 9 25%, had she been able to attend.

Figure 11. Proportion of local organizers across Working Groups and Investigative Workshops



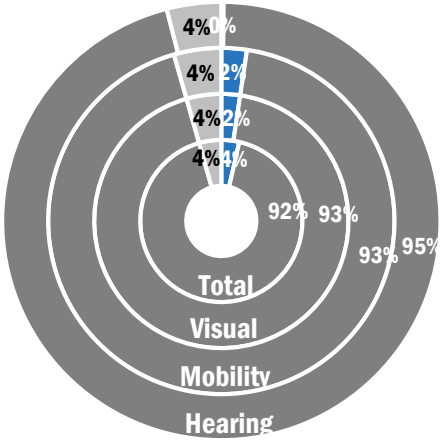
Benchmark.

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

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

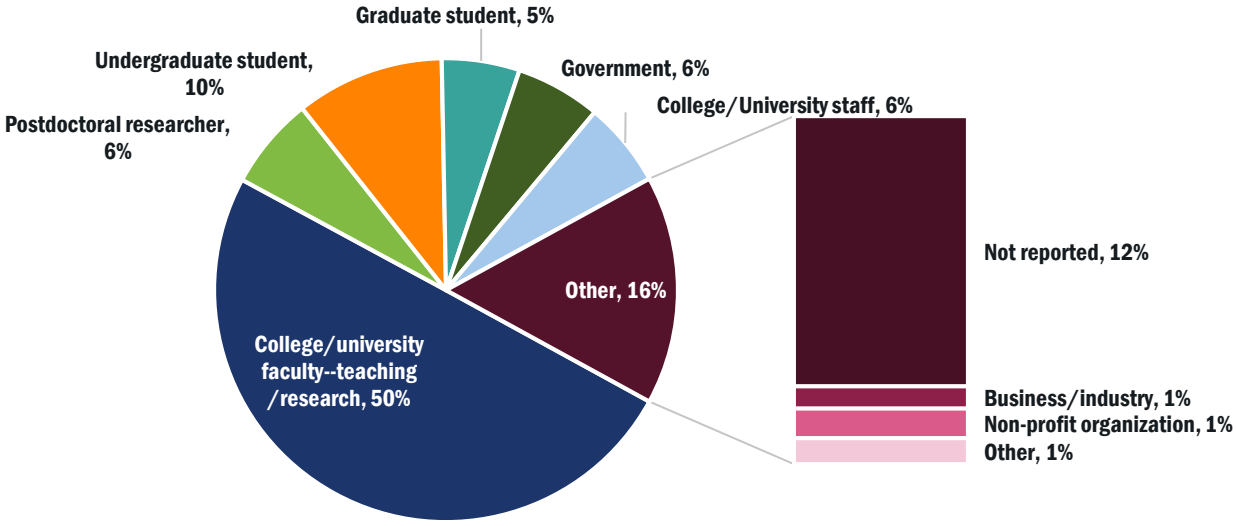
ABILITY DIVERSITY. Disclosure of disability status by participants to NIMBioS is optional. Around 2% overall indicated having some sort of disability during RP 9 **(Figure 12).**

Figure 12. Disability status of participants for Yes, No, and Not reported (*n* = 589)



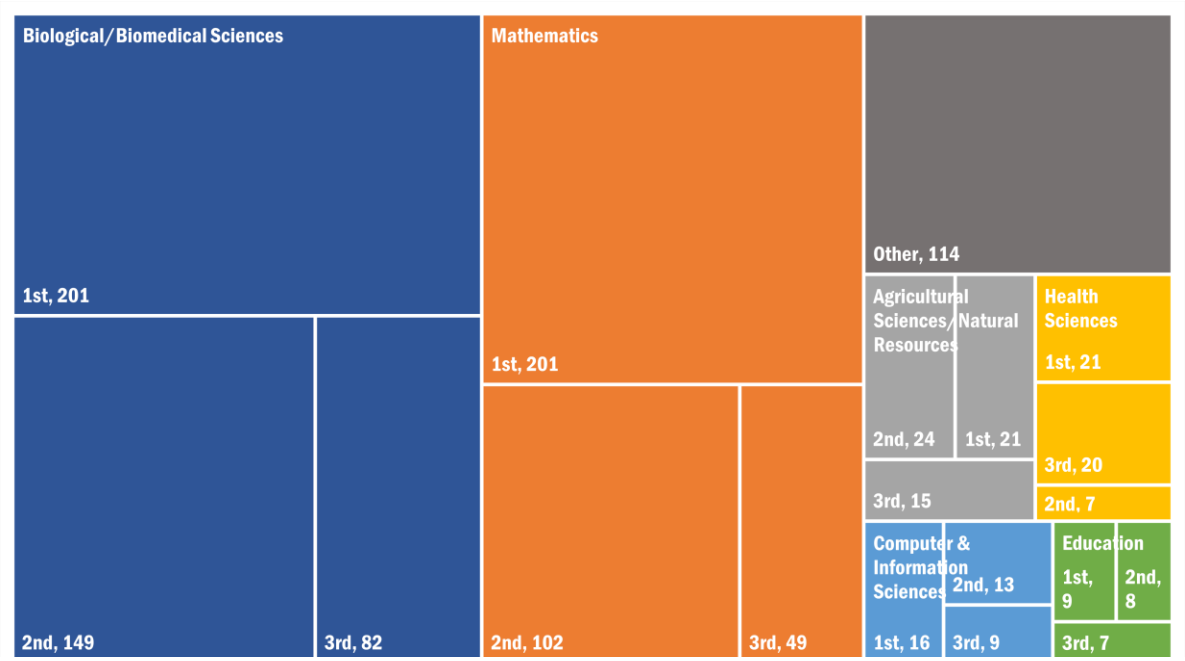
OCCUPATIONAL DIVERSITY. The majority of NIMBioS participants were college/university faculty or staff, undergraduate students, or postdoctoral researchers; however, participants came from government, industry, non-profit, or other positions as well (**Figure 13**).

Figure 13. Employment status of participants (*n* = 589)



DISCIPLINARY DIVERSITY. Most participants at NIMBioS indicated their primary fields of study, as well as areas of concentration within those fields. Many indicated their secondary and tertiary fields of study as well. The most commonly reported fields of study included biological/biomedical sciences and mathematics although many other disciplines were represented (**Figure 14**).

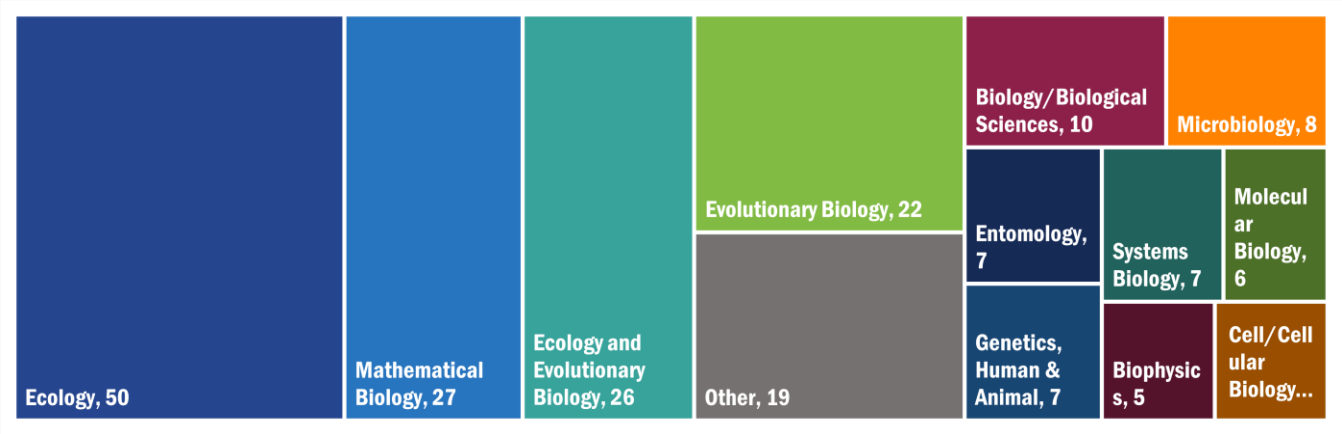
Figure 14. Primary (1st), secondary (2nd), and tertiary (3rd) discipline areas of participants



Note. Other includes Engineering (13, 2, 7), Social Sciences (12, 6, 4), Physics (8, 3, 7), Chemistry (6, 4, 5), Ocean/Marine Sciences (1, 9, 1), Geological & Earth Sciences (- , 7, 1), Business (-, 4, 2), Humanities (1, 3, -), Other professional field (1, -, 2), Astronomy/Meteorology (-, 2, -), Communications (2, -.-), and Psychology (-, 1, -). Counts in parentheses represent primary, secondary, and tertiary discipline area of participants.

The 201 participants indicating Biological/Biomedical Sciences as their primary field of study indicated 24 different areas of concentration within which they would classify their primary areas of research/expertise. The most commonly indicated area of concentration was ecology (30%), followed by ecology & evolutionary biology (14%), and mathematical biology (11%) (**Figure 15**).

Figure 15. Participant expertise area concentrations within biological/biomedical sciences field of study (*n* = 201)



Note. Other concentrations include Biology/Biomedical Sciences (3), Mathematical Ecology (3), Other Concentration (3), Environmental Science (2), Nutrition Sciences (2), Biomedical Sciences (1), Biometrics & Biostatistics (1), Neuroscience (1), Physiology, Human & Animal (1), Plant Genetics (1), and Plant Physiology (1).

INSTITUTIONAL DIVERSITY. Participants during RP 9 represented 187 different institutions, including colleges and universities, government institutions, industry, non-profits, and high schools (Figure 16). Of the 166 universities represented, most were classified as comprehensive (having undergraduate and graduate programs) (**Figure 17**).

Figure 16. Types of institutions represented (*n* = 187)

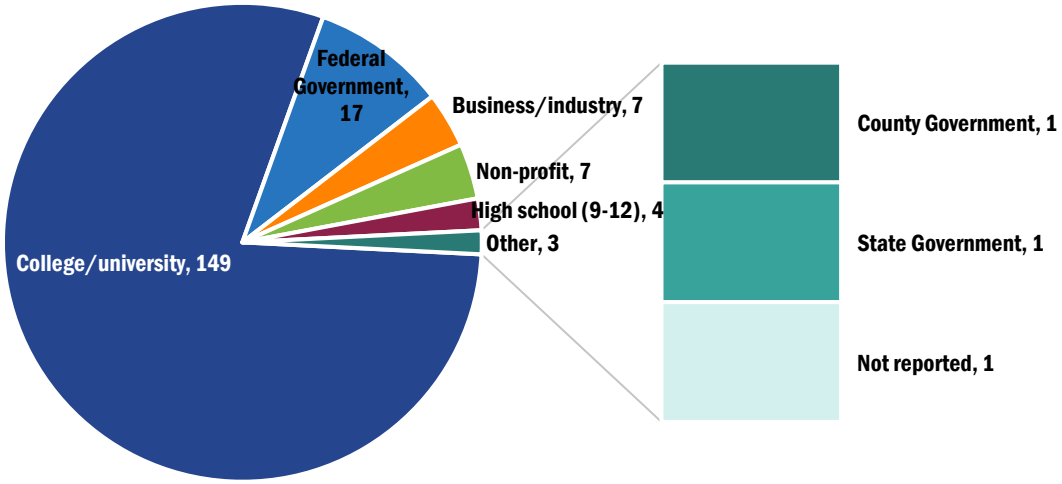
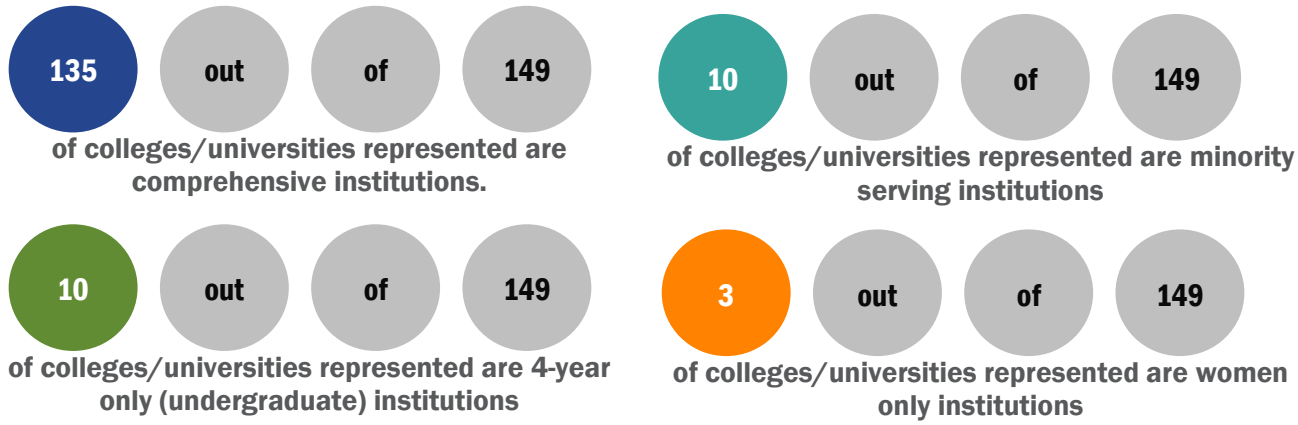


Figure 17. Characteristics of participants' universities (n = 176)



PROCESS EVALUATION

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

NIMBioS conducted formal process evaluations of its first and last Working Group meetings, Investigative Workshops, Undergraduate Research Conference at the Interface of Biology and Mathematics, Postdoctoral Fellowship program, Tutorial, and Summer Research Experience programs. Evaluations were carried out via electronic surveys sent to all participants either after participation in a NIMBioS event, or both before and after participation if a pre/post comparison of responses was warranted. Evaluation findings, along with suggestions for improvement, were shared with event organizers, as well as NIMBioS staff as needed. Improvements to program content and format, as well as NIMBioS' overall operations, are made accordingly. Following is a summary of the process evaluations of NIMBioS' major activities during RP 9.

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: Overall Summary

Number of Working Groups supported by NIMBioS
53

Average membership:
14
(*SD*=3)

Total participation:
762

Total unique participation:
679

Average meeting length:
3.5 days
(*SD*= .87)

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

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

Working Group Summary. During RP 9, NIMBioS hosted 15 Working Group meetings, including the start of 3 new groups and the return of 11 established groups – see Figure 18. A total of 154 participants (144 unique) from 100 institutions took part in the Working Groups. During RP 9, participants came together from 11 different major fields of study to focus on the respective scientific questions of their groups.

Figure 18 . Timeline of AR9 Working Group and Investigative Workshop events including the number of participants for each event

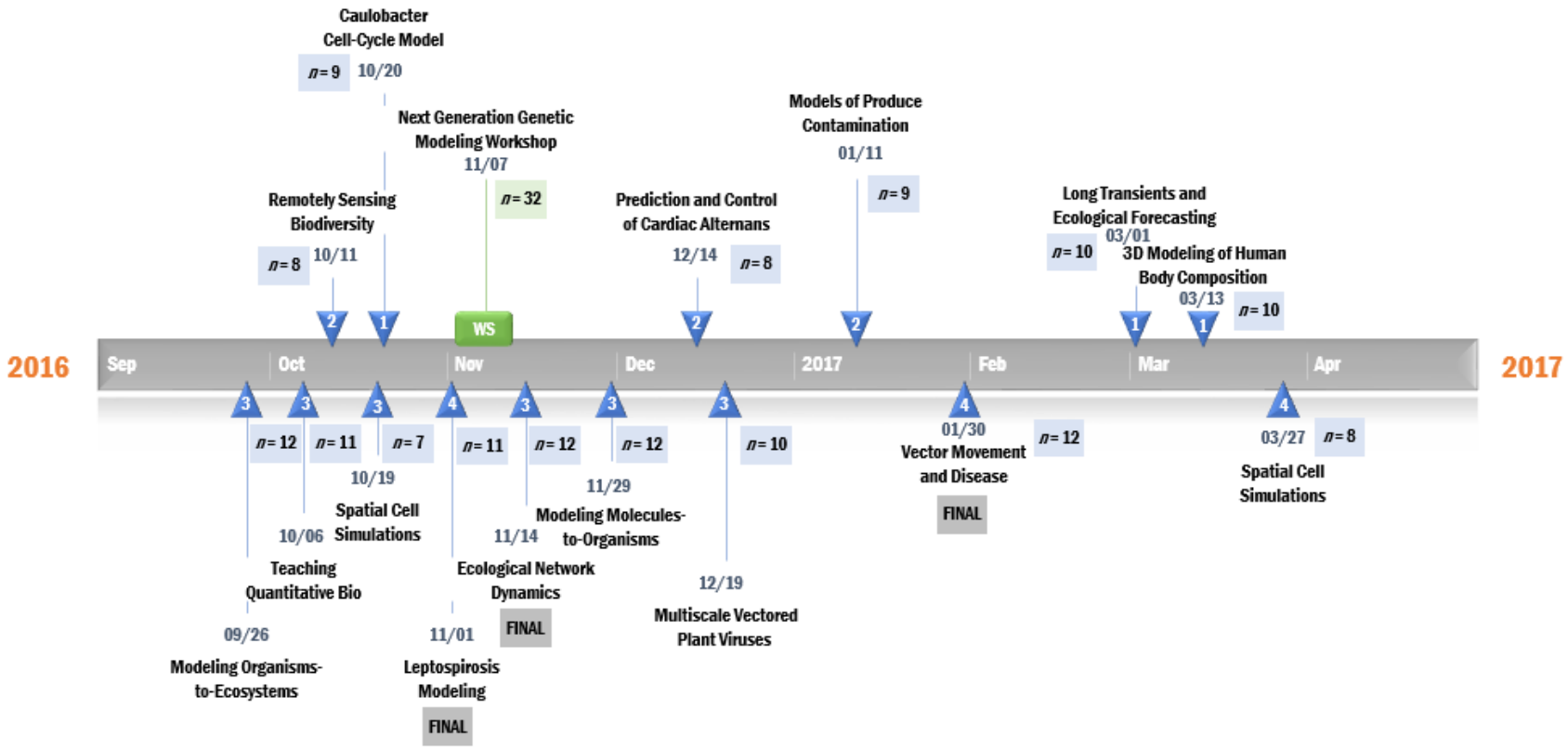
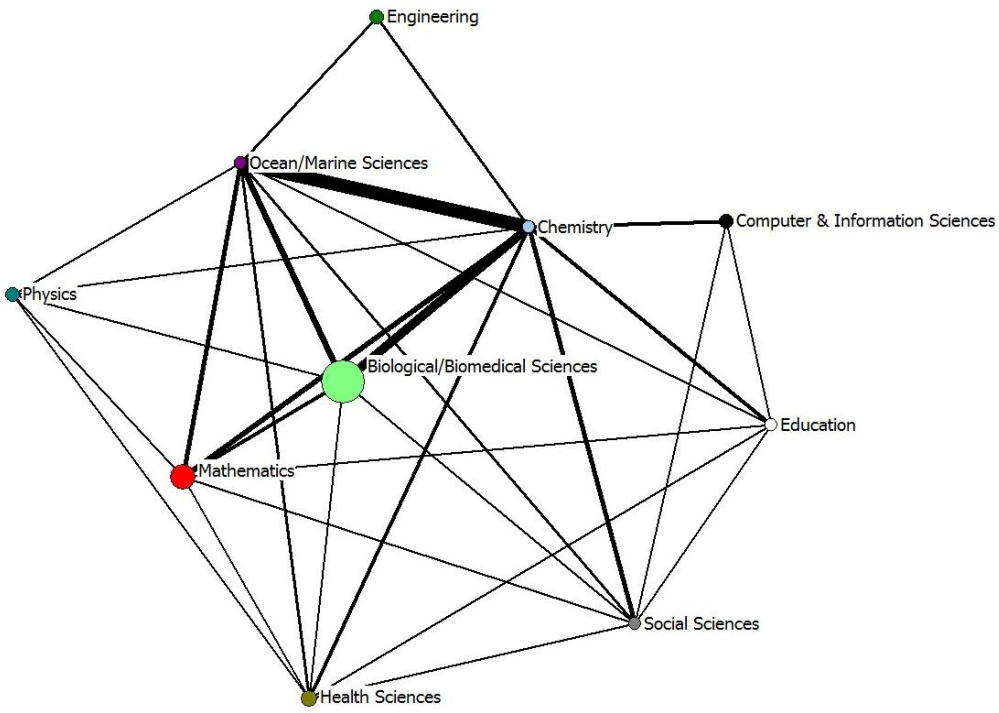


Figure 19 shows the cross-disciplinary connections fostered among Working Group members through the meetings hosted at NIMBioS during RP 9. Node radius is representative of the log scaled number of participants in each field of study. Line size is representative of the number of times researchers from each field were brought together to collaborate and problem-solve at NIMBioS.

Figure 19. Working Group cross-disciplinary collaboration



Working Group Organizer feedback

NIMBioS collects overall satisfaction feedback from Working Group organizers to the following question: As an event organizer, how satisfied were you overall with the way your event was managed by NIMBioS? 100% of organizers (n = 33) were very satisfied (n =27) or satisfied (n = 6) with how NIMBioS managed their working group event.

100% of organizers were satisfied with how NIMBioS handled the event!

From the organizers:

> The staff was very helpful, both in planning the meetings, when we were at the meeting, and afterward for reimbursement etc.

> NIMBioS is the best organization for catalyzing great working meetings, bar none.

Working Groups: Feedback

"Many thanks to NIMBioS for the very efficient support and wonderful hospitality.

"The support was almost magical with food laid out just in time for breaks and a quick resettlement of our cancelled flights. The staff is amazing.

The most useful aspect of the working group:

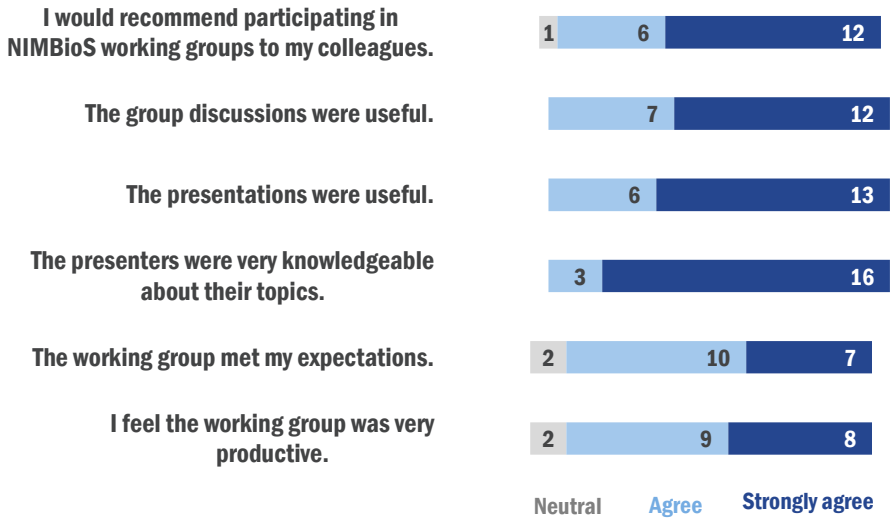
"Open discussion forum among a variety of expertise. Some truly new ideas came to me as a result. Very collaborative environment which means it was easy to think of new ideas. At the same time, very rooted in how to make this a self-sustaining effort. Very cool presentations which encouraged brainstorming and feedback.

Working group First Meetings

During RP 9, NIMBioS hosted the first meetings of three Working Groups, with a total of 29 participants. Evaluation surveys were sent to all participants. A total of 27 participants took part in the evaluation of the first meetings of their Working Groups. Eight of these participants were organizers and only answered questions about how they felt NIMBioS managed their events. (See http://www.NIMBioS.org/workinggroups/ for more details about specific Working Groups).

HIGHLIGHTS OF WORKING GROUP FIRST MEETING EVALUATION RESPONSES (FIGURES 20 TO 21).

Figure 20. Overall agreement with the content and format of the Working Group



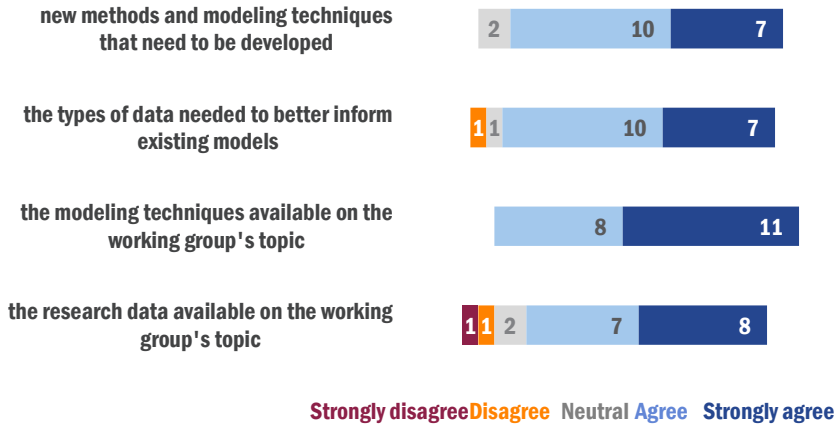
100% of participants indicated they had a better understanding of the research happening in the field in disciplines other than their own as a result of participating in this Working Group.

Working Groups: Feedback

"Whether these working groups result in joint research and publications or not, they are extremely productive because they allow plentiful opportunities for researchers with similar interests but complementary expertise to exchange ideas and formulate new problems and solutions, and not only pose questions, but also get answers.

"The meeting on January in NIMBioS was excellent and we have organized different tasks to be completed until the next meeting. I believe we are going in the good direction. Thanks NIMBIOS for giving us this opportunity.

Figure 21. Participants who felt the exchange of ideas during the Working Group would influence their future research:



Working Group Second, Third and fourth Meetings

During the reporting period, NIMBioS hosted the second meetings of three Working Groups, with 25 participants, the third meeting of six Working Groups, with 68 participants, and the fourth meeting of three groups, with 32 participants (Figure 18). Beginning in March 2011, NIMBioS changed its policy on evaluation of Working Group meetings to only sending full evaluation surveys to participants after the first and final meetings, rather than after every meeting, however, comments were solicited about the general feeling about the group's progress.

Concluded Working Groups

A total of 40 working groups having concluded with NIMBioS, with three Working Groups reaching their conclusions during the current reporting period (Figure 18). It is the policy of NIMBioS to send follow-up evaluation surveys to Working Group participants after the final meeting. A total of 247 participants from 32 Working Groups responded to the final evaluation for their groups.

Working Groups: Feedback

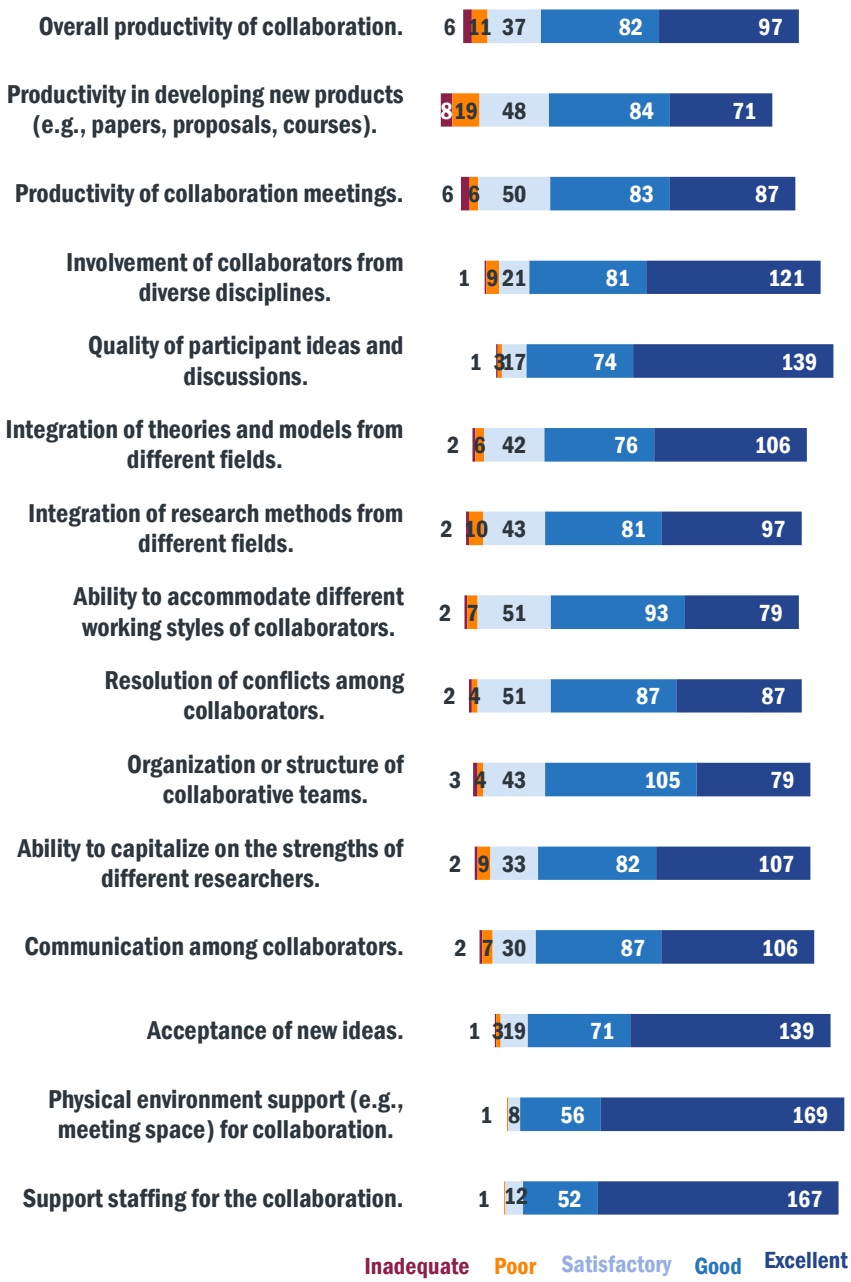
"NIMBioS support was fantastic, and provides an excellent and unique forum for interdisciplinary research to happen.

"A very stimulating intellectual environment

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

HIGHLIGHTS OF WORKING GROUP FOLLOW-UP EVALUATION RESPONSES (FIGURES 22 TO 24)

Figure 22. Evaluation of various aspects of Working Groups



Working Groups: Feedback

"I was very pleased with the way NIMBioS hosted us. This was a very stimulating meeting.

"This working group was very productive and it was a lot of fun working with everyone. I have continued collaborating with people from the working group even though the grant from NIMBioS has expired.

"I've participated in, led, or co-lead 5 WGs similar to Nimbios...some more applied, some not. First, UT, Knoxville, the hotel, and the facility are excellent...the best so far. Nimbios staff are also amazing and deserve much credit! The location, structure, and management of Nimbios sets a strong basis an effective team...it's by far the best place I've been to yet...

Figure 23. Evidence to support new insights and collaborations within the group

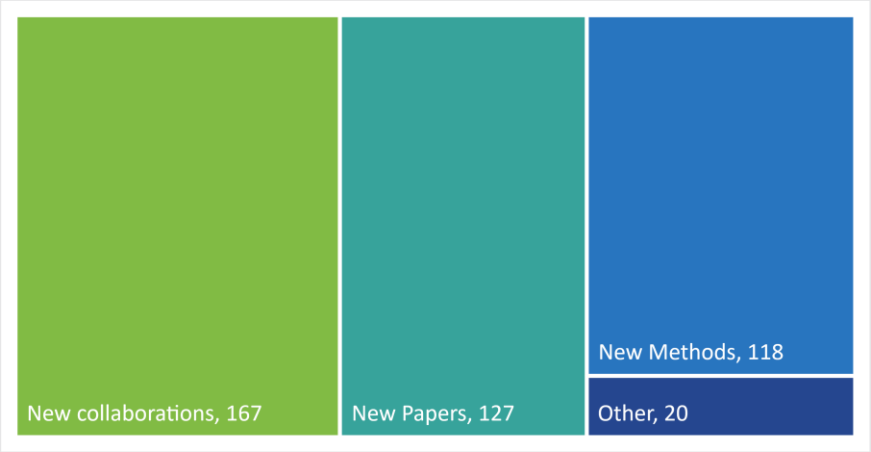
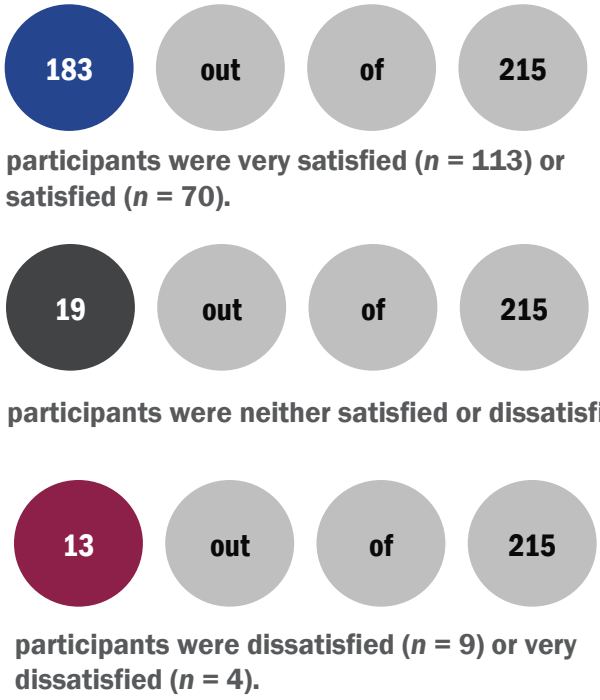


Figure 24. Overall satisfaction level with the Working Group



Investigative Workshops: Overall Summary

Number of Investigative Workshops supported by NIMBioS
42

Average attendance:
36
(*SD*=5)

Total participation:
1,532

Total unique participation:
1,377

Average meeting length:
2.9 days
(*SD*= .40)

INVESTIGATIVE WORKSHOPS

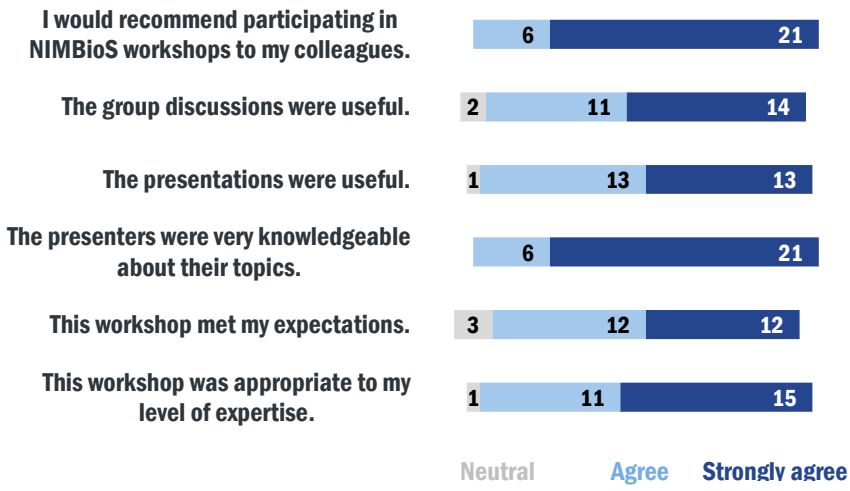
NIMBioS Investigative Workshops differ from Working Groups in that they focus on a broader topic or set of related topics at the interface of biology and mathematics and have relatively large size (30-40 participants). Workshops attempt to summarize/synthesize the state of the art and identify future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

NIMBioS hosted one Investigative Workshop during RP 9 with a total of 32 on-site participants and 10 virtual participants (Figure 18). Evaluation surveys were sent to all on-site Workshop participants. A total of 30 participants took part in the evaluation of the Workshops.

HIGHLIGHTS OF WORKSHOP EVALUATION RESPONSES (FIGURES 25 TO 26)

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

Figure 25. Overall satisfaction with the content and format of the Workshop

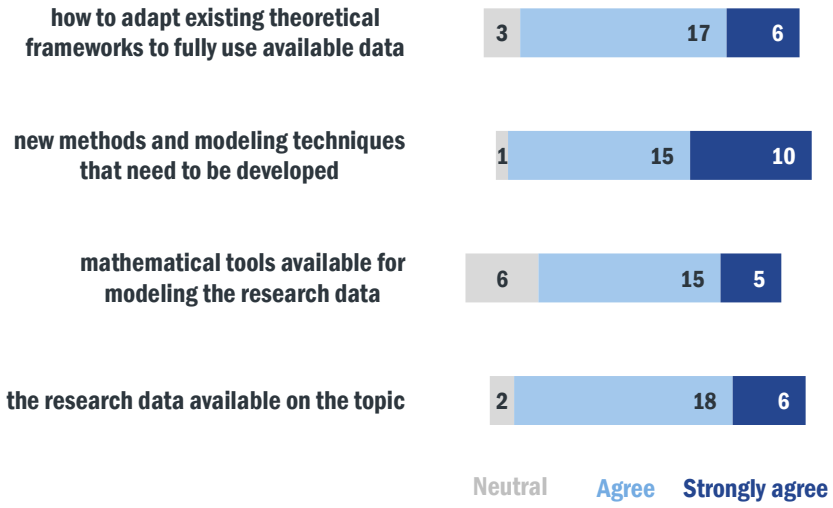


Workshop Feedback

"The diversity of participants was extremely helpful because we were able to consider a wide range of opinions and scientific experience and background.

"Best workshop I've participated in, and I'm mid- to late-career. I normally dislike small groups, and I'm not sure if I just got lucky but my group was terrific. Plus, Sean Hoban did a great job as coordinator/director. It was really a good use of my time, far more so than I ever expected.

Figure 26. Participant responses to the following question-- As a result of participating in this Workshop, I have a better understanding of:



EDUCATION AND OUTREACH PROGRAM ACTIVITIES

Tutorial

While NIMBioS has hosted a total of 20 tutorials, no tutorials have been hosted within the current AR9 period.

Tutorials: Overall Summary

Number of Tutorials supported by NIMBioS
20

Total unique participation:
573

Average attendance:
33

Average meeting length:
3.5 days
(*SD* = .40)

Total attendance:
654

16 out of 16

of SRE participants were very satisfied (n = 12) or satisfied (n = 4) with the research experience.

summer research experience

The NIMBioS Summer Research Experience (SRE) program took place on the University of Tennessee, Knoxville (UT) Knoxville campus June 06-July 29, 2016. Sixteen undergraduates were chosen to participate in the program. (While this SRE program technically fell within the dates of reporting period eight (RP 8), the SRE program for 2017 will not conclude until after the RP 9 annual report is due, so results from the previous year's SRE evaluation are provided each year.)

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

The five research projects for the 2016 program included: 1) Using statistical filters to follow fast organelle movements in plant cells; 2) Dynamic modeling of human emotion; 3) Mouse trap! Modeling the spread of mice & hantavirus in pressured landscapes; 4) Decoding allostery by mathematical analysis of molecular dynamics simulations; and 5) Developing computer games for teaching biology.

CONTEXT

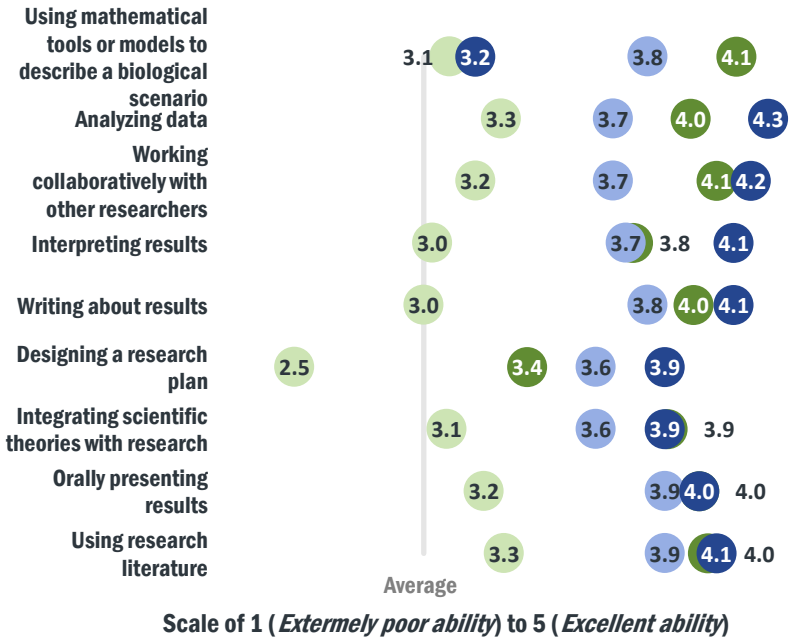
1. Participants will be satisfied with the program overall.
2. The research experience will meet participant expectations.
3. The research experience will impact participant plans to go to graduate school.
4. Participants will increase their research skills during the program.
5. Participant will feel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

HIGHLIGHTS OF SRE EVALUATION RESPONSES (FIGURES 27 TO 28)

SRE Feedback

"NIMBioS is not quite well known to my peers in my school (at least for me, I haven't ever heard of this until I searched online for stat/math/bio summer research program). This was such a great experience for meeting with people, and learning about research, and having fun! There's a pretty big bio department in my school so I'm pretty sure there would be plenty of people interested in this once they know there's such an institution that offers such a great summer experience.

Figure 27. Participant pre-and post-program skills as rated by SRE participants and Mentors. (Lighter colors indicate pre-scores and darker colors indicate post-scores.)



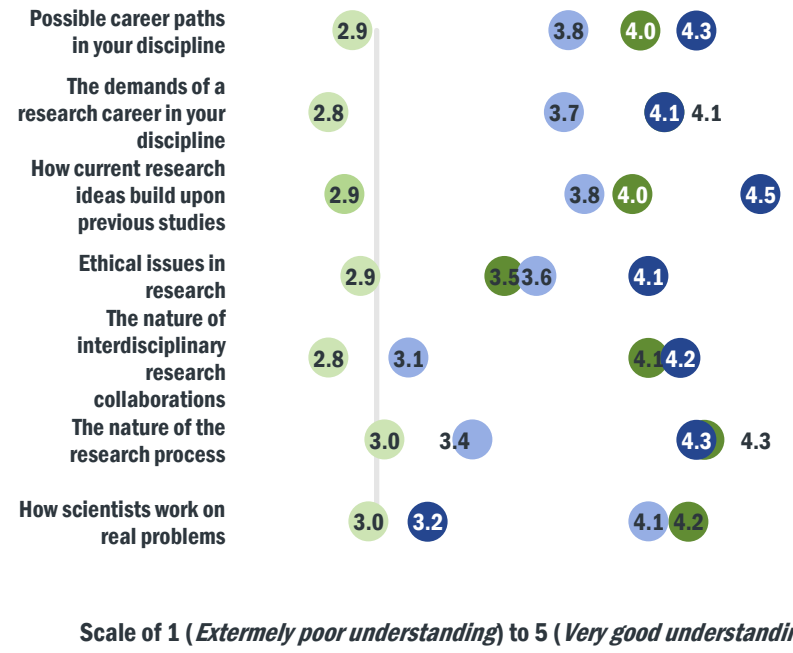


Figure 28. (above) Participant pre- and post-program knowledge as rated by SRE participants and Mentors. (Lighter colors indicate pre-scores and darker colors indicate post-scores.)

URC Feedback

"I enjoyed very much my first conference experience with NIMBioS. I got a lot of positive influences on my personal career plans and also my passion about doing research in math and biology.

"Overall, my experience was incredible and I am so grateful to have been able to fly to UT in order to present research that my team and I have been working on for months. I find research so fascinating and really loved that I got to participate in something like this.

"The meeting has never failed to meet my expectations as I attend from year to year.
And this year had been particularly rewarding because the students I came with appreciated the opportunity to share their work and mingle with other students doing great research.
It is my hope that this meeting will lead to future collaboration. (faculty)

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

The NIMBioS seventh annual Undergraduate Research Conference at the Interface of Biology and Mathematics took place at the University of Tennessee's Conference Center in downtown Knoxville October 08-09, 2016. The event was organized by the NIMBioS Education and Outreach Associate Director for Education, Outreach, and Diversity, Suzanne Lenhart, and the Education and Outreach Coordinator Kelly Sturner.

A total of 83 participants (plus 2 organizers) attended the eighth annual Undergraduate Research Conference, which provided opportunities for undergraduates to present their research at the interface of biology and mathematics. Student talks and posters were featured as well as a panel discussion on career opportunities. Evaluation surveys were sent to all participants in the conference, with the exception of event organizers. A total of 54 participants took part in the evaluation.

CONTEXT

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

HIGHLIGHTS OF URC EVALUATION RESPONSES (FIGURES 29 TO 30)

Figure 29. Respondent agreement levels with statements about various aspects of the conference for undergraduate and non-undergraduate participants.

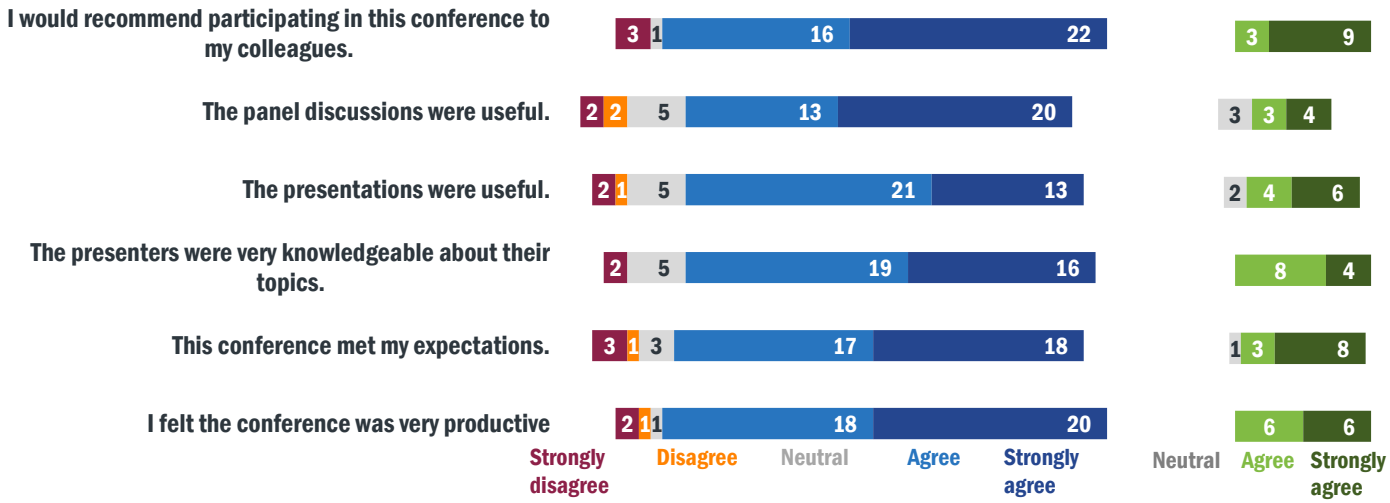
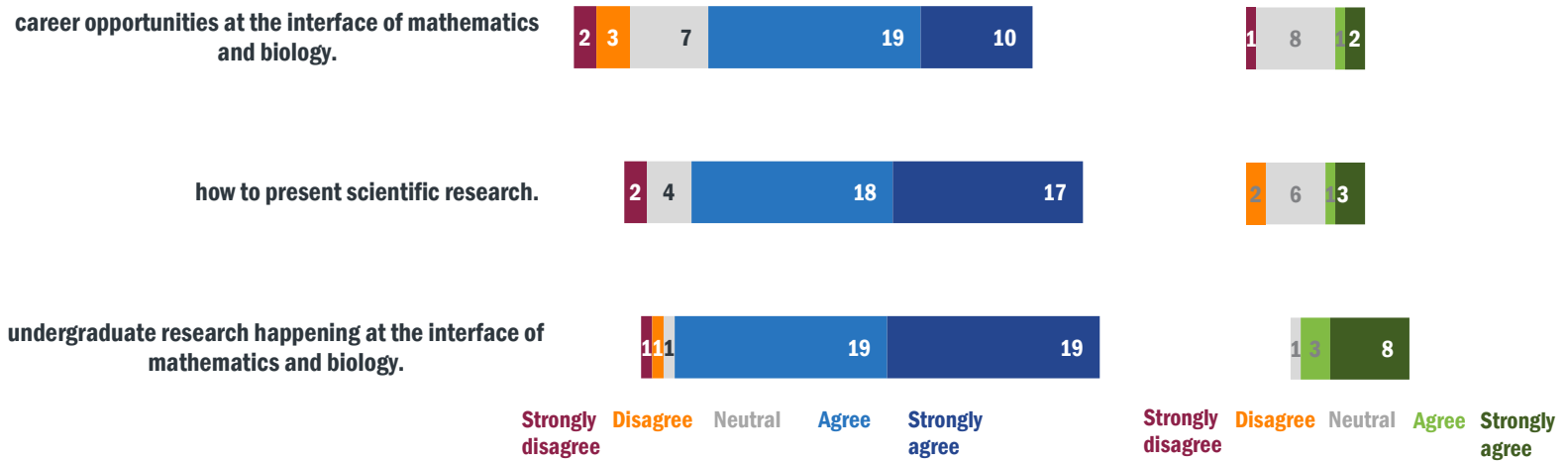


Figure 30. For undergraduate and non-undergraduate participants-- As a result of attending this conference, I have a better understanding of:



Postdoc Overall Summary

Postdoctoral alumni
39

Current postdocs
7

Average appointment:
1.91 years
(SD = 0.44)

NIMBIOS POSTDOCTORAL FELLOWSHIP PROGRAM

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

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

CONTEXT

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

Postdoc Feedback

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

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

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

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, 34 (87%) alumni from the program have filled out the form.

HIGHLIGHTS OF POSTDOCTORAL FEL OWSHIP PROGRAM RESPONSES (FIGURES 31 TO 33)

Figure 31. Postdoctoral fellow satisfaction with program mentors

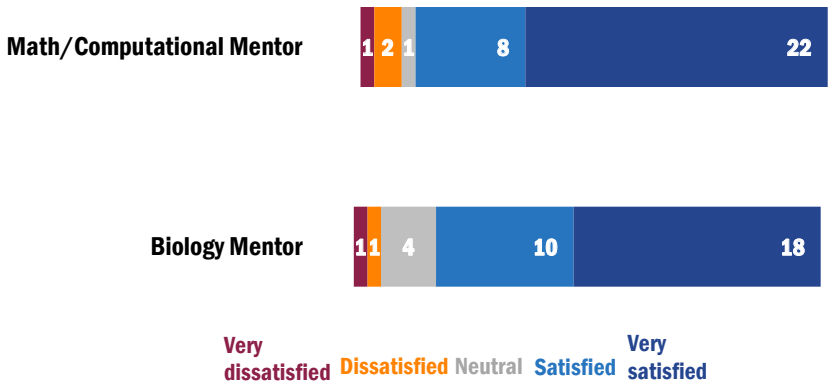
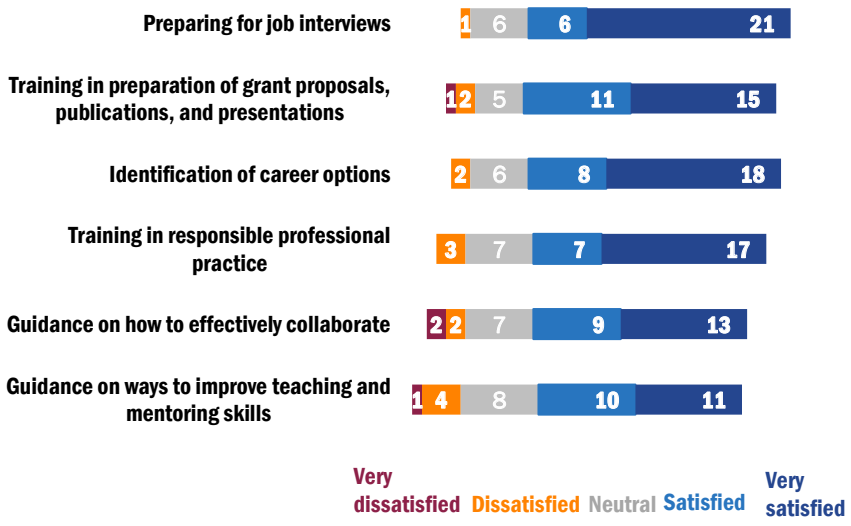


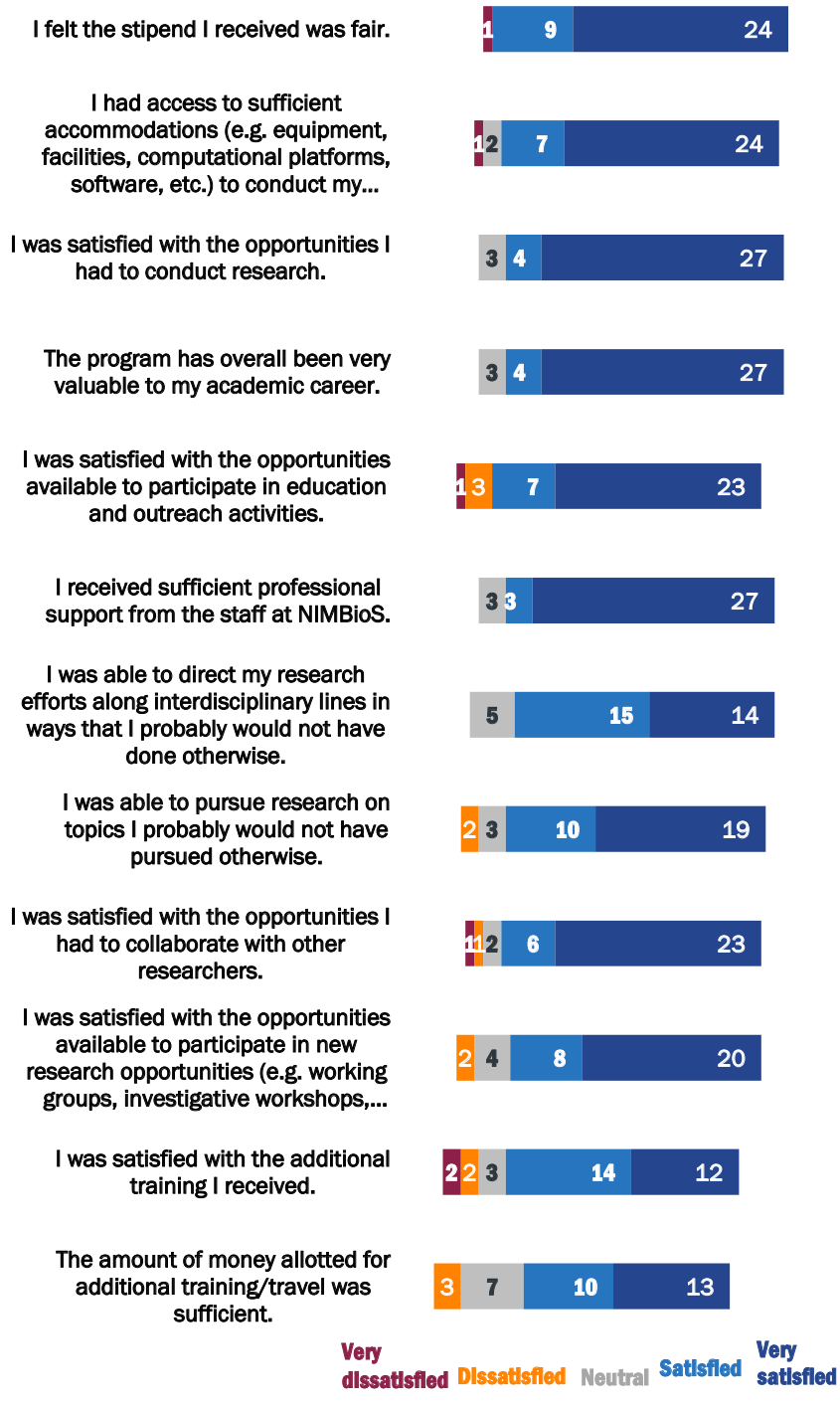
Figure 32. Postdoctoral fellow satisfaction with advice/assistance received from program mentors



Postdoc Feedback

"I was extremely impressed with the NIMBioS postdoctoral fellowship program. Paul Armsworth dedicated a tremendous amount of effort to facilitate our careers and build a strong collaborative network amongst the postdocs (including the alumni), and was a great role model for all of us. Whether he realized it or not, we took note of how productive Paul was and tried to change our habits to become more effective and efficient workers. Having such a high-energy, collaborative, and diligent group of postdocs was inspiring. We would often have a healthy level of competition among each other, and would encourage each other to meet new challenges. Some postdocs were not as sociable as others, but overall it was a great group to learn from and colleagues that I hope I interact with in the future. Thanks to the NIMBioS leadership team and staff for everything that they did! I cannot thank them enough for going above and beyond the call of duty to foster the growth of the postdocs and build a supportive and collegial work environment among the entire NIMBioS community.

Figure 33. Postdoctoral fellow satisfaction with overall program experience



PRODUCT EVALUATION

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

CONTEXT

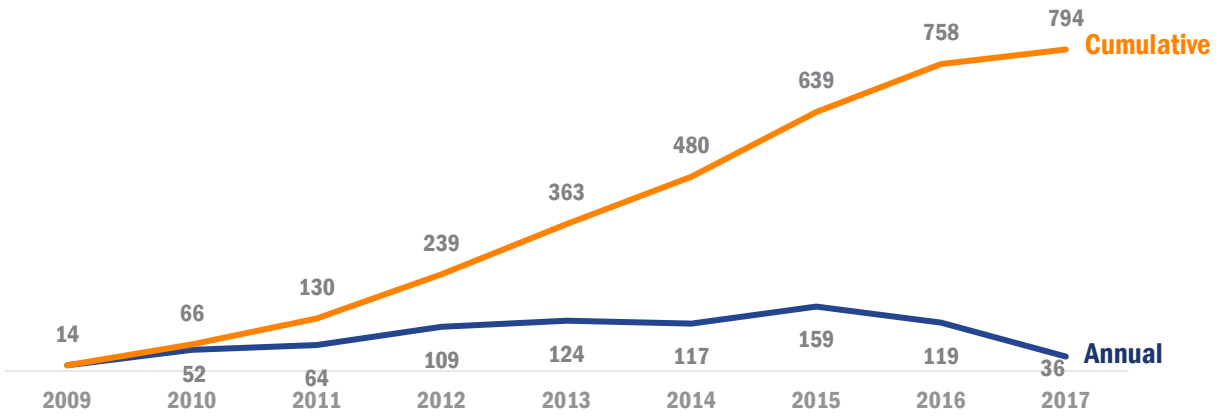
1. NIMBioS publications will be highly interdisciplinary.
2. NIMBioS publications will be highly cited.
3. NIMBioS publications will highly collaborative.
4. NIMBioS participants will produce other scholarly products, including book chapters, presentations, proposals for follow-on research, meetings/Workshops,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

PUBLICATIONS

Activities at NIMBioS have led to 794 published journal articles on a range of subjects from January 2009- April 2017, (**Figures 34 to 35** and **Table 1**). An additional eight are in press at writing and 16 have been submitted for review. The articles cover research ranging across many areas of ecology, evolutionary biology, applied mathematics, and computational biology.

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

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



Note. 2017 includes publications submitted by participants to NIMBioS through April 2016

NIMBioS products are published in many high-ranking journals in their respective fields. Table 1 highlights the number of products in a selection of high-impact journals according to the Web of Science impact factor. Prominent high impact journals include Nature, Cell, Science, Ecology Letters, and Trends in Ecology and Evolution.

NIMBioS publications come from a variety of activities, although Working Group participants tend to publish the largest portion of journal articles (29%), followed by NIMBioS Postdoctoral Fellows (27%) (Figure 36).

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

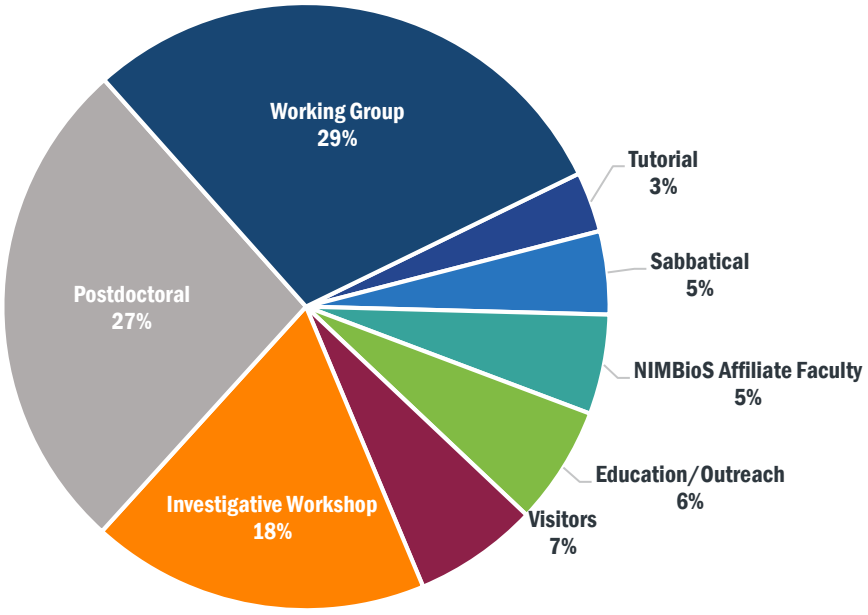


Table 1. Number of NIMBioS articles published in a selection of high-impact journals during the current reporting period (through April 2016) and since NIMBioS' inception, sorted by journal 5-Year Impact Factor

Journal Title	5-Year Impact Factor *	# of NIMBioS Publications in Year 9 **	# of NIMBioS Publications Since Inception ***
Nature	41.46	0	5
Cell	32.86	0	1
Science	34.92	1	8
Trends in Ecology and Evolution	19.42	0	7
Ecology Letters	14.94	1	11
Systematic Biology	15.27	0	7
PLoS Biology	10.73	0	3
Nature Communications	12.00	0	2
Proceedings of the National Academy of Sciences	10.29	3	19
Current Biology	9.73	0	1
PLoS Genetics	7.48	0	2
Nucleic Acids Research	8.65	0	3
Phil Trans of the Royal Soc B-Biological Sciences	7.22	1	7
Molecular Ecology	6.23	1	11
Ecology	5.98	1	7
Proc of the Royal Soc B-Biological Sciences	5.366	2	12
PLoS Computational Biology	5.12	0	8
Evolution	4.37	0	17
Journal of Animal Ecology	5.25	0	4
American Naturalist	4.13	0	13
Journal of the Royal Society Interface	4.41	0	5
PLoS One	3.54	1	36
Animal Behaviour	3.28	0	9
BMC Bioinformatics	3.44	0	2

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

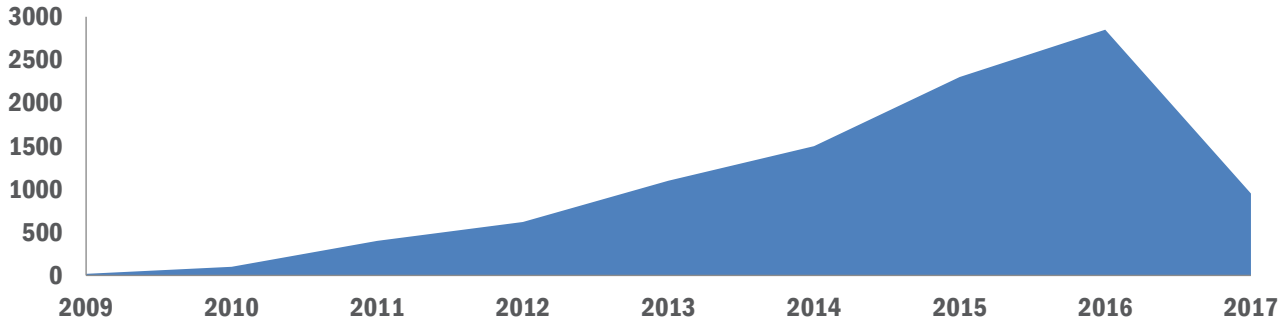
** Number of publications in Year 9 includes all publications reported since compilation of the previous Annual Report (April 2015) through April 2017.

*** September 2008 – April 2017

Bibliometric indicators

CITATION ANALYSIS OF PUBLICATIONS. Of the 794 journal articles reported by NIMBioS participants, 719 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 2,210 researchers from 819 unique institutions spanning 57 countries. These articles have appeared in 269 different journals, many of which are considered to have high-impact in the academic community. These articles have been collectively cited 9,991 times, with an average of 13.92 cites per article, and an h-index of 43 (Figure 37). The cites per article falls within the range of the two major research fields of the publications during the last 10 years; mathematics (4.14 citers/paper) and biology (16.91 cites/paper). Eighty-five participants have authored five or more papers each as a result of NIMBioS affiliated collaborations.

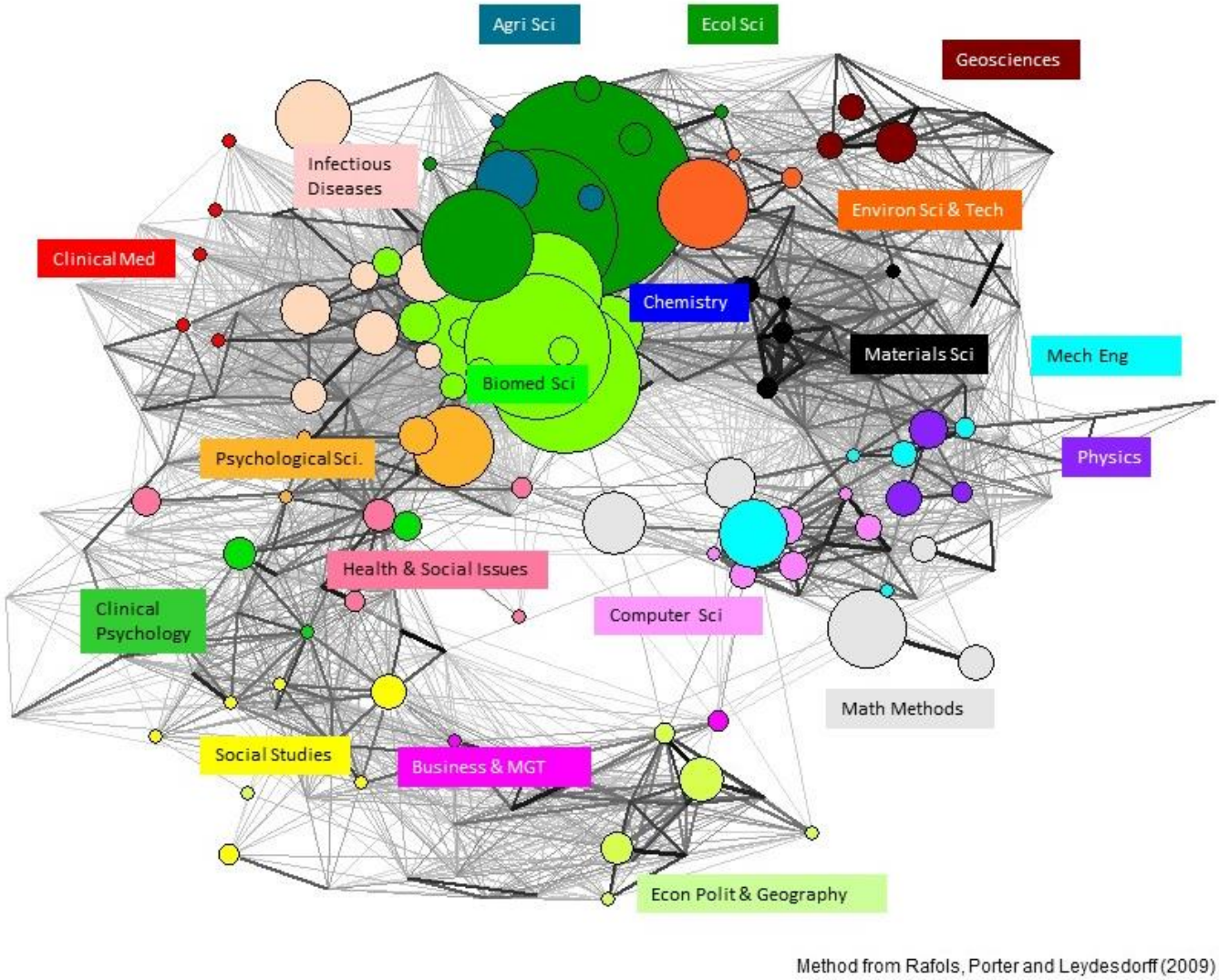
Figure 37. Citations per year for NIMBioS articles



DISCIPLINARY SPAN OF PUBLICATIONS. The 719 published articles in WOS span 104 discipline areas, as designated by the ISI WOS Categories. Categories are assigned at the journal level based upon a combination of citation patterns and editorial judgment at the ISI. Subject categories are used in bibliometric research as a representation of the research areas in which scientists work.

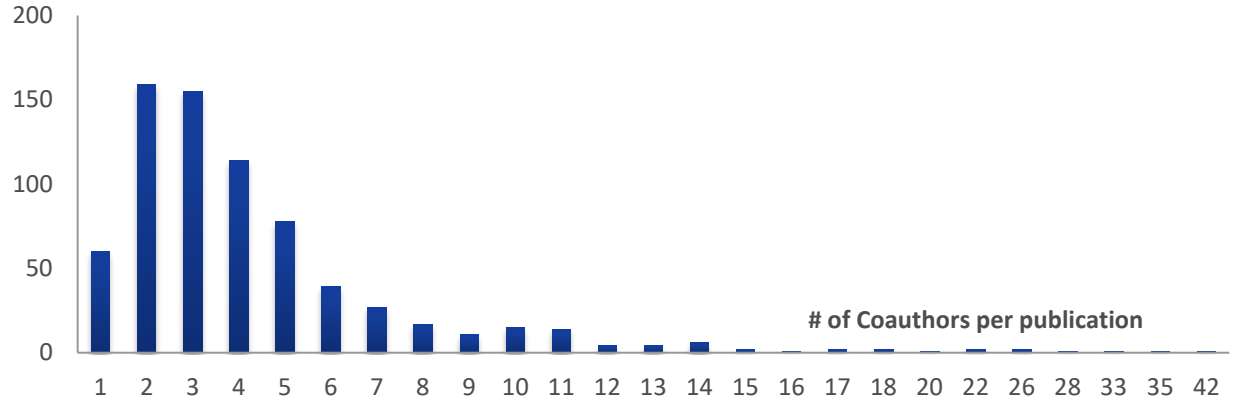
Figure 38 locates the subject categories of the 719 NIMBioS articles on a network map of the WOS Categories. The gray background intersections are the 224 WOS Categories, located based on cross-citation relationships among all WOS journals in 2007 (from Rafols, Porter, and Leydesdorff, 2009). The 19 labeled "macro-disciplines" are based on factor analysis of that cross-citation matrix also. Nearness on the map indicates a closer relationship among disciplines. Circular node sizes reflect the relative number of NIMBioS participant publications. The most common subject category in which NIMBioS publications fell was Ecology (204), followed by Evolutionary Biology (14), Biology (103), Mathematical & Computational Biology (100), Multidisciplinary Sciences (92), and Genetics & Heredity (58).

Figure 38. Web of Science categories for 719 WoS journal articles to date



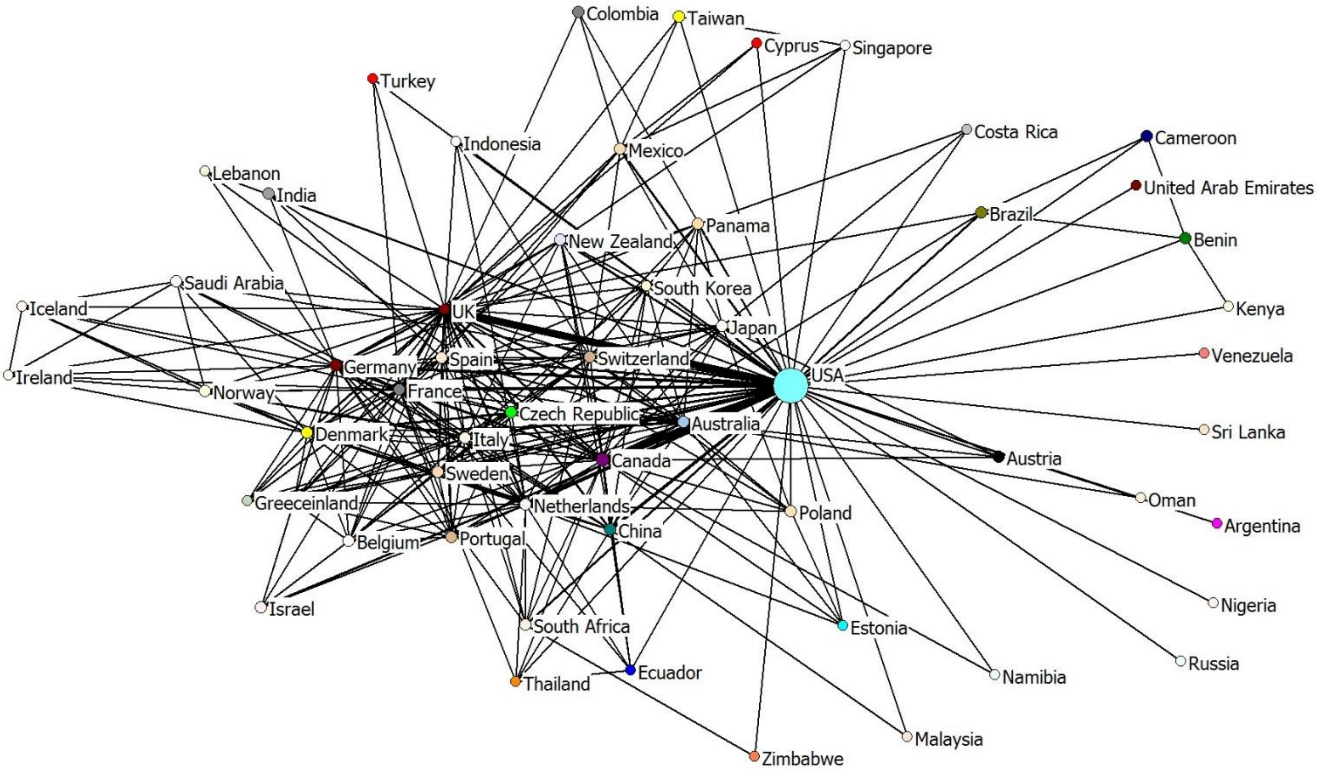
COAUTHORSHIP. One of the core values of NIMBioS is to take a collaborative approach to science and science education. We are interested, therefore, in examining the number of co-authors on NIMBioS-related publications as one indicator of scientific collaboration. For the 719 publications reported thus far, the average number of co-authors per paper is 4.5 (Figure 39).

Figure 39. Coauthorship frequency of NIMBioS publications



INTERNATIONAL COAUTHORSHIP. NIMBioS also fosters international collaboration among researchers. While 57 different countries have been represented by NIMBioS coauthorship through the current reporting period, the average number of countries of coauthors per paper is 1.7, with a range of 1-12 countries represented per paper (**Figure 40**).

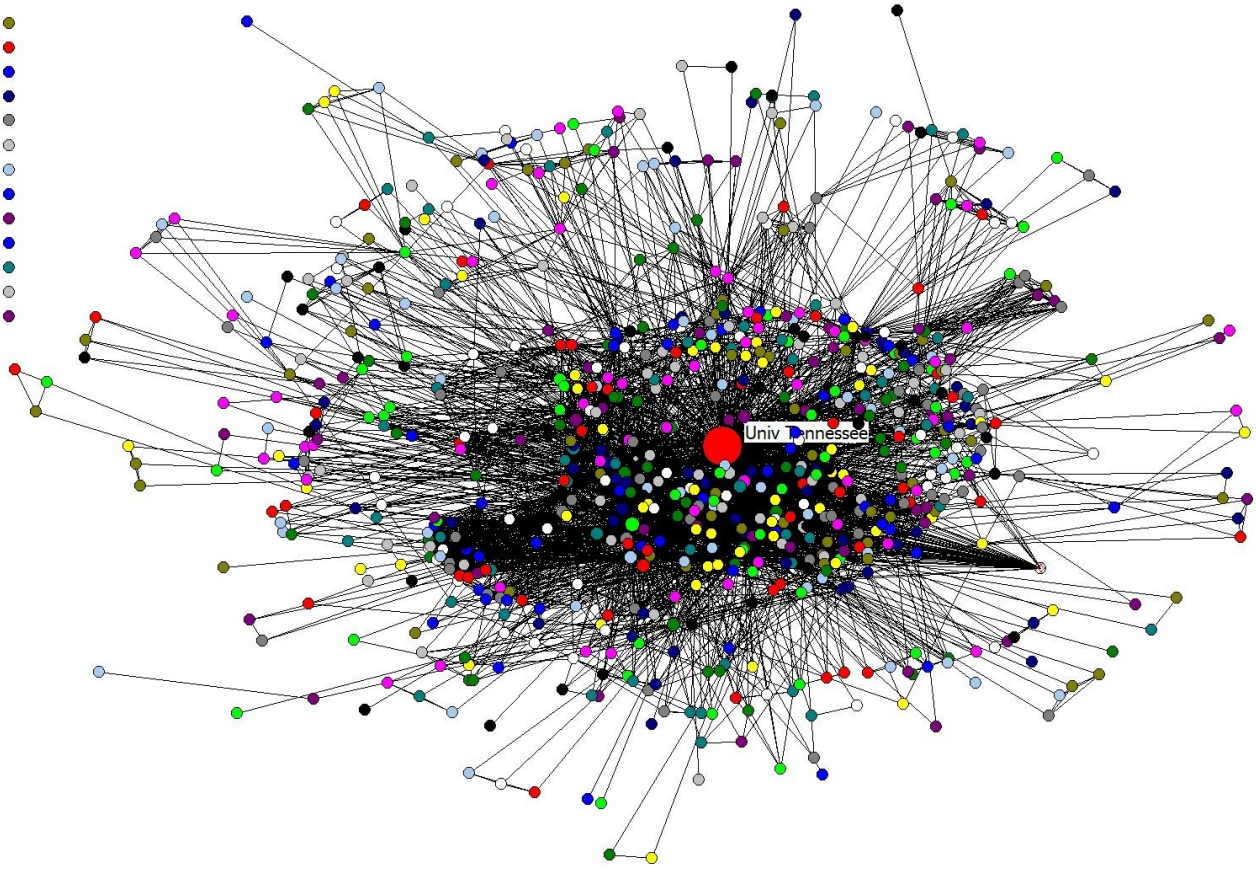
Figure 40. International collaboration on NIMBioS publications



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 819 unique institutions **(Figure 42)**. The average number of institutions represented per paper was 3.4, with a range of 1-35 institutions per paper.

Figure 41. Cross-institutional collaboration of 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 13 of the 819 institutions represented have published single-institution papers. The University of Tennessee is at the center of the graph.

OTHER SCHOLARLY PRODUCTS

In addition to journal publications, participants report other types of products that have resulted from their activities at NIMBioS. **Figure 43** summarizes these types of products for the nine-year period. In addition to the items listed in Figure 43, NIMBioS participants have reported 858 conference presentations related to NIMBioS affiliation.

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