



NIMBioS

National Institute for Mathematical  
and Biological Synthesis

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

**National Institute for Mathematical and Biological Synthesis**  
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National Institute for STEM Evaluation and Research

115 Philander P. Claxton Education Building

The University of Tennessee, Knoxville

p. (865) 974-9348

f. (865) 974-9300

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

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## CIPP Model

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

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

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

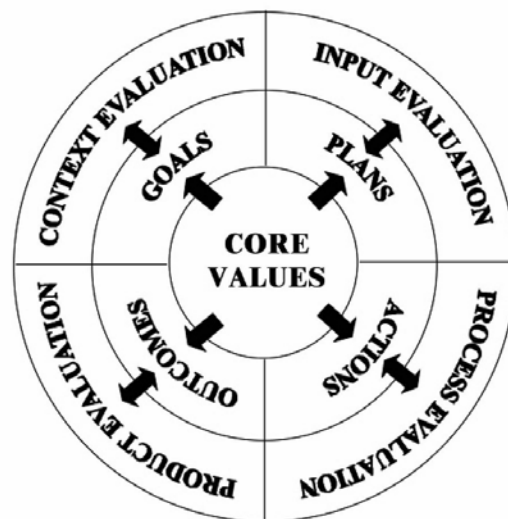
**Product Evaluation** assesses outcomes of the program.

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

## INTRODUCTION

This is an evaluation summary of NIMBioS activities during the ninth annual reporting period (RP 10) to the National Science Foundation. This report covers the period of September 1, 2017 through June 30, 2018. The NIMBioS evaluation program follows the CIPP systems approach, which considers not only the outcomes of the center, but how the outcomes are achieved. The evaluation addresses four main interconnected evaluation phases as seen in Figure 1:

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



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

## CONTEXT EVALUATION

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

## INPUT EVALUATION

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

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

## PROCESS EVALUATION

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

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

## PRODUCT EVALUATION

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

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



## ACTIVITIES – REPORTING PERIOD 10

Table 1. Research program activities

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

### Education and Outreach (EO) program activity highlights:

NIMBioS Interdisciplinary Seminar Series

Biology in a Box Program

Summer Research Experiences (SRE) Program

Undergraduate Research Conference at the Interface of Biology  
and Mathematics

UT STEM REU Symposium

Applications of Spatial Data: Ecological Niche Modeling Tutorial

The Search for Selection Tutorial

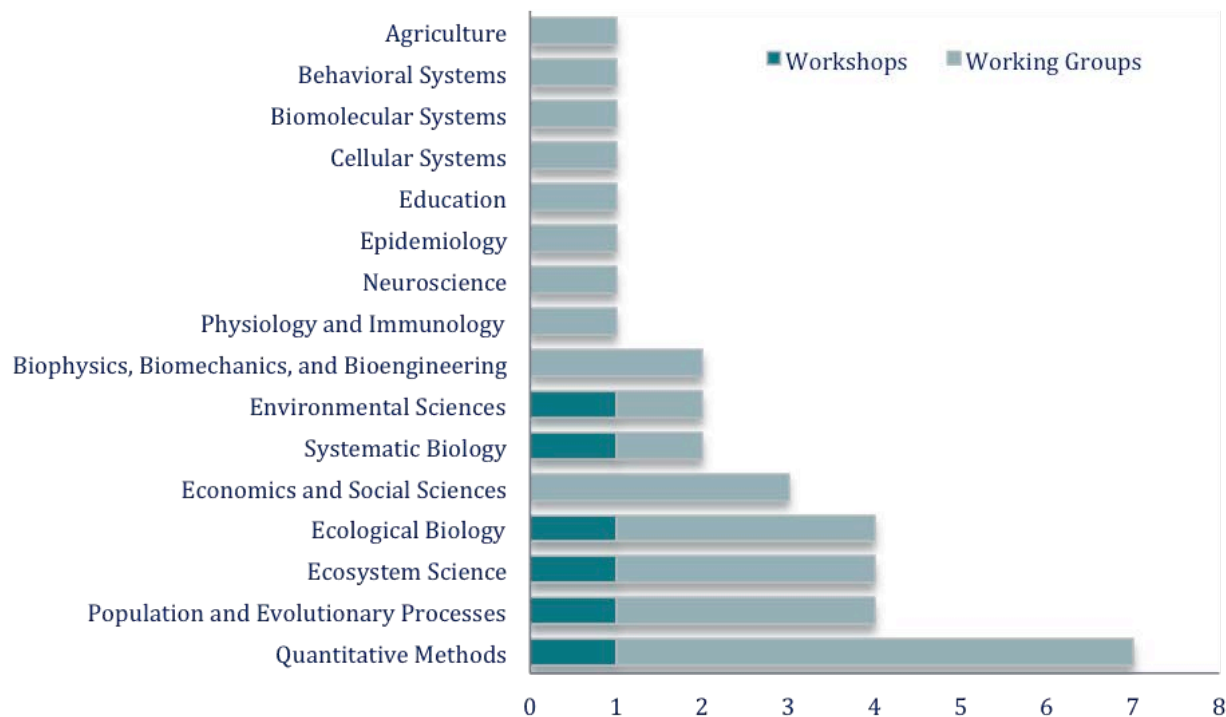
Modern Math Workshop at SACNAS meeting

**Other events:** 1 Advisory Board Meeting (Oct 2017)

## DIVERSITY OF RESEARCH ACTIVITIES

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

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



## DIVERSITY OF PARTICIPANTS

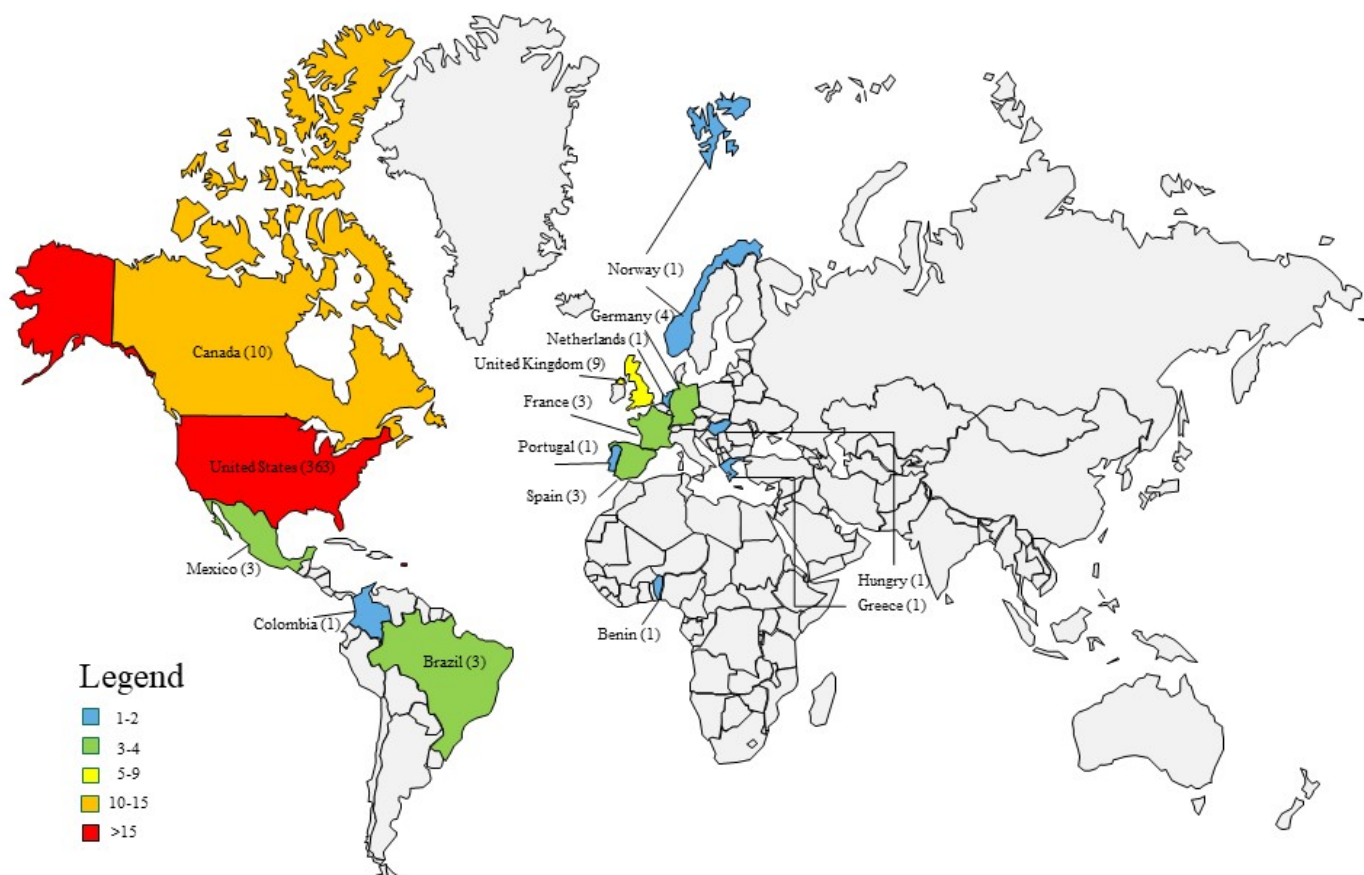
One of the core values of NIMBioS is to increase the diversity of researchers and educators at the interface of mathematics and biology. NIMBioS collects voluntary demographic data from event applicants to gauge whether our program is fairly reaching and benefitting everyone regardless of demographic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

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

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

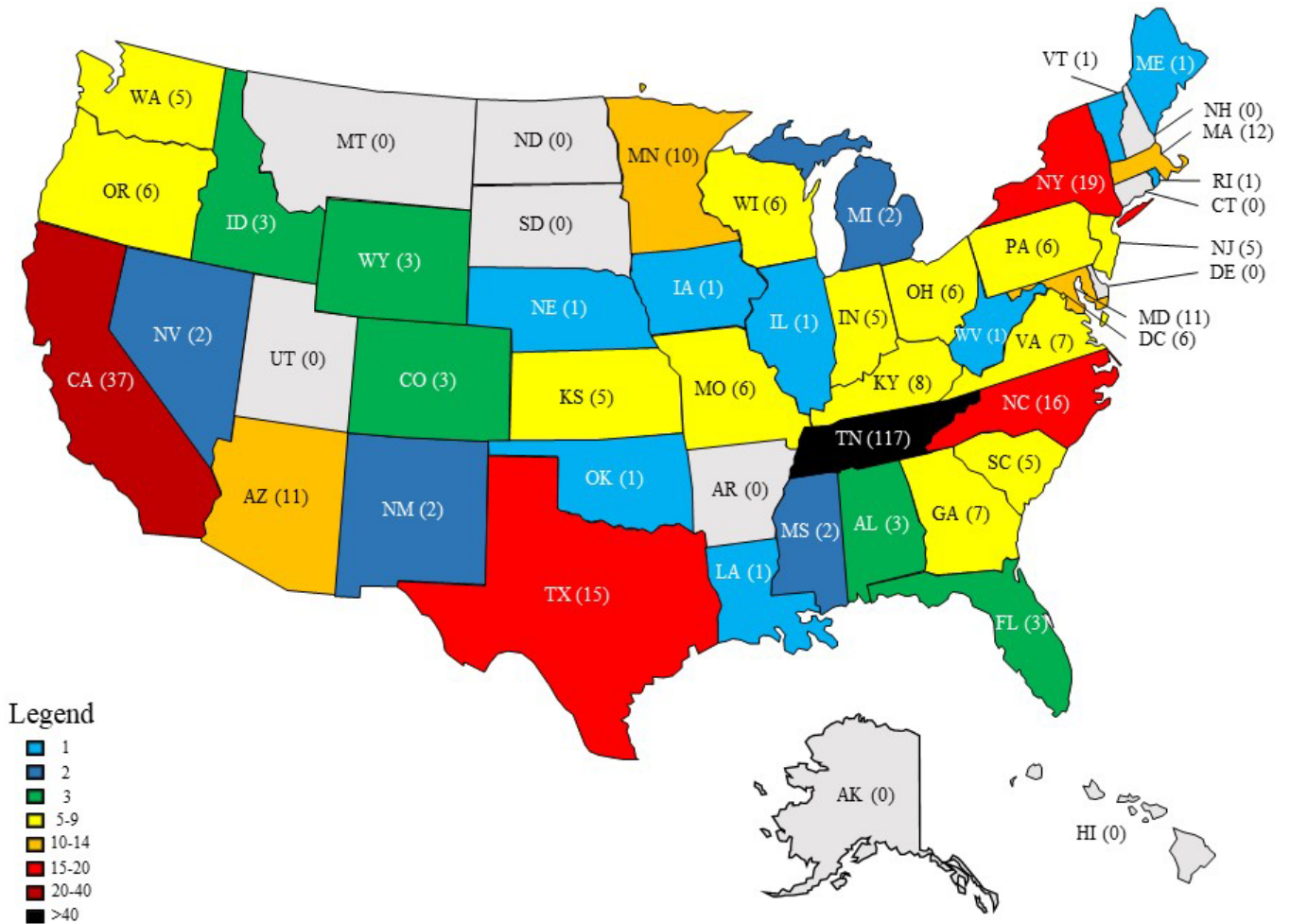
**Geographic Diversity.** During RP 10, 408 participants (350 unique individuals) from 15 countries participated in NIMBioS events. Most participants came from the United States (89%), followed by Canada (2%) and The United Kingdom (2%) (Figure 3). Roughly 1% of participants did not indicate country.

Figure 3. NIMBioS RP 10 participants by country



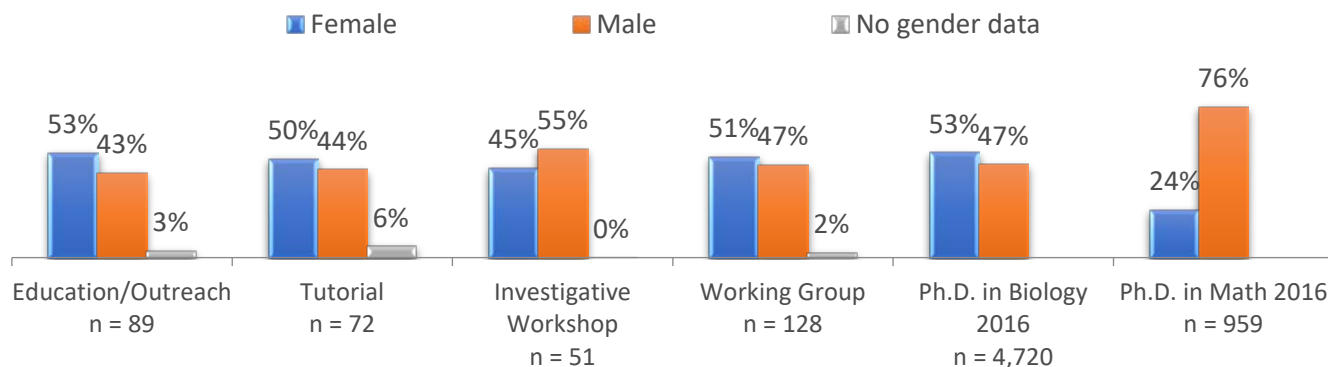
Within the U.S., 40 different states, as well as the District of Columbia, were represented. The largest percentage of participants came from within Tennessee (33%), followed by California (9%), North Carolina (5%), New York (5%), Texas (3%), and Massachusetts (3%) (Figure 4).

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



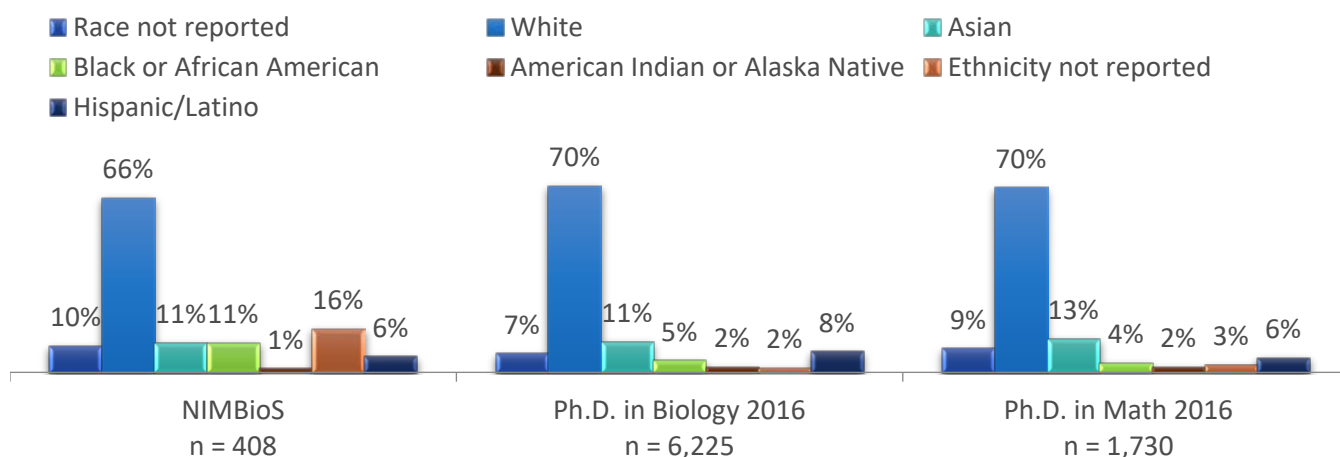
**Gender, Racial, and Ethnic Diversity.** Across all events during RP 10, female participation was 48% (no gender data for 3.8%). Within specific activity types, the gender ratio varied slightly, from 53% in Education/ Outreach to 45% in Investigative Workshops (**Figure 5**). Comparison groups shown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

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



Overall minority representation across NIMBioS events during RP 10 was 12% and falls within ranges for doctoral recipients in the biological and mathematical sciences (Figure 6). Comparison groups shown are all U.S. citizen and permanent residents receiving doctorates and receiving doctorates in biology and mathematics in the U.S. in 2016<sup>1</sup>. Minority representation varied among programs.

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

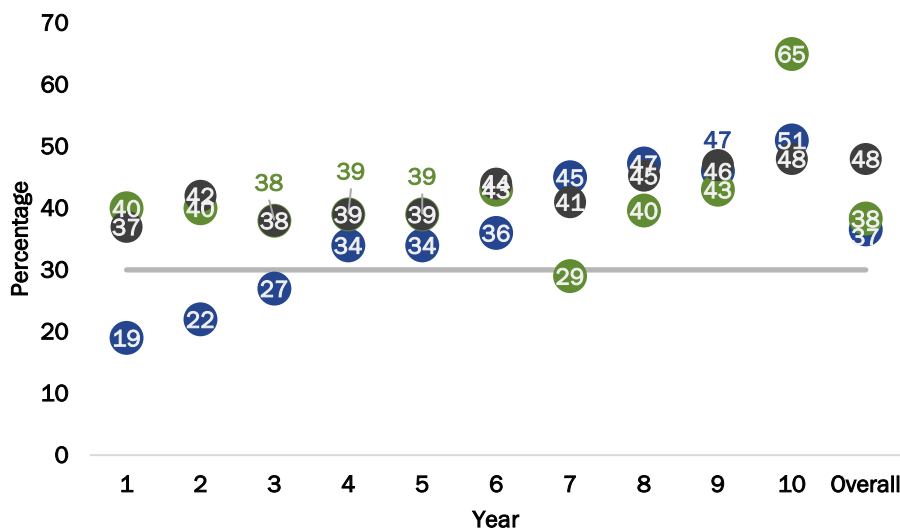


<sup>1</sup> For the purposes of this report, “minority” refers to those who self-identify as American Indian or Alaska Native, black or African American, and/or Hispanic or Latino (NSF Survey of Earned Doctorates, 2016 Data)

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

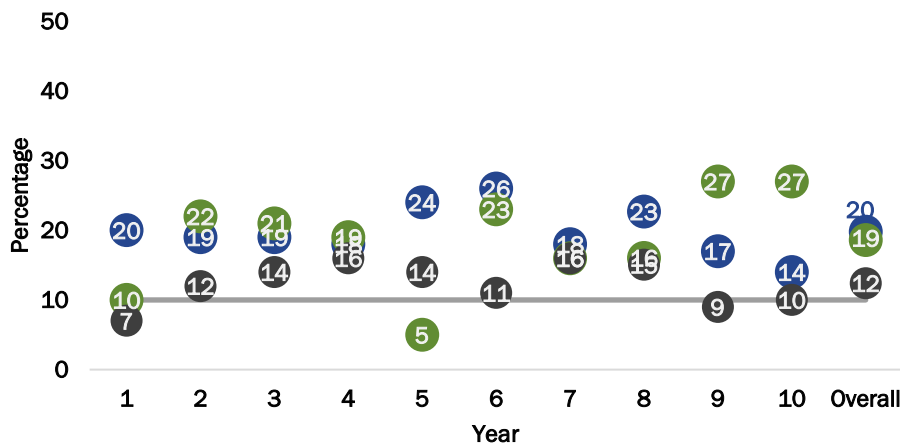
Figure 7 to Figure 12:

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



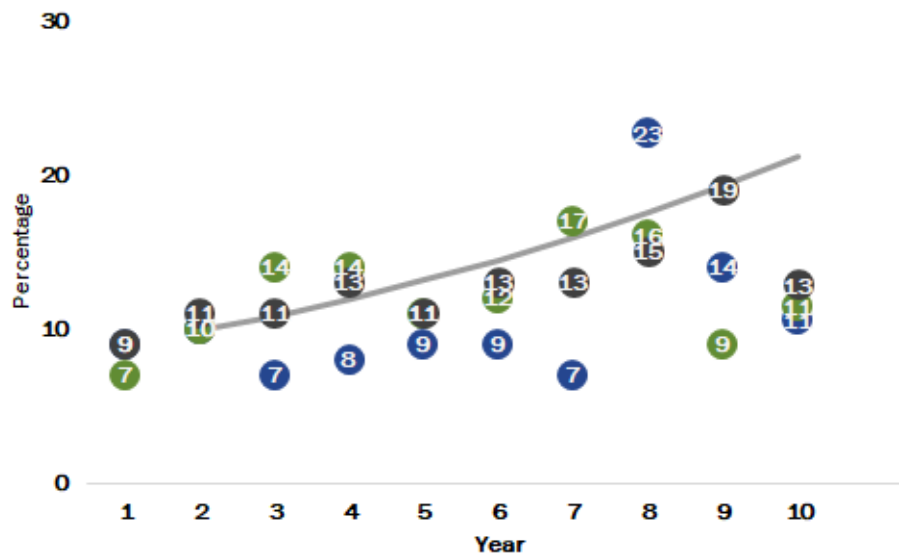
**Benchmark.**  
The proportion of female participants will be at least 30%.

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



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

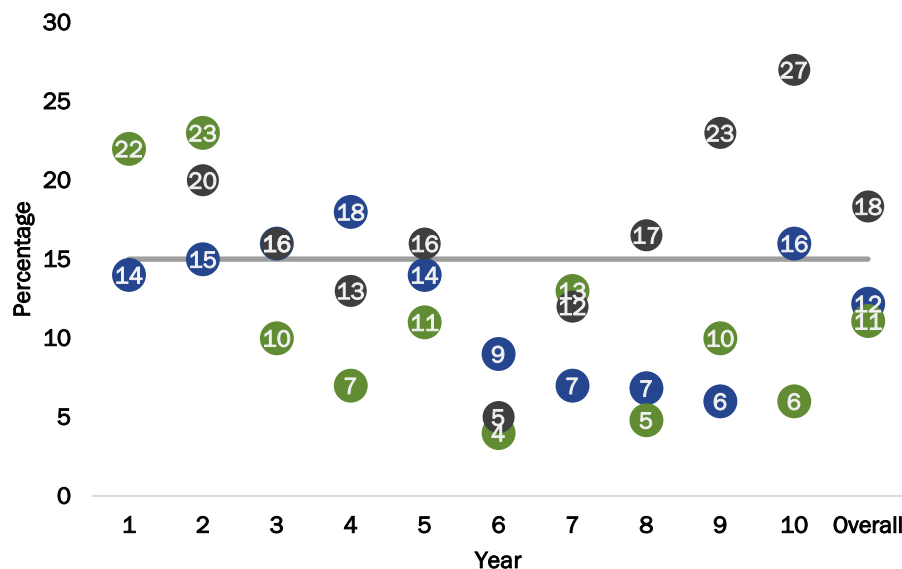
Figure 9. Proportion of participants from under-represented groups across all NIMBioS activities, Working Groups and Investigative Workshops



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

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

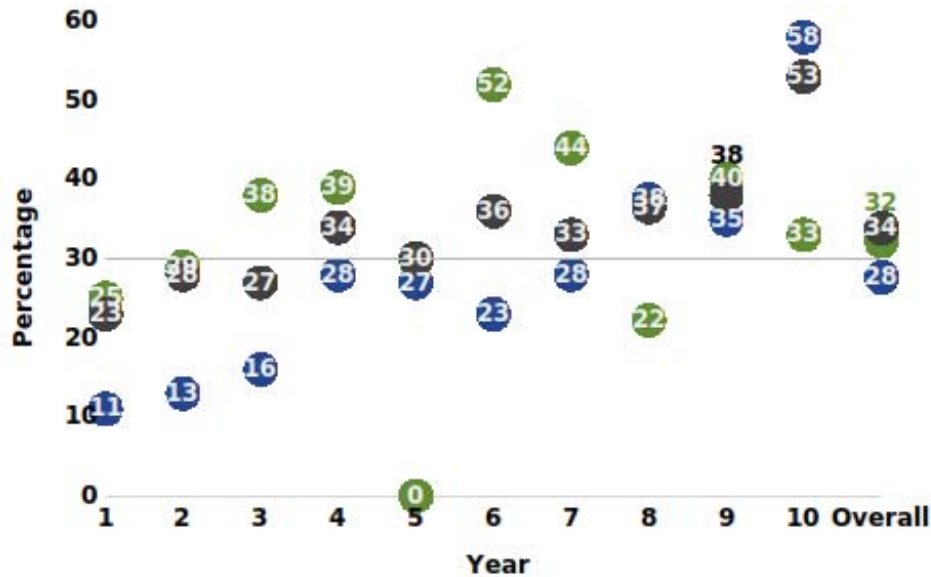
Figure 10. Proportion of local participants across all NIMBioS activities, Working Groups and Investigative Workshops



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

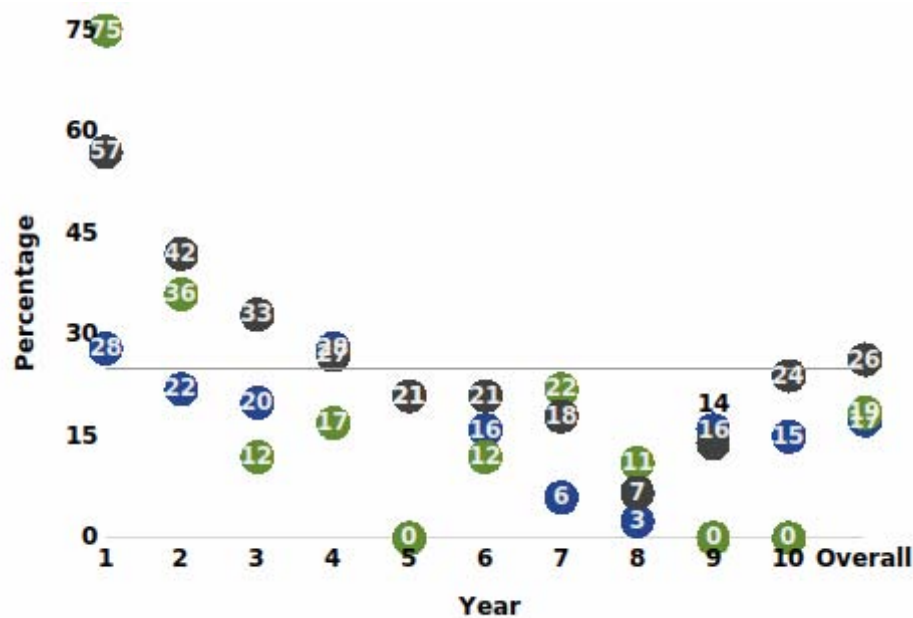
## BENCHMARKS FOR DIVERSITY IN ACTIVITY ORGANIZERS:

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



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

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



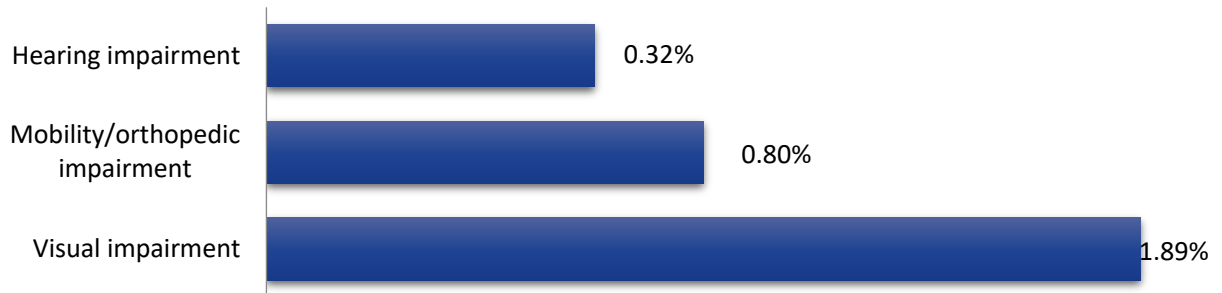
**Benchmark.**  
The participation by local UT/ORNL organizers will be less than 25% of all organizers.



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

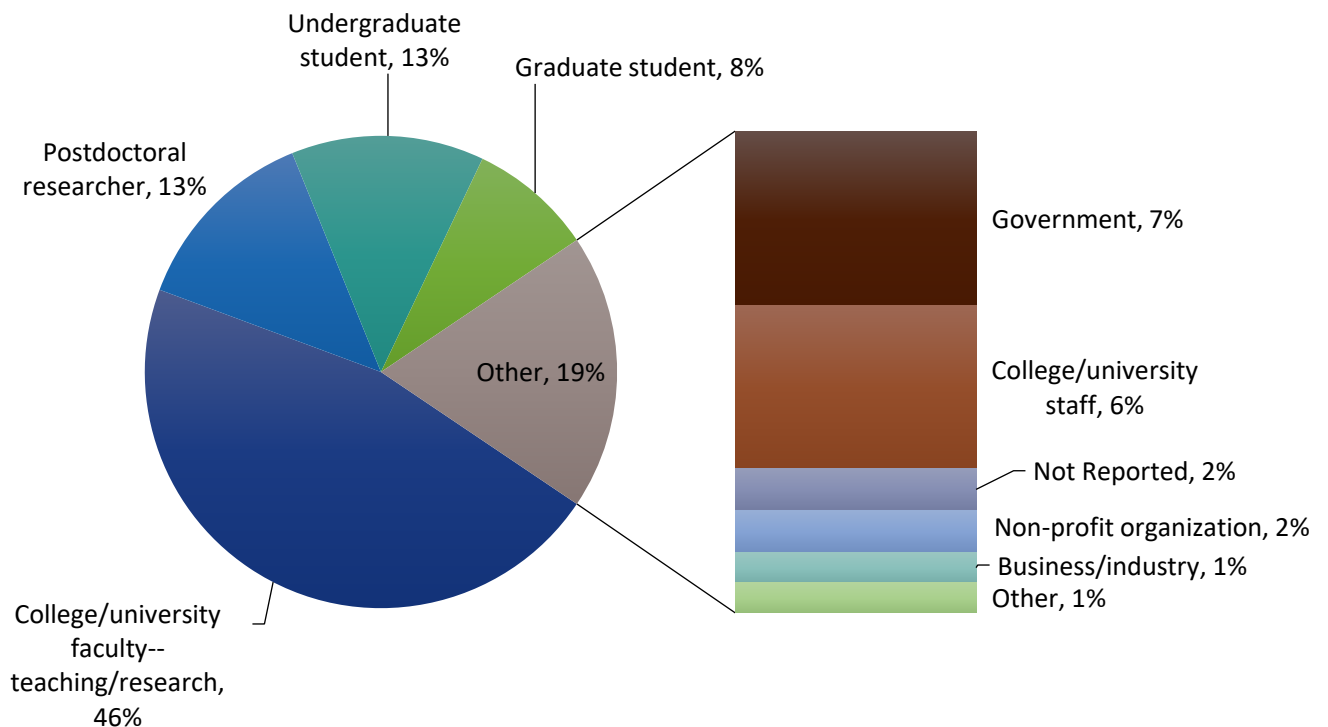
**ABILITY DIVERSITY.** Disclosure of disability status by participants to NIMBioS is optional. Around 3.5% overall indicated having some sort of disability during RP 10 (**Figure 13**).

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



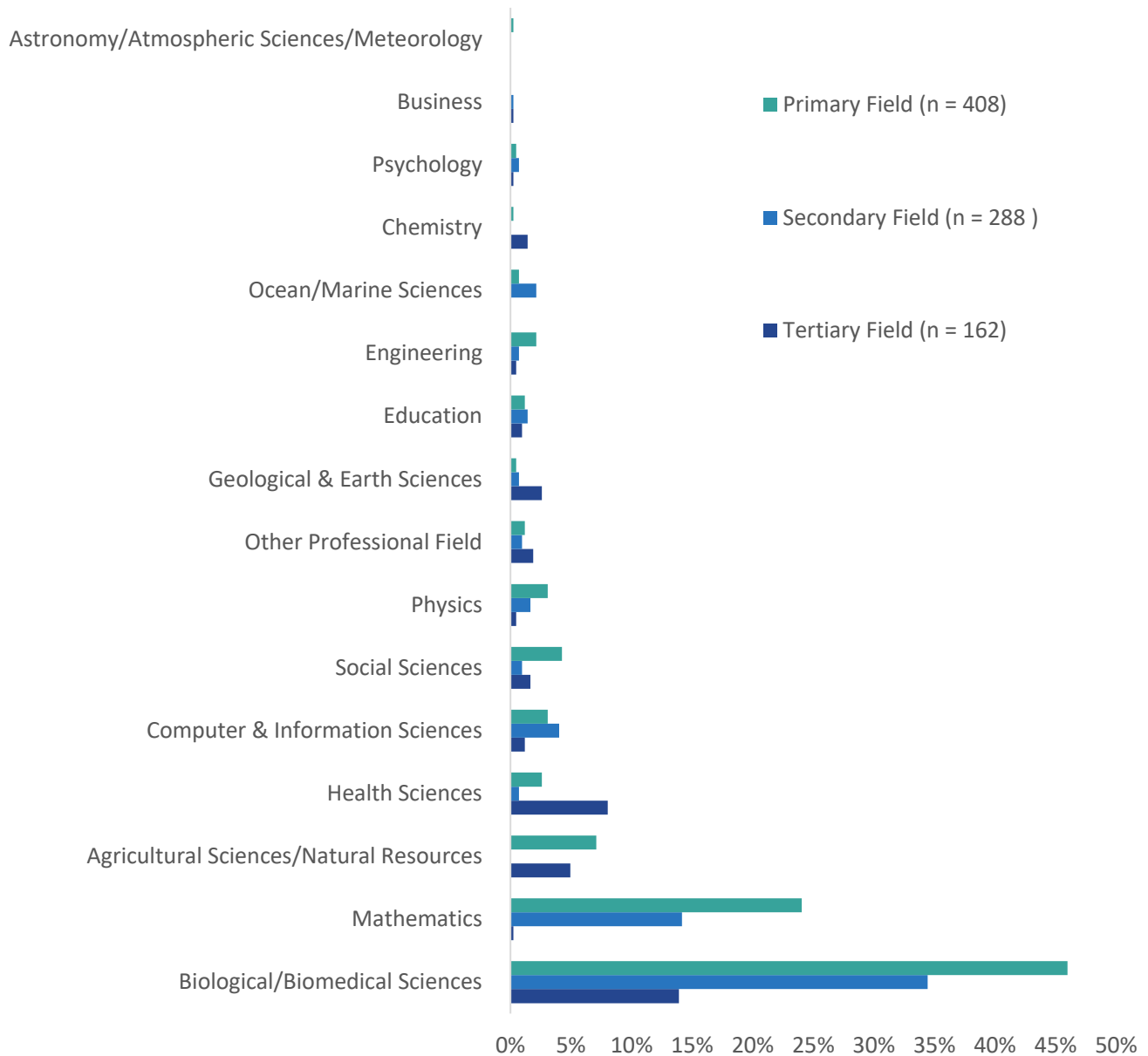
**OCCUPATIONAL DIVERSITY.** The majority of NIMBioS participants were college/university faculty, undergraduate students, or postdoctoral researchers; however, participants came from government, industry, non-profit, or other positions as well (**Figure 14**).

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



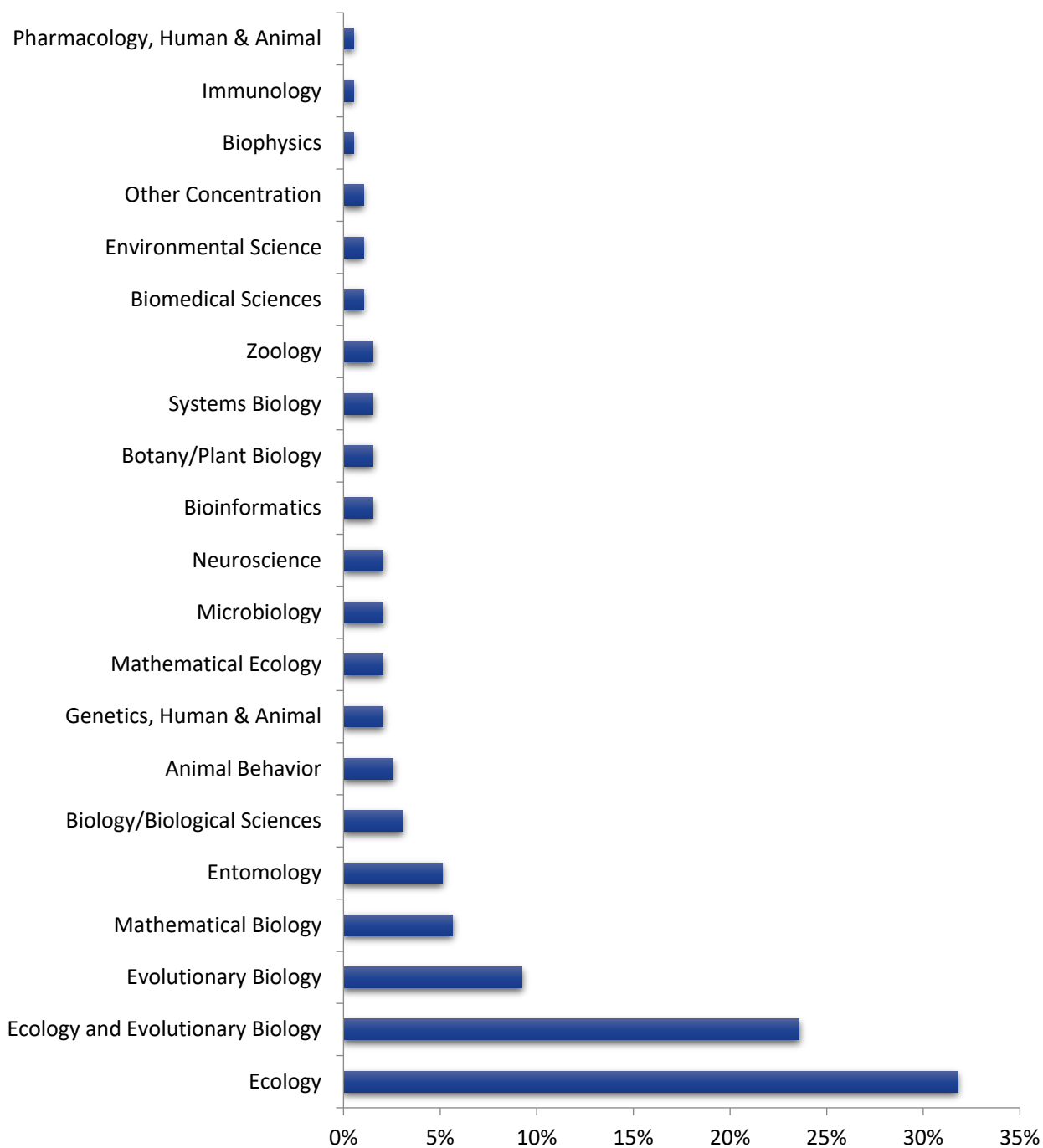
**DISCIPLINARY DIVERSITY.** Most participants at NIMBioS indicated their primary fields of study, as well as areas of concentration within those fields. Many indicated their secondary and tertiary fields of study as well. The most commonly reported fields of study included biological/biomedical sciences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

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



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

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



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

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

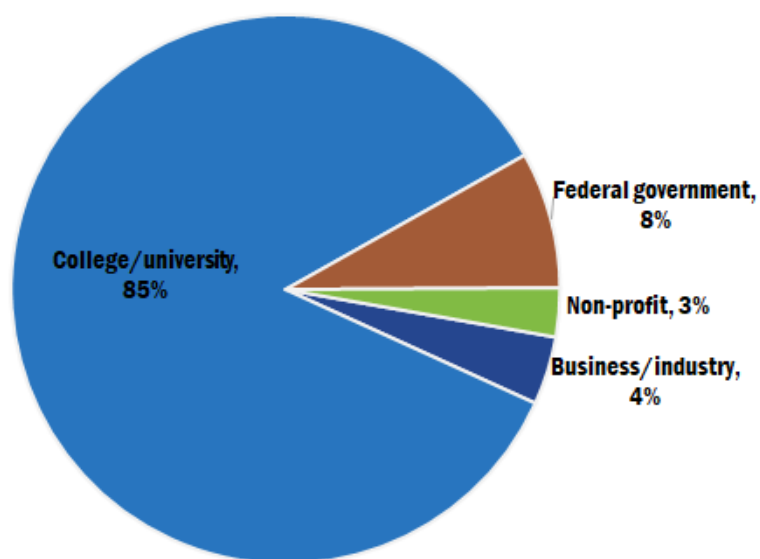
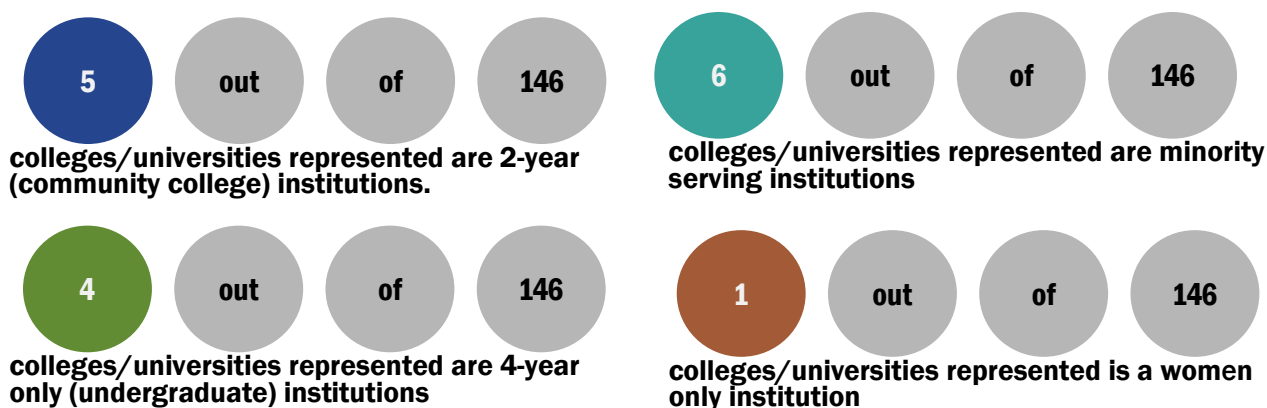


Figure 18. Characteristics of participants' universities ( $n = 146$ )



## **PROCESS EVALUATION**

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

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

### **CONTEXT**

1. Participants will be satisfied with the event overall.
2. The event will meet participant expectations.
3. Participants will feel the group made adequate progress toward its stated goals.
4. Participants will feel they gained knowledge about the main issues related to the research problem.
5. Participants will feel they gained a better understanding of the research across disciplines related to the group's research problem.
6. Participants feel that participating in the event will have on their future research.
7. Participants will be satisfied with the accommodations offered by NIMBioS.

## Working Groups: RP 10 Summary

Number of Working Groups  
supported by NIMBioS  
during RP10

**10**

Total Meetings

**11**

Total participation:

**128**

Total unique participation:

**110**

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

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

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

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

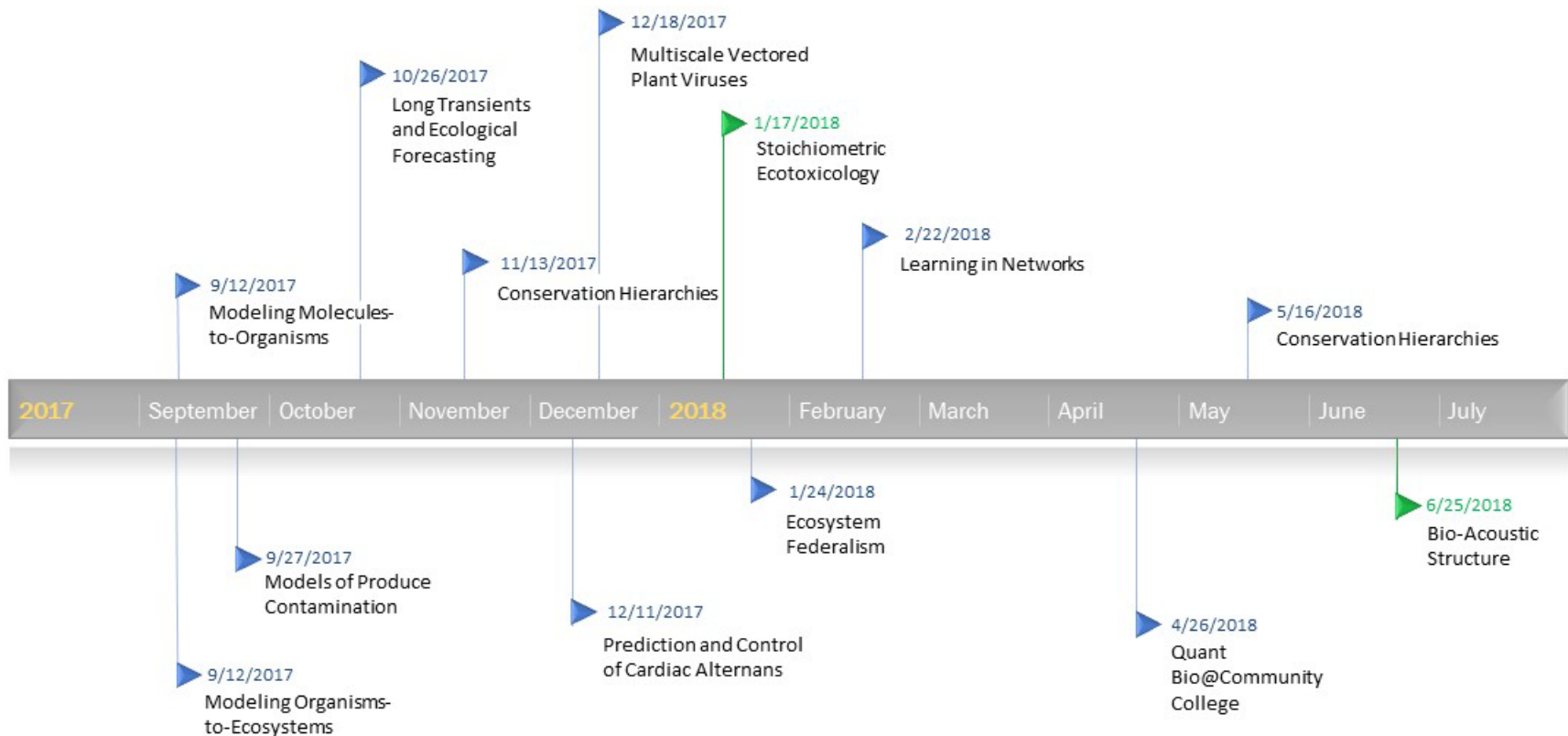
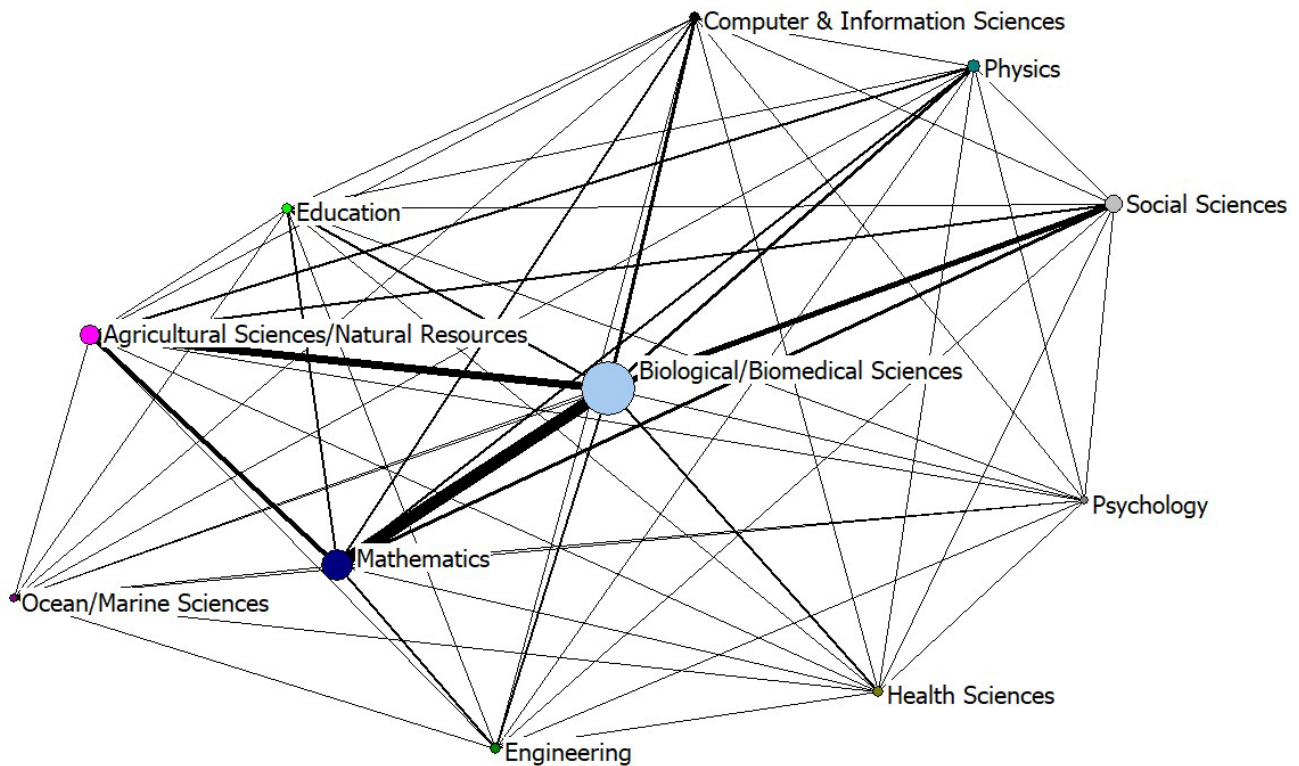


Figure 20 shows the cross-disciplinary connections fostered among Working Group members through the meetings hosted at NIMBioS during RP 10. Node radius is representative of the log scaled number of participants in each field of study. Line size is representative of the number of times researchers from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

**Figure 20. Working Group cross-disciplinary collaboration**



### Working Group Organizer feedback

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

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



## Working Groups: Feedback

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

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

The most useful aspect of the working group:

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

From the organizers:



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

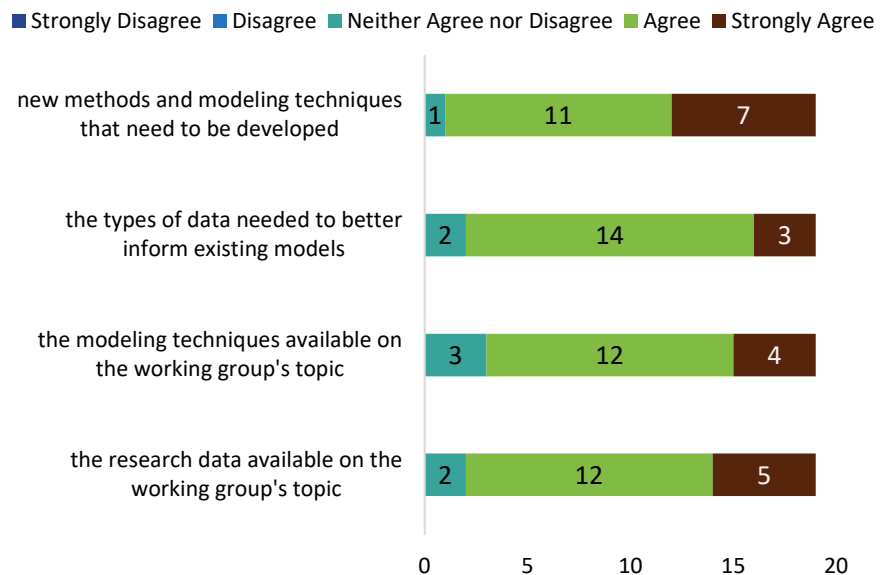
NIMBioS was incredible!

### Working group First Meetings

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

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

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



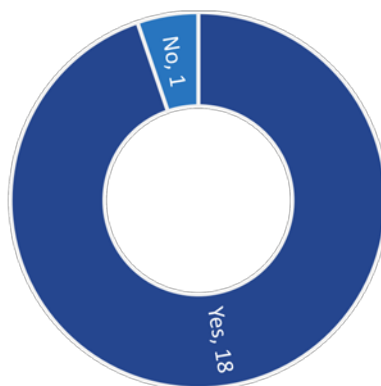
**95%** of participants indicated they had a better understanding of the research happening in the field in disciplines other than their own because of participating in this Working Group.

## Working Groups: Feedback

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

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

Figure 22. Participant response to whether the exchange of ideas during the Working Group would influence their future research:



### Working Group Second, Third and Fourth Meetings

During the reporting period, NIMBioS hosted the second meetings of three Working Groups, with 32 participants, the third meeting of two Working Groups, with 20 participants, and the fourth meeting of three groups, with 35 participants. Beginning in March 2011, NIMBioS changed its policy on evaluation of Working Group meetings to only sending full evaluation surveys to participants after the first and final meetings, rather than after every meeting. However, comments were solicited about the general feeling about the group’s progress.

### Concluded Working Groups

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

## Working Groups: Feedback

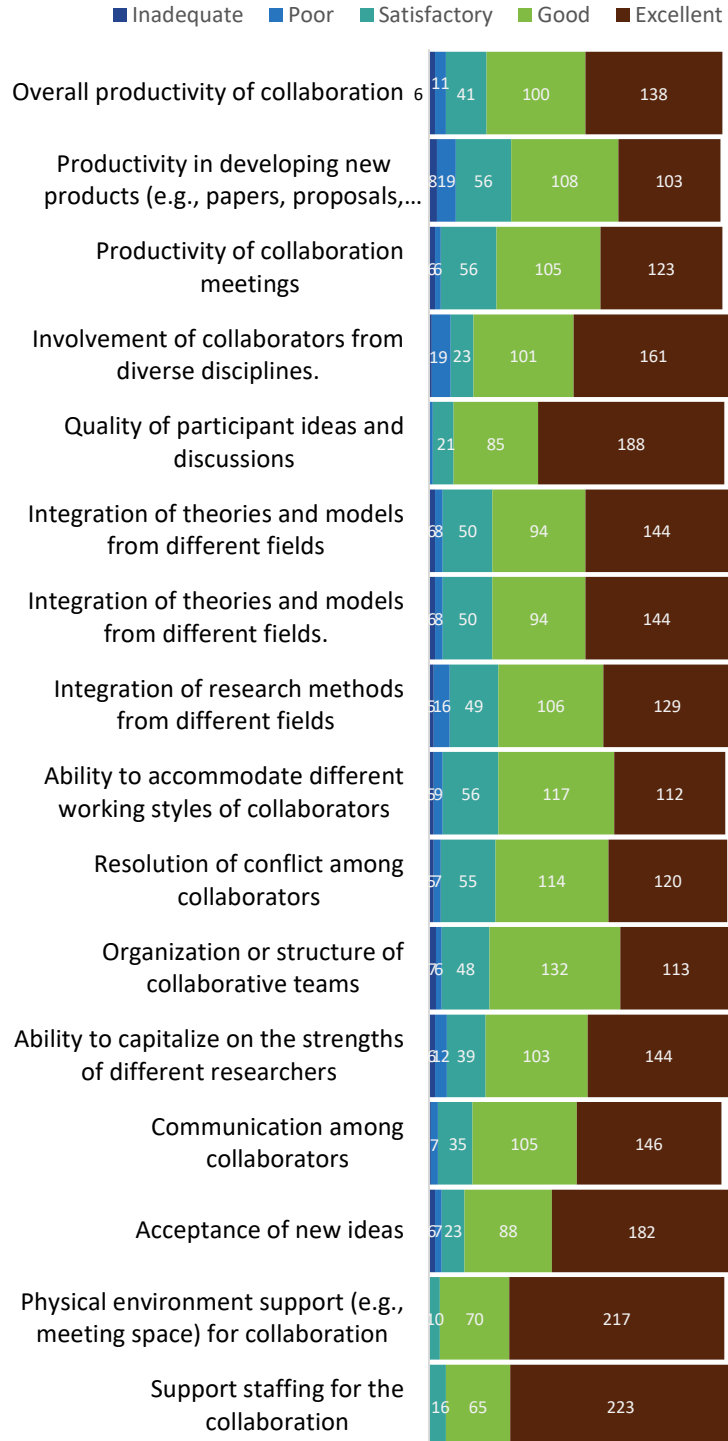
“Because we struggled to talk to three different audiences: mathematicians, biologists, and STEM education researchers, the conversations stretched all of us to understand standards within these communities different than our own.

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

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

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

Figure 23. Evaluation of various aspects of Working Groups



## Working Groups: Feedback

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

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

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

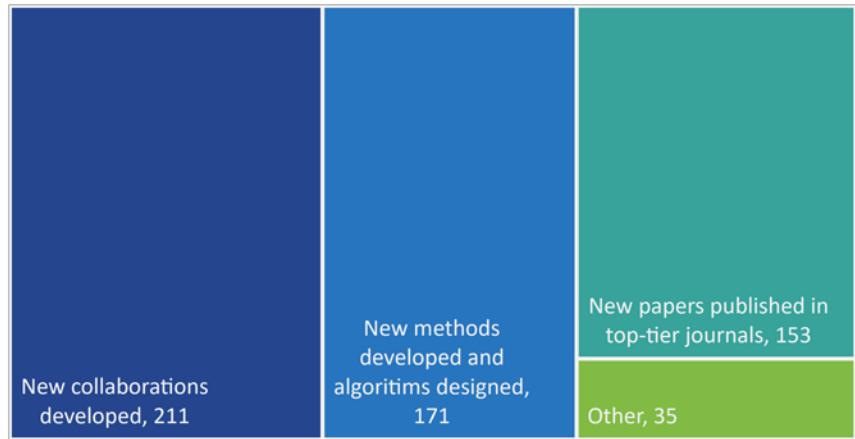
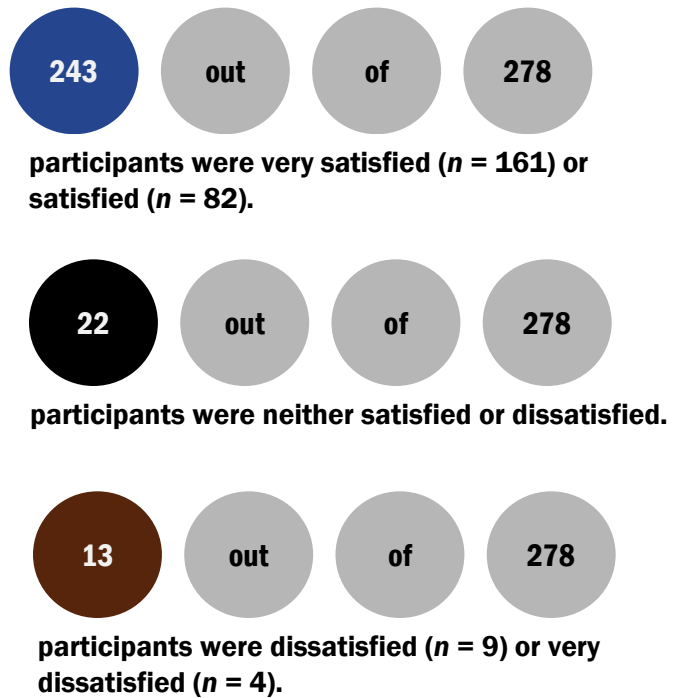


Figure 25. Overall satisfaction level with the Working Group



# Investigative Workshops: RP 10 Summary

Number of Investigative Workshops supported by NIMBioS

2

Total participants

51

## INVESTIGATIVE WORKSHOPS

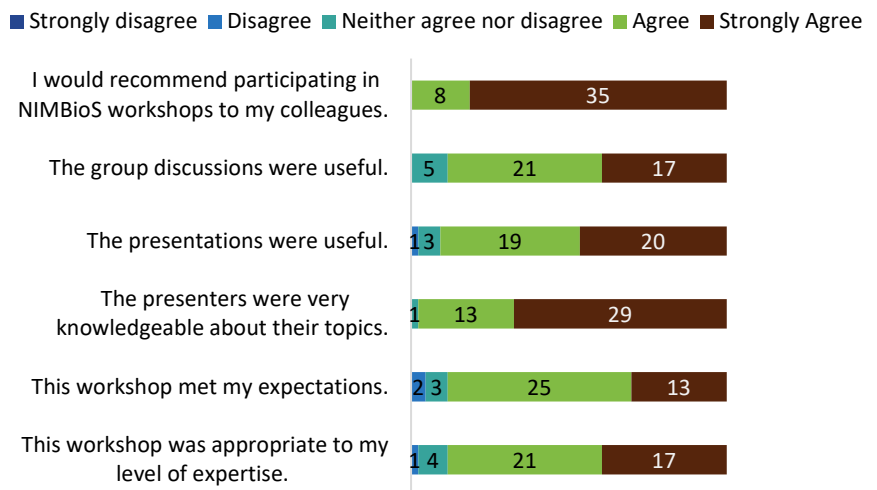
NIMBioS Investigative Workshops differ from Working Groups in that they focus on a broader topic or set of related topics at the interface of biology and mathematics and have relatively large size (30-40 participants). Workshops attempt to summarize/synthesize the state of the art and identify future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

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

### HIGHLIGHTS OF WORKSHOP EVALUATION RESPONSES (FIGURES 26 TO 27)

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

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



## Workshop Feedback

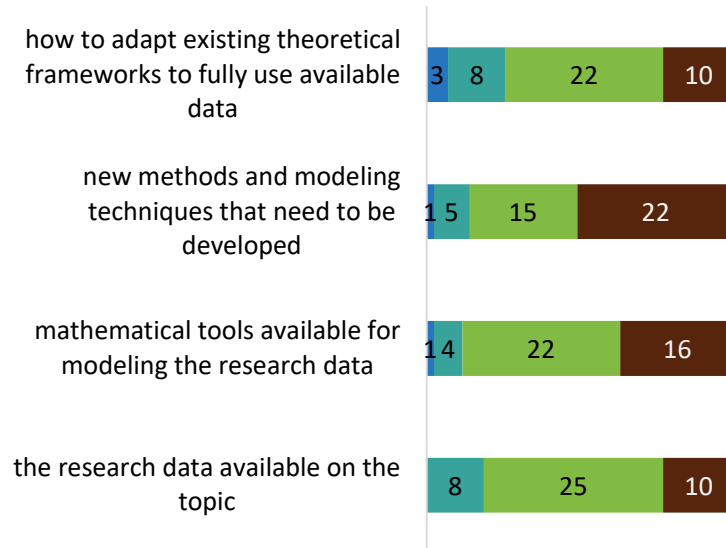
“One of the best workshops I have attended because it connected disciplines that routinely do not substantively engage. This workshop is stimulating progress and could facilitate development of a new focus area within subdisciplines.

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

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

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

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



## Tutorials: RP10 Summary

Number of Tutorials  
supported by NIMBioS

2

Total participation:

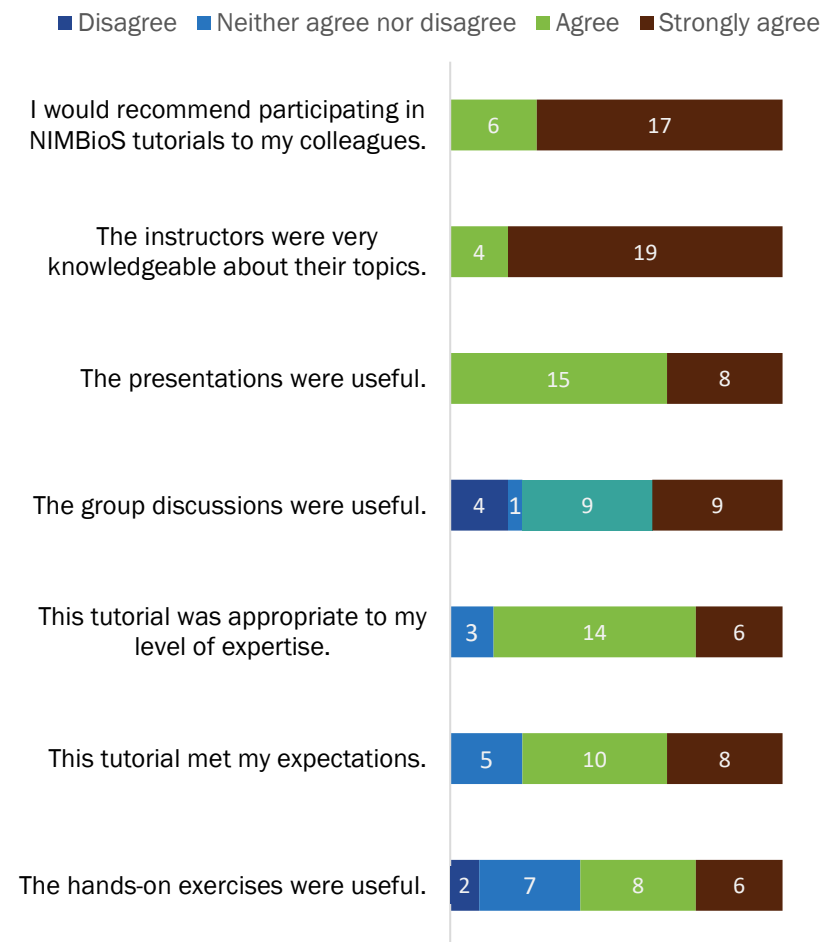
72

## EDUCATION AND OUTREACH PROGRAM ACTIVITIES

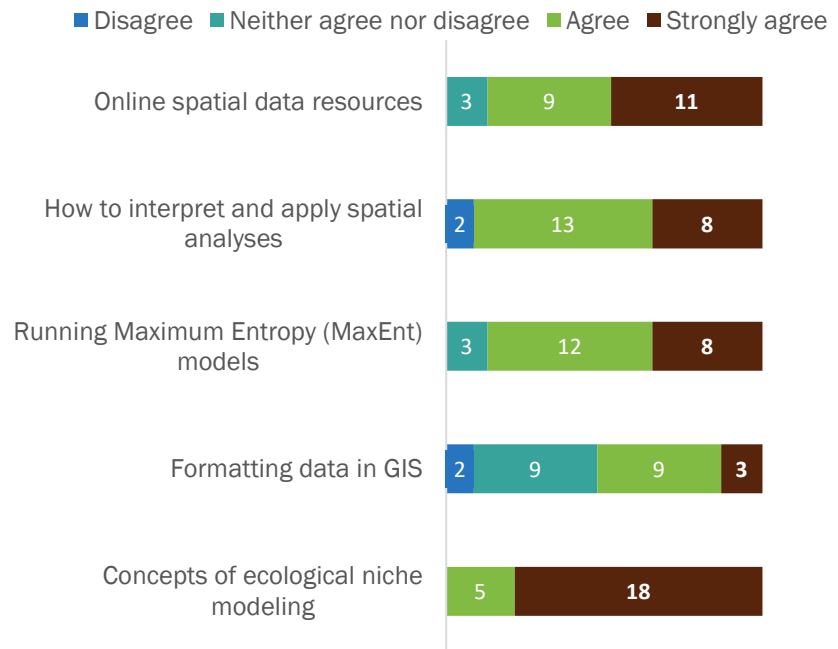
### Tutorials

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

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



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



17 out of 24

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

20 out of 23

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



## SRE Highlights



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

93%

of SRE Participants would recommend the program to others

100%

of 2017 SRE Mentors were satisfied with the NIMBioS SRE program

## Summer Research Experience

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

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

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

### CONTEXT

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

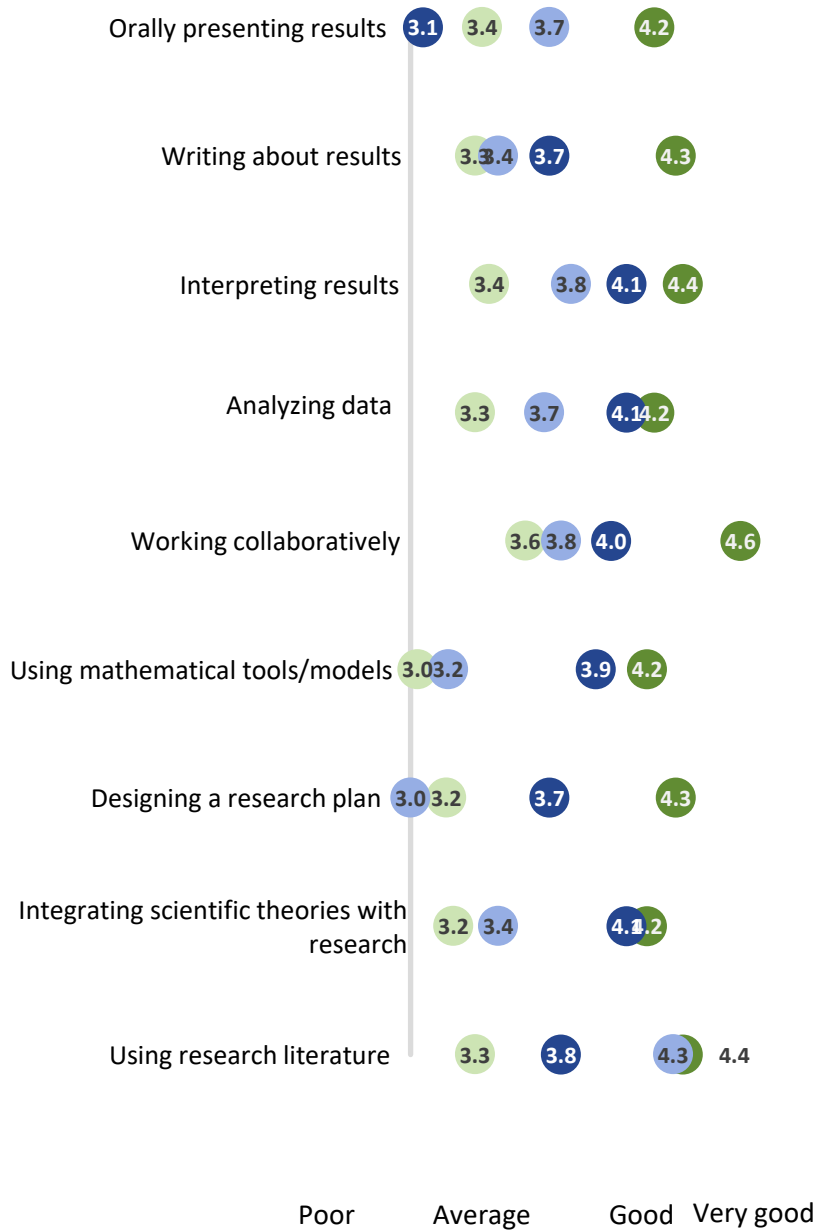
### HIGHLIGHTS OF SRE EVALUATION RESPONSES (FIGURES 30 TO 31)

## SRE Feedback

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

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

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

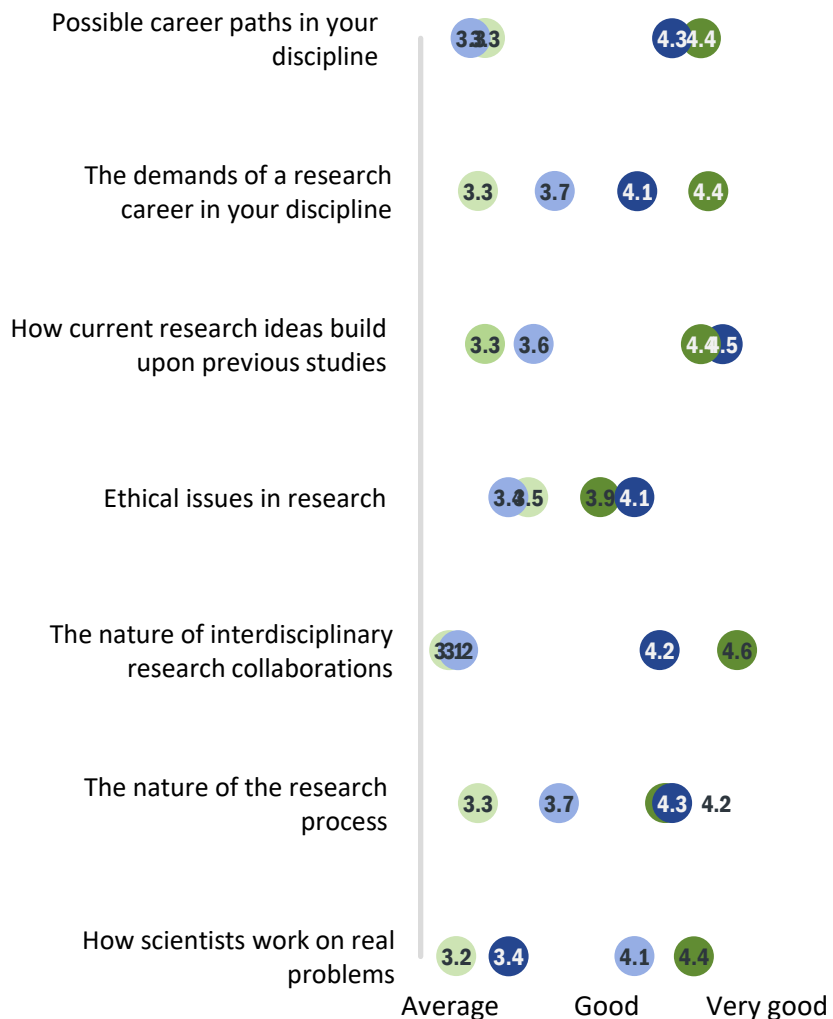


## SRE Feedback

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

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

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



## URC Feedback

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

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

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

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

The NIMBioS ninth annual Undergraduate Research Conference at the Interface of Biology and Mathematics took place at the University of Tennessee's Conference Center in downtown Knoxville November 11-12, 2017. The event was organized by the NIMBioS Associate Director for Education and Outreach Suzanne Lenhart and NIMBioS Education and Outreach Coordinator Greg Wiggins.

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

#### CONTEXT

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

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

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

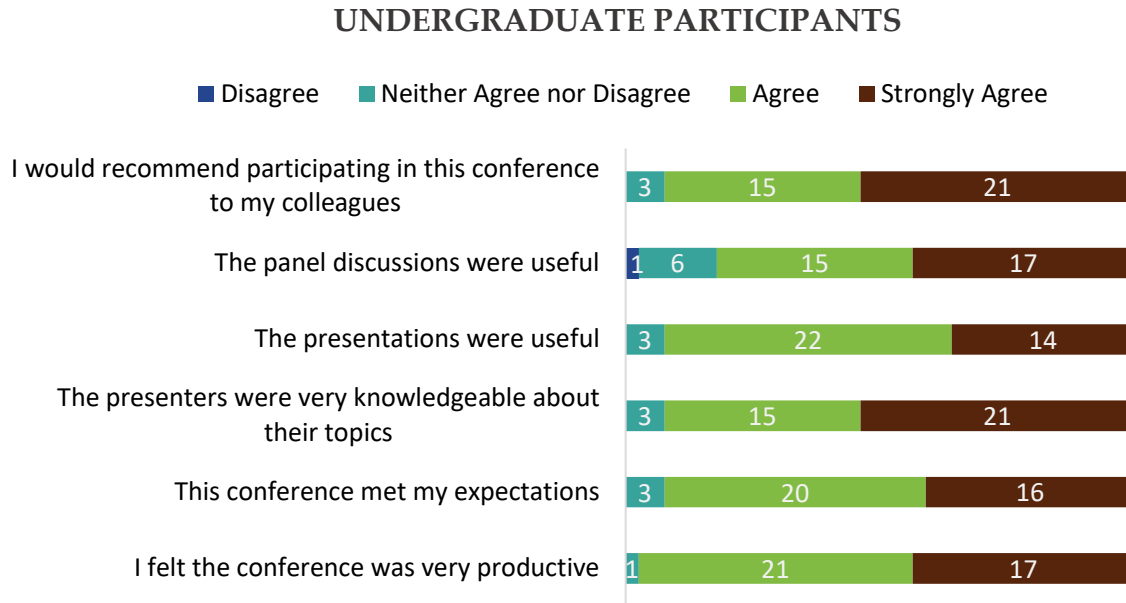


Figure 33. Respondent agreement levels with statements about various aspects of the conference for **non-undergraduate** participants.

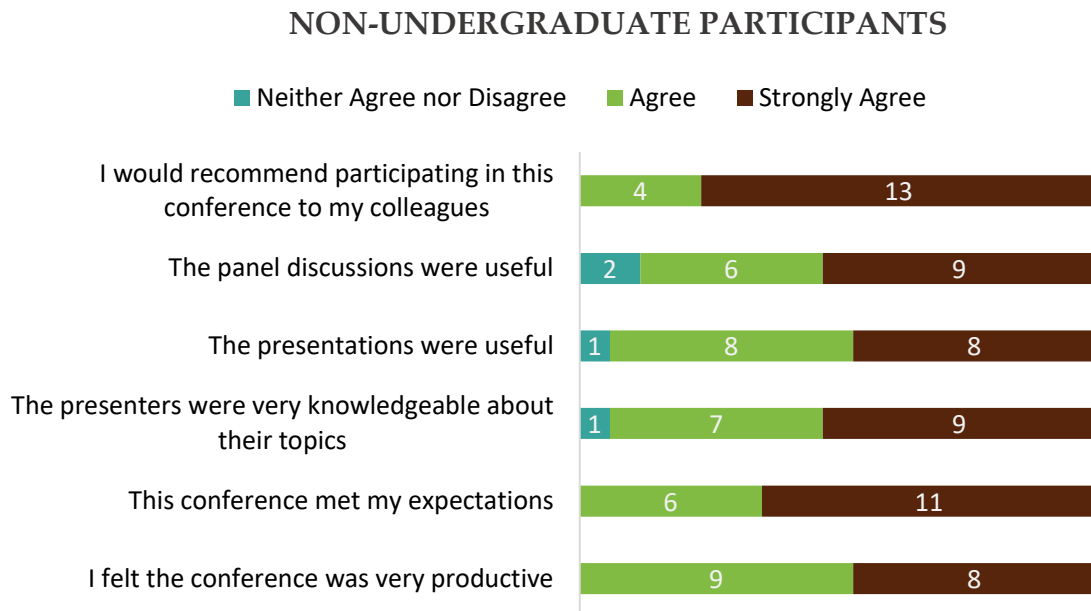


Figure 34. For **undergraduate** participants-- As a result of attending this conference, I have a better understanding of:

### UNDERGRADUATE PARTICIPANTS

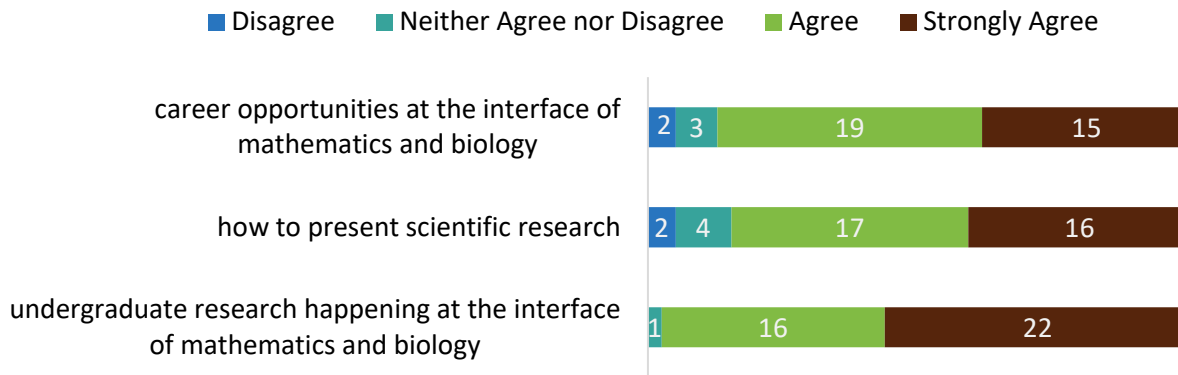
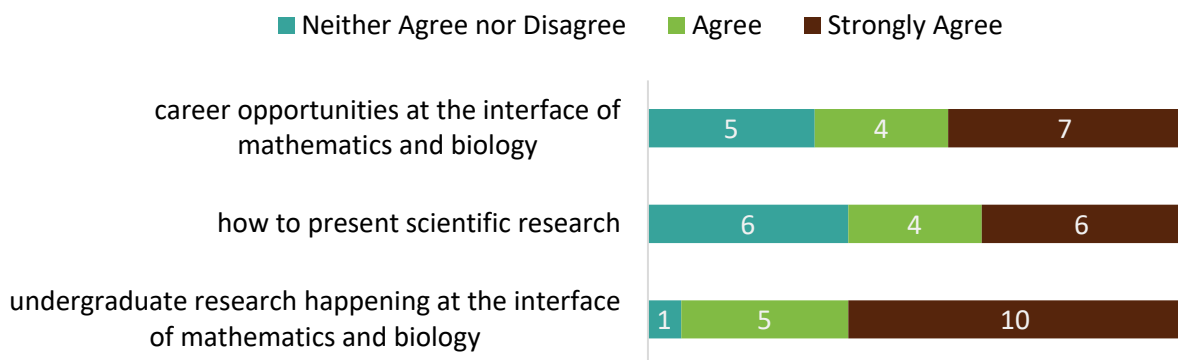


Figure 35. For **non-undergraduate** participants-- As a result of attending this conference, I have a better understanding of:

### NON-UNDERGRADUATE PARTICIPANTS



## Postdoc Overall Summary

Postdoctoral alumni  
**40**

RP 10 postdocs  
**7**

Average appointment:  
**1.91 years**  
(SD = 0.44)

### NIMBIOS POSTDOCTORAL FELLOWSHIP PROGRAM

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

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

#### CONTEXT

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

## Postdoc Feedback

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

“The independent nature of the postdoc is valuable. The opportunity to collaborate with other postdoc was also a positive from my experience at NIMBioS.

Upon leaving the Postdoctoral Fellowship program at NIMBioS, program participants are asked to fill out a short exit evaluation form that examines several aspects of satisfaction with the program’s operations. To date, 36 (90%) alumni from the program have filled out the form.

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

Figure 36. Postdoctoral fellow satisfaction with program mentors

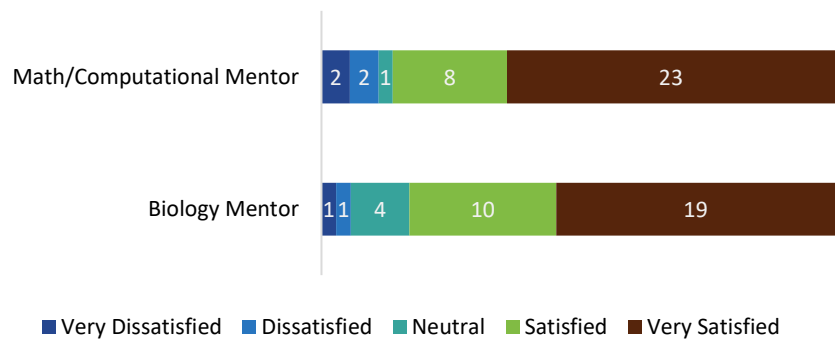
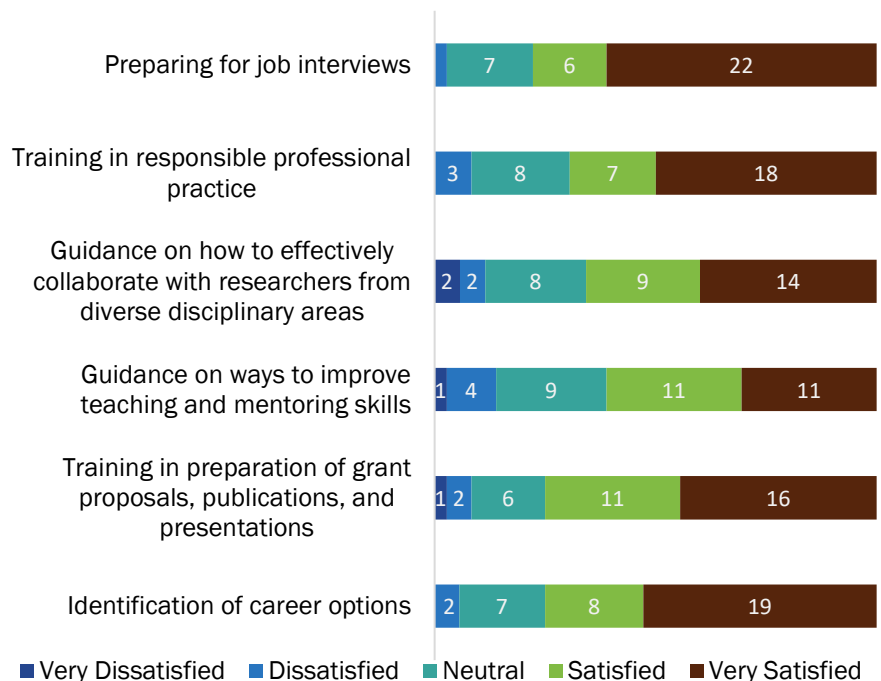


Figure 37. Postdoctoral fellow satisfaction with advice/assistance received from program mentors





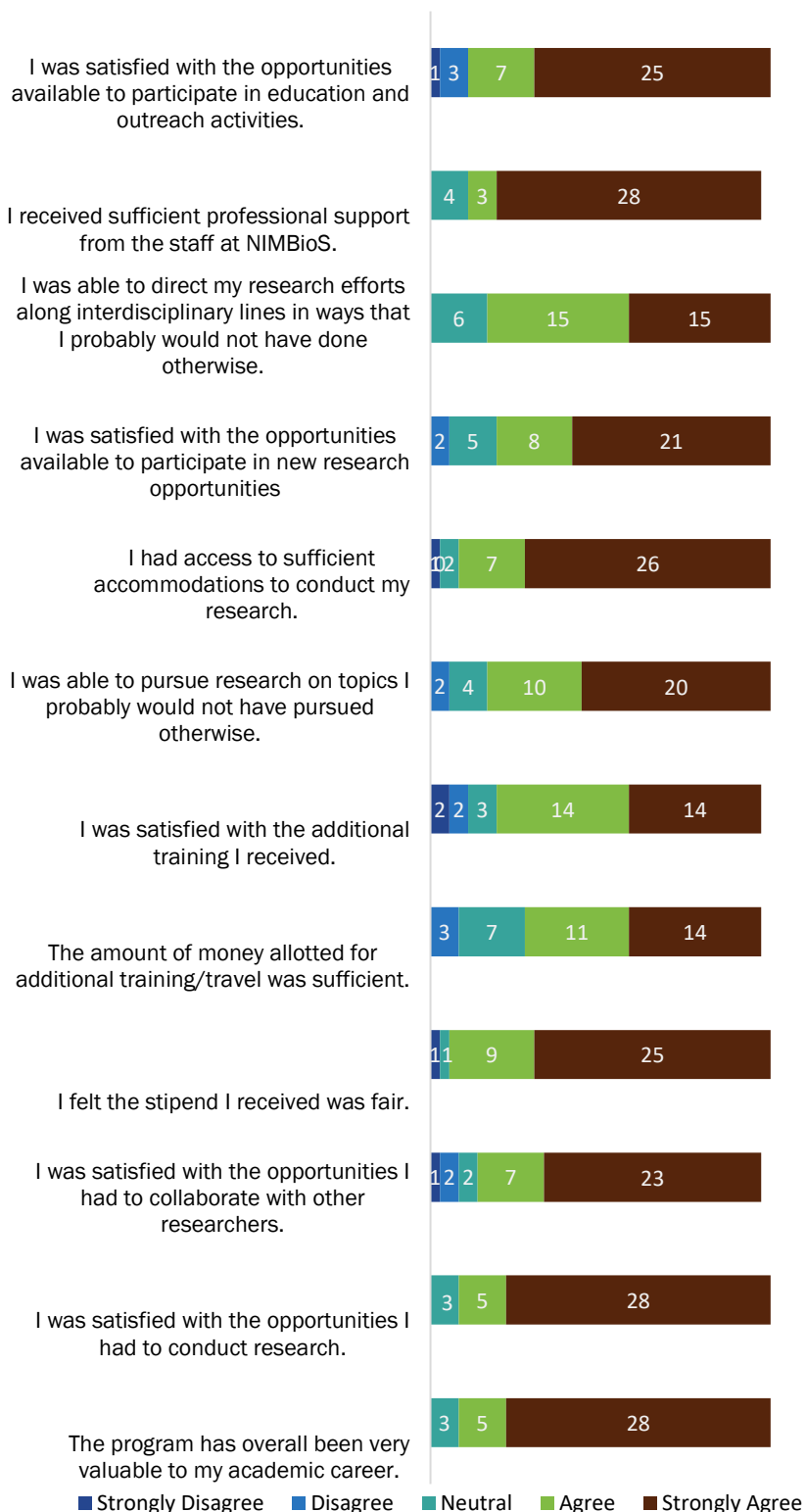
## Postdoc Feedback

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

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

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

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



## PRODUCT EVALUATION

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

### CONTEXT

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

## PUBLICATIONS

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

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

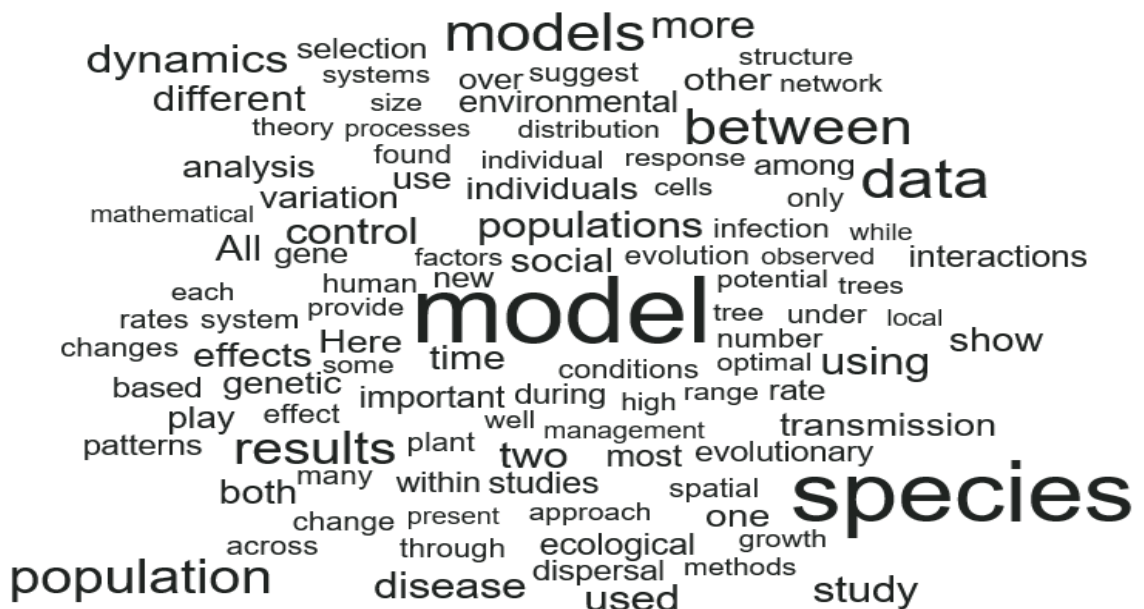
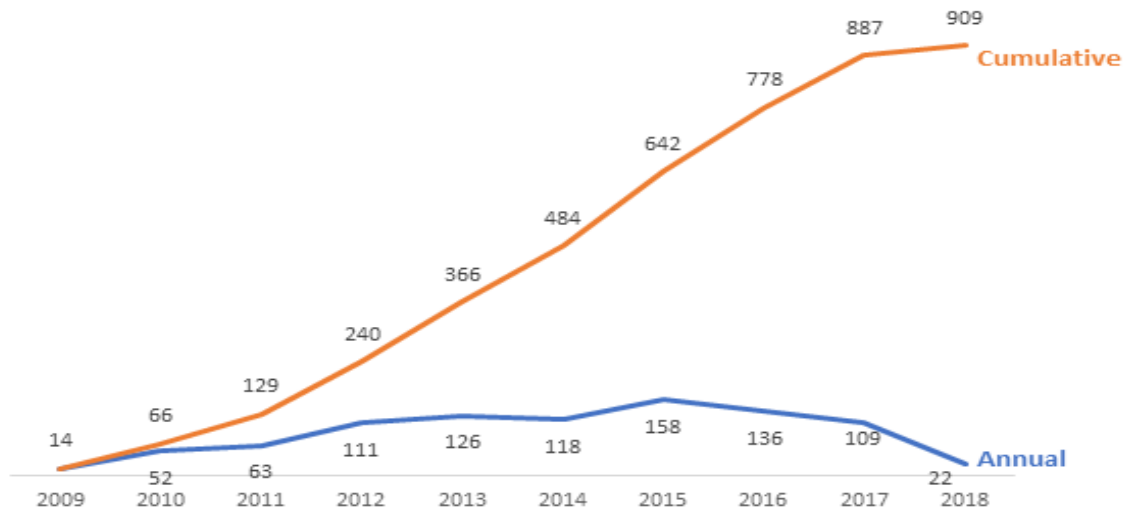


Figure 40. Number of **cumulative** and **annual** published journal articles reported from NIMBioS activities since 2009, by publication year

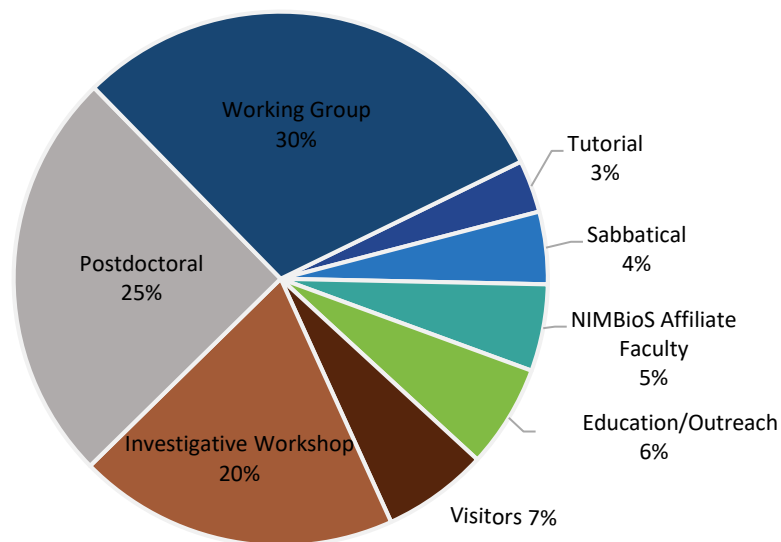


Note. 2018 includes publications submitted by participants to NIMBioS through June 2018

NIMBioS products are published in many high-ranking journals in their respective fields. Table 2 highlights the number of products in a selection of high-impact journals according to the Web of Science impact factor. Prominent high impact journals include Nature, Cell, Science, Ecology Letters, and Trends in Ecology and Evolution.

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

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



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

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

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

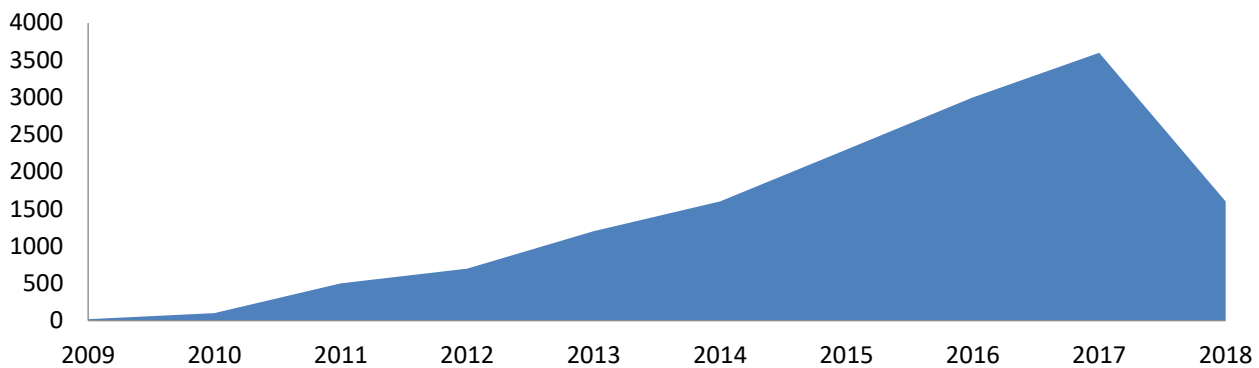
\*\* Number of publications in Year 10 includes all publications reported since compilation of the previous Annual Report (April 2017) through June 2018.

\*\*\* September 2008 – June 2018

## Bibliometric Indicators

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

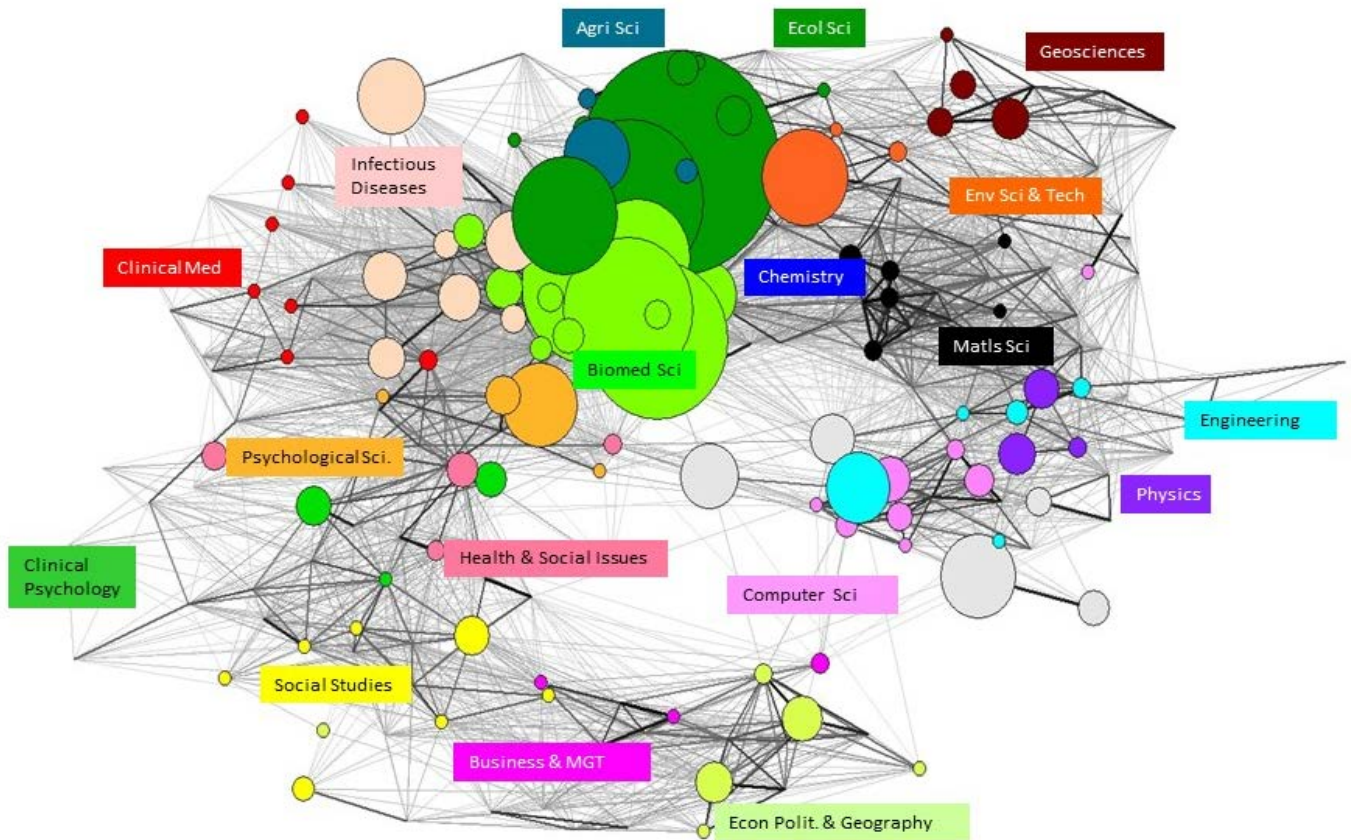
**Figure 42. Citations per year for NIMBioS articles**



**DISCIPLINARY SPAN OF PUBLICATIONS.** The 819 published articles in WOS span 104 discipline areas, as designated by the ISI WOS Categories. Categories are assigned at the journal level based upon a combination of citation patterns and editorial judgment at the ISI. Subject categories are used in bibliometric research as a representation of the research areas in which scientists work.

Figure 43 locates the subject categories of the 819 NIMBioS articles on a network map of the WOS Categories. The gray background intersections are the 224 WOS Categories, located based on cross-citation relationships among all WOS journals in 2007 (from Rafols, Porter, and Leydesdorff, 2009). The 19 labeled “macro-disciplines” are based on factor analysis of that cross-citation matrix also. Nearness on the map indicates a closer relationship among disciplines. Circular node sizes reflect the relative number of NIMBioS participant publications. The most common subject category in which NIMBioS publications fell was Ecology (230), followed by Evolutionary Biology (123), Biology (116), Mathematical & Computational Biology (115), Multidisciplinary Sciences (98), and Genetics & Heredity (63).

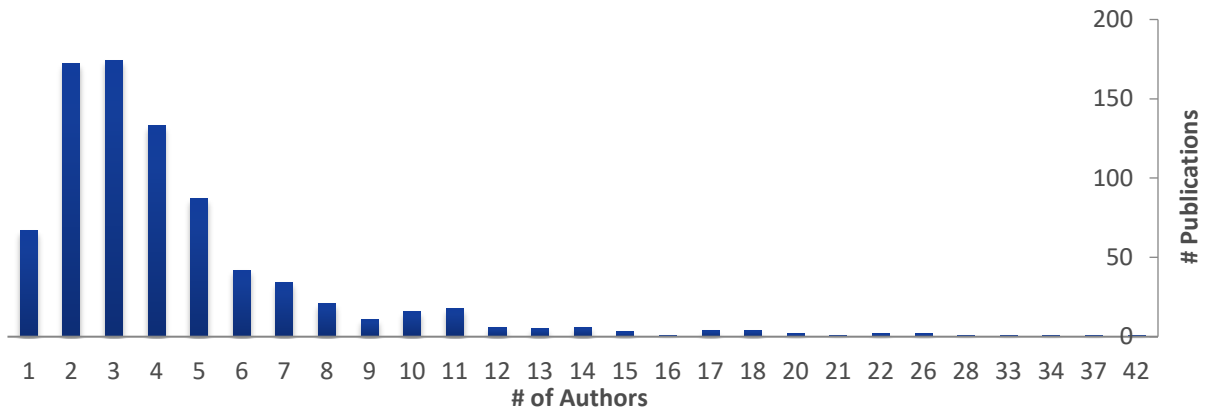
Figure 43. Web of Science categories for 819 WoS journal articles to date



Rafols, Porter and Leydesdorff (2009)

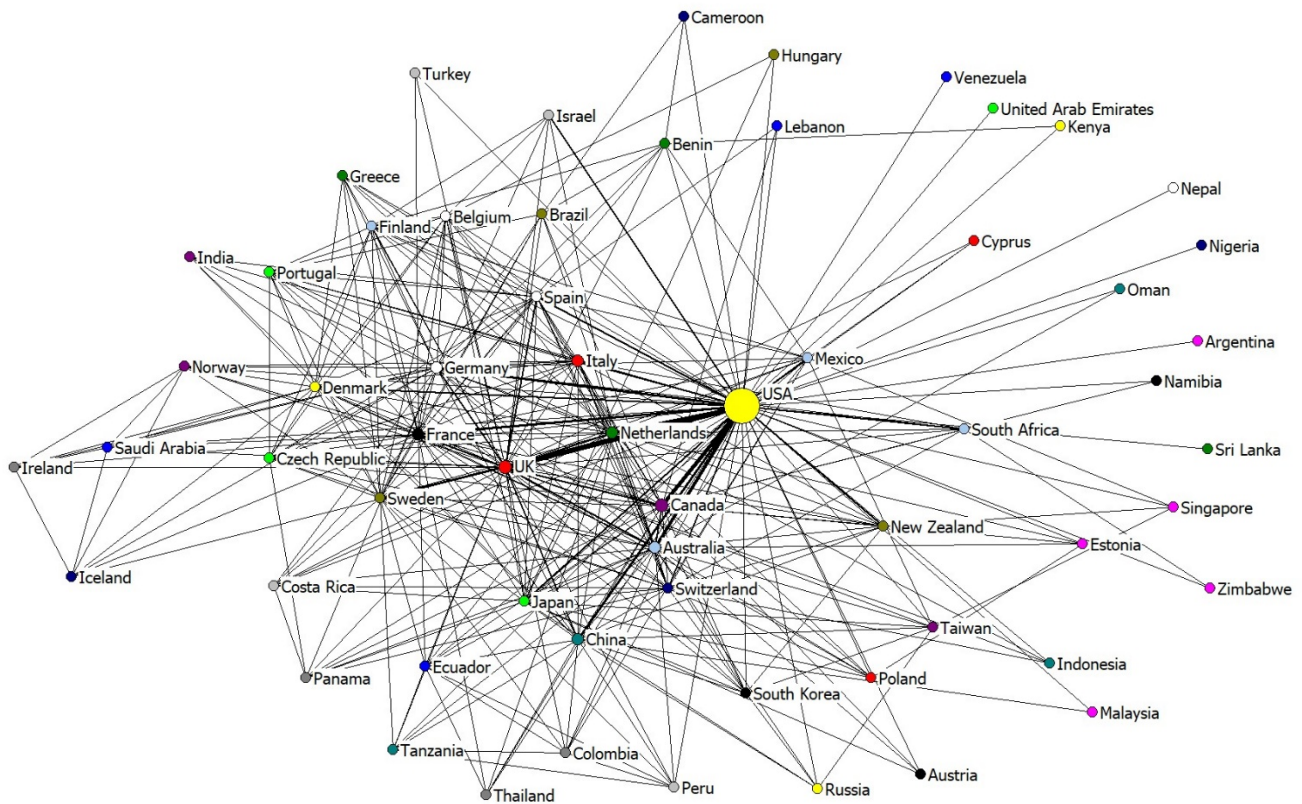
**COAUTHORSHIP.** One of the core values of NIMBioS is to take a collaborative approach to science and science education. We are interested, therefore, in examining the number of co-authors on NIMBioS-related publications as one indicator of scientific collaboration. For the 819 publications reported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

Figure 44. Coauthorship frequency of NIMBioS publications



INTERNATIONAL COAUTHORSHIP. NIMBioS also fosters international collaboration among researchers. While 61 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 45).

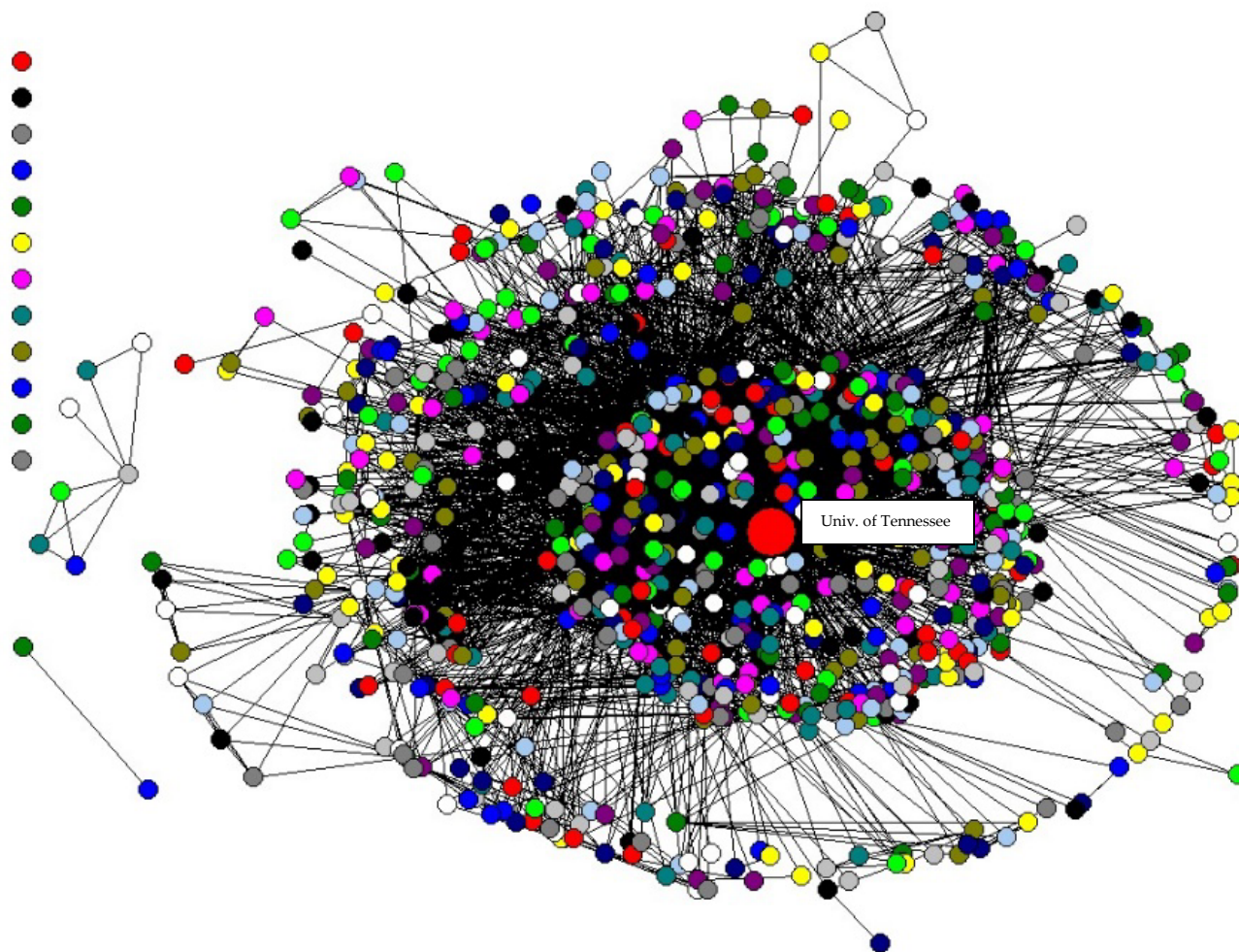
Figure 45. International collaboration on NIMBioS publications



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

**CROSS-INSTITUTIONAL COAUTHORSHIP.** Coauthors of NIMBioS publications through the current reporting period came from 919 unique institutions (Figure 46). The average number of institutions represented per paper was 3.5, with a range of 1-35 institutions per paper.

**Figure 46. 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 12 of the 919 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 47 summarizes these types of products for the ten-year period. In addition to the items listed in Figure 43, NIMBioS participants have reported 910 conference presentations related to NIMBioS affiliation.

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

