



# **NIMBIOS EVALUATION REPORT**

**REPORTING PERIOD EIGHT**

**SEPTEMBER 1, 2015-APRIL 30, 2016**

**NATIONAL INSTITUTE FOR MATHEMATICAL AND BIOLOGICAL SYNTHESIS**

**May, 2016**

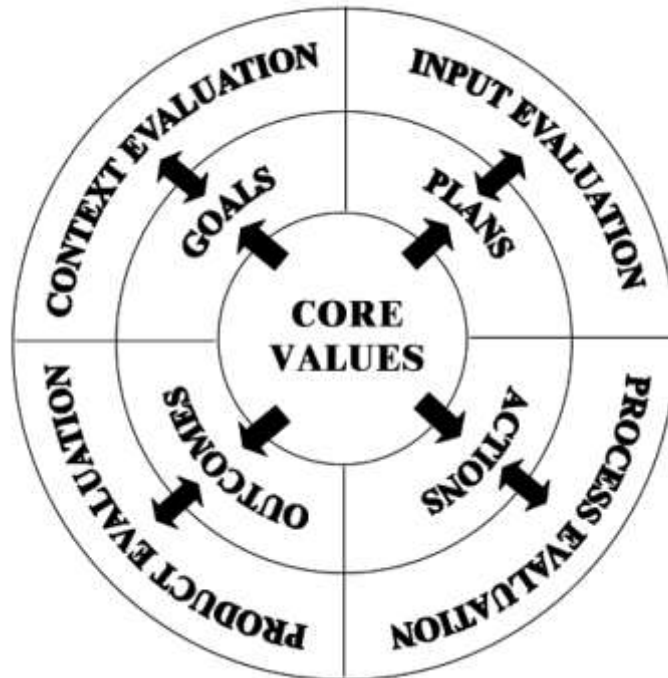
## CONTENTS

INTRODUCTION .....	1
Context (Goals).....	1
Inputs .....	1
Process .....	2
Products .....	2
Input Evaluation .....	3
Context.....	3
Summary of Activities .....	3
Diversity of Research Activities.....	4
Diversity of Participants .....	4
Diversity Benchmarks.....	8
Process Evaluation .....	14
Context.....	14
Working Groups .....	14
Investigative Workshops.....	21
Education and Outreach Program Activities.....	23
Product Evaluation.....	31
Context.....	31
Publications.....	31
Bibliometric indicators .....	33
Other Scholarly Products .....	36

## INTRODUCTION

This is an evaluation summary of NIMBioS activities during the eighth annual reporting period (RP 8) to the National Science Foundation. This report covers the period of September 1, 2015-April 30, 2016. The NIMBioS evaluation program follows the CIPP systems approach, which takes into account 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**<sup>1</sup>:

**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 (GOALS)

Context 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.

### INPUTS

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:

<sup>1</sup> Stufflebeam, D.L. (2003). The CIPP model for evaluation. In T. Kelleghan & D.L. Stufflebeam (Eds.) *International Handbook of Education Evaluation* (pp. 31-61). London: Kluwer Academic Press.

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

## PROCESS

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.

## PRODUCTS

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.

## INPUT EVALUATION

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

### CONTEXT

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

### SUMMARY OF ACTIVITIES

Research program activities during RP 8 included:

- 24 Working Group meetings
- 2 Investigative Workshops
- 1 Tutorial
- 40 Short-term visitors
- 11 Postdoctoral Fellows
- 1 Visiting Graduate Student Fellow
- 5 Graduate Research Assistantships

Education and Outreach (EO) program activity highlights during RP 8 included (see Annual Report for more details on these and other EO events):

- 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
- SHADES (Sharing Adventures in Engineering and Science)
- STEM Education Seminar Series
- Southern Appalachian Science & Engineering Fair
- Adventures in STEM Camp

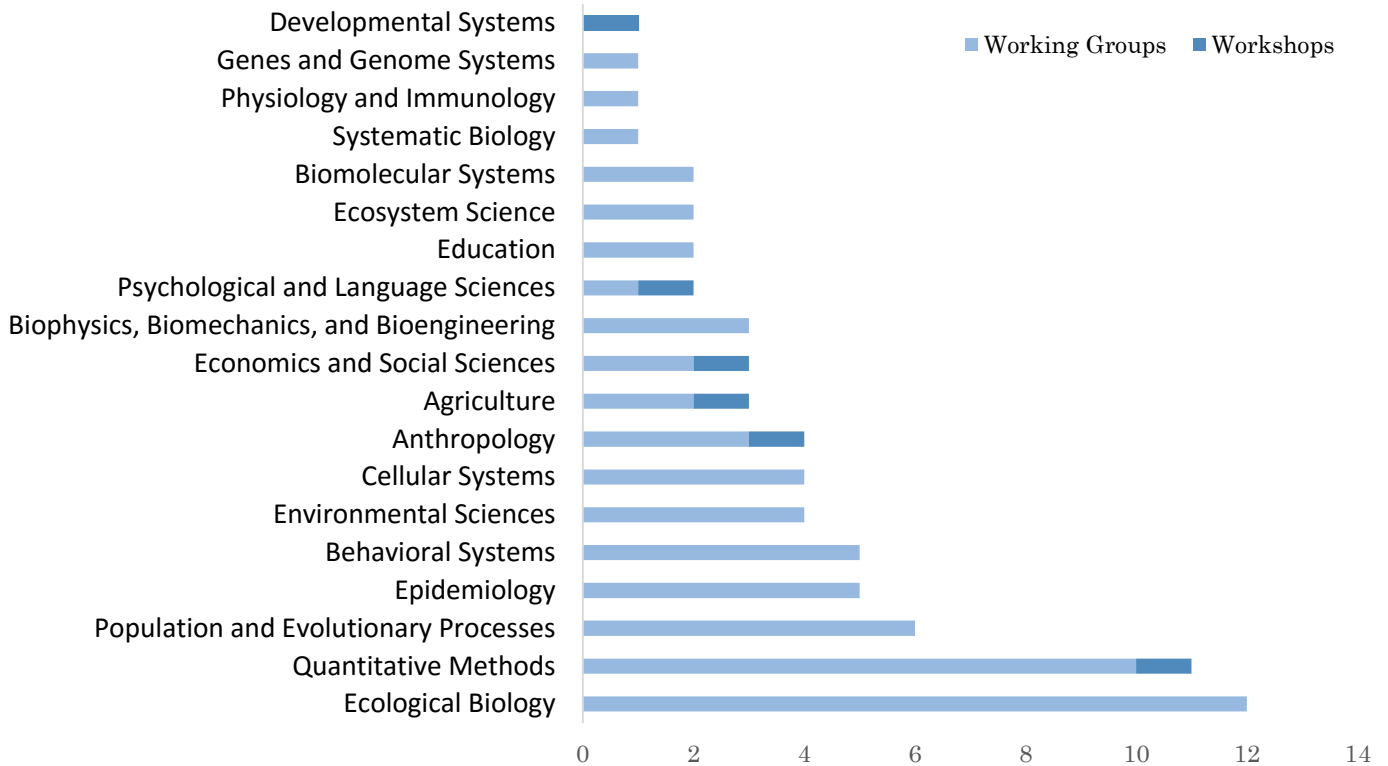
Other events included: 3 Advisory Board Meetings (1 in-person and 2 virtual)

## 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** shows the diversity of subject areas associated with NIMBioS Working Group Meetings and Investigative Workshops during RP 8 (each supported event may have up to three subject areas).

**Figure 2. Diversity of Subject Areas of Working Group Meetings and Investigative Workshops, RP 8**

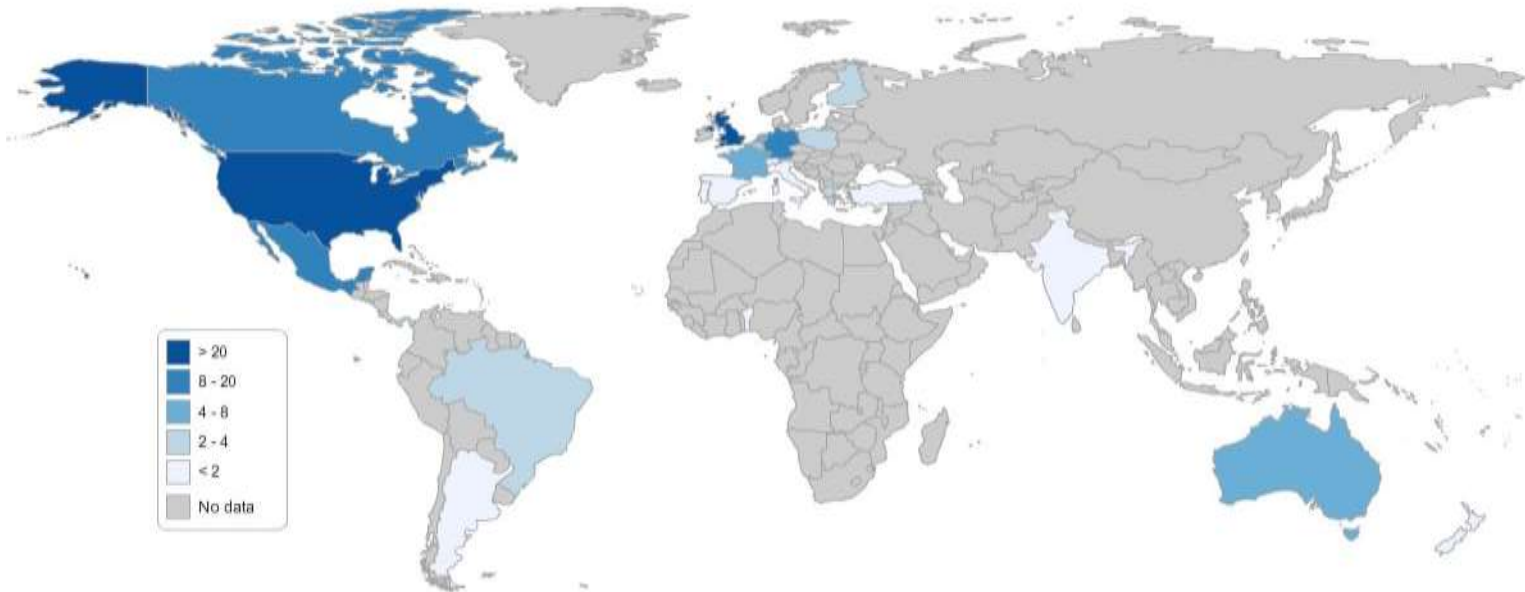


## DIVERSITY OF PARTICIPANTS

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. An electronic demographic survey aligned to the reporting requirements of the National Science Foundation was sent to all participants before their arrival at NIMBioS. Four weeks before the date of each event, a link to the survey was sent to each participant who had not visited NIMBioS within the last year. Reminder emails were sent to non-responding participants at one and two weeks after the initial contact date. The overall response rate for the demographic survey during RP 8 was 95%. 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.

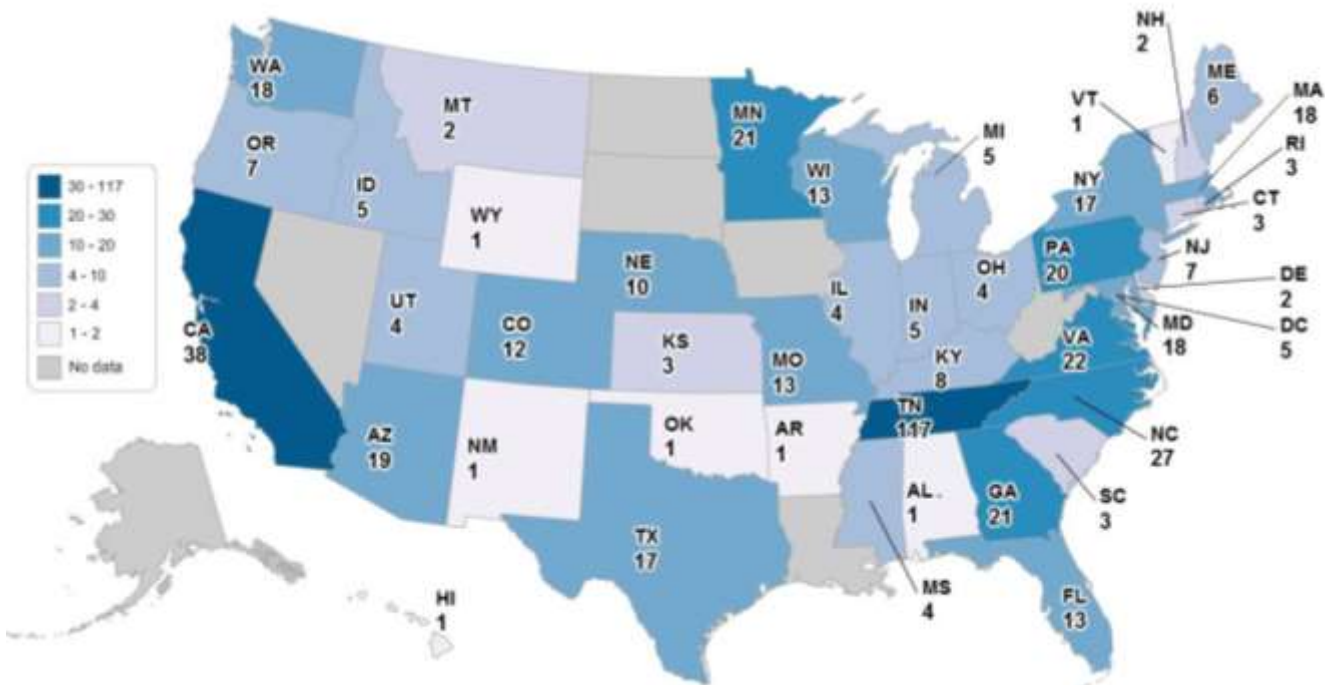
**GEOGRAPHIC DIVERSITY.** During RP 8, 624 participants (473 different individuals) from 23 countries participated in NIMBioS events. Most participants came from the United States (84%), followed by The United Kingdom (4%) and Canada (3%) (FIGURE 3).

**Figure 3. NIMBioS RP 8 participants by country**



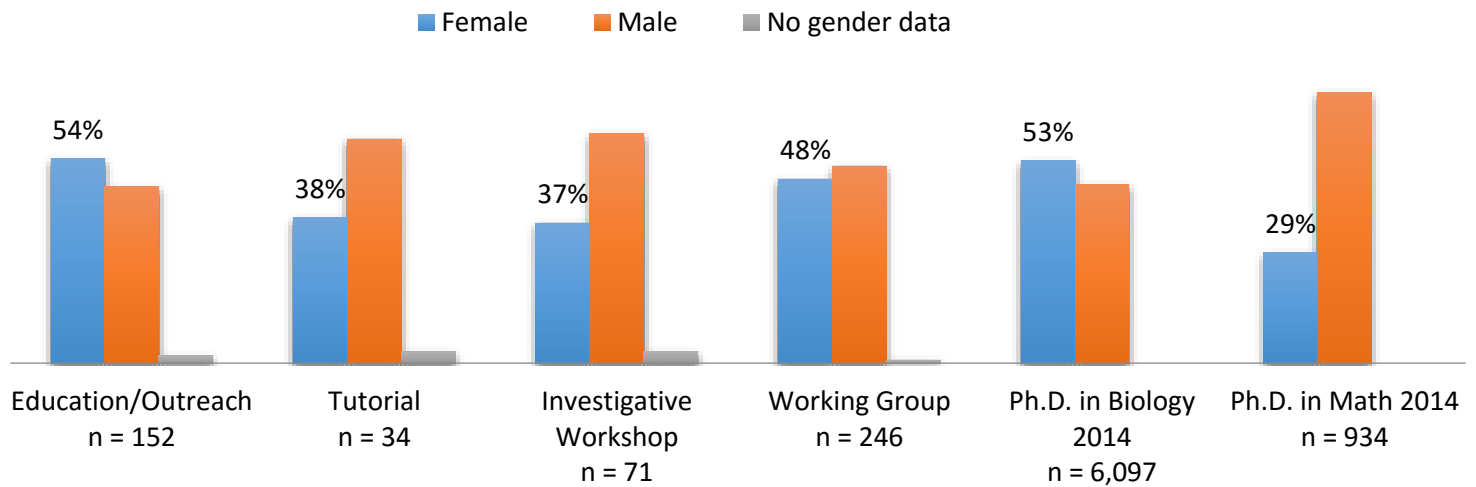
Within the U.S., 44 different states, as well as the District of Columbia, were represented. The largest percentage of participants came from within Tennessee (22%), followed by California (7%), North Carolina (5%), Virginia (4%), Minnesota (4%), and Georgia (4%) (Figure 4. NIMBioS RP 8 Participants by U.S. State ).

**Figure 4. NIMBioS RP 8 Participants by U.S. State**



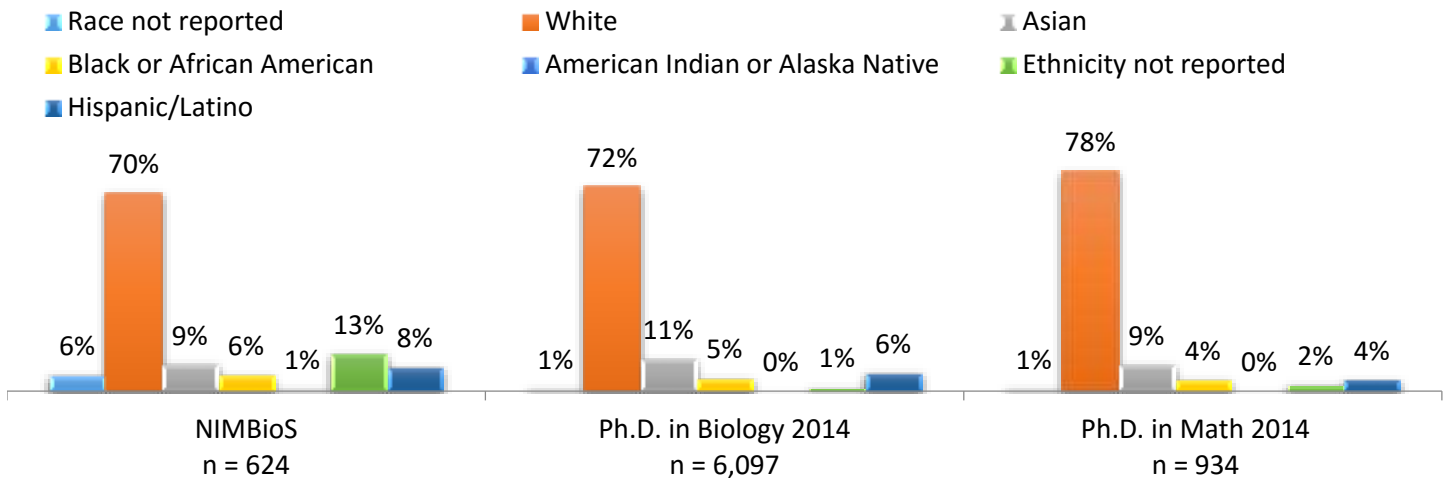
**GENDER, RACIAL, AND ETHNIC DIVERSITY.** Across all events during RP 8, female participation was 45% (no gender data for 5%). Within specific activity types, the gender ratio varied slightly, with the greatest gender equity seen in education and outreach activities and the least in Investigative Workshops (**Figure 5**). Two comparison groups shown are all individuals receiving doctorates in biology and mathematics in the U.S. In 2014<sup>2</sup>. 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<sup>2</sup> during RP 8 was around 14%. Representation of various minority categories was greater than current trends for doctoral recipients in the biological and mathematical sciences (**Figure 6**). Comparison groups shown are all U.S. citizen and permanent residents receiving doctorates in biology and mathematics in the U.S. in 2014<sup>3</sup>.

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



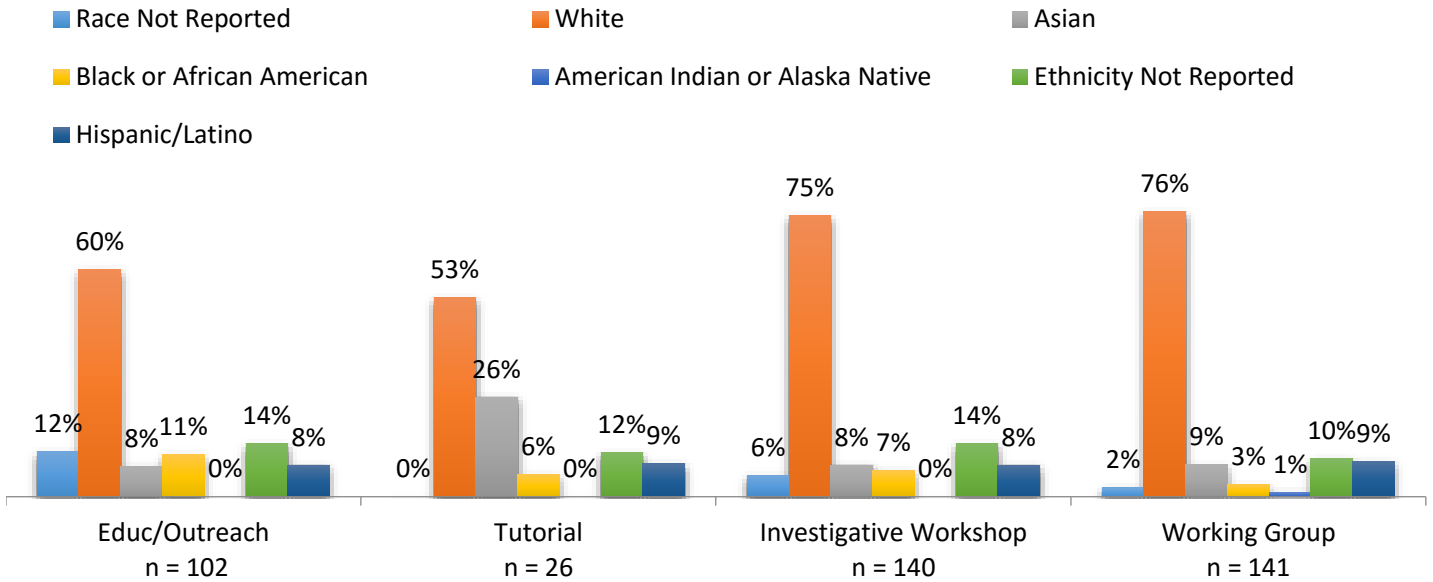
<sup>2</sup> For the purposes of this report, “minority” refers to those who self-identify as American Indian or Alaska Native, black or African American, and/or Hispanic or Latino (NSF Survey of Earned Doctorates, 2014)

<sup>3</sup> Data from the 2014 NSF Survey of Earned Doctorates, [http://www.nsf.gov/statistics/sed/2014/data\\_table](http://www.nsf.gov/statistics/sed/2014/data_table).



Minority representation varied among programs (Tutorials are considered part of Education and Outreach at NIMBioS, but are reported upon separately). Hispanic/Latino participants were represented between 8%-9% for all activity types. Among the different event types, participants self-identifying racially as white were always in the majority. Black or African American participants were represented most strongly in Education/Outreach Events (11%) (**Figure 7**).

**Figure 7. Minority representation of participants, by major event type**



**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 that we establish a variety of benchmarks for our programs.

The Site Review 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:

1. Gender: Across all Working Groups and Investigative Workshops, the proportion of female participants will be at least 30%.
2. Geographic - International participation: Across all Working Groups and Investigative Workshops, at least 10% of participants will be from outside the USA.
3. Under-represented groups (overall): Across all NIMBioS activities, we will increase the percent of participants from under-represented groups by approximately 10% per year. [ $F(t+1) = 1.1 F(t)$  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  $(t+1)$ ].
4. Underrepresented groups (Working Groups and Investigative Workshops): Comparable to the overall goal for all activities, we aim to increase the proportion of participants from under-represented groups in Working Groups and Investigative Workshops by 10% per year.
5. Local participants: To avoid overrepresentation of the University of Tennessee community in activities, we will limit 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:

1. Gender: Across all Working Groups and Investigative Workshops, approximately 30% of the organizers will be female.
2. Local: No more than 25% of Working Group/Investigative Workshop organizers will be UT faculty/staff.
3. Underrepresented groups: We will encourage researchers from underrepresented groups to be organizers/co-organizers of requests for support, but no specific goal is set because of the small number of organizers.

**Table 1** shows values by year for the above benchmarks.

**Table 1. Diversity measures for NIMBioS Working Groups, Investigative Workshops, and all events (including Tutorials and Education and Outreach activities in addition to Working Groups and Workshops) by year**

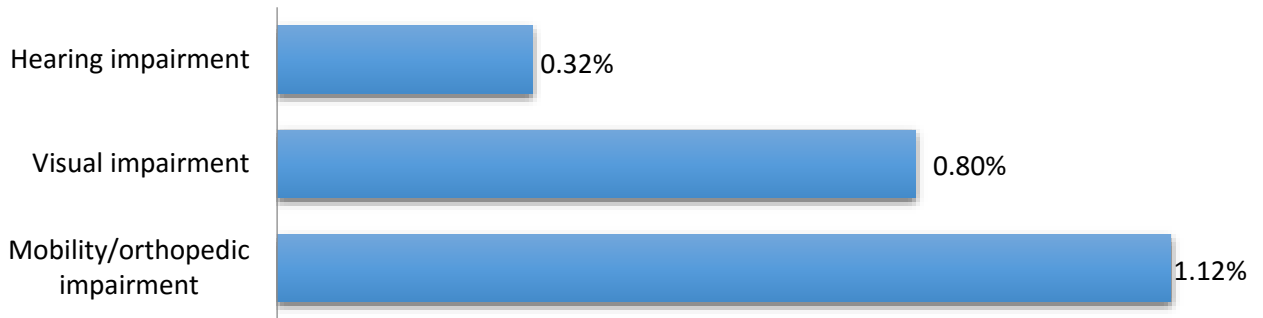
		Yr 1*	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr7	Yr8**	Overall
Participant diversity										
Gender	(Benchmark: approximately 30% female)									
	Working Groups	19%	22%	27%	34%	34%	36%	45%	48%	33%
	Investigative Workshops	40%	40%	38%	39%	39%	43%	29%	37%	38%
	All events	37%	42%	38%	39%	39%	44%	41%	45%	41%
International	(Benchmark: approximately 10% outside USA)									
	Working Groups	20%	19%	19%	18%	24%	26%	18%	22%	21%
	Investigative Workshops	10%	22%	21%	19%	5%	23%	16%	24%	18%
	All events	7%	12%	14%	16%	14%	11%	16%	15%	13%
URG										
	Working Groups	9%	10%	7%	8%	9%	9%	7%	11%	9%
	Investigative Workshops	7%	10%	14%	14%	11%	12%	17%	15%	13%
	All events	9%	11%	11%	13%	11%	13%	13%	14%	12%
Local	(Benchmark: No more than 15% from UT/ORNL)									
	Working Groups	14%	15%	16%	18%	14%	9%	7%	4%	12%
	Investigative Workshops	22%	23%	10%	7%	11%	4%	13%	6%	12%
	All events	35%	20%	16%	13%	16%	5%	12%	8%	16%
Organizer diversity										
Gender	(Benchmark: approximately 30% female)									
	Working Groups	11%	13%	16%	28%	27%	23%	28%	35%	23%
	Investigative Workshops	25%	29%	38%	39%	0%	52%	44%	17%	31%
	All events	23%	28%	27%	34%	30%	36%	33%	36%	31%
Local	(Benchmark: No more than 25% UT Faculty/Staff)									
	Working Groups	28%	22%	20%	28%	21%	16%	6%	2%	18%
	Investigative Workshops	75%	36%	12%	17%	0%	12%	22%	17%	24%
	All events	57%	42%	33%	27%	21%	21%	18%	7%	28%

\*Year 1 includes activities from March-August 2009

\*\* Year 8 includes activities from September 2015-April 2016

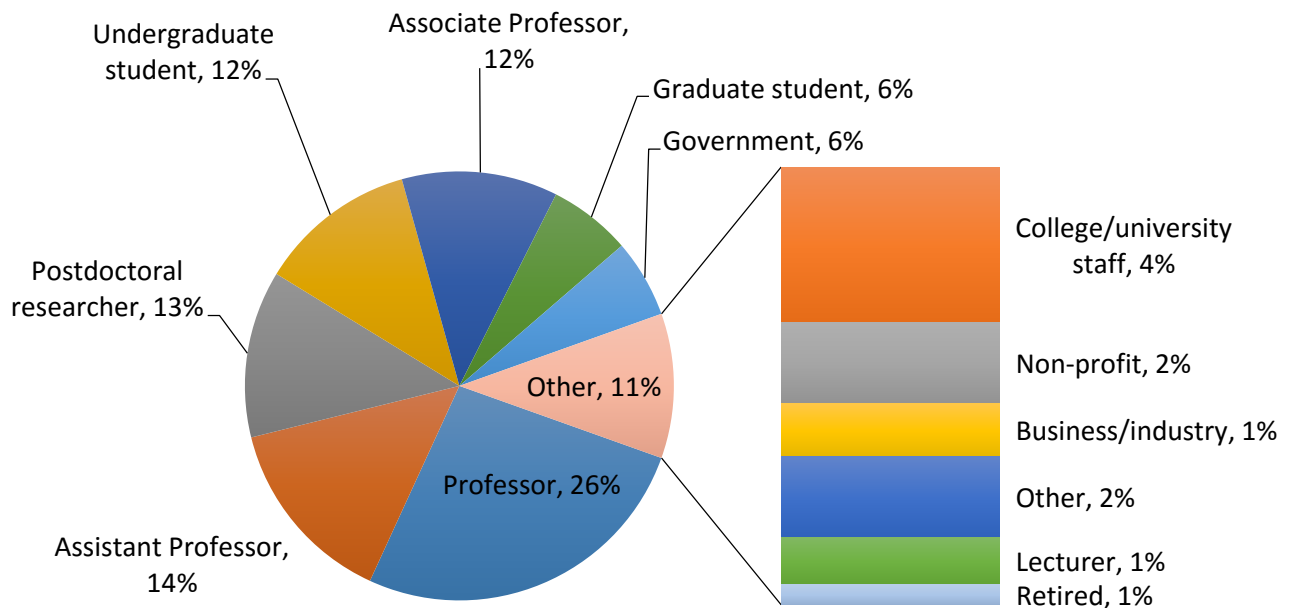
**ABILITY DIVERSITY.** Disclosure of disability status by participants to NIMBioS is optional. Around 2% overall indicated having some sort of disability during RP 8 (**Figure 8**).

**Figure 8. Disability status of participants (n = 595)**



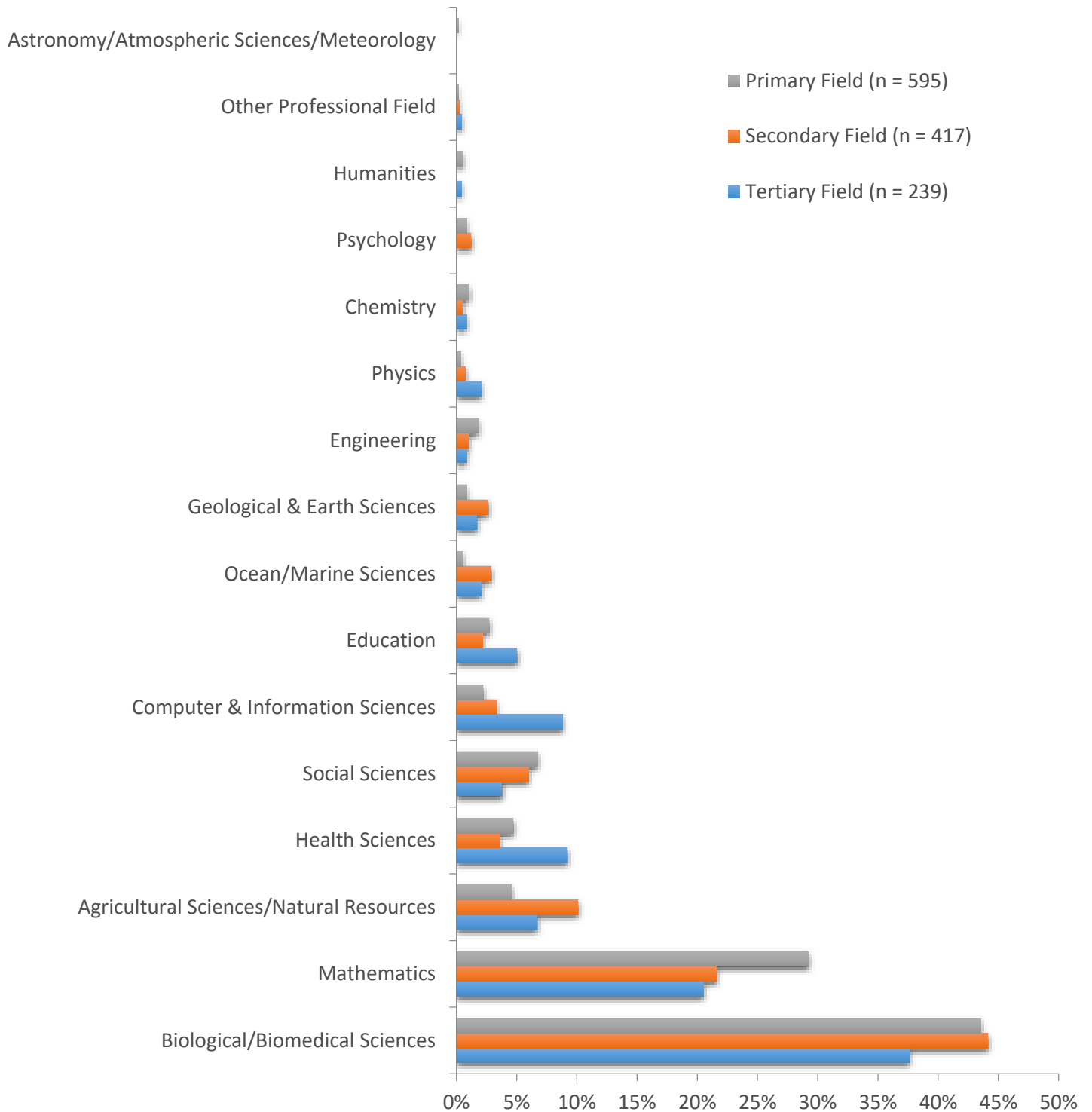
**OCCUPATIONAL DIVERSITY.** The majority of NIMBioS participants were college/university faculty or staff, undergraduate students, or postdoctoral researchers; however, participants came from government, industry, non-profit, or other positions as well (**Figure 9**).

**Figure 9. Employment status of participants (n = 595)**



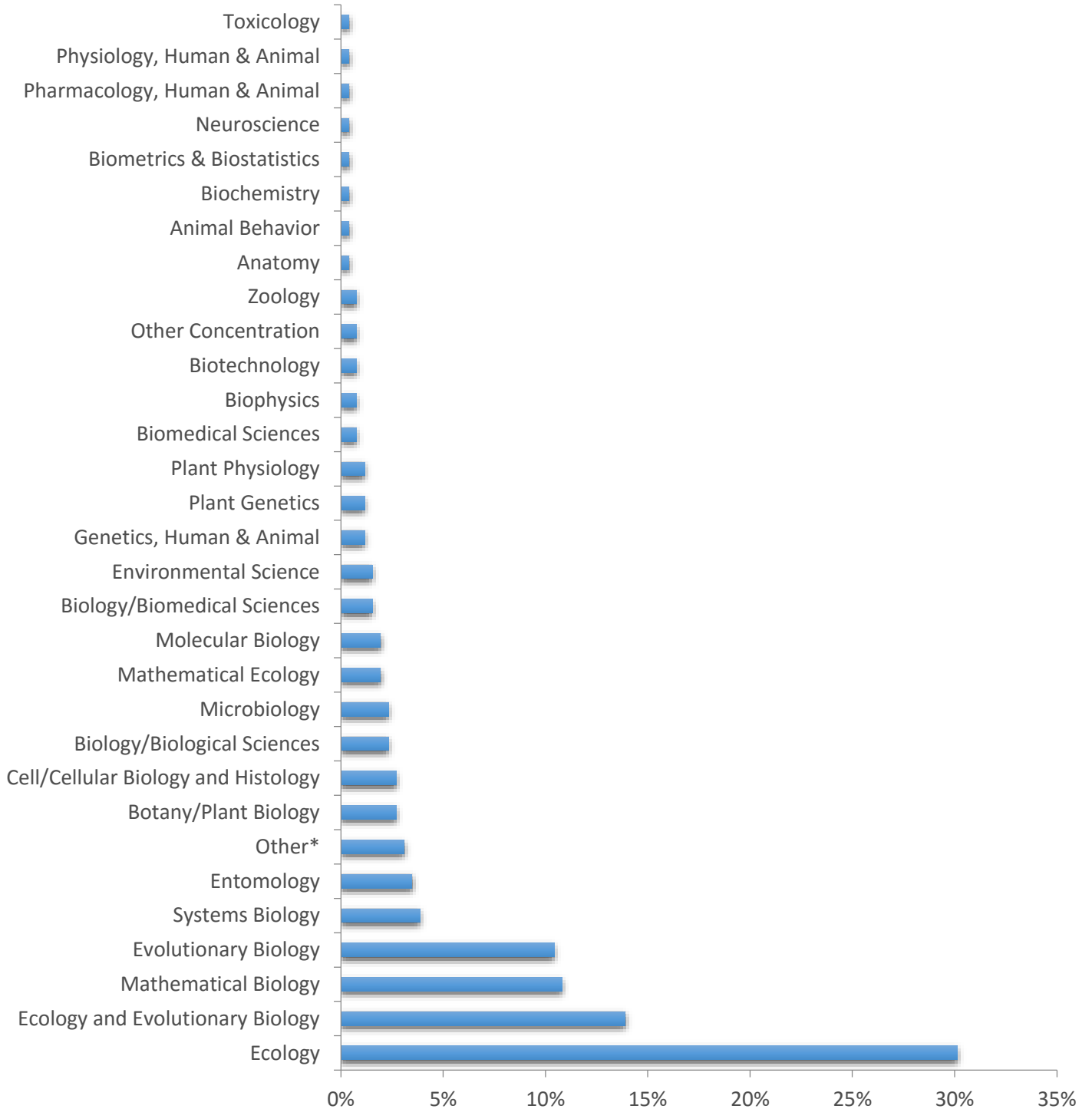
**DISCIPLINARY DIVERSITY.** Most participants at NIMBioS indicated their primary fields of study, as well as areas of concentration within those fields. Many indicated their secondary and tertiary fields of study as well. The most commonly reported fields of study included biological/biomedical sciences and mathematics although many other disciplines were represented (**Figure 10**).

**Figure 10. Primary, secondary, and tertiary discipline areas of participants**



The 259 participants indicating Biological/Biomedical Sciences as their primary field of study indicated 30 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 11).

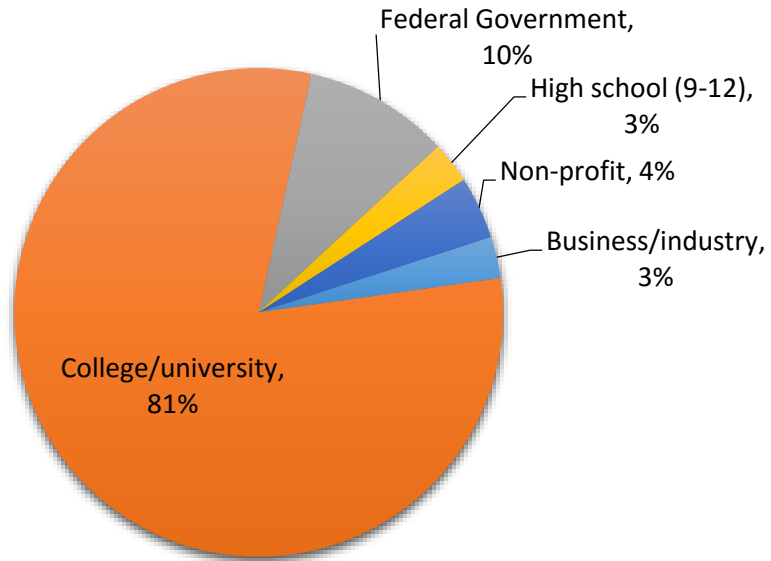
**Figure 11. Participant expertise area concentrations within biological/biomedical sciences field of study (n = 259)**



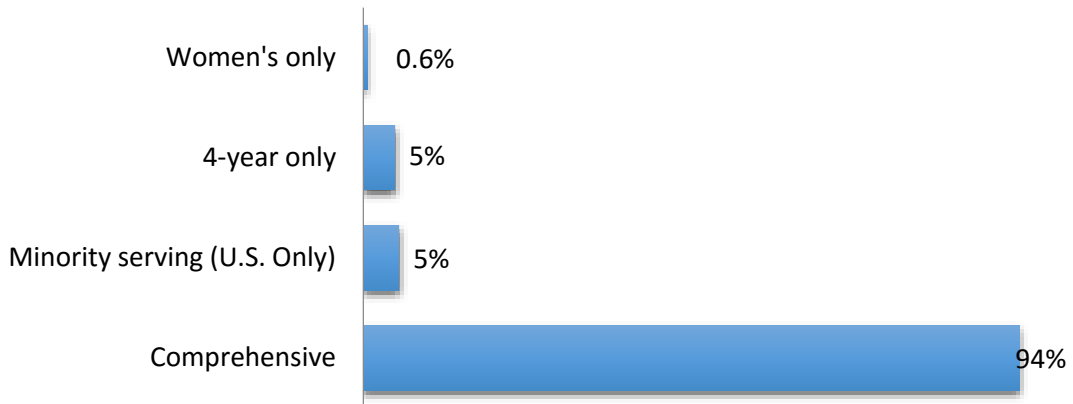
\* Other concentrations having one participant each: Anatomy, Animal Behavior, Biochemistry, Biometrics & Biostatistics, Neuroscience, Pharmacology, Human & Animal, Physiology, Human & Animal, Toxicology

INSTITUTIONAL DIVERSITY. Participants during RP 8 represented 218 different institutions, including colleges and universities, government institutions, industry, non-profits, and high schools (**Figure 12**). Of the 176 universities represented, most were classified as comprehensive (having undergraduate and graduate programs) (**Figure 13**).

**Figure 12. Types of institutions represented (n = 218)**



**Figure 13. Characteristics of participants' universities (n = 176)**



## PROCESS EVALUATION

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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 brief summary of the process evaluations of NIMBioS' major activities during RP 8.

### 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.** 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.

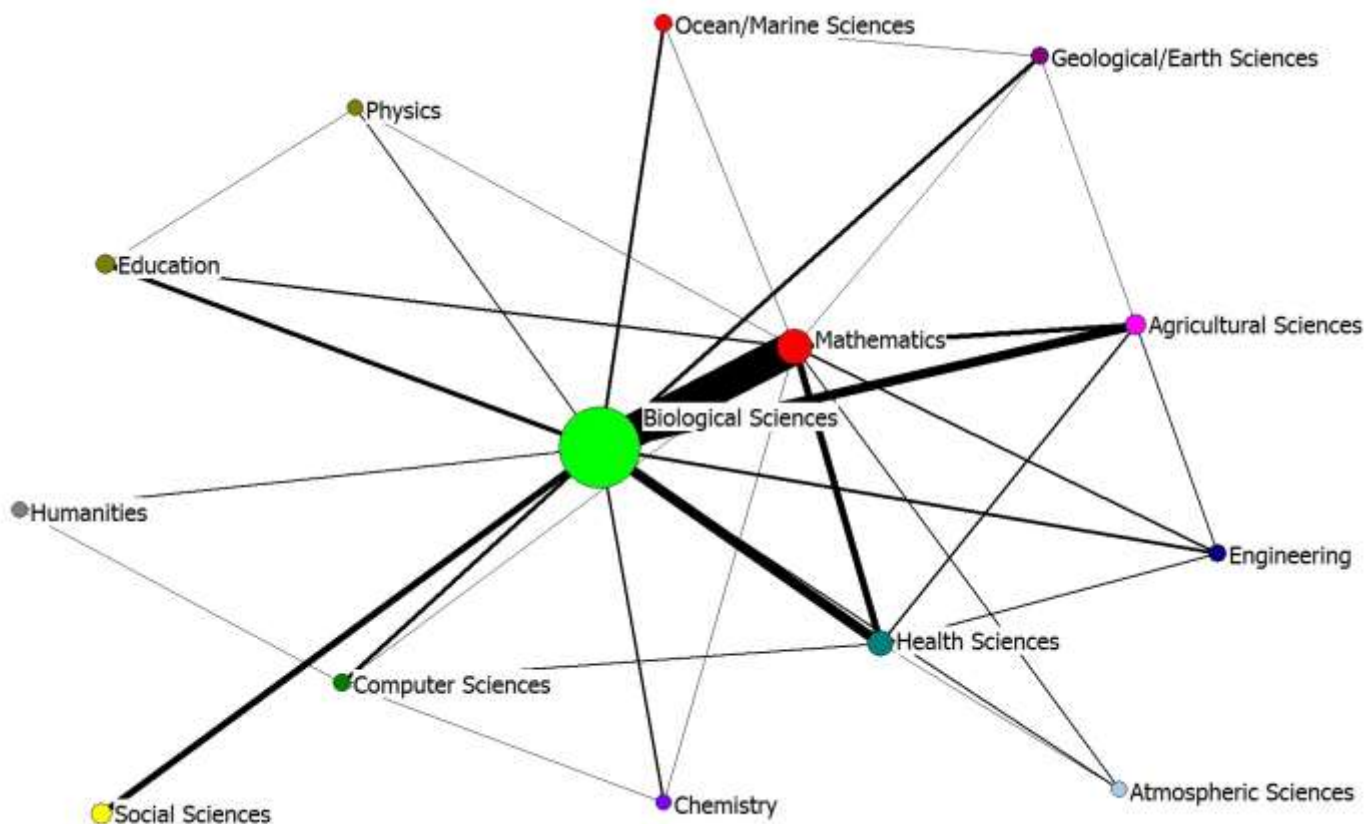
Working Groups are relatively small (10-12 participants, with a maximum of 15), focus on a well-defined topic and have well-defined goals and metrics of success (e.g., publications, databases, software). Selection of Working Groups is based upon the potential scientific impact and inclusion of participants 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 3-5 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 8, NIMBioS hosted 24 Working Group meetings, including the start of eight new groups and the return of nine established groups. A total of 246 participants (179 unique) from 112 institutions took part in the Working Groups. During RP 8, participants came together from 15 different major fields of study to focus on the respective scientific questions of their groups.

**Figure 14** shows the cross-disciplinary connections fostered among Working Group members through the meetings hosted at NIMBioS during RP 8. 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.

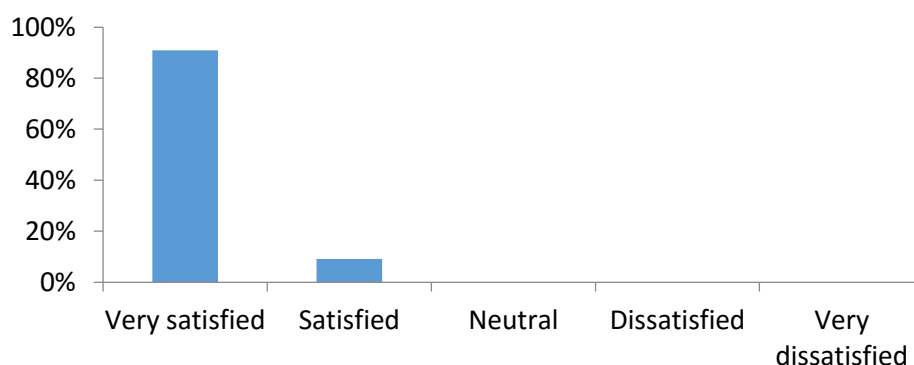
**Figure 14. Working Group cross-disciplinary collaboration**



## 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? Figure 15 summarizes the responses to this question for RP 8 organizers for all Working Group meetings.

**Figure 15. Working Group organizer satisfaction with NIMBioS handling of event (n = 44)**



### Working Group organizer comments:

*In both this Working Group and a workshop that I previously co-organized through NIMBIOS, I have been thrilled with the level of support that NIMBIOS has provided with respect to helping to organize the event. I would hold it up as a model of how to do things right.*

*NIMBioS staff make the process so easy. I never had to worry about any logistical details and could focus entirely on the meeting. Also, the guidance we received in adding participants was very helpful.*

*The organization was fantastic. We love coming to NIMBioS, the staff does an amazing job of making us feel welcome, and comfortable that allows us to focus on the science and be productive.*

## WORKING GROUP FIRST MEETINGS

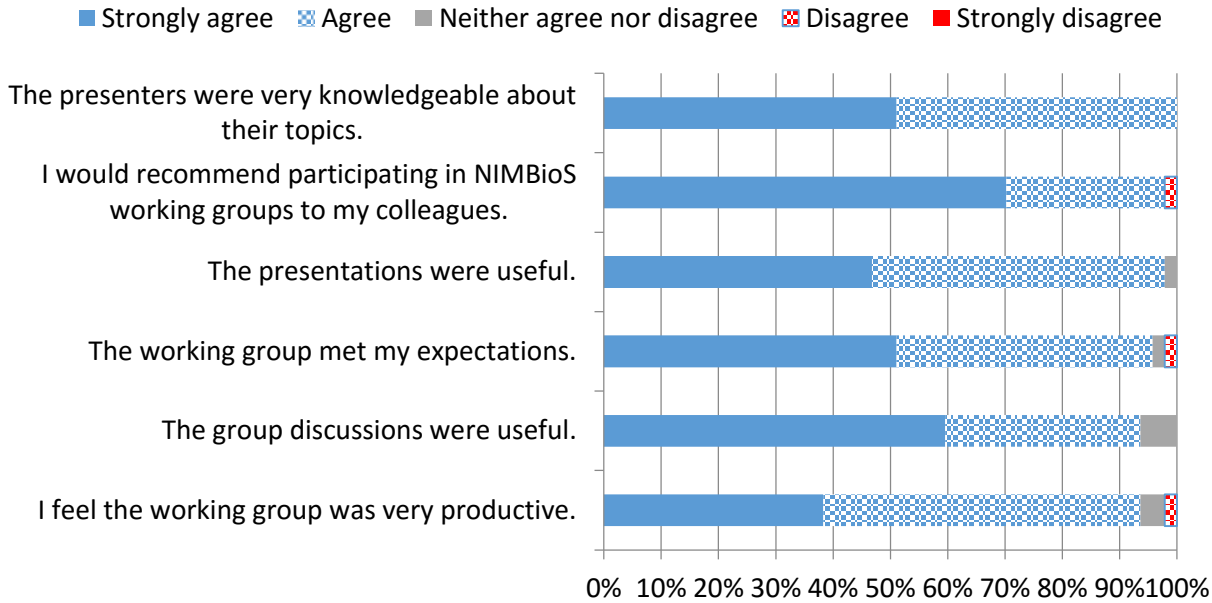
During RP 8, NIMBioS hosted the first meetings of eight Working Groups, with 84 participants (**Table 2**). (See <http://www.NIMBioS.org/workinggroups/> for more details about specific Working Groups). Evaluation surveys were sent to all participants. A total of 67 participants took part in the evaluation of the first meetings of their Working Groups. Eighteen of these participants were organizers and only answered questions about how they felt NIMBioS managed their events.

**Table 2. Working Group First Meetings Hosted by NIMBioS**

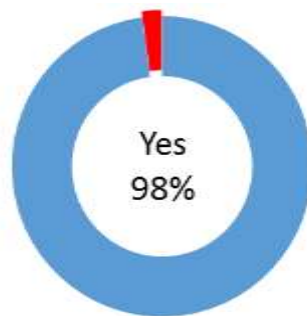
Title of Working Group	Dates	# Participants
Teaching Quantitative Bio	Oct 22-24, 2015	11
Modeling Molecules-to-Organisms	Nov 16-20, 2015	11
Modeling Organisms-to-Ecosystems	Nov 16-20, 2015	12
Spatial Cell Simulations	Dec 1-3, 2015	10
Cooperation and Cognition	Dec 9-11, 2015	8
Multiscale Vectored Plant Viruses	Dec 14-16, 2015	11
Models of Produce Contamination	Apr 13-15, 2016	11
Remotely Sensing Biodiversity	Apr 21-23, 2016	10

HIGHLIGHTS OF WORKING GROUP FIRST MEETING EVALUATION RESPONSES (FIGURES 16-18)

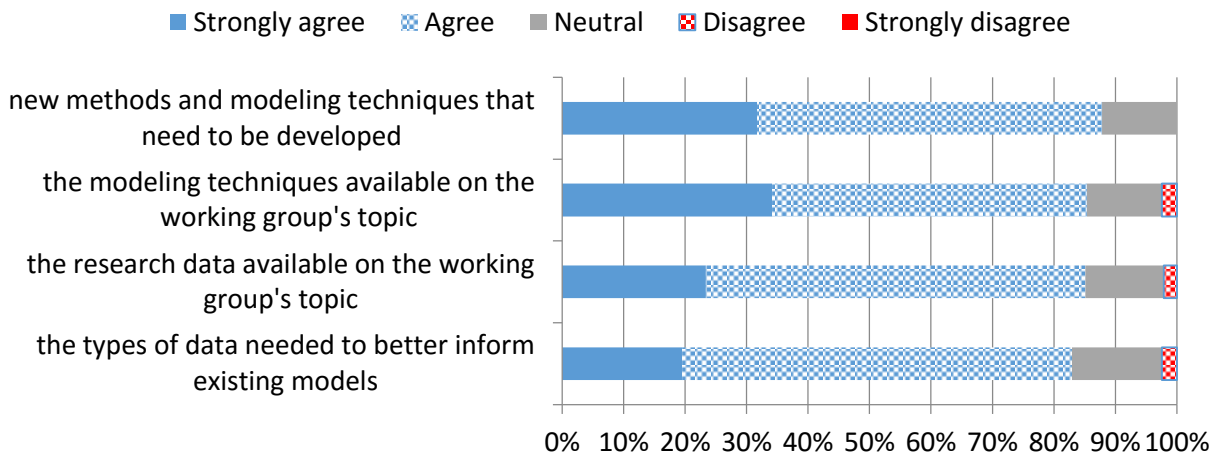
**Figure 16. Overall satisfaction with the content and format of the Working Groups**



**Figure 17. Participant responses to the following question--As a result of participating in this Working Group, I have a better understanding of the research happening in the field in disciplines other than my own:**



**Figure 18. Participants who felt the exchange of ideas during the Working Group would influence their future research:**



## WORKING GROUP SECOND AND THIRD MEETINGS

During the reporting period, NIMBioS hosted the second meetings of nine Working Groups, with 91 participants, and the third meeting of four Working Groups, with 42 participants (Table 3).

**Table 3. Working Group Second and Third Meetings Hosted by NIMBioS**

Title of Working Group	Dates	# Participants
<b>Second Meetings</b>		
Leptospirosis Modeling	Sep 14-18	9
Vector Movement and Disease	Oct 26-29	14
Climate Proxies	Nov 3-5	9
Ecological Network Dynamics	Dec 7-11	8
Dispersal Biogeography	Mar 17-19	10
Spatial Cell Simulations	Mar 21-23	9
Teaching Quantitative Bio	Mar 24-26	10
Modeling Organisms-to-Ecosystems	Apr 4-7	10
Modeling Molecules-to-Organisms	Apr 18-21	13
<b>Third Meetings</b>		
Evolutionary Approaches to Sustainability	Oct 26-30	9
Modeling Antimicrobial Resistance Intervention	Mar 7-9	8
Vector Movement and Disease	Mar 29-Apr 2	16
Climate Proxies	Apr 4-6	9

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.

Participant comments from Working Group meetings 2-3:

*The Working Group is progressing well and NIMBIOS provides us a frame for great interactions. I could not attend to the last meeting but I could connect by skype and interact with the group.*

*I think this is a very productive Working Group composed of members who work quite well together. A very positive experience for me as a young scientist.*

*Great experience! I enjoyed every meeting and every interaction. Nimbios helps to develop and support productive collaborations and stimulate new ideas.*

*Overall, the experience was GREAT!!! It provided an opportunity to meet a number of very "interesting" researchers doing work on topics previously unknown to me. Also, several (possible) research collaborations may materialize.*

*I am deeply grateful to NIMBioS for the support for our Working Group - we would otherwise not have had the support/opportunity to come together in this way and our resulting collaborations have been very exciting and productive.*

*The organization was fantastic. We love coming to NIMBioS, the staff does an amazing job of making us feel welcome, and comfortable that allows us to focus on the science and be productive.*

*Excellent interactions. We are able to calibrate model, review datasets, implement data fitting code, and decided on model parameter ranges.*

## CONCLUDED WORKING GROUPS

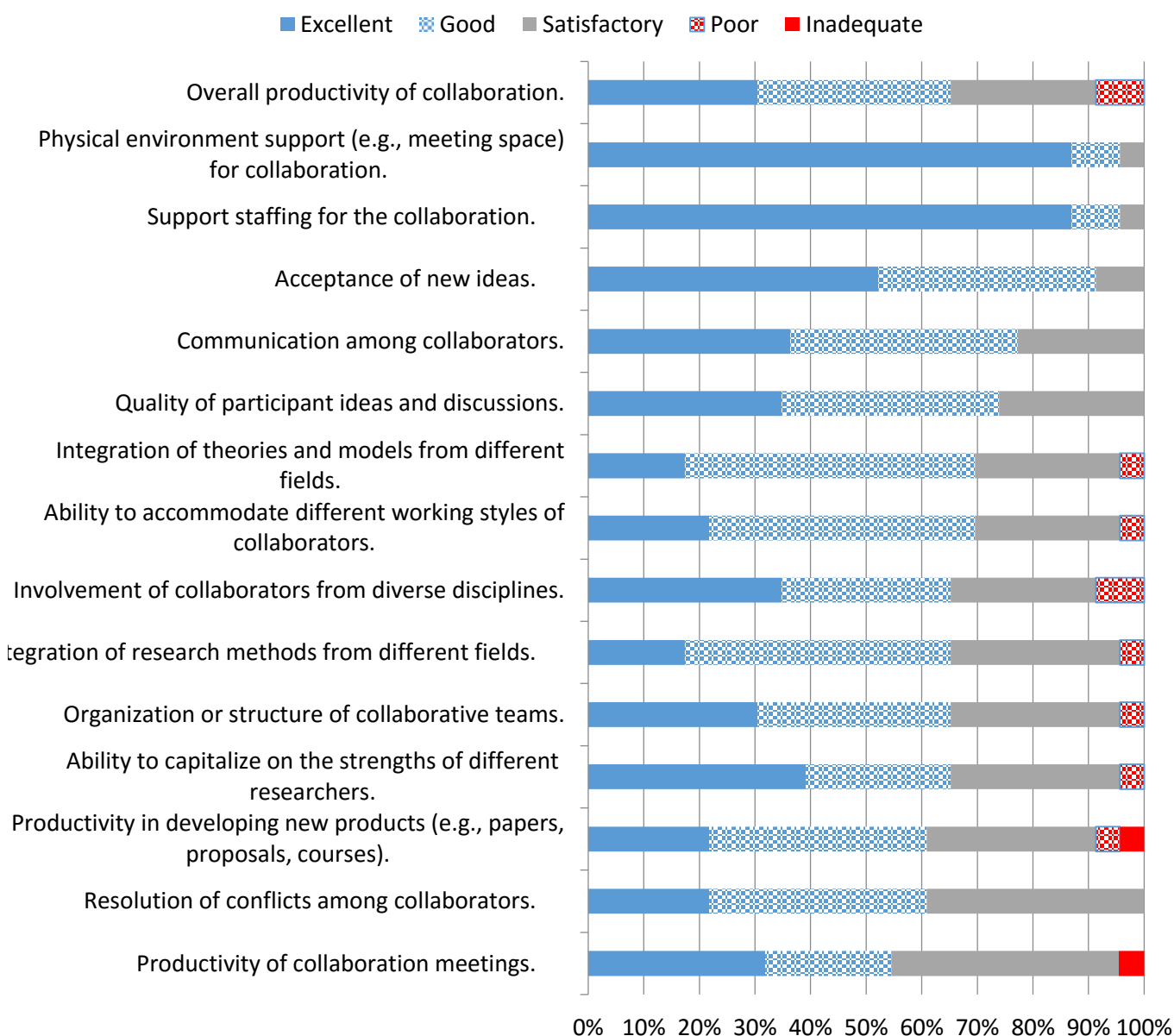
NIMBioS received notification that three Working Groups had reached their conclusions as of April 2016 (**Table 4**). It is the policy of NIMBioS to send follow-up evaluation surveys to Working Group participants after the final meeting summary has been received from Working Group organizers. A total of 24 participants responded to the final evaluation for their groups.

**Table 4. Concluded Working Groups, RP 8**

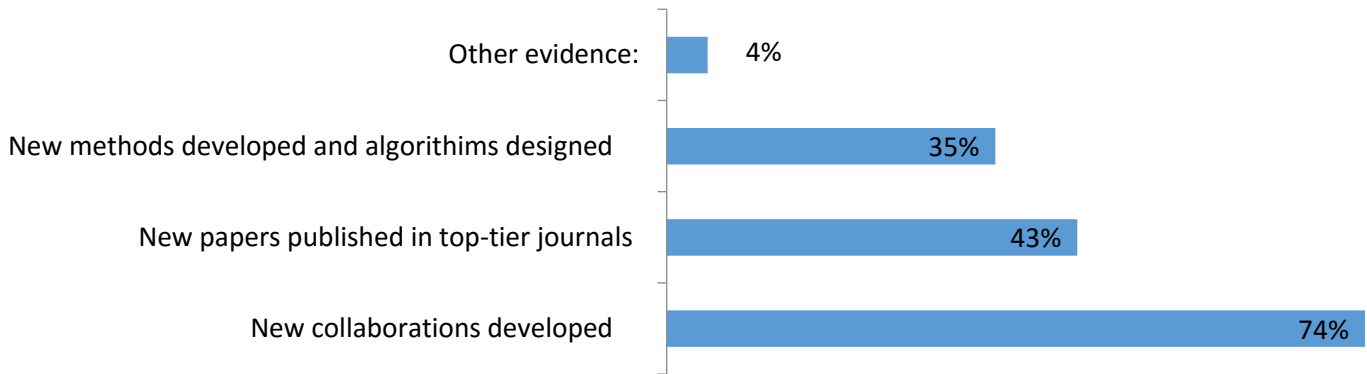
Title of Working Group	Dates	# Participants
Climate Change and Vector-borne Diseases	Dec 15-17	12
Computational Landscape Genomics	Mar 21-23	7
Evolutionary Approaches to Sustainability	Mar 28-Apr 1	9

## HIGHLIGHTS OF WORKING GROUP FOLLOW-UP EVALUATION RESPONSES (FIGURES 19-20)

**Figure 19. Evaluation of various aspects of Working Groups**



**Figure 20. Evidence to support new insights and collaborations within the group**



**Concluded Working Group participant comment:**

*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!*

## 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.

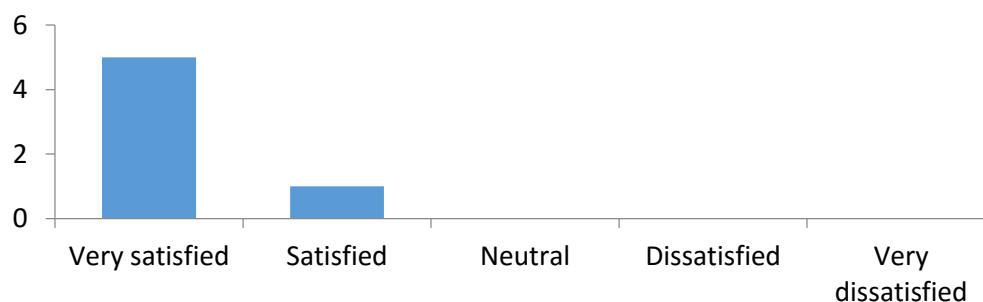
NIMBioS hosted two Investigative Workshops during RP 8 with a total of 71 on-site participants and 66 virtual participants (**Table 5**). Evaluation surveys were sent to all on-site Workshop participants. A total of 69 participants took part in the evaluation of the Workshops.

**Table 5. Investigative Workshops Hosted by NIMBioS**

Title of Workshop	Dates	# Participants
Morphological Plant Models	Sep 02-04	38
Evolution and Warfare	Sept 16-18	33

### HIGHLIGHTS OF WORKSHOP EVALUATION RESPONSES (FIGURES 21-23)

**Figure 21. Workshop organizer satisfaction with NIMBioS handling of event (n = 6)**

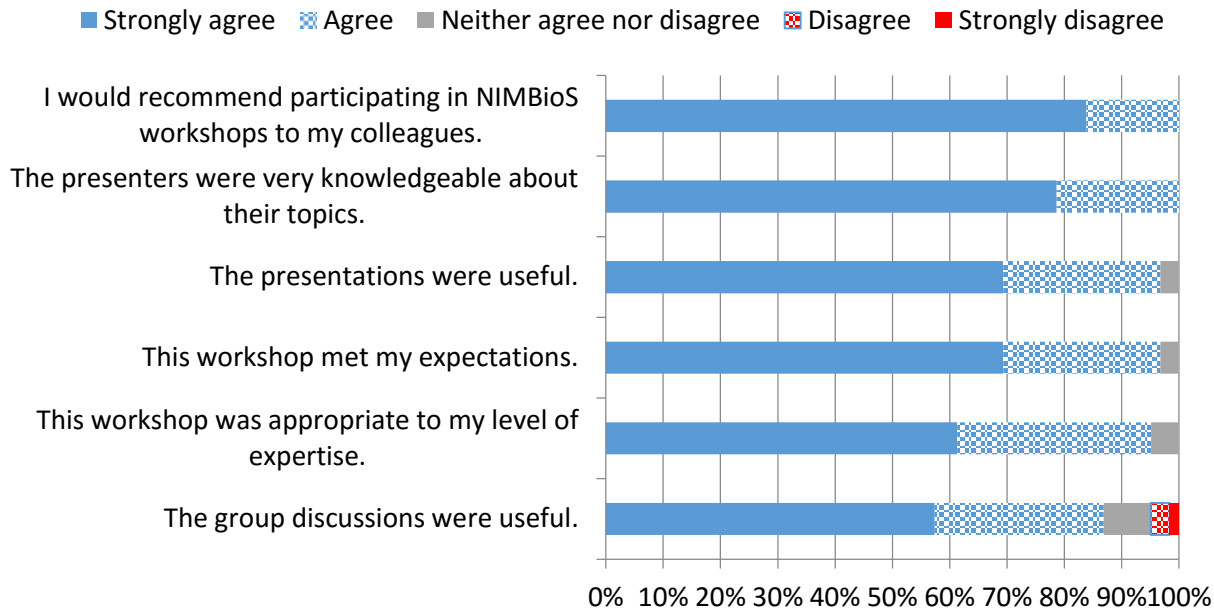


#### Investigative Workshop organizer comments:

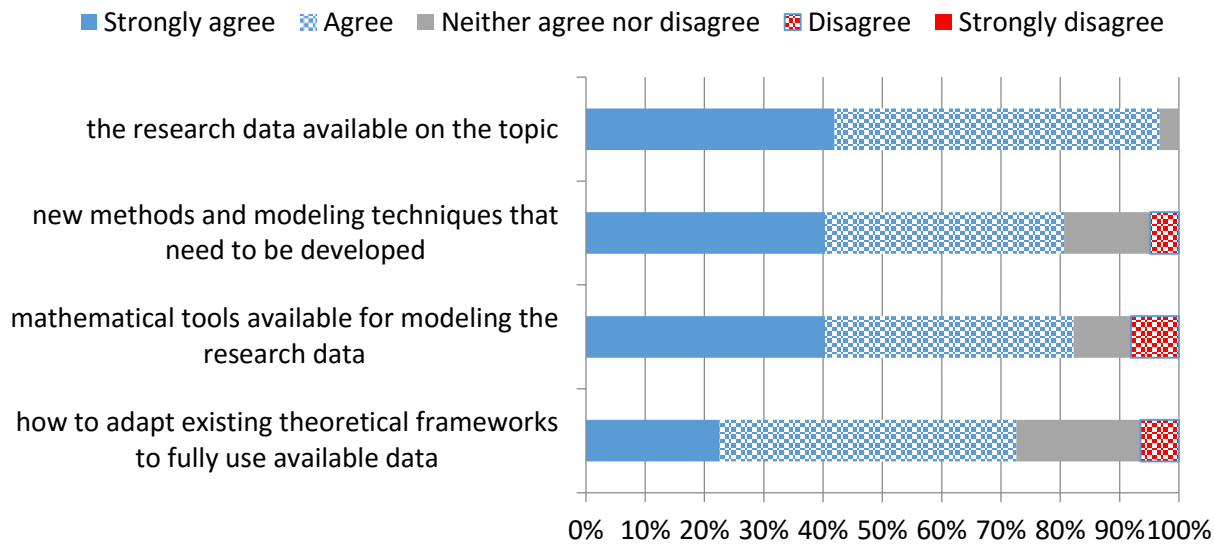
*I have never experienced a more efficient, hassle-free workshop as an organizer than with NIMBioS. Because everything was set-up, this allowed me to focus on the workshop itself and the resulting collaborations and future projects that developed from this meeting. I have nothing but praise for NIMBioS and I wish their model was emulated more.*

*I greatly appreciated that NIMBioS handled many details (e.g., the website, travel and lodging arrangements) that would have been very difficult for me as an organizer to handle on my own. The NIMBioS staff were helpful and professional throughout.*

**Figure 22. Overall satisfaction with the content and format of the Workshop**



**Figure 23. Participant responses to the following question-- As a result of participating in this Workshop, I have a better understanding of:**



**Investigative Workshop participant comments:**

*Having participated over the years in many meetings that bring together people from different disciplines, I think this was one of the most successful in quickly establishing a very productive cross-disciplinary dialogue*

*The mix of people with very different approaches to the topic of the workshop was excellent. The talks identified many questions that will be important to take into consideration in my own future studies, so I think the workshop will have a lasting positive impact on my research at least.*

*A great workshop and definitely much needed in plant biology. This workshop served to fill a hole in the plant research community and bring together different disciplines.*



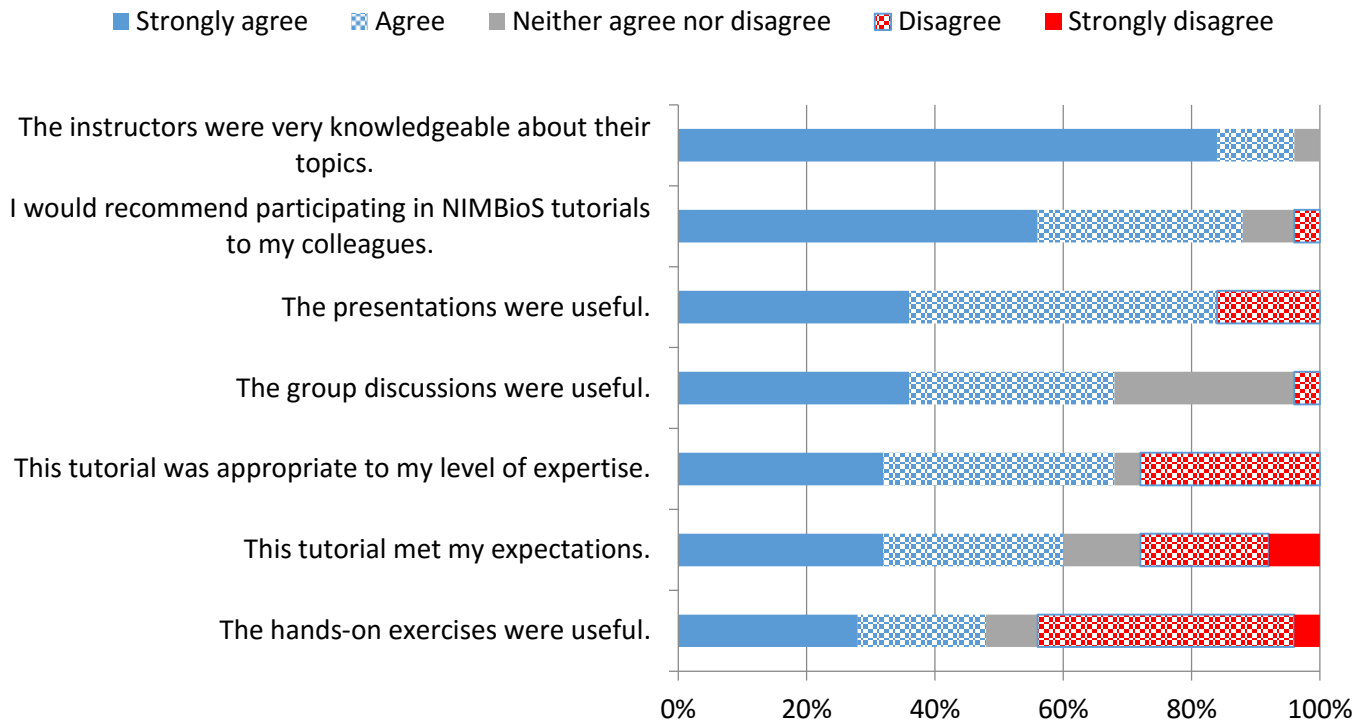
## EDUCATION AND OUTREACH PROGRAM ACTIVITIES

### TUTORIAL: GAME THEORETICAL MODELING OF EVOLUTION IN STRUCTURED POPULATIONS

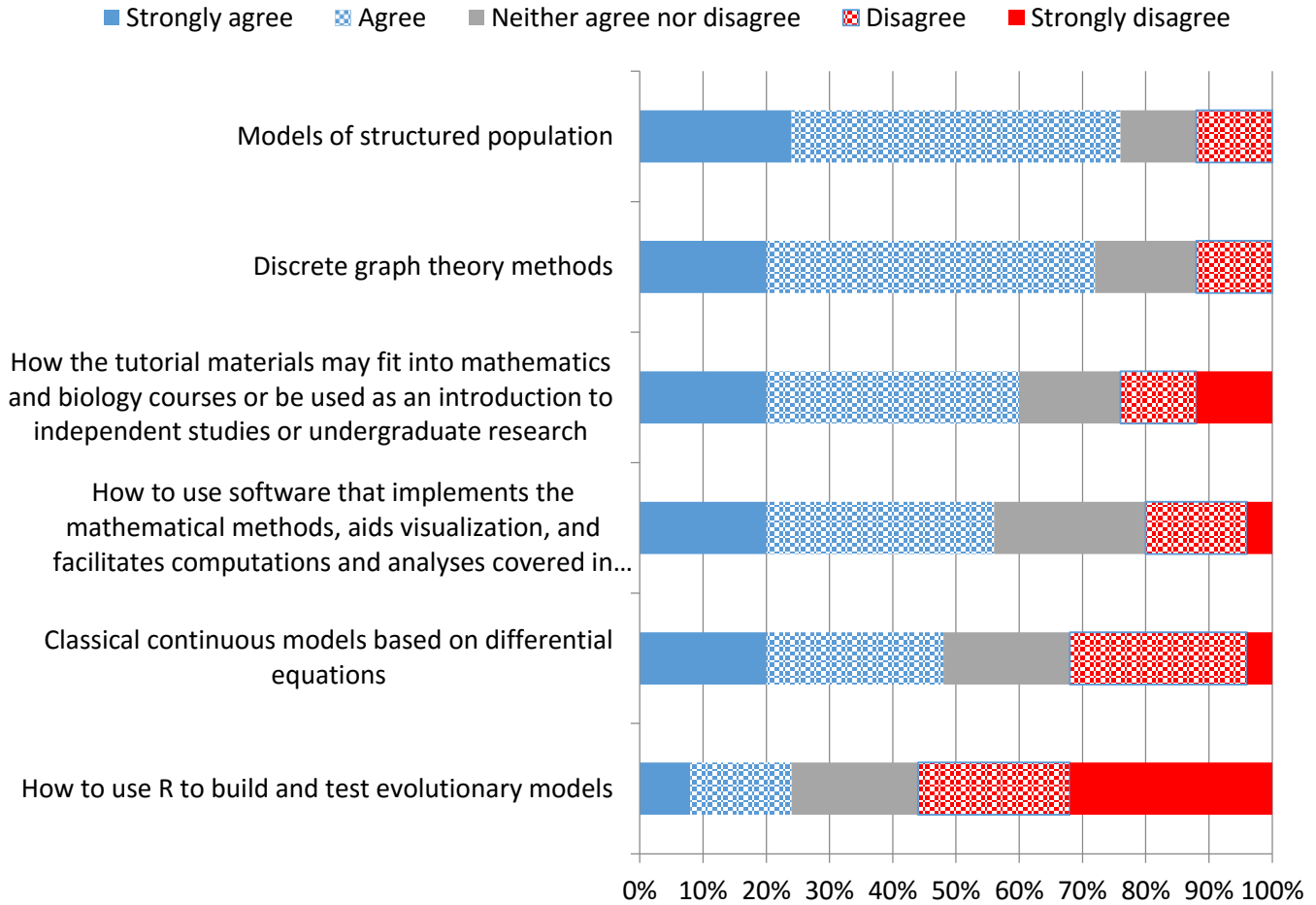
The Game Theoretical Modeling of Evolution in Structured Populations Tutorial took place April 25-27 at NIMBioS. Organizers were Mark Broom (City University, London), Jeremy Van Cleve (University of Kentucky), Jonathan Rowell and Jan Rychtar (University of North Carolina, Greensboro). This Tutorial introduced participants to the discrete graph theory methods and models of structured population as well as classical continuous models based on differential equations. A total of 30 participants (plus four organizers) attended the tutorial. The evaluation survey was sent to all attendees and organizers, and 28 participants completed the survey.

#### HIGHLIGHTS OF TUTORIAL EVALUATION RESPONSES (FIGURES 24-25)

**Figure 24. Overall satisfaction with the content and format of the Tutorial**



**Figure 25. Participant responses to the following question-- As a result of participating in this Tutorial, I have a better understanding of:**



**Tutorial participant comments:**

*The venue and facilities were excellent. I really enjoyed my stay in Knoxville and at NIMBioS in particular.*

## SUMMER RESEARCH EXPERIENCE

The NIMBioS *Summer Research Experience (SRE)* program took place on the University of Tennessee, Knoxville (UT) Knoxville campus June 8-July 31, 2015. Fifteen undergraduates and two high school teachers were chosen to participate in the program. (While this SRE program technically fell within the dates of reporting period seven (RP 7), the SRE program for 2016 will not conclude until after the RP 8 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 2015 program included:

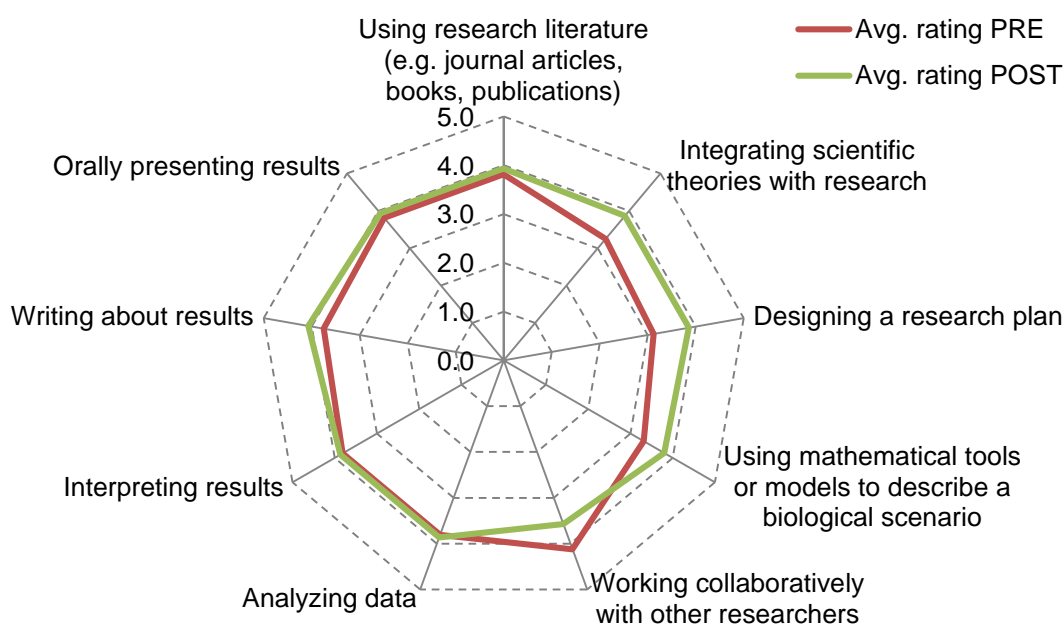
- Modeling the distribution of fluid pressure in the kidney
- Development of mathematical models of Mycobacterium tuberculosis in mice
- Canine distemper modeling
- Exploring stressors in the host-pathogen interaction: Can a host use self-harming defenses to adequately protect itself?
- Ships, ports, invasions and math: Invasive species movements through global shipping routes

## CONTEXT

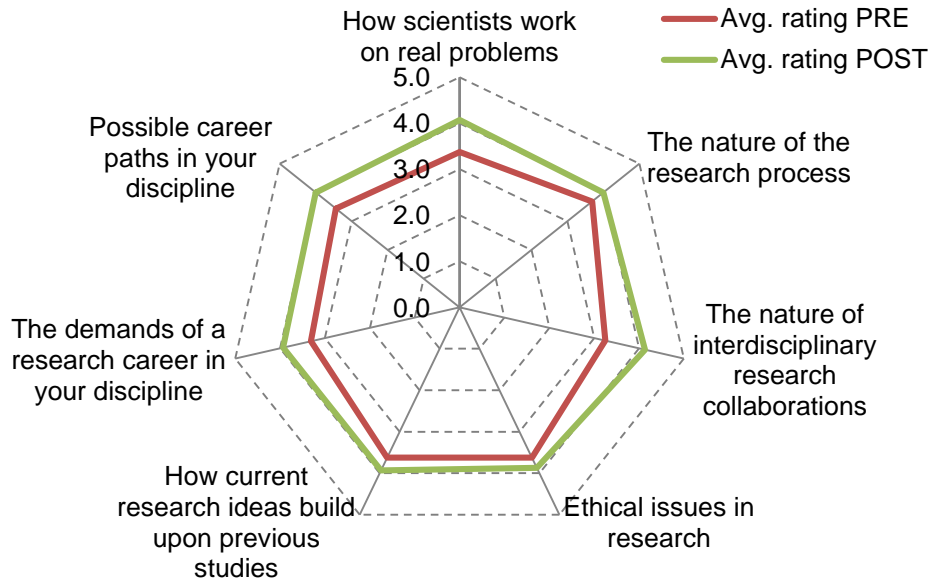
1. Participants will be satisfied with the program overall.
2. The research experience will meet participant expectations.
3. The research experience will impact participant plans to go to graduate school.
4. Participants will increase their research skills during the program.
5. Participant will feel 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 REU EVALUATION RESPONSES (FIGURES 26-28)

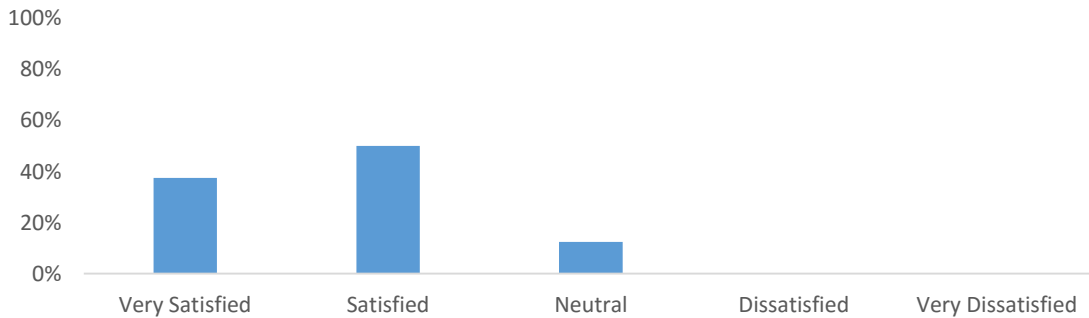
**Figure 26. Participant pre-and post-program skills, response scale of 1 = extremely poor at the skill to 5 = excellent at the skill**



**Figure 27. Participant pre- and post-program knowledge, response scale of 1 = extremely poor understanding to 5 = excellent understanding**



**Figure 28. Overall satisfaction with the research experience**



**SRE participant comments:**

*It is an incredible opportunity to work in an interdisciplinary, collaborative environment as an undergraduate. There aren't many programs in biomathematics that offer this experience. The program also really exceeded my expectations in the amount of lectures, opportunities to meet graduate students and postdocs, and social events. The other SRE students were incredibly talented, and having us all housed on one floor of Laurel Hall was great so we got to get to know each other well. Overall, I learned an incredible amount and had a great summer.*

*I would recommend the program because of the large impact it has made on shaping who I become after my undergraduate career. I learned much about myself from this program, as well as learned much about the people who will become my peers one day. Additionally, the administration staff is top-notch along with Suzanne, which really makes the whole process enjoyable.*

## 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 November 21-22, 2015. 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.

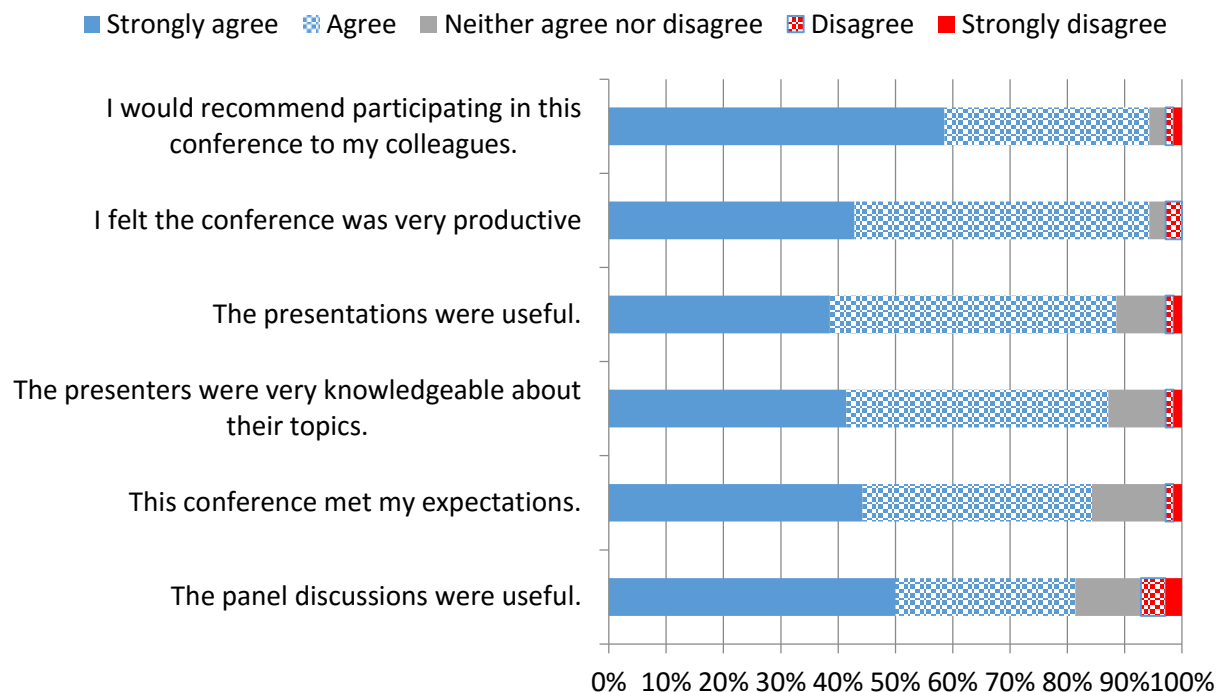
A total of 90 participants (plus 2 organizers) attended the seventh annual Undergraduate Research Conference, which provided opportunities for undergraduates to present their research at the interface of biology and mathematics. Student talks and posters were featured as well as a panel discussion on career opportunities. Evaluation surveys were sent to all participants in the conference, with the exception of event organizers. A total of 71 participants took part in the evaluation.

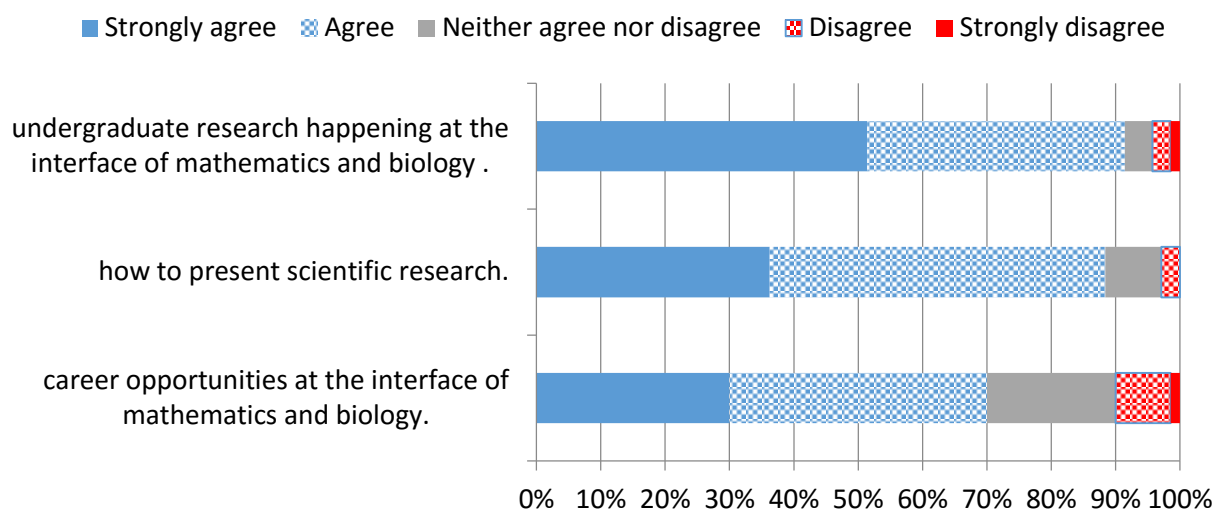
### CONTEXT

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 29-30)

**Figure 29. Respondent agreement levels with statements about various aspects of the conference**



**Figure 30. As a result of attending this conference, I have a better understanding of:****Tutorial participant comments:**

*It was a great opportunity to see others doing similar work but with varying approaches. The conference definitely manifested many ideas within me to augment my research, and new research ideas entirely that involve meshing the two disciplines even more.*

*I have been hesitant to go into a math heavier field, but after the panel discussion, I think I would be successful in the field as long as I am eager to work hard to greater my understanding*

*Great conference. This experience was only possible due to NIMBioS generous funding to our group!*

**NIMBIOS POSTDOCTORAL FELLOW EXIT SURVEY HIGHLIGHTS**

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.

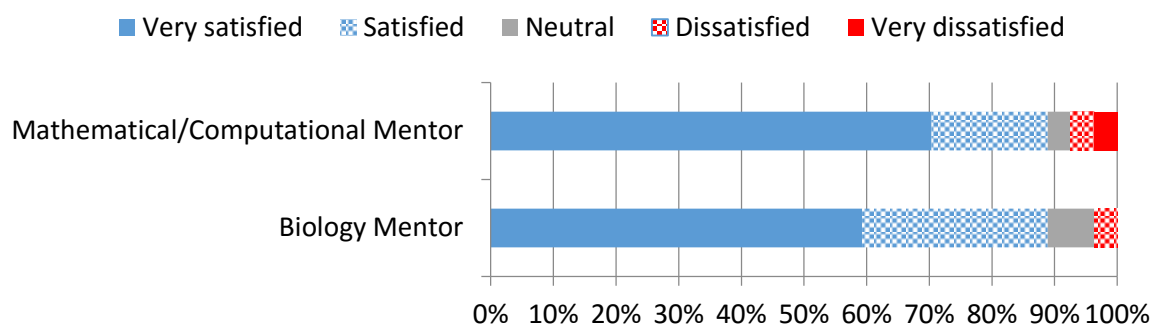
Upon leaving the Postdoctoral Fellowship program at NIMBioS, program participants are asked to fill out a short exit evaluation form that examines several aspects of satisfaction with the program's operations. To date, 27 (84%) alumni from the program have filled out the form.

CONTEXT

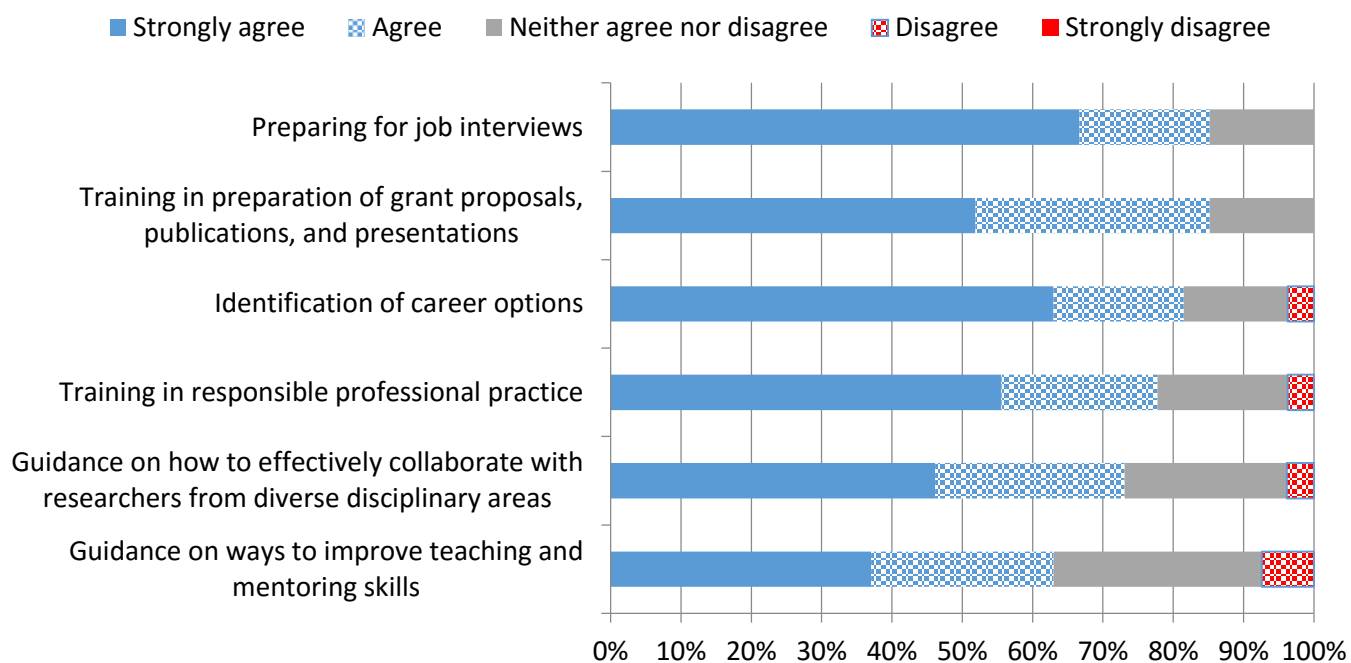
1. Participants will be satisfied with the structure of the program.
2. Participants will feel the program has been valuable to their academic careers.
3. Participants will be satisfied with the accommodations offered by NIMBioS to conduct research.
4. Participants will be with their mentors overall.
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.

HIGHLIGHTS OF POSTDOCTORAL FELLOWSHIP PROGRAM RESPONSES (FIGURES 31-33)

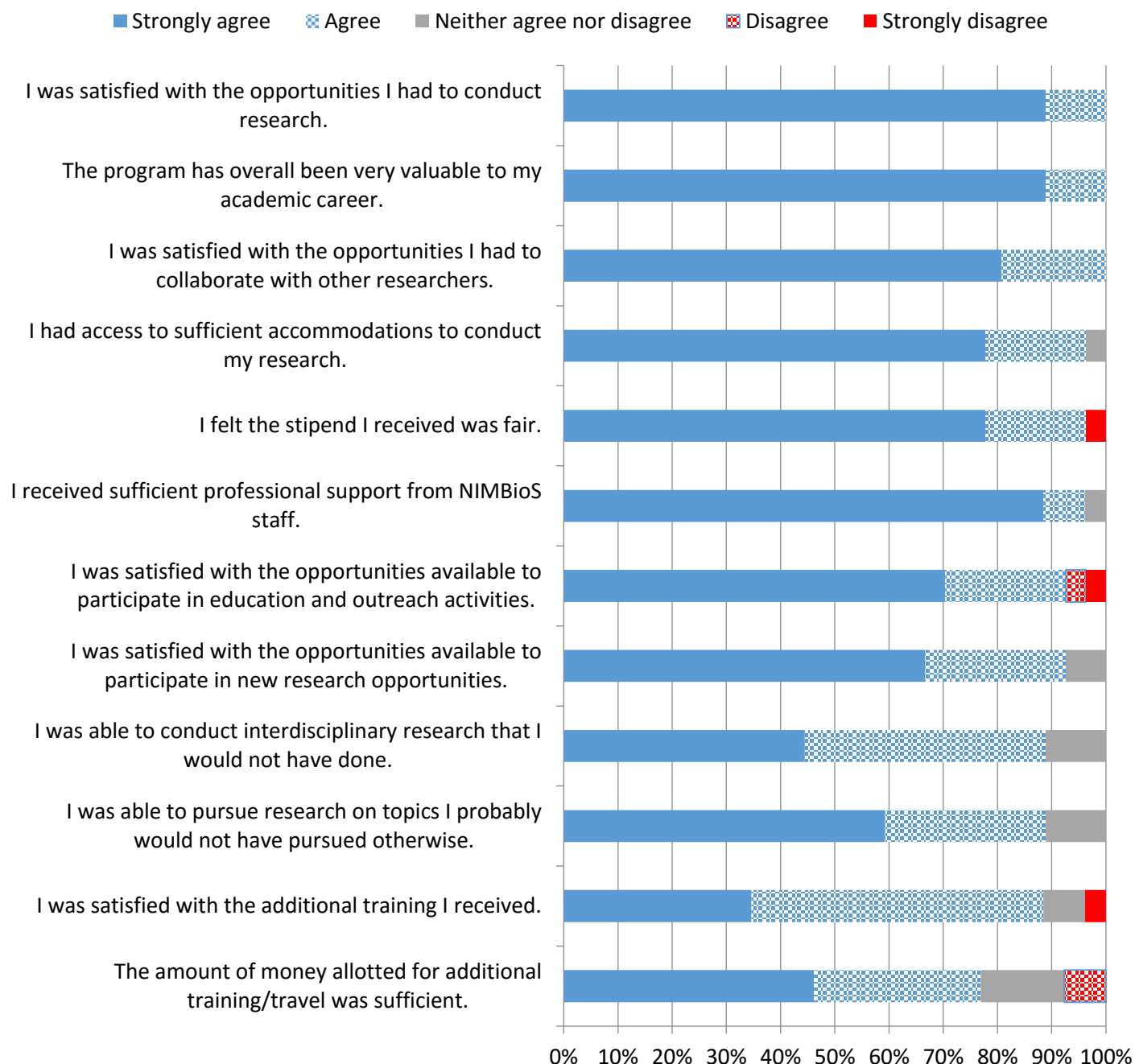
**Figure 31. Postdoctoral fellow satisfaction with program mentors**



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



**Figure 33. Postdoctoral fellow satisfaction with overall program experience**



**NIMBioS Postdoctoral Fellowship alumni comments:**

*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.*





NIMBioS products are published in many high-ranking journals in their respective fields. **Table 6** 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.

**Table 6. 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 8 **	# of NIMBioS Publications Since Inception ***
Nature	41.30	-	5
Cell	35.53	-	1
Science	35.26	2	7
Trends in Ecology and Evolution	19.82	2	7
Ecology Letters	16.78	2	10
Systematic Biology	14.79	2	7
PLoS Biology	11.9	1	3
Nature Communications	11.9	-	2
Proceedings of the National Academy of Sciences	10.56	1	16
Current Biology	10.13	-	1
PLoS Genetics	8.56	-	2
Nucleic Acids Research	8.87	-	3
Phil Trans of the Royal Soc B-Biological Sciences	7.89	2	6
Molecular Ecology	6.33	3	10
Ecology	6.16	-	6
Proc of the Royal Soc B-Biological Sciences	5.65	1	10
PLoS Computational Biology	5.28	2	8
Evolution	5.25	2	17
Journal of Animal Ecology	5.32	1	4
The American Naturalist	4.96	2	13
Journal of the Royal Society Interface	4.65	-	5
PLoS One	3.7	9	35
Animal Behaviour	3.42	2	9
BMC Bioinformatics	3.45	-	2

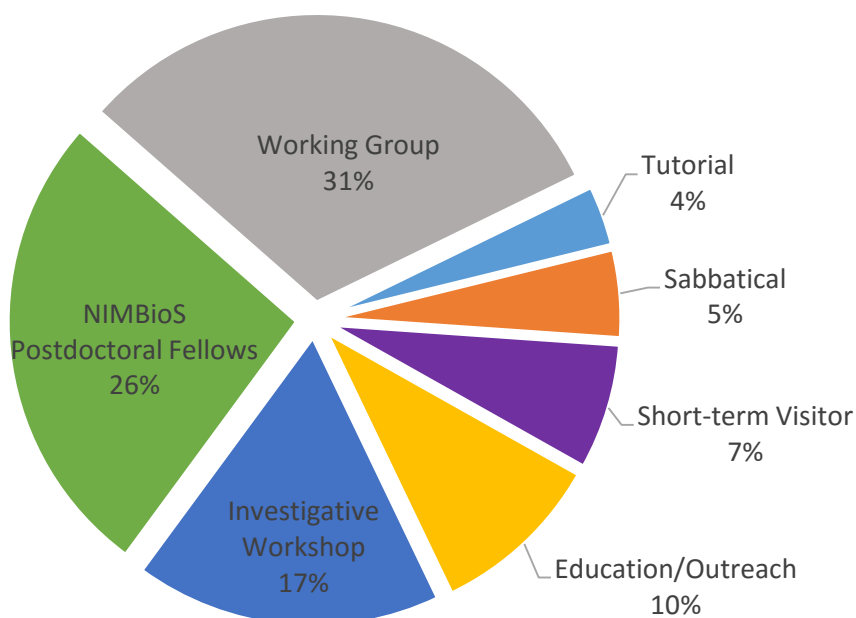
\* The journal impact factor is a measure of the frequency with which the “average article” in a journal has been cited in a particular year. The impact factor is an indicator of a journal’s relative importance, especially as compared to other journals in the same field. Impact factor calculation:  $\text{cites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

\*\* Number of publications in Year 8 includes all publications reported since compilation of the previous Annual Report (April 2015) through April 2016.

\*\*\* September 2008 – April 2016

NIMBioS publications come from a variety of activities, although Working Group participants tend to publish the largest portion of journal articles (31%), followed by NIMBioS Postdoctoral Fellows (26%) (**Figure 36**).

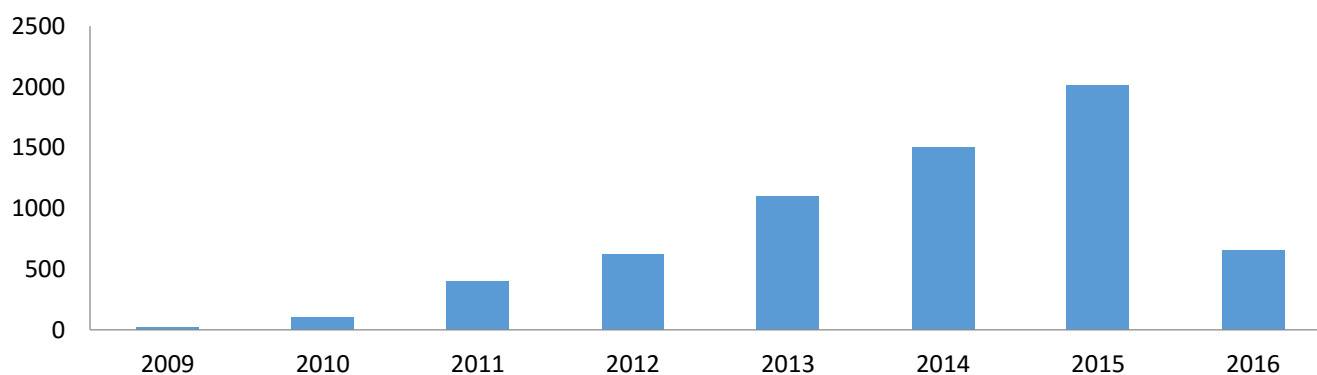
**Figure 36. Distribution of journal publications submitted to NIMBioS by participants**



## BIBLIOMETRIC INDICATORS

**CITATION ANALYSIS OF PUBLICATIONS.** Of the 678 journal articles reported by NIMBioS participants, 530 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 1,455 researchers from 610 unique institutions spanning 52 countries. These articles have appeared in 214 different journals, many of which are considered to have high-impact in the academic community. These articles have been collectively cited 6,641 times, with an average of 12.70 cites per article, and an h-index of 35 (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 citers/paper). Forty-four participants have authored five or more papers each as a result of NIMBioS affiliated collaborations.

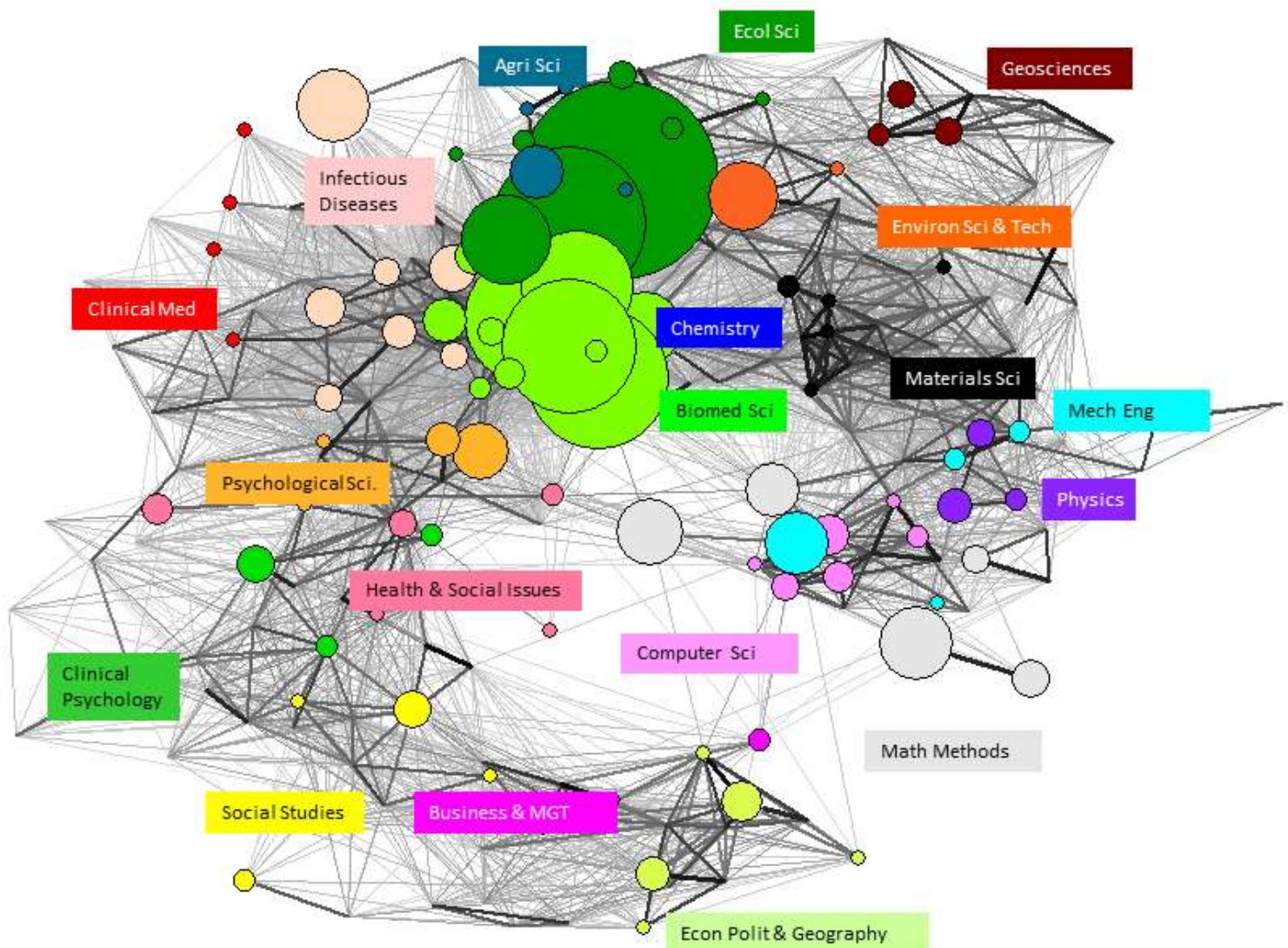
**Figure 37. Citations per year for NIMBioS articles**



**DISCIPLINARY SPAN OF PUBLICATIONS.** The 530 published articles span 97 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 530 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 (153), followed by Evolutionary Biology (91), Mathematical & Computational Biology (79), Biology (72), Multidisciplinary Sciences (70), and Genetics & Heredity (48).

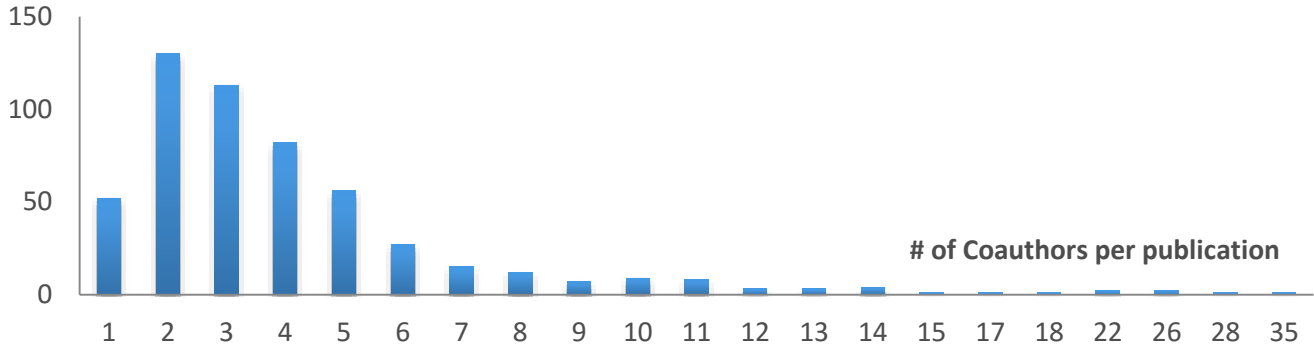
**Figure 38. Web of Science Categories for 530 WoS journal articles to date**



Method from 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 530 publications reported thus far, the average number of co-authors per paper is 4.2 (Figure 39).

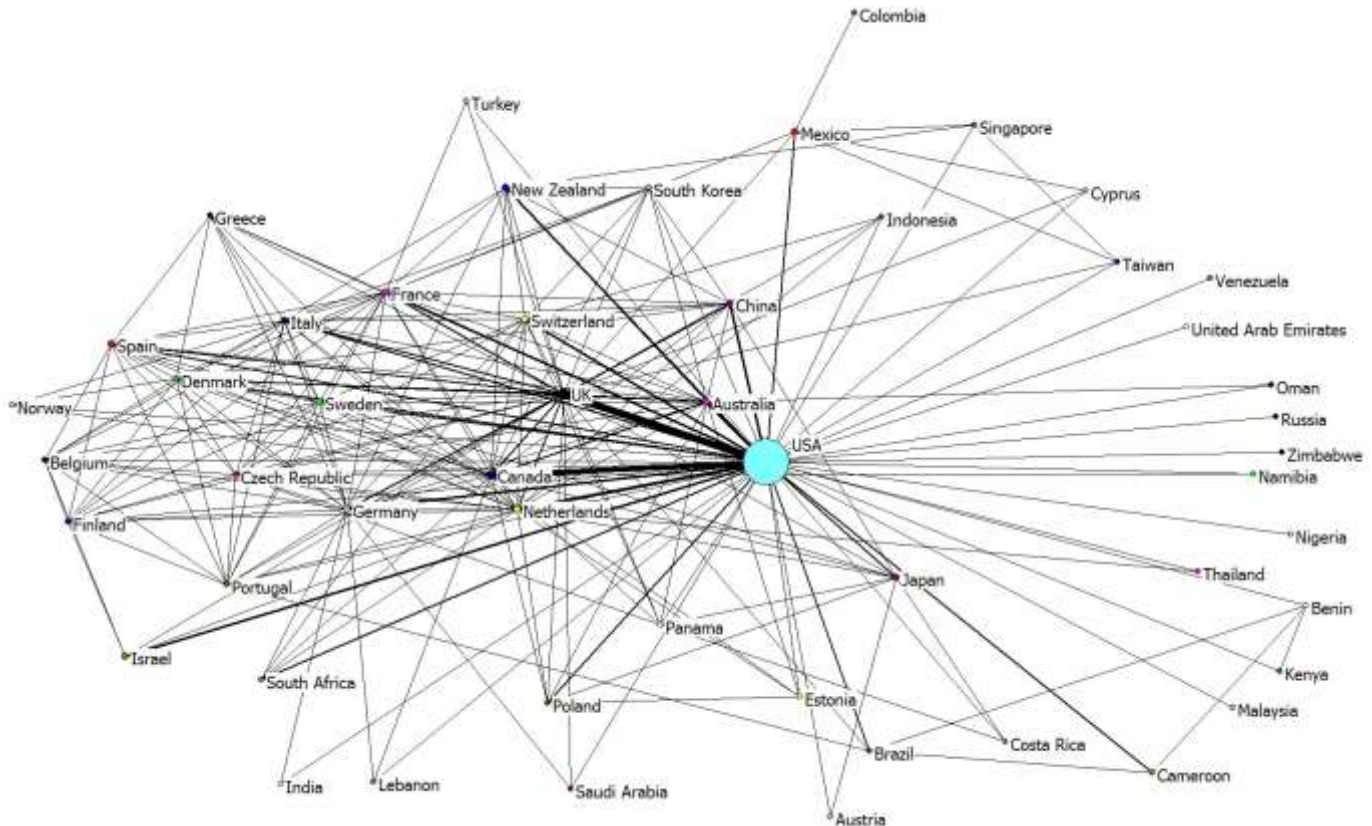
Figure 39. Coauthorship frequency of NIMBioS publications



INTERNATIONAL COAUTHORSHIP. NIMBioS also fosters international collaboration among researchers. While 52 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).

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.

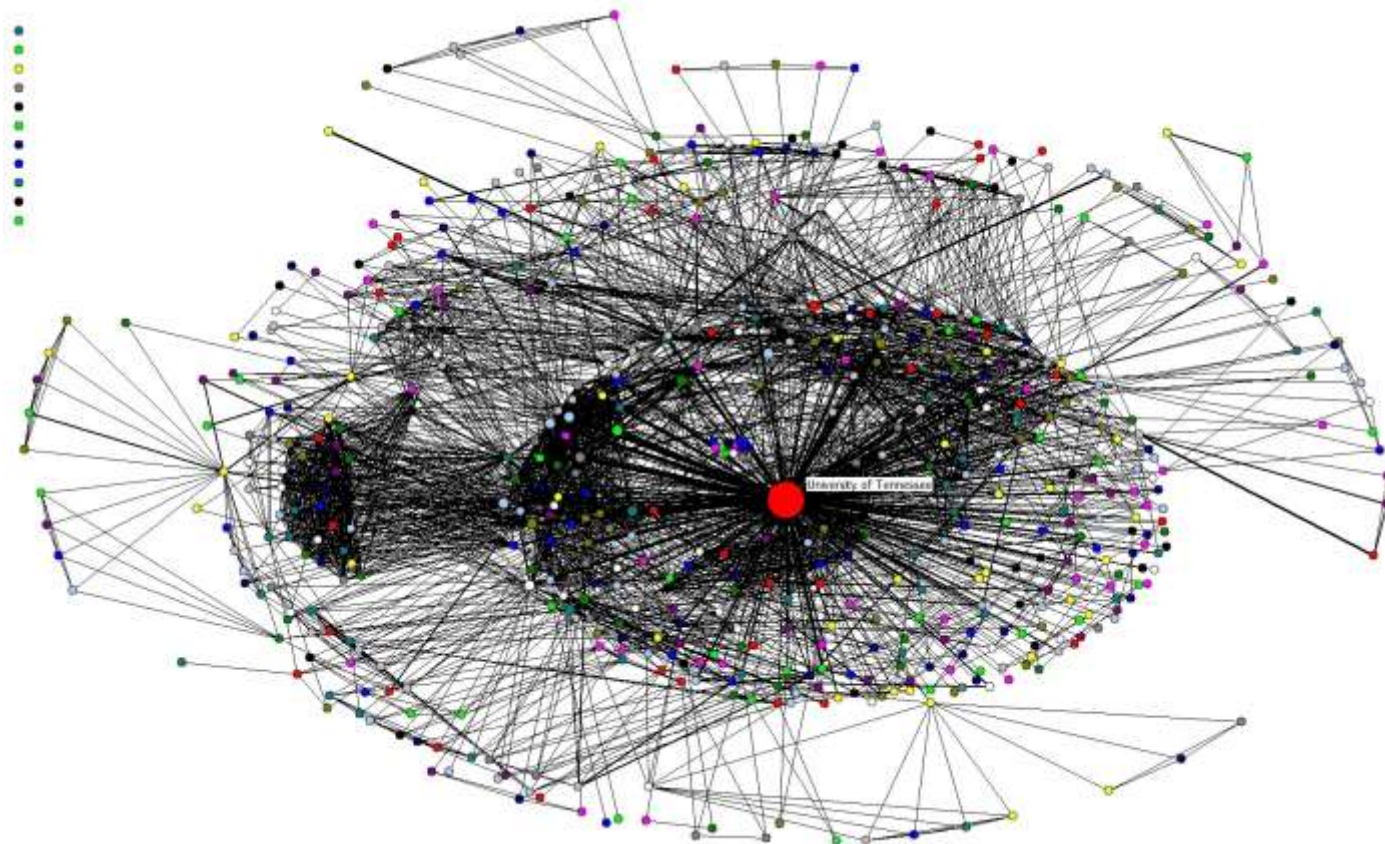
Figure 40. International collaboration on NIMBioS publications



**CROSS-INSTITUTIONAL COAUTHORSHIP.** Coauthors of NIMBioS publications through the current reporting period came from 610 unique institutions (**Figure 41**). The average number of institutions represented per paper was 3.0, with a range of 1-32 institutions per paper.

**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 11 of the 610 institutions represented have published single-institution papers. The University of Tennessee is at the center of the graph.**

**Figure 41. Cross-institutional collaboration of NIMBioS publications**



## OTHER SCHOLARLY PRODUCTS

In addition to journal publications, participants report other types of products that have resulted from their activities at NIMBioS. **Figure 42** summarizes these types of products for the eight-year period. In addition to the items listed in Figure 42, NIMBioS participants have reported 619 conference presentations related to NIMBioS affiliation.

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

