NIMBIOS EVALUATION REPORT

REPORTING PERIOD Seven

SEPTEMBER 1, 2014-March 31, 2015

NATIONAL INSTITUTE FOR MATHEMATICAL AND BIOLOGICAL SYNTHESIS

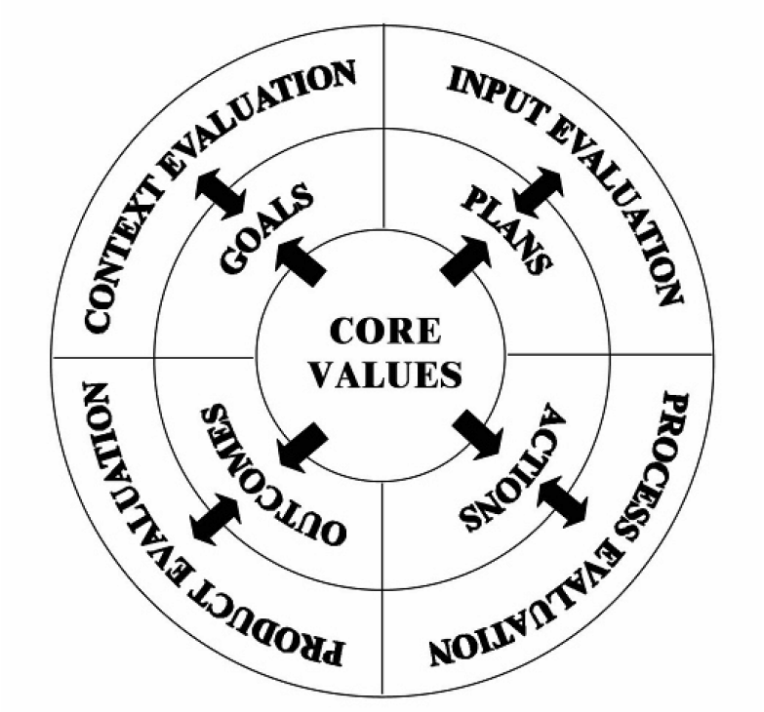
April, 2015

CONTENTS

INTRODUCTION

This is an evaluation summary of NIMBioS activities during the sixth annual reporting period (RP 7) to the National Science Foundation. This report covers the period of September 1, 2014-March 31, 2015. 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**[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 (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:

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.

[1] 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.

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

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 7 included:

- 12 Working Group meetings
- 4 Investigative Workshops
- 1 Tutorial
- 25 Short-term visitors
- 13 Postdoctoral Fellows
- 1 Visiting Graduate Student Fellow
- 5 Graduate Research Assistantships

Education and Outreach (EO) program activity highlights during RP 7 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

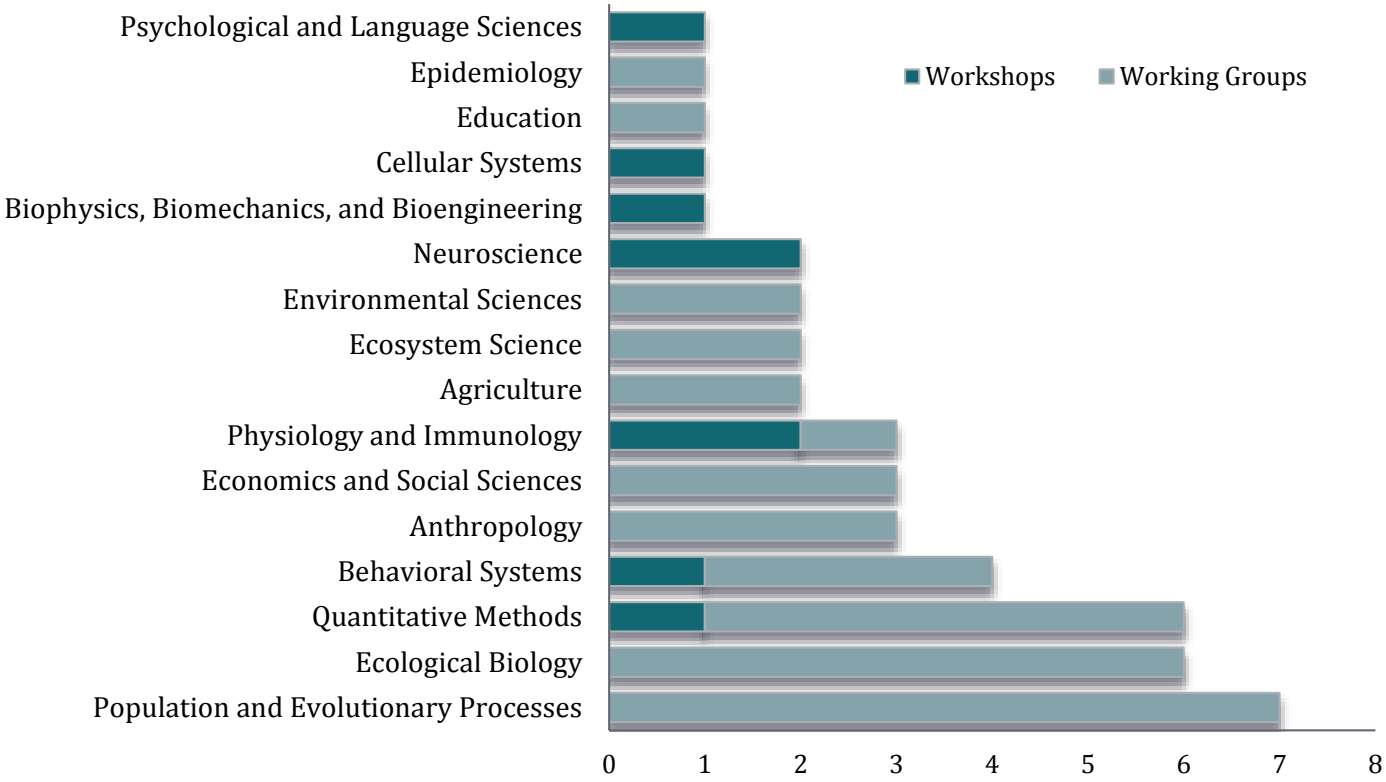
Other events included: 3 Advisory Board Meetings (1 in-person and 2 virtual)

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 Groups and Investigative Workshops during RP 7 (each supported event may have up to three subject areas).

Figure 2. Diversity of Subject Areas of Working Groups and Investigative Workshops, RP 7



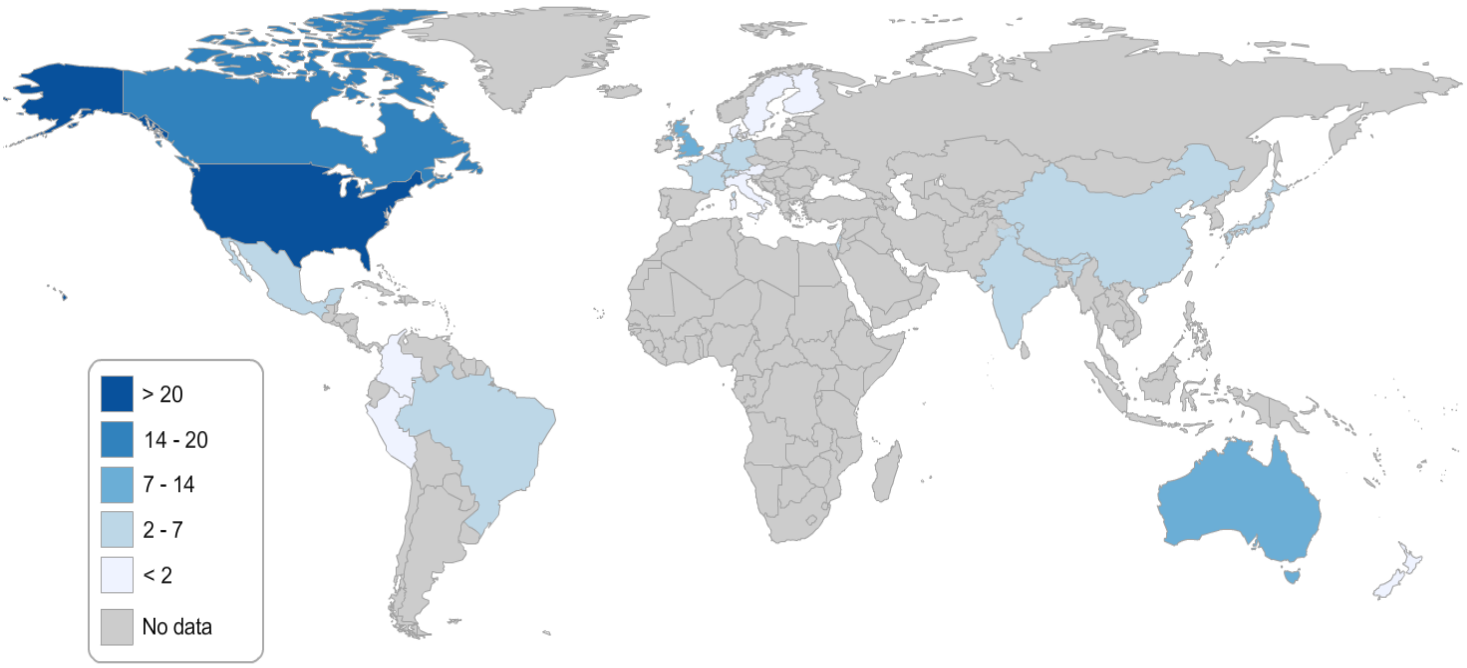
DIVERSITY OF PARTICIPANTS

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 7 was 77%. 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.

Participant Demographics

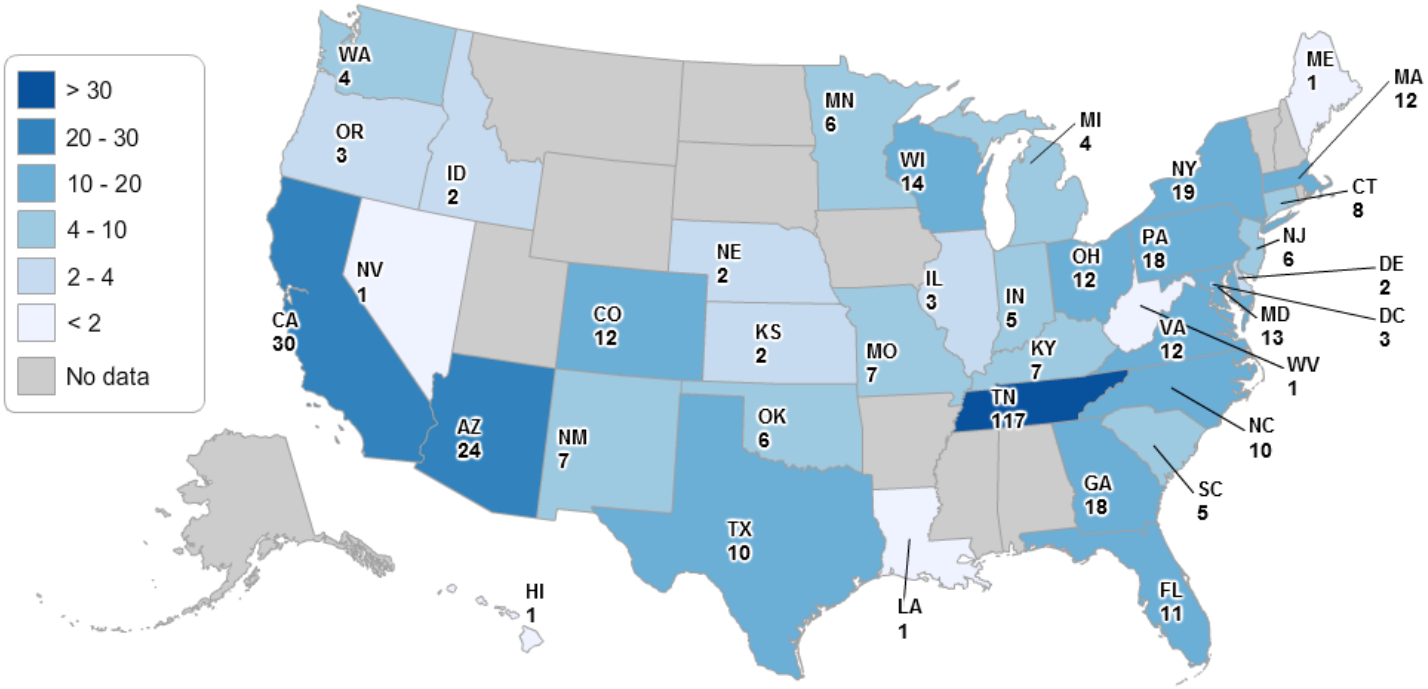
GEOGRAPHIC DIVERSITY. During RP 7, a total of 496 participants (196 different individuals) from 24 countries participated in NIMBioS events. Most participants came from the United States (85%), followed by Canada (4%) (**Figure 3**).

Figure 3. NIMBioS RP 7 Participants by Country



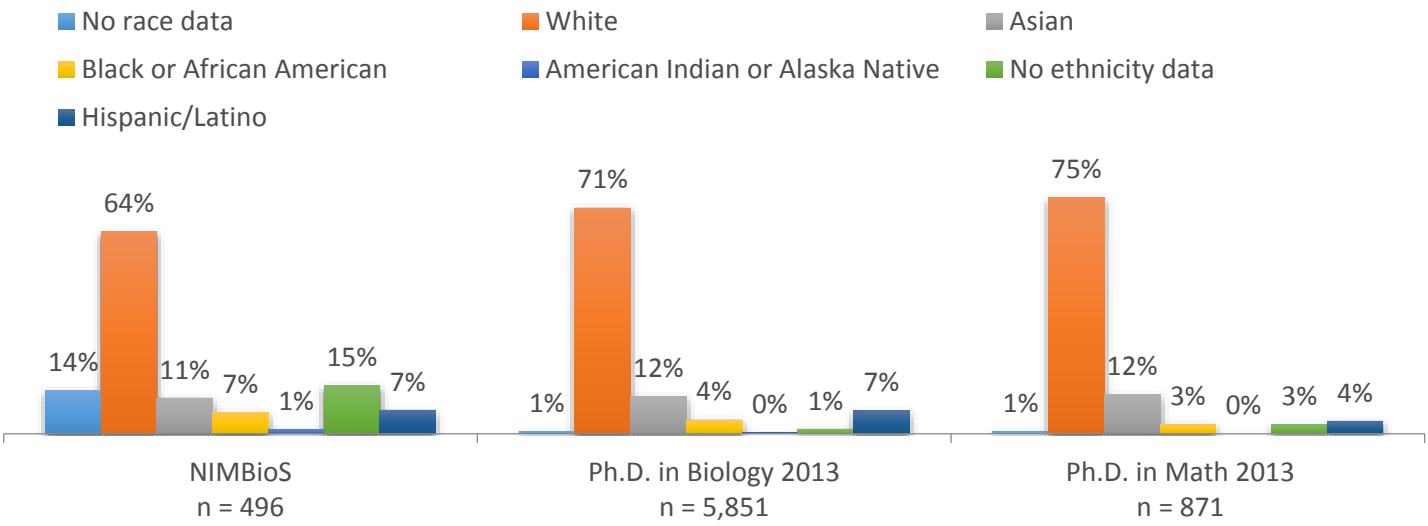
Within the U.S., 39 different states, as well as the District of Columbia, were represented. The largest percentage of participants came from within Tennessee (28%), followed by California (7%), Arizona (6%), New York (5%), Pennsylvania (4%), and Georgia (4%) (**Figure 4**).

Figure 4. NIMBioS RP 7 Participants by U.S. State



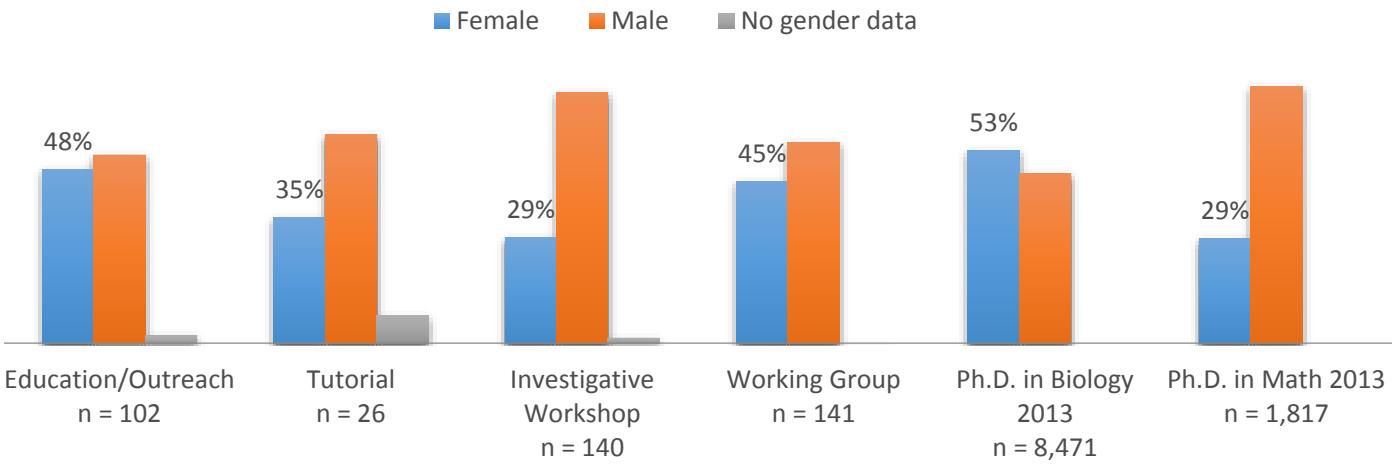
GENDER, RACIAL, AND ETHNIC DIVERSITY. Across all events during RP 7, female participation was 41% (no gender data for 2%). Within specific activity types, the gender ratio varied slightly, with the greatest gender equity seen in education and outreach activities and the least in Investigative Workshops (**Figure 5**). Two comparison groups shown are all individuals receiving doctorates in biology and mathematics in the U.S. In 2013[2]. 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



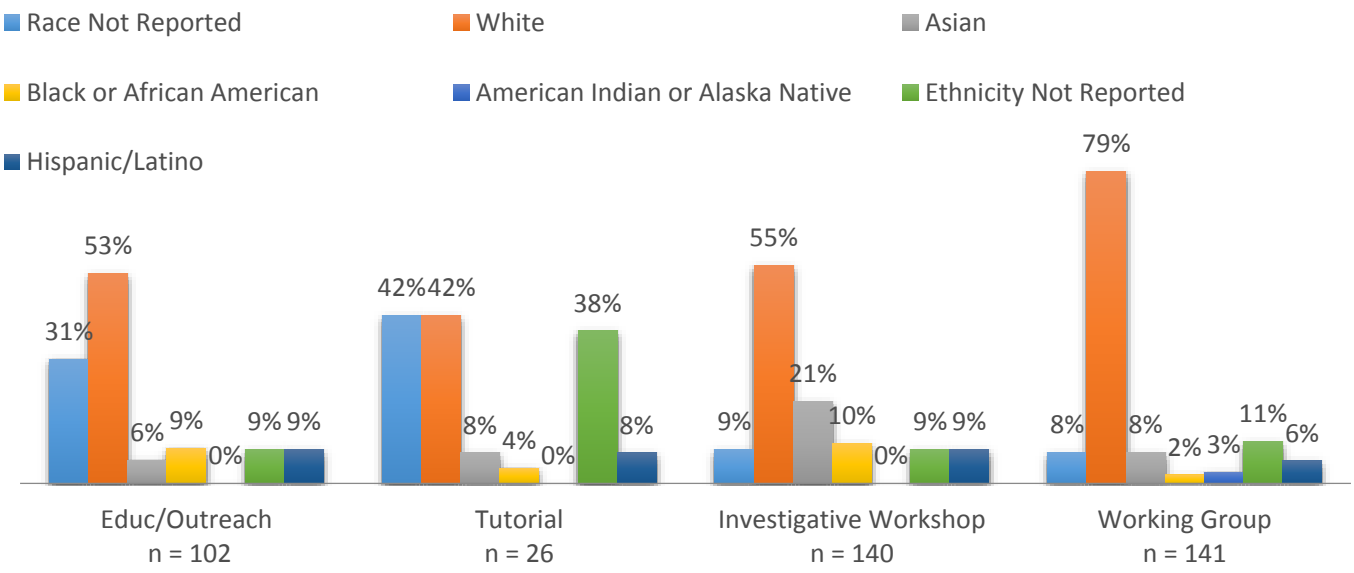
Overall minority representation[2] during RP 7 was around 13%. Representation of various minority categories was near current trends for doctoral recipients in the biological sciences, and greater than that in the mathematical sciences (**Figure 6)**. Comparison groups shown are all U.S. citizen and permanent residents receiving doctorates in biology and mathematics in the U.S. in 2013[3].

Figure 6. Minority representation of NIMBioS participants



Minority representation varied among programs (Tutorials are considered part of Education and Outreach at NIMBioS, but are reported upon separately). Education and Outreach and Investigative Workshop activities showed greatest percentage of Hispanic/Latino participants (9%). 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 Workshop (10%) and Education/Outreach Events (9%), and Hispanic individuals were represented well in all events (**Figure 7**).

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



[2] 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, 2013)

[3] Data from the 2013 NSF Survey of Earned Doctorates, http://www.nsf.gov/statistics/sed/2012/data_table.

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 1shows 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

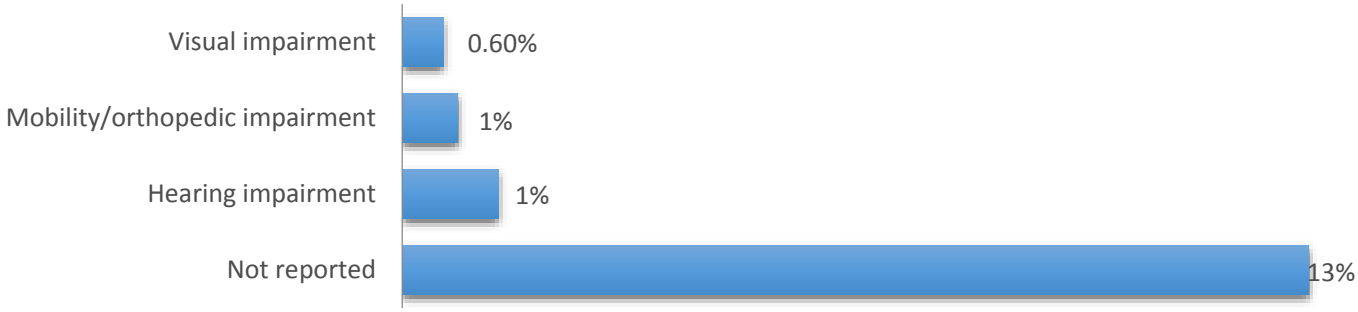
		Yr 1*	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr7	Overall
Participant diversity									
Gender	(Benchmark: approximately 30% female)								
	Working Groups	19%	22%	27%	34%	34%	36%	45%	31%
	Investigative Workshops	40%	40%	38%	39%	39%	43%	29%	38%
	All events	37%	42%	38%	39%	39%	44%	41%	40%
International	(Benchmark: approximately 10% outside USA)								
	Working Groups	20%	19%	19%	18%	24%	26%	18%	21%
	Investigative Workshops	10%	22%	21%	19%	5%	23%	16%	17%
	All events	7%	12%	14%	16%	14%	11%	16%	13%
URG									
	Working Groups	9%	10%	7%	8%	9%	9%	7%	8%
	Investigative Workshops	7%	10%	14%	14%	11%	12%	17%	12%
	All events	9%	11%	11%	13%	11%	13%	13%	12%
Local	(Benchmark: No more than 15% from UT/ORNL)								
	Working Groups	14%	15%	16%	18%	14%	9%	7%	13%
	Investigative Workshops	22%	23%	10%	7%	11%	4%	13%	13%
	All events	35%	20%	16%	13%	16%	5%	12%	17%
Organizer diversity									
Gender	(Benchmark: approximately 30% female)								
	Working Groups	11%	13%	16%	28%	27%	23%	28%	21%
	Investigative Workshops	25%	29%	38%	39%	0%	52%	44%	32%
	All events	23%	28%	27%	34%	30%	36%	33%	30%
Local	(Benchmark: No more than 25% UT Faculty/Staff)								
	Working Groups	28%	22%	20%	28%	21%	16%	6%	20%
	Investigative Workshops	75%	36%	12%	17%	0%	12%	22%	25%
	All events	57%	42%	33%	27%	21%	21%	18%	31%

*Year 1 includes activities from March-August 2009

** Year 7 includes activities from September 2014-March 2015

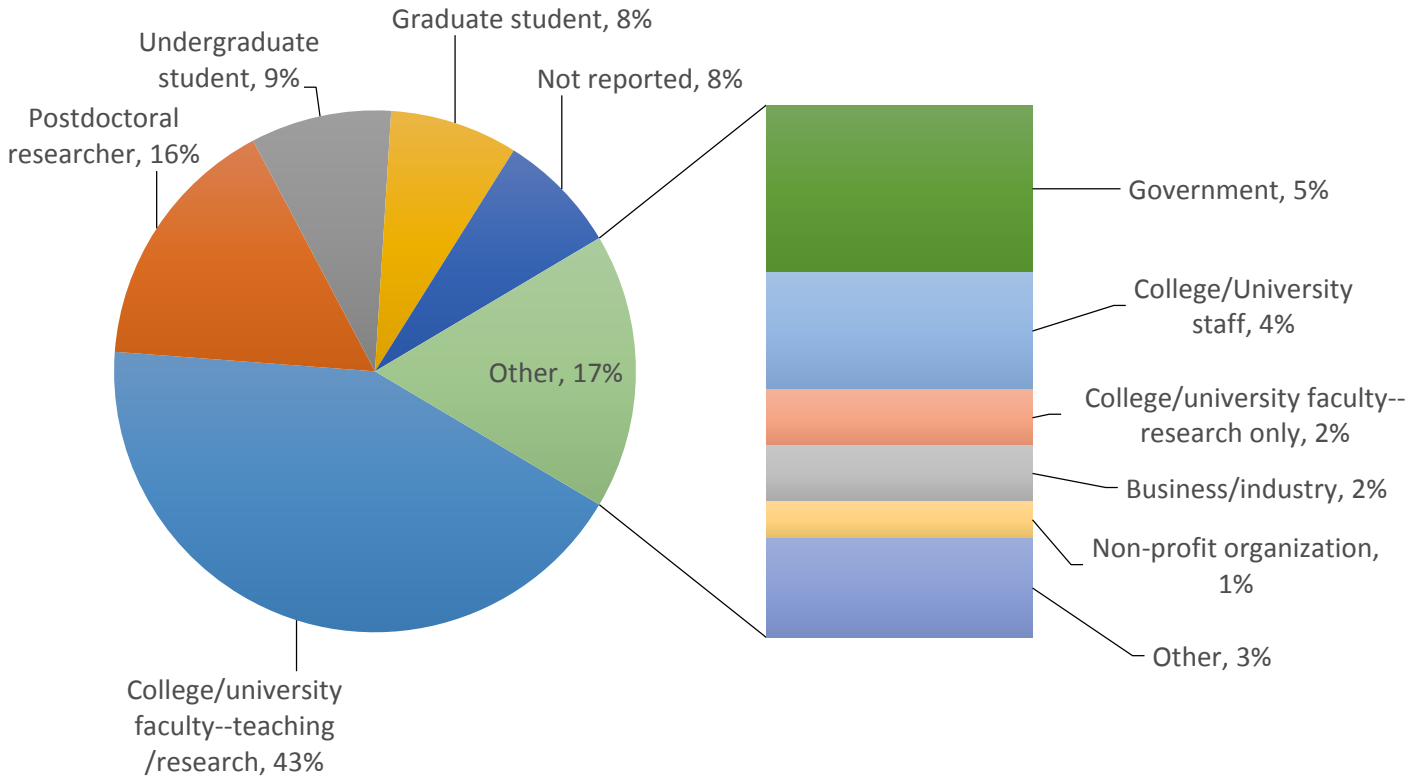
ABILITY DIVERSITY. Disclosure of disability status by participants to NIMBioS is optional. Around 2% overall indicated having some sort of disability during RP 7 (**Figure 8).**

Figure 8. Disability status of participants (n = 496)



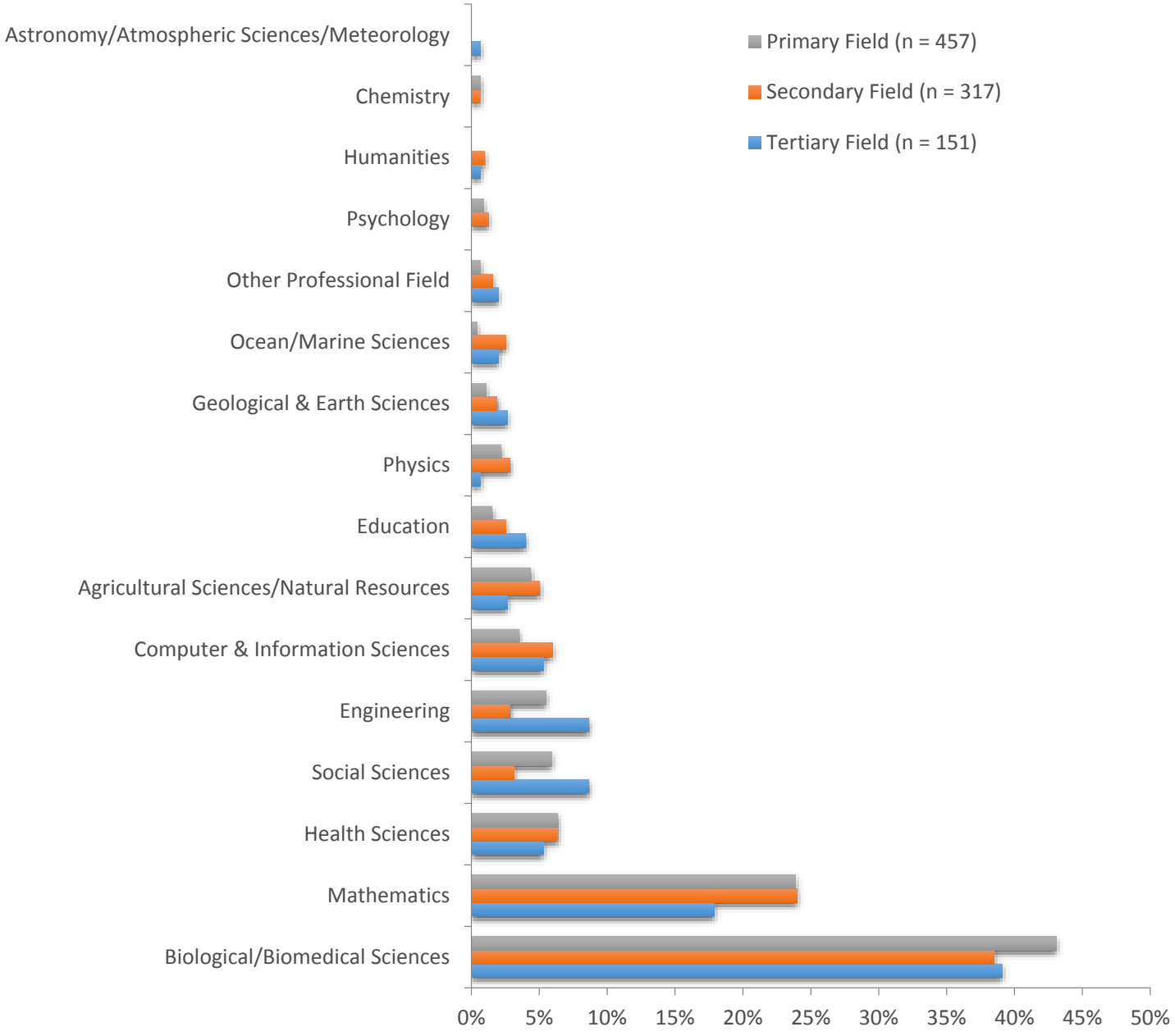
Institutional and Disciplinary Diversity. The majority of NIMBioS participants were college/university faculty or staff, undergraduate students, or postdoctoral researchers; however, participants came from government, industry, non-profit, or other positions as well (**Figure 9**).

Figure 9. Employment status of participants (n = 496)



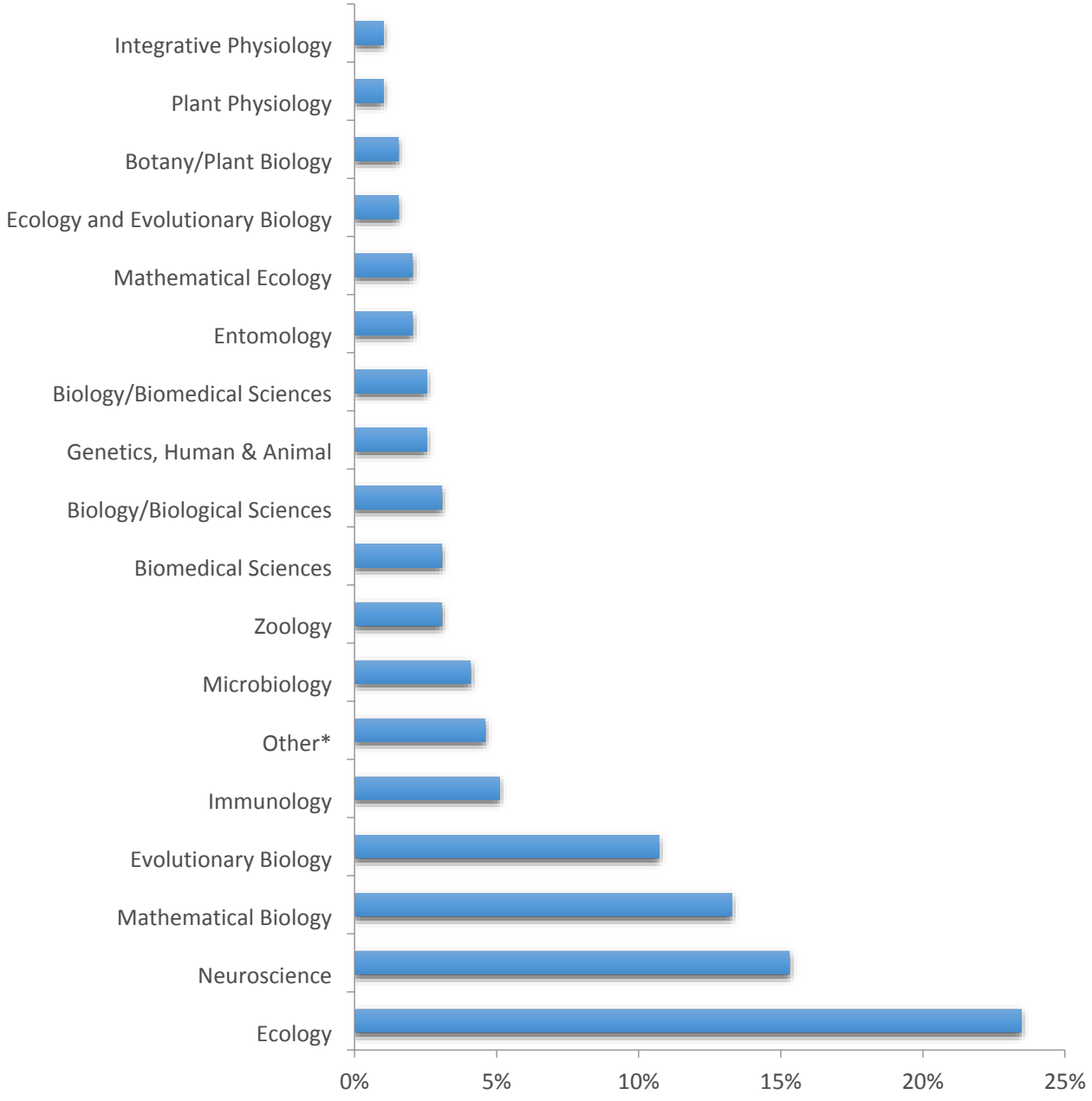
Most participants at NIMBioS indicated their primary fields of study, as well as areas of concentration within those fields. Many indicated their secondary and tertiary fields of study as well. The most commonly reported fields of study included biological/biomedical sciences and mathematics although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

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



The 196 participants indicating Biological/Biomedical Sciences as their primary field of study indicated 27 different areas of concentration within which they would classify their primary areas of research/expertise. The most commonly indicated area of concentration was ecology (24%), followed by neuroscience (15%), mathematical biology (13%) and evolutionary biology (11%) (**Figure 11**).

Figure 11. Participant expertise area concentrations within biological/biomedical sciences field of study (n = 196)



* Other concentrations having one participant each: Biotechnology, Molecular Biology, Physiology, Human & Animal, Biometrics & Biostatistics, Electrophysiology, Bioinformatics , Biochemistry, Biophysics, and Epidemiology

Participants during RP 7 represented 190 different institutions, including colleges and universities, government institutions, industry, non-profits, and high schools (**Figure 12**). Of the 151 universities represented, most were classified as comprehensive (having undergraduate and graduate programs) (**Figure 13**).

Figure 12. Types of institutions represented (n = 190)

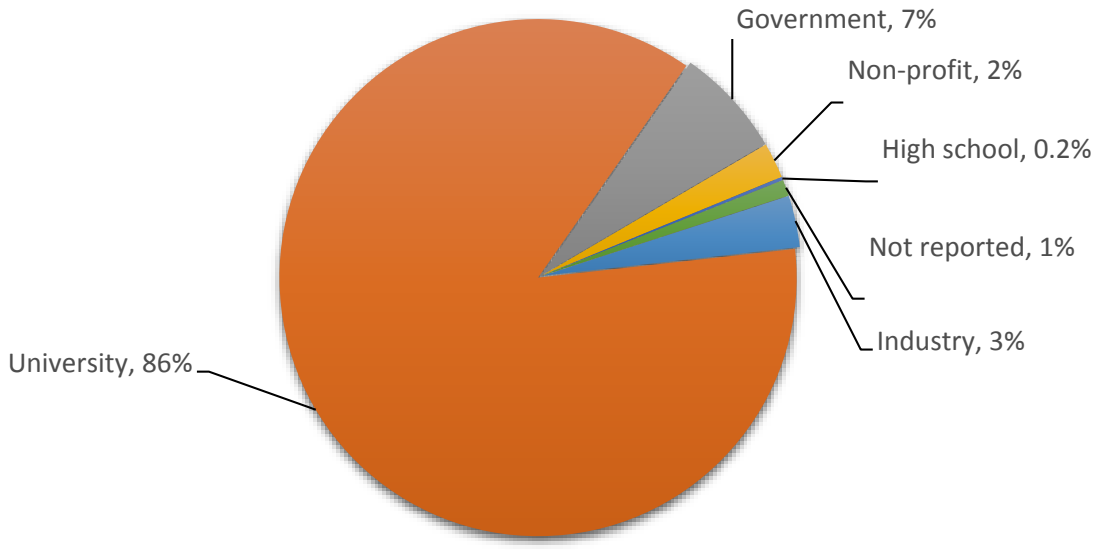
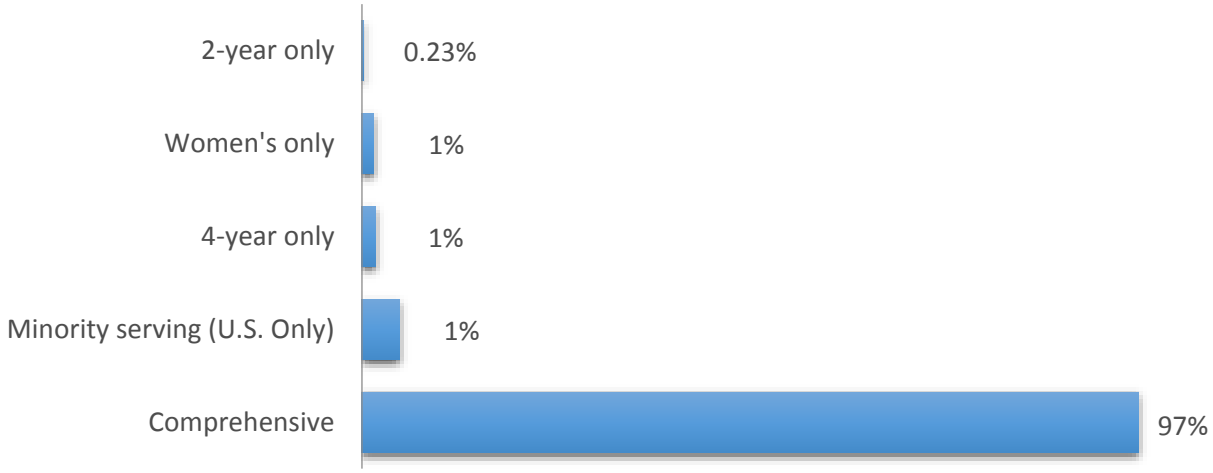


Figure 13. Characteristics of participants' universities (n = 151)



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, and Research Experiences for Undergraduates/Veterinary Students 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 7.

RESEARCH ACTIVITIES PROCESS EVALUATION 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.

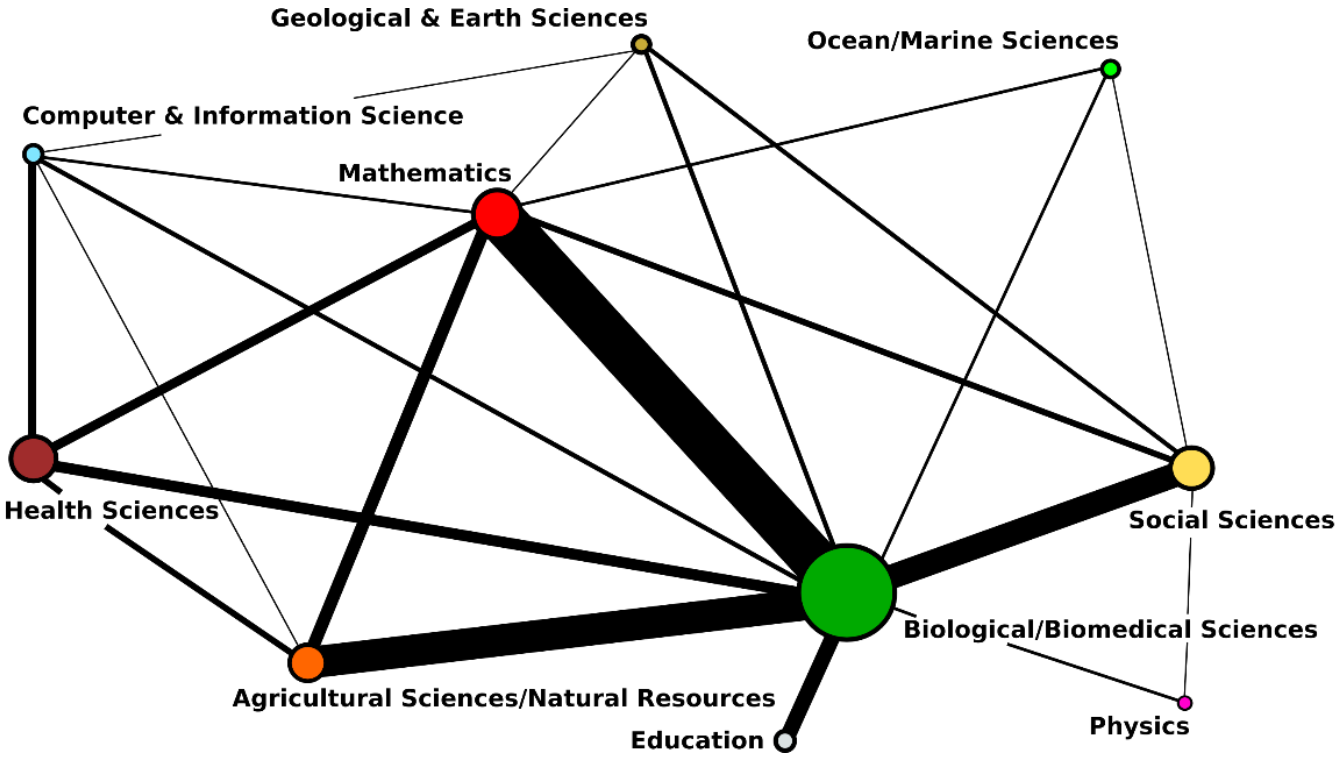
WORKING GROUPS. NIMBioS Working Groups are chosen to focus on major scientific questions at the interface between biology and mathematics that require insights from diverse researchers. The questions to be addressed may be either fundamental, applied or both, and may be focused around a particular biological 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, RP 7. During RP 7, NIMBioS hosted a total of 12 Working Group meetings, including the start of four new groups and the return of 8 established groups. A total of 141 participants from 77 institutions took part in the Working Groups. During RP 7, participants came together from 10 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 7. 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.

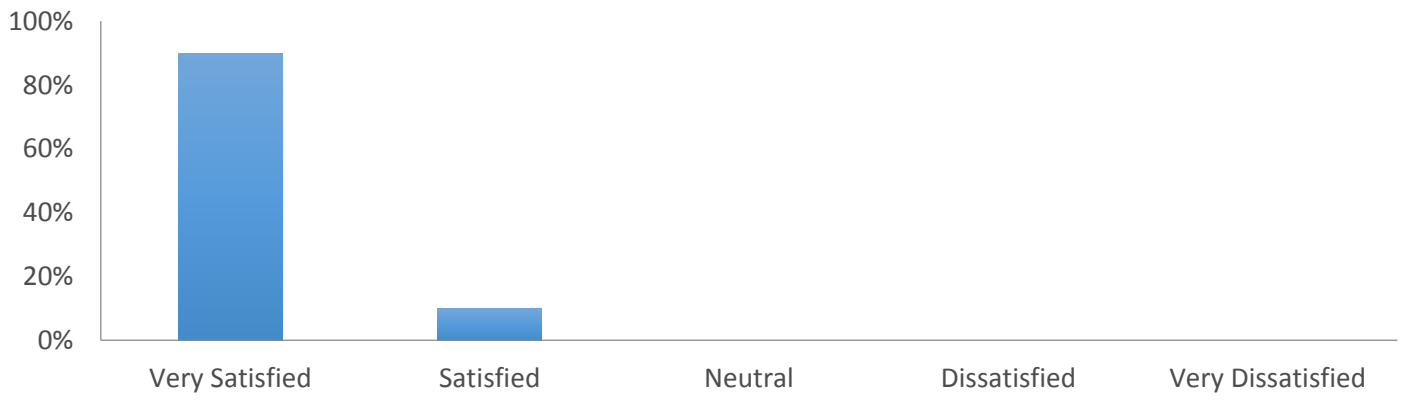
Figure 14. Working Group cross-disciplinary collaboration



ORGANIZER FEEDBACK

Beginning in November 2011, NIMBioS began collecting 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 7 organizers of beginning Working Groups.

Figure 15. Working Group organizer satisfaction with NIMBioS handling of event (n = 20)



Working Group organizer comments:

All of your help with the logistics of travel, food, and technology was extremely helpful and allowed us to focus on the content of the Working Group instead of small details.

NIMBioS does an outstanding job of organizing meetings. I've been at prior meetings organized by some NIMBioS personnel although not officially connected to NIMBioS, and I know someone who has organized a Workshop. I expected a first-rate operation, and that is what I got.

FIRST MEETINGS

During RP 7, NIMBioS hosted the first meetings of four Working Groups, with a total of 51 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 38 participants took part in the evaluation of the first meetings of their Working Groups. Eleven 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
Modeling Antimicrobial Resistance (AMR) Intervention	9/19-22/14	14
A DEB Model for Trees	10/14-17/14	11
Expanding Data Nuggets	1/7-9/15	12
Vector Movement and Disease	3/30-4/2/15	14

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

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

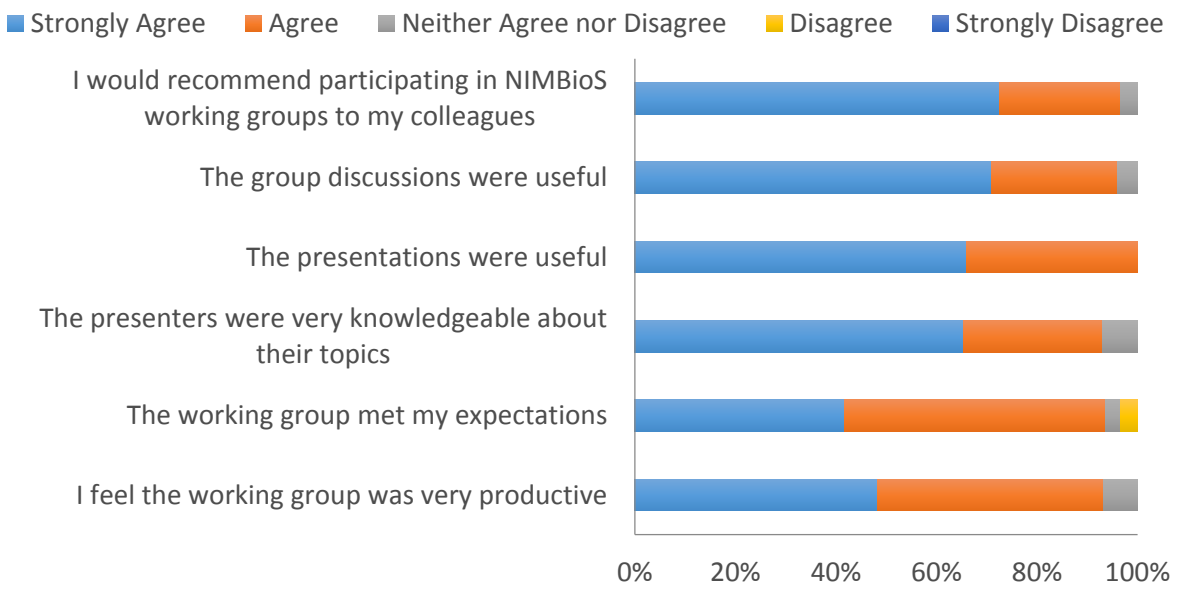


Figure 17. Participant responses to the following question--*As a result of participating in this Working Group, I have a better understanding of:*

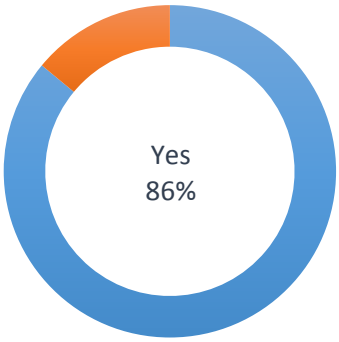
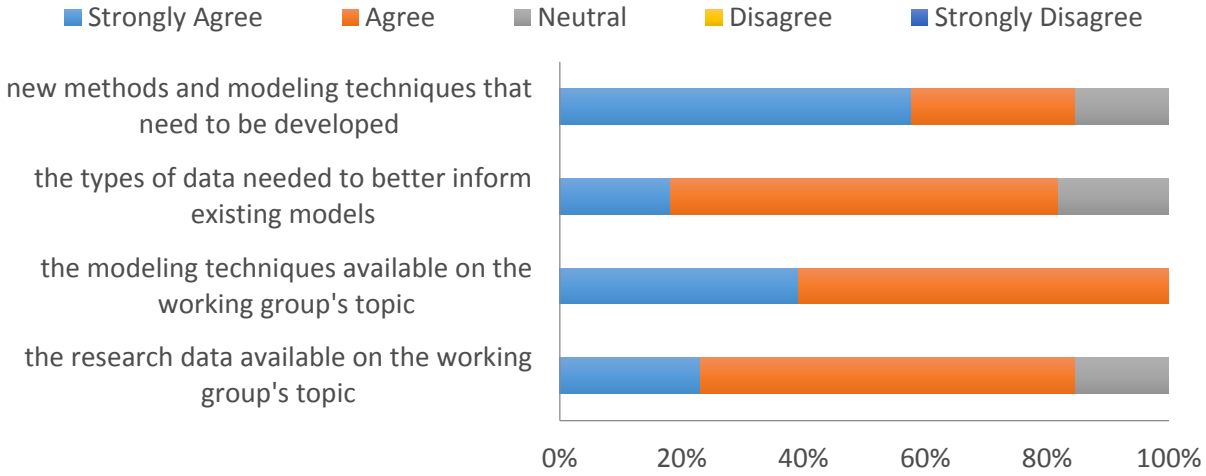


Figure 18. Participants who felt the exchange of ideas during the Working Group would influence their future research:



WORKING GROUP SECOND, THIRD, AND FOURTH MEETINGS

During the reporting period, NIMBioS hosted the second meetings of four Working Groups, with a total of 48 participants, and the third meeting of two Working Groups, with a total of 20 participants. Two groups held their fourth meetings with 22 participants (**Table 3**).

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

Title of Working Group	Dates	# Participants
Second Meetings		
Evolution of Sustainability	11/17-20/15	9
Habitat for Migratory Species	1/26-29/15	17
Evolution of Institutions	2/11-13/15	10
Modeling Antimicrobial Resistance (AMR) Intervention	2/23-25/15	12
Third Meetings		
Plant-Soil Feedback Theory	11/3-5/15	11
Nonautonomous Systems and Terrestrial Carbon Cycle	11/17-21/15	9
Fourth Meetings		
Hierarchy and Leadership	10/13-15/14	10
'Pretty Darn Good' Control: Extensions of Optimal Control for Ecological Systems	1/21-23/15	12

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. Some **participant comments from Working Group meetings 2-4**:

Excellent interactions. I anticipate that I will organize a subgroup to consider model applications to inform conservation action for migratory species

Excellent organization - despite the weather! I was very impressed by the NIMBioS getting our room set-up even though the University was closed.

It was a very productive meeting with clear linkages between the different projects and a clearly arising overarching vision that is the precondition for the future synthesis. The atmosphere was very open and inspiring. A couple of virtual Meetings is planed till the next physical meeting at NIMBioS. Excellent support by the NIMBioS staff.

NIMBioS is great chance for face-to-face collaborations and developing new ideas!

We were incredibly productive during our recent stay, and it was due in part to a very accommodating facility and people associated with it.

CONCLUDING WORKING GROUPS

NIMBioS received notification that three Working Groups had reached their conclusions (**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 35 participants responded to the final evaluation for their groups.

Table 4. Concluded Working Groups, RP 7

Title of Working Group	Dates	# Participants
Play, Evolution, and Sociality	Nov 2011-Nov 2014	19
Multiscale Modeling of the Life Cycle of *Toxoplasma gondii*	May 2011-July 2013	13
Hierarchy and Leadership	April 2013-Oct 2014	15

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

Figure 19. Evaluation of various aspects of Working Groups

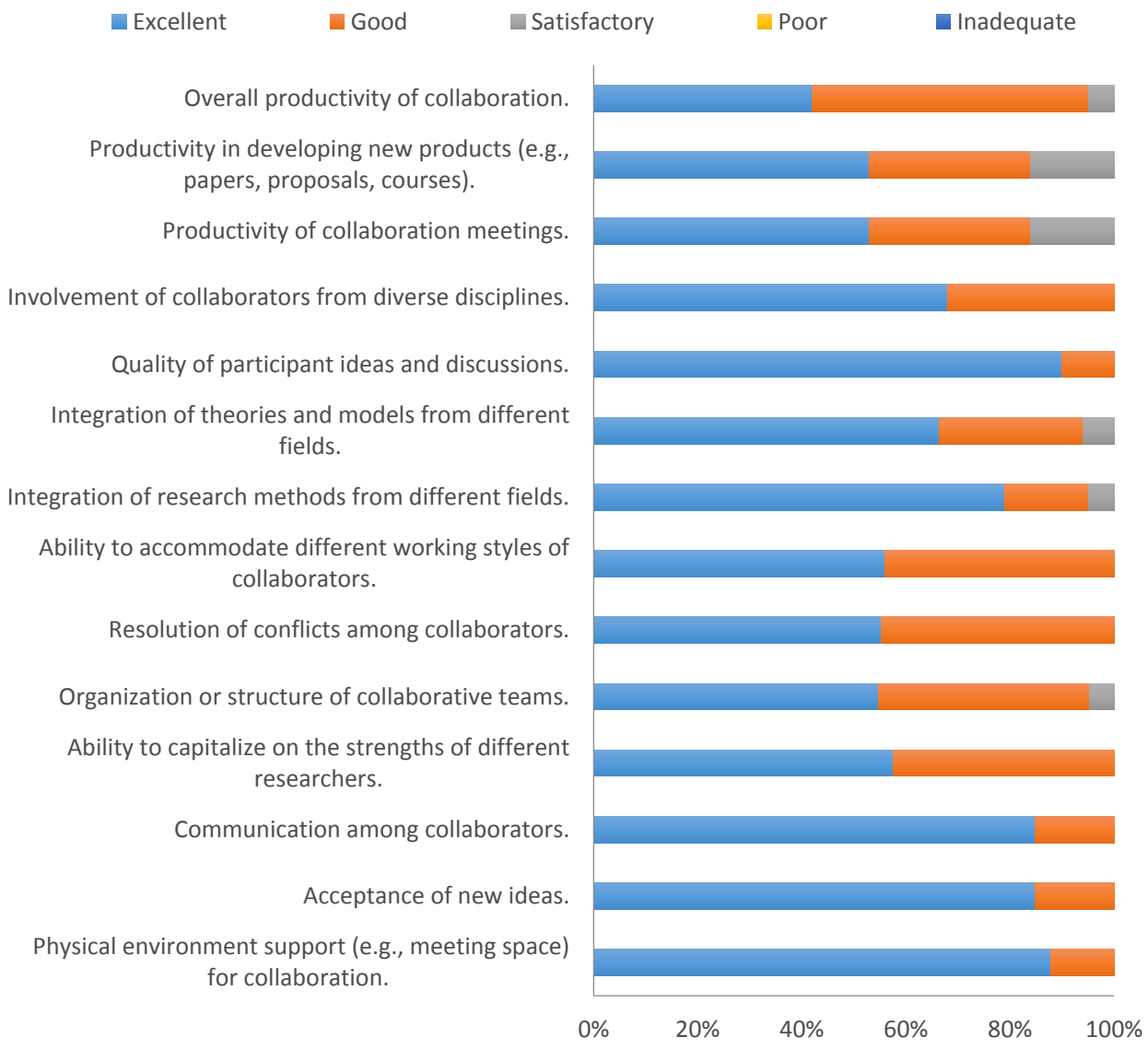
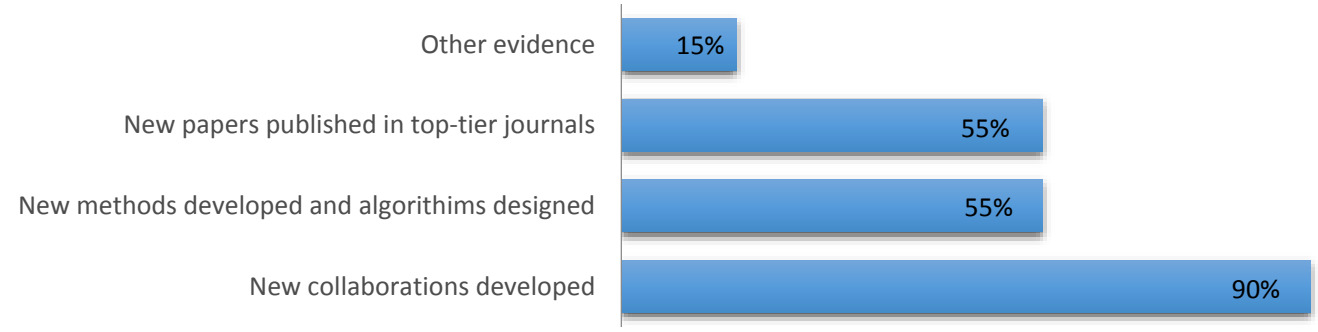


Figure 20. Evidence to support new insights and collaborations within the group



Concluded Working Group participant comments:

Organizational team was immaculate.

Overall, a fantastic experience.

Submitted proposal, manuscript in progress, and plans for future studies.

We have multiple paper pending publication.

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.

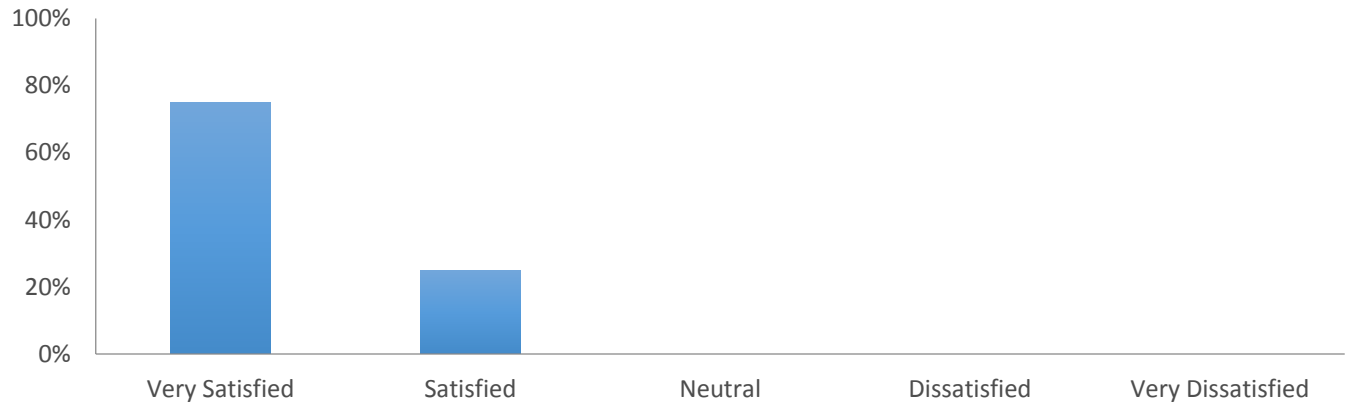
NIMBioS hosted four Investigative Workshops during RP 7 with a total of 140 participants (**Table 5**). Evaluation surveys were sent to all Workshop participants. A total of 119 participants took part in the evaluation of the Workshops.

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

Title of Workshop	Dates	# Participants
Heart Rhythm Disorders	12/3-5/14	37
Lymphoid Cells in Acute Inflammation	1/15-16/15	38
Neurobiology of Expertise	3/11-13/15	27
Olfactory Modeling	3/2-4/15	38

HIGHLIGHTS OF WORKSHOP EVALUATION RESPONSES (FIGURES 21-23)

Figure 21. Workshop organizer satisfaction with NIMBioS handling of event (n = 8)



Investigative workshop organizer comments:

The NIMBioS staff was very attentive and helpful before, during, and after the workshop. Eric Carr, in particular, went above and beyond to help us make the technology work for our purposes. Also, the facilities and equipment were perfect for our event. Having the breakfasts and lunches catered in was a great way to save time and facilitate conversations.

The NIMBioS staff was very proactive and responsive to all organizer requests before and during the meeting. Great experience organizing the workshop

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

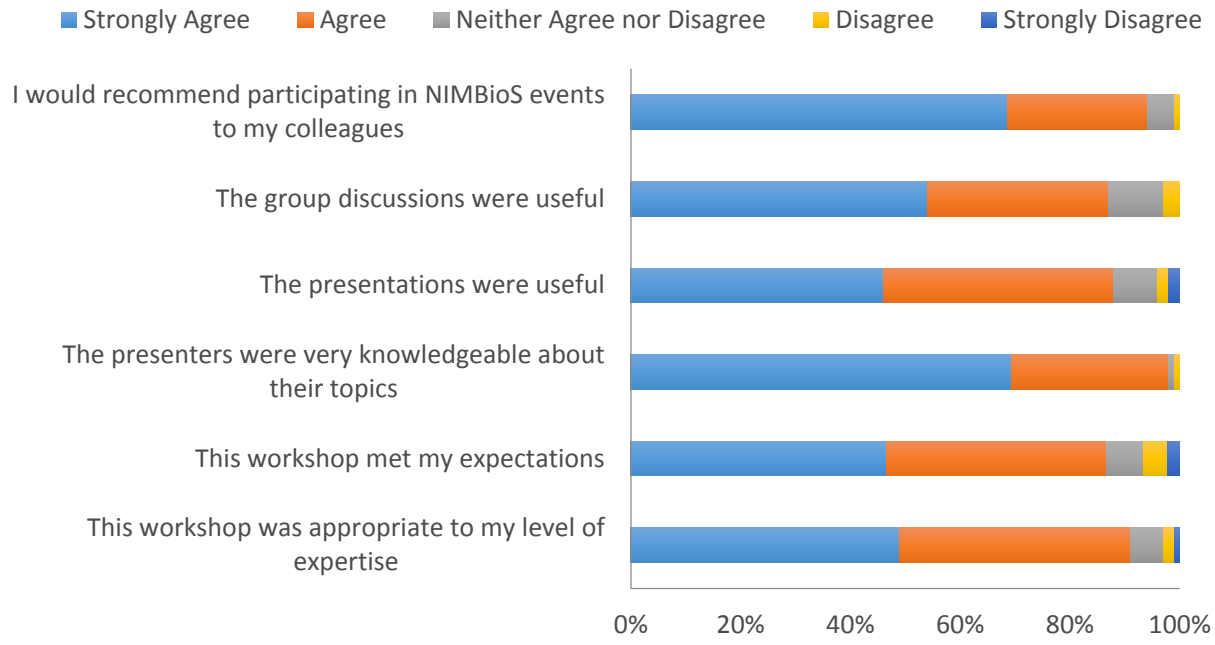
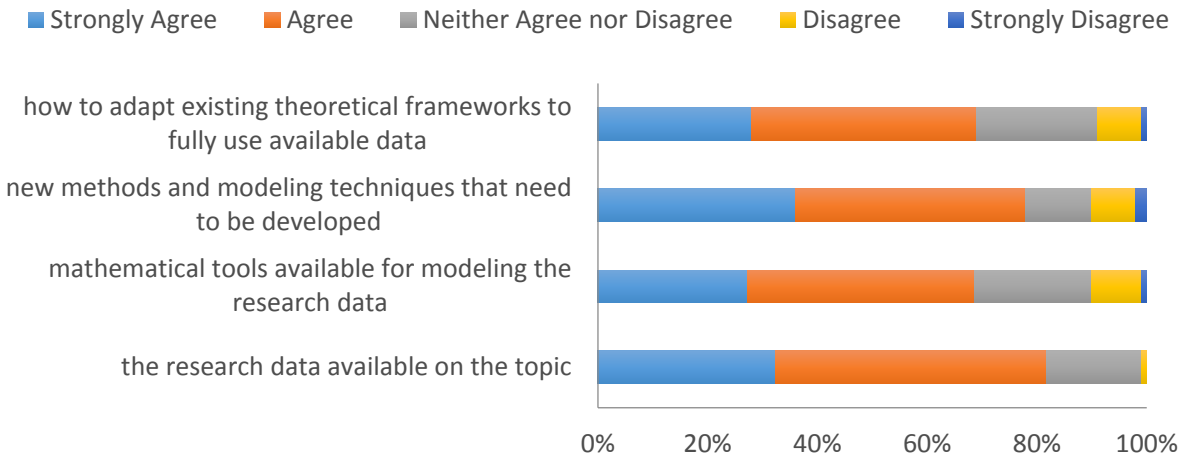


Figure 23. ***Participant responses to the following question-- As a result of participating in this Workshop, I have a better understanding of:***



Investigative Workshop participant coments:

I had a useful time. The staff were great and NIMBioS is certainly worthy of further support. Strange how when the Government creates something useful it then abandons it. The free market does NOT apply to Science and Academe which are a public good. NIMBioS is a public good - I would hope NSF (of all people) recognize this.

It was a great experience participating in this workshop and I think that I have established contacts will be very helpful for my research and that of other participants in the foreseeable future. I have been very motivated to participate in future versions of these workshops of NIMBioS

Thank you for the opportunity to participate in the NIMBioS workshop. It was a stimulating scientific experience from which I will reap many benefits in the future. The topic The Neurobiology of Expertise is so broad, but the structure of the workshop allowed us to get focused and productive in an amazing short period of time. It is sometimes difficult to bring together scientists from such a diverse backgrounds, but at the end of the 2 and a half days, many of us developed concrete plans for future research. Special thanks to Chris and Jennifer Spar for making us feel so welcome.

Thanks for helping us make our workshop a huge success. It exceeded our expectations and the NIMBioS staff and facilities had a lot to do with that. Also, the location provided a 'neutral' environment and we feel that this played a big role in facilitating cross talk between and among disciplines and more open discussion that might not have happened in environments where there may be a perceived bias.

EDUCATION AND OUTREACH PROGRAM ACTIVITIES

TUTORIAL: USING R FOR HPC

The Using R for HPC Tutorial was a joint training supported by the University of Tennessee, NIMBioS, Extreme Science and Engineering Discovery Environment (XSEDE), and the National Institute for Computational Sciences (NICS). Organizers were Eric Carr (NIMBioS) and Drew Schmidt (XSEDE and NICS). This half-day (four hour) Tutorial, introduced participants to debugging, profiling and performance analysis, optimization, foreign language API's, and parallel programming with R. There was also a comprehensive hands-on component to reinforce topics introduced during the lecture portion. The Tutorial was live-streamed, as well as attended in person. A total of 24 participants (plus two organizers) attended the in-person training, while an additional 359 attended online. The evaluation survey was sent to all 385 participants and organizers, and 176 participants completed the survey.

HIGHLIGHTS OF TUTORIAL EVALUATION RESPONSES (FIGURES 24-25)

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

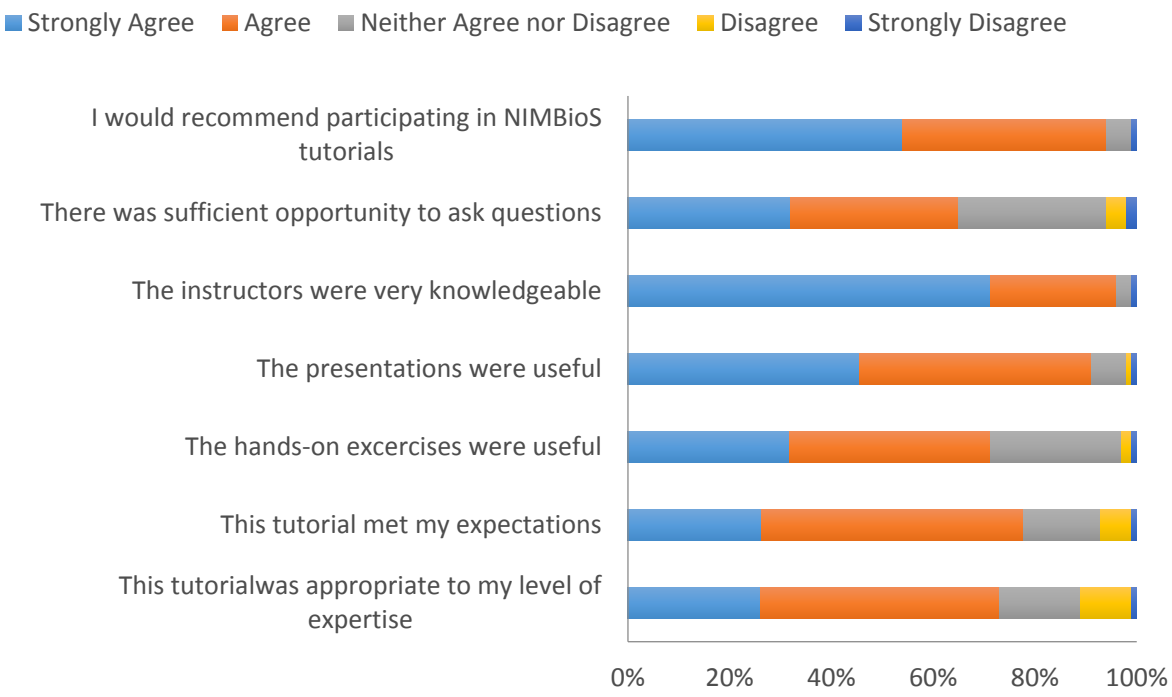
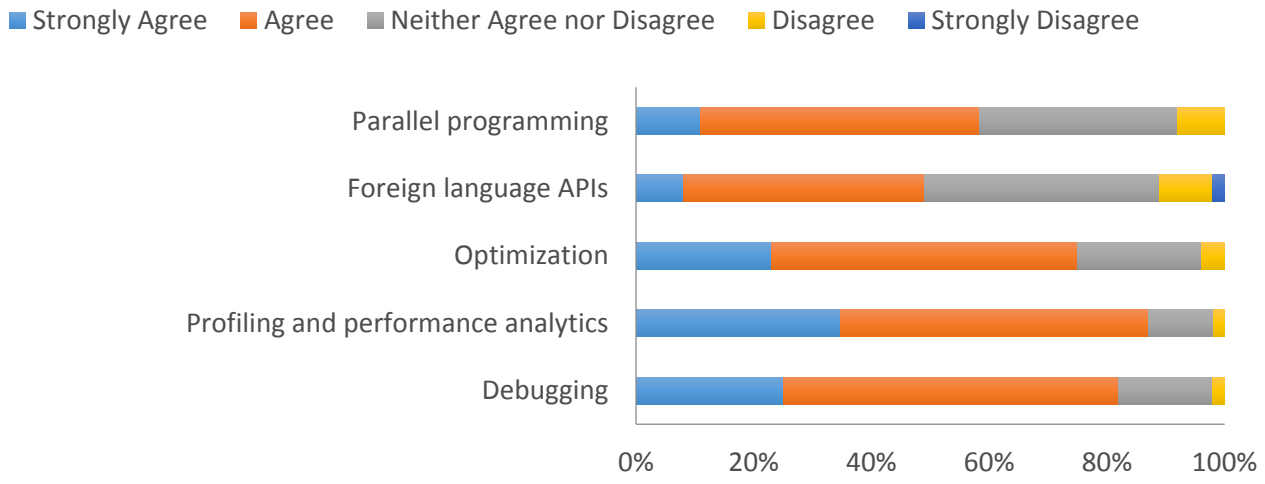


Figure 25. ***Participant responses to the following question-- As a result of participating in this Tutorial, I have a better understanding of:***



Tutorial participant comments:

Had a great experience! Thought the lectures were the right lengths. Thought the spacing of the tutorial was great, with the mix of lectures and breaks. Really appreciated the breaks after each lecture to let me rest my poor brain.

I really appreciated that this was open to the public. I found it to be a very informative session and the speaker was fantastic.

Often the academic world does itself a great disservice when it strictly adheres to the philosophy of teaching to the exclusion of training. This was not the case in this tutorial; I greatly appreciated the content and the training approach.

Thank you! I appreciate the opportunity to participate in events like this remotely and consider it an important part of my professional development. I look forward to hearing about similar opportunities!

SUMMER RESEARCH EXPERIENCE

The NIMBioS *Summer Research Experience (SRE*) program took place on the University of Tennessee, Knoxville (UT) Knoxville campus June 9-August 1, 2014. Eighteen 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 six (RP 6), the SRE program for 2015 will not conclude until after the RP 7 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.

The six research projects for the 2014 program included:

- Prospects for the continued global Argentine ant supercolony
- Modeling transmission and control of bovine respiratory disease
- A dynamic systems approach to tracking the facial expressions and conscious experience of emotion
- Living on the edge: How location within a geographic range affects genetics and individual fitness
- Statistical techniques for predicting cardiac rhythm disorder
- Mathematical modeling of granuloma formation in Johne's Disease

Program organizers were Suzanne Lenhart (Dept. Mathematics/NIMBioS), and Kelly Sturner (NIMBioS). Matt Zefferman (Evolutionary social science, Ant supercolony), Keenan Mack (Evolution of cooperation, Ant supercolony), Cristina Lanzas (Veterinary Medicine, Bovine respiratory disease), Suzanne Lenhart (Mathematics, Bovine respiratory disease), Shi Chen (Veterinary Science, Bovine respiratory disease), Jeff Larsen (Social psychology, Facial expressions), Charles Collins (Mathematics, Facial expressions), Julia Earl (Ecosystem ecology, life history theory, conservation biology, Geo-fitness), Sean Hoban (Small population dynamics, Geo-fitness), Xiaopeng Zhao (Computational biology, disease modeling, Cardiac rhythm disorder), Heather Finotti (Mathematics, Cardiac rhythm disorder), Shigetoshi Eda (Wildlife health, Johne's disease), and Vitaly Ganusov (Theoretical immunology, Johne's disease).

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

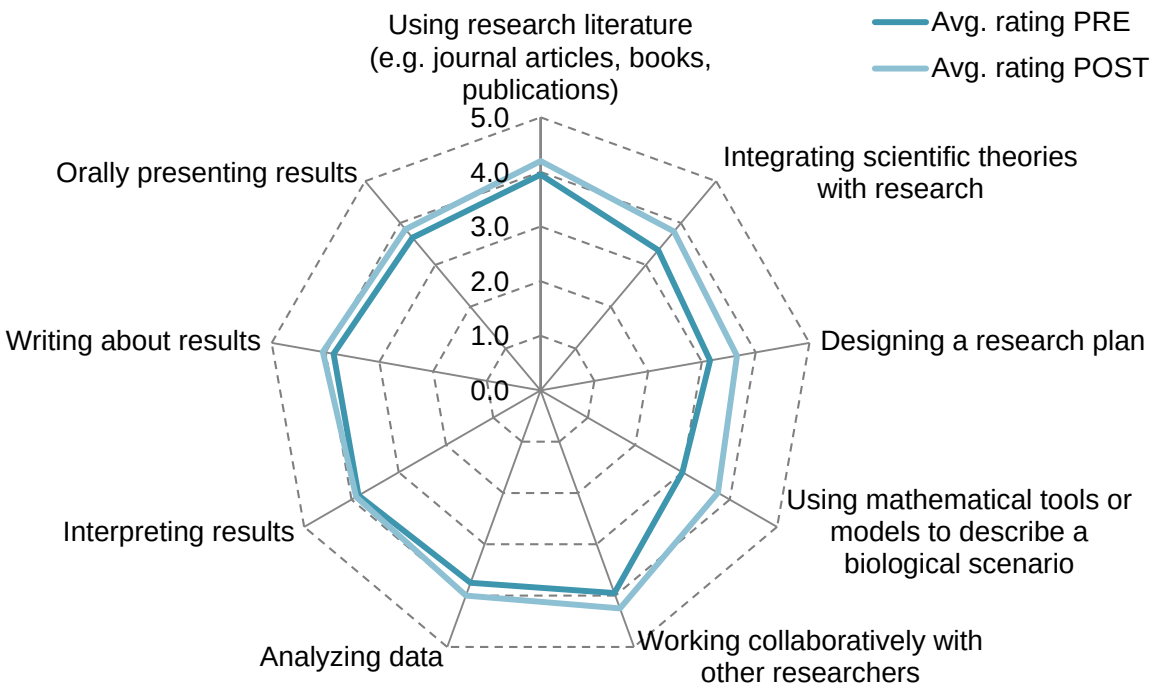


Figure 27. Participant pre- and post-program knowledge, response scale of 1 = extremely poor understanding to 5 = excellent understanding

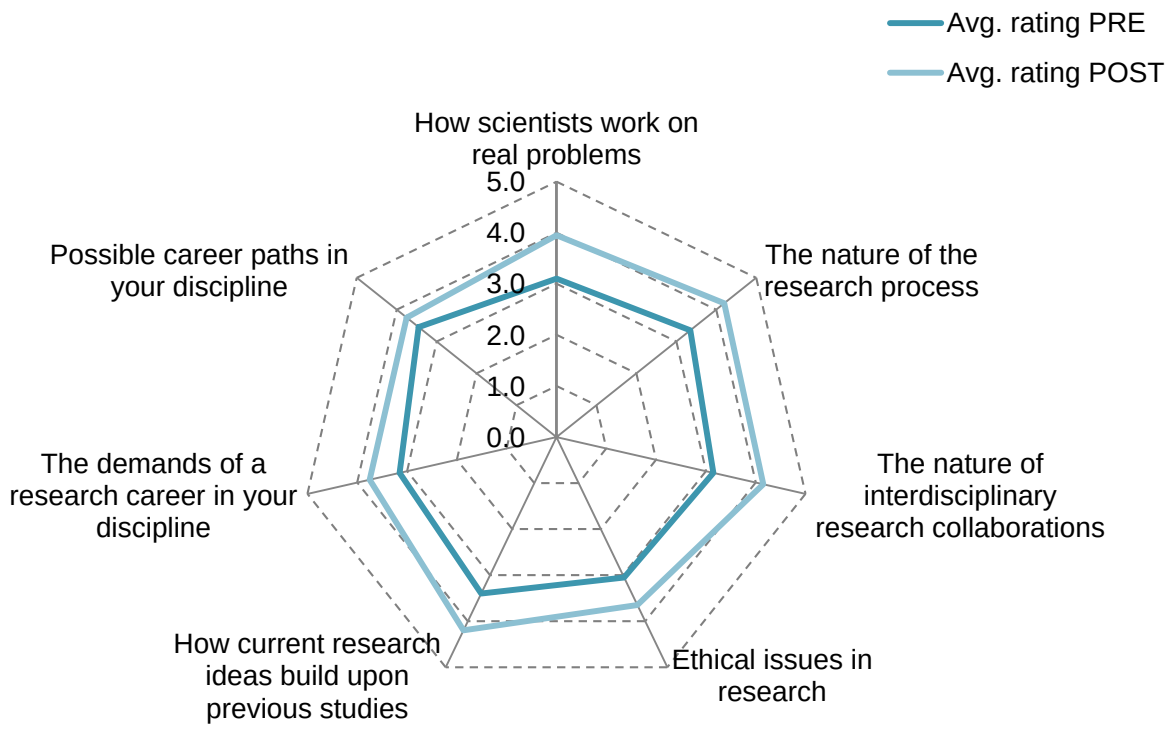
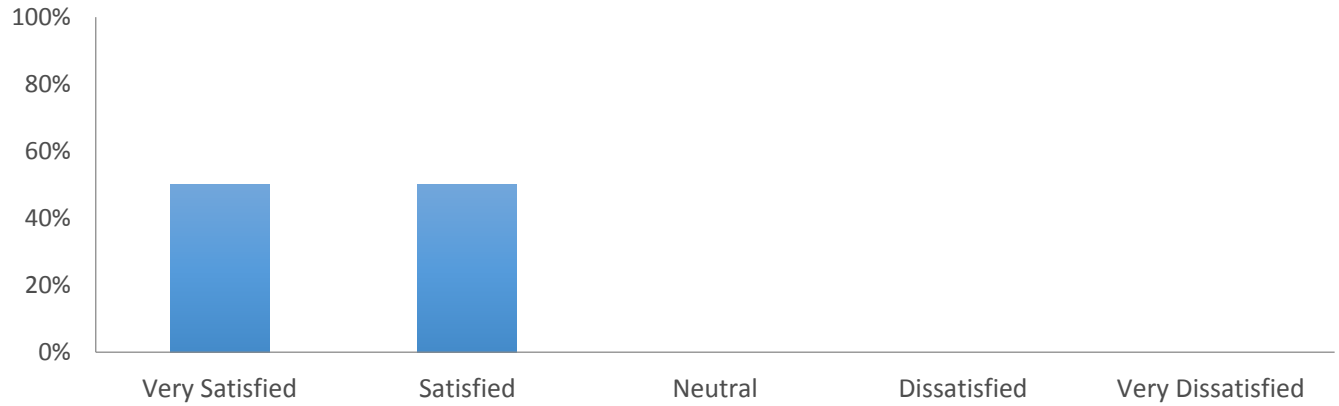


Figure 28. Overall satisfaction with the research experience



SRE participant comments:

I had an amazing experience and learned a lot. We will also be looking to get a publication out of this work so it is very exciting. The SRE was also nice because it didn't consume my entire summer!

I thought it was a great experience to branch out and see the world in different perspectives. Often times, majoring in one thing only makes you look at the way in a very specific, defined manner. However, the program really opened my eyes.

UNDERGRADUATE RESEARCH CONFERENCE AT THE INTERFACE OF BIOLOGY AND MATHEMATICS (URC)

The NIMBioS sixth 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 1-2, 2014. 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.

More than 100 participants participated in the event. The sixth annual Undergraduate Research Conference 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 77 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.
7.

HIGHLIGHTS OF URC EVALUATION RESPONSES (FIGURES 29-30)

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

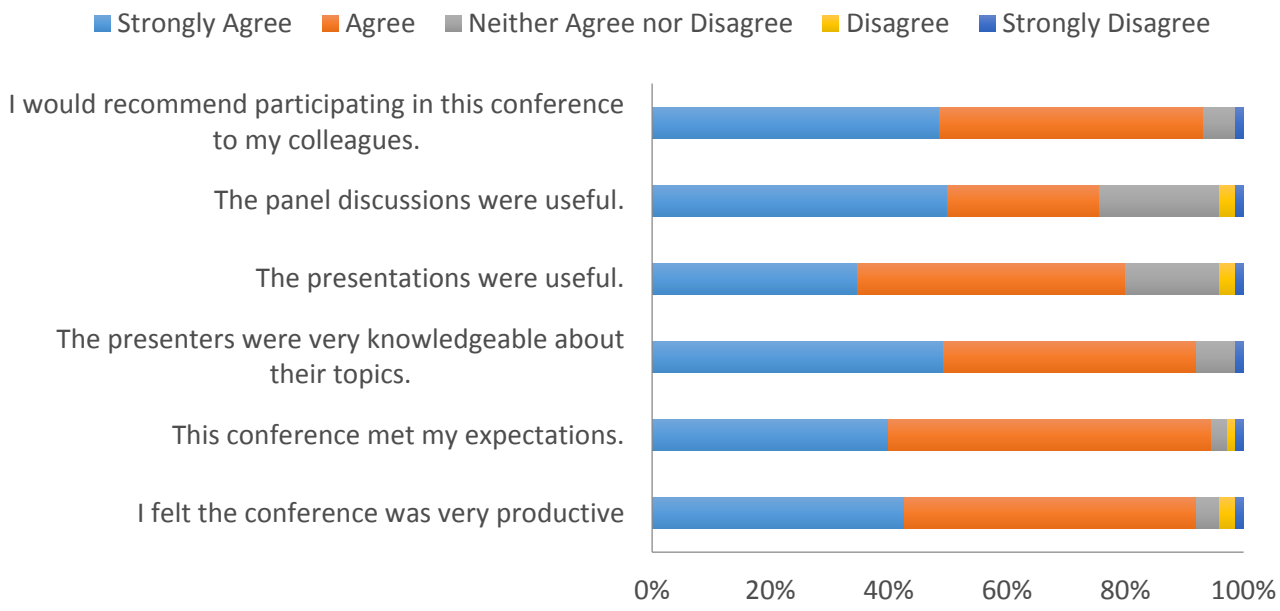
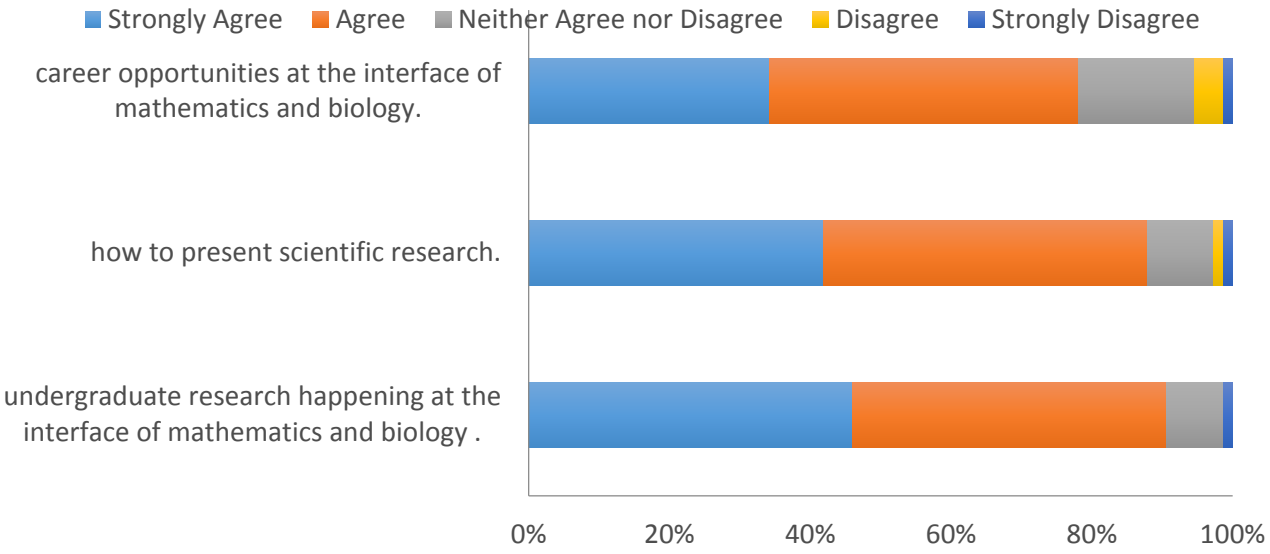


Figure 30. ***As a result of attending this conference, I have a better understanding of***



URC participant comments:

I am so grateful I had the opportunity to attend the conference. It was enlightening, and would not have been financially possible for me without the support I received to come through NIMBioS

This conference impacted me in many ways and helped me learn and grow regarding research opportunities. I am honored to have been part of such event.

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 data bases, 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, 23 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

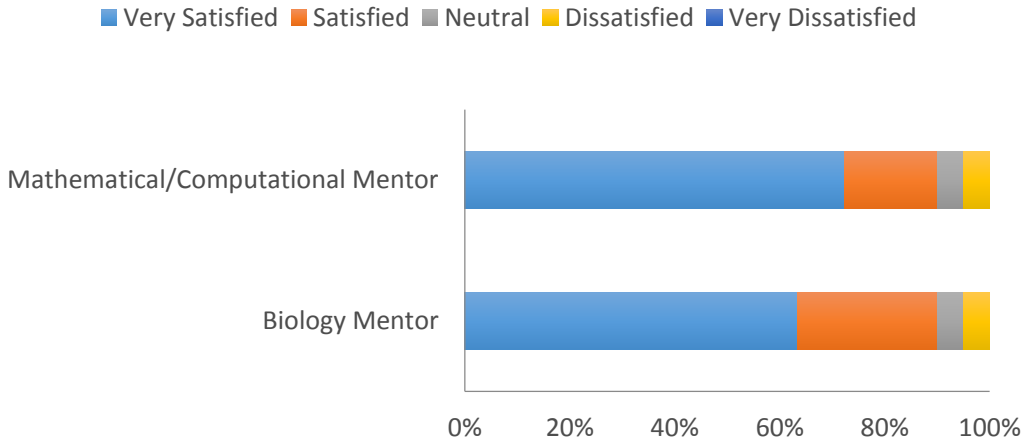


Figure 32. Postdoctoral fellow satisfaction with advice/assistance received from program mentors

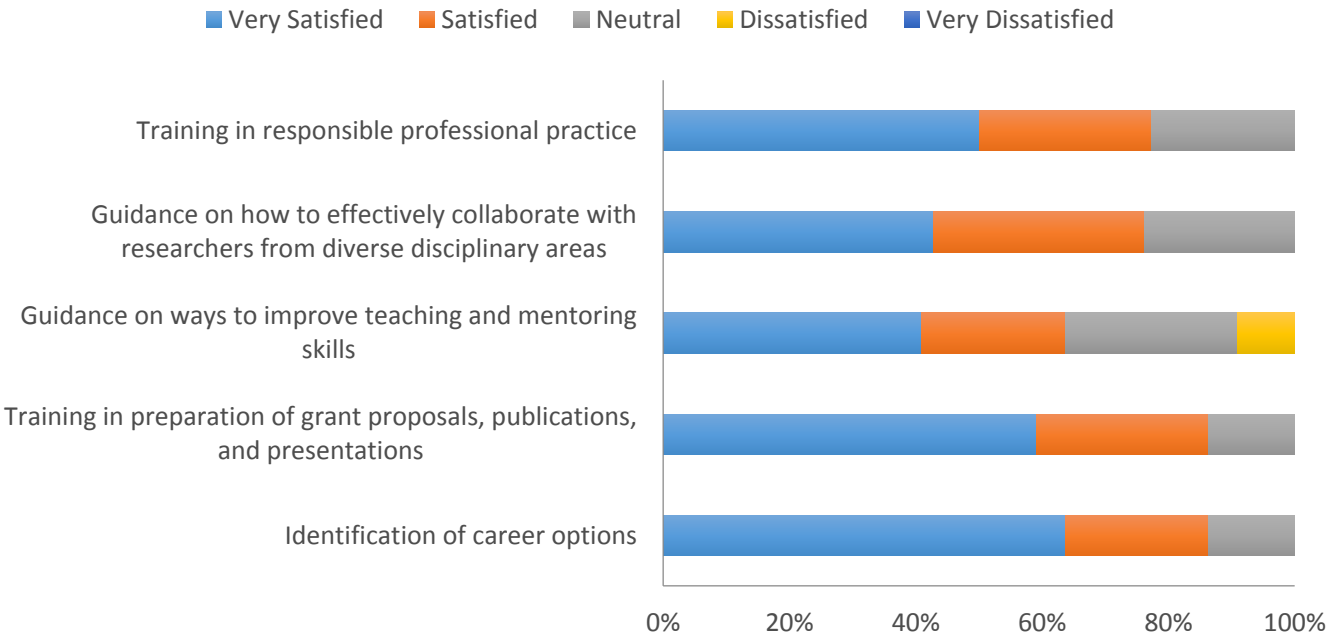
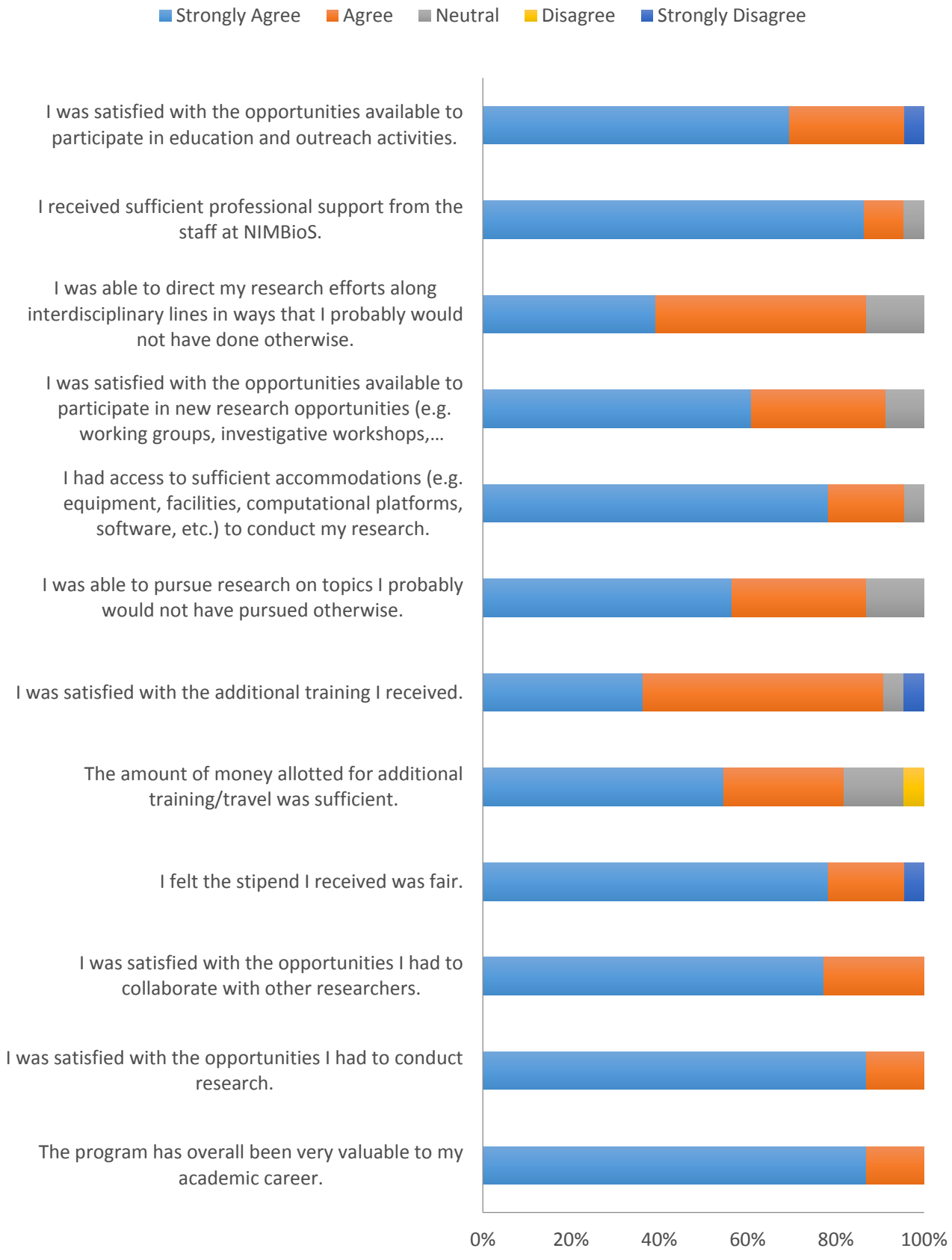


Figure 33. Postdoctoral fellow satisfaction with overall program experience



NIMBioS Postdoctoral Fellowship alumni comments:

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

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.

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

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 501 published journal articles on a range of subjects from 2009- April 2015 (**Figures 34 and 35** and **Table 6**). An additional seven are in press at writing and 16 have been submitted for review. The articles cover research ranging across many areas of ecology, evolutionary biology, applied mathematics, and computational biology.

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

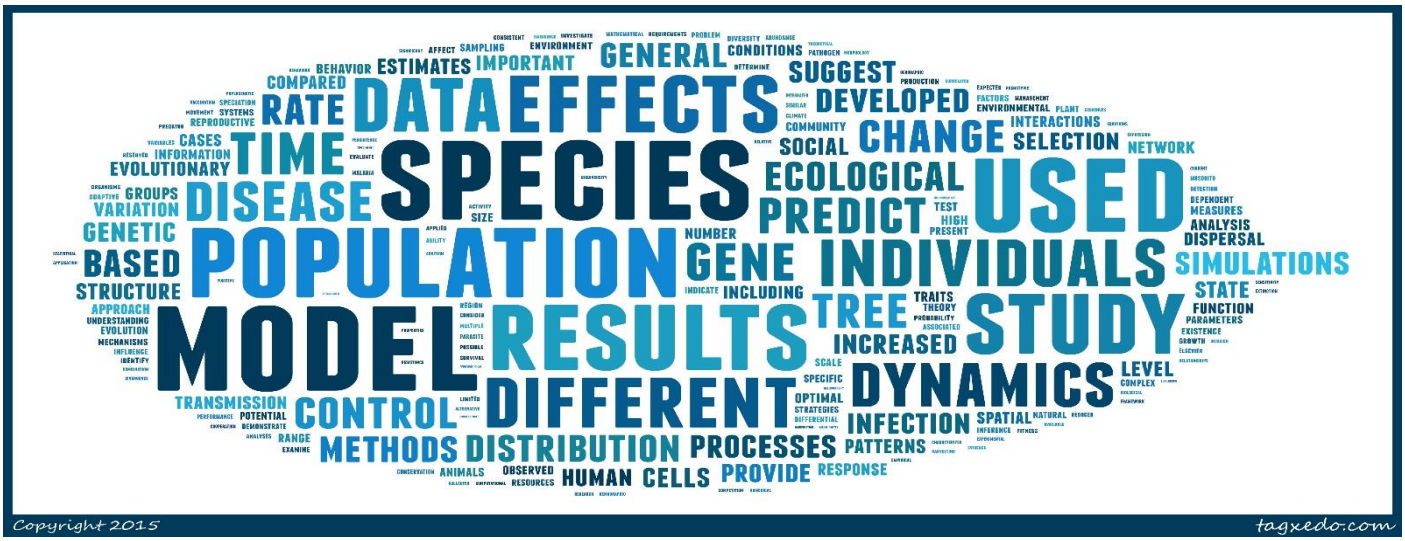
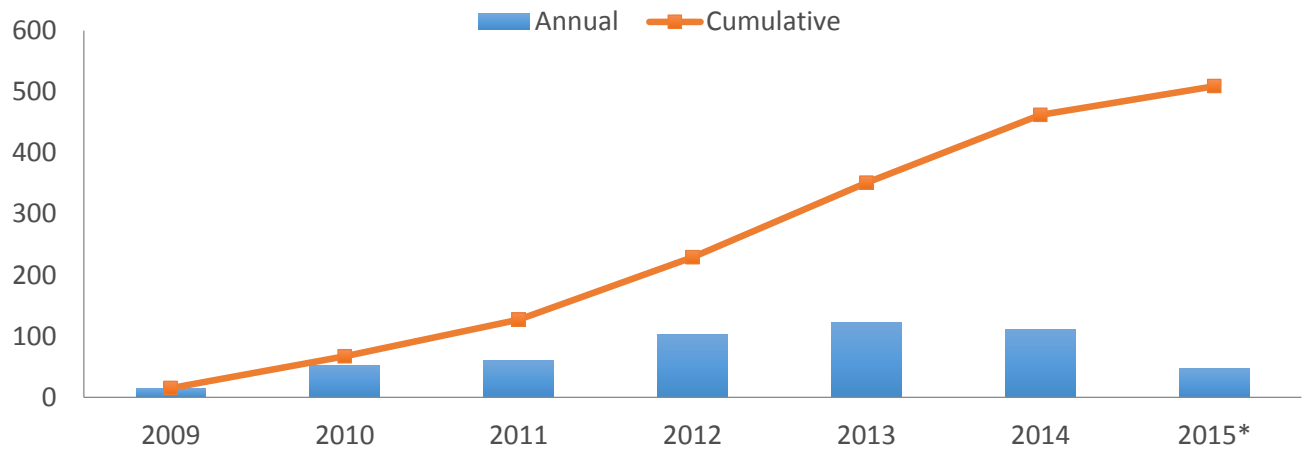


Figure 35. Number of publications reported from NIMBioS activities since 2009, by publication year



*2015 includes publications submitted by participants to NIMBioS through April, 2015

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 2015) and since NIMBioS' inception, sorted by journal 5-Year Impact Factor

Journal Title	5-Year Impact Factor *	# of NIMBioS Publications in Year 7 **	# of NIMBioS Publications Since Inception ***
Nature	42.35	2	5
Cell	35.02	-	1
Science	34.46	-	5
Trends in Ecology and Evolution	18.99	-	5
Ecology Letters	17.79	-	8
Systematic Biology	14.22	2	5
PLoS Biology	12.81	-	2
Nature Communications	11.02	2	2
Proceedings of the National Academy of Sciences	10.73	3	15
Current Biology	10.23	-	1
PLoS Genetics	8.90	-	2
Nucleic Acids Research	8.38	1	3
Phil Trans of the Royal Soc B-Biological Sciences	7.96	2	4
Molecular Ecology	6.54	3	7
Ecology	6.37	1	6
Proc of the Royal Soc B-Biological Sciences	5.81	3	9
PLoS Computational Biology	5.67	1	6
Evolution	5.47	5	15
Journal of Animal Ecology	5.44	1	3
The American Naturalist	5.20	4	11
Journal of the Royal Society Interface	4.88	2	5
PLoS One	4.02	6	26
Animal Behaviour	3.50	3	7
BMC Bioinformatics	3.49	1	2

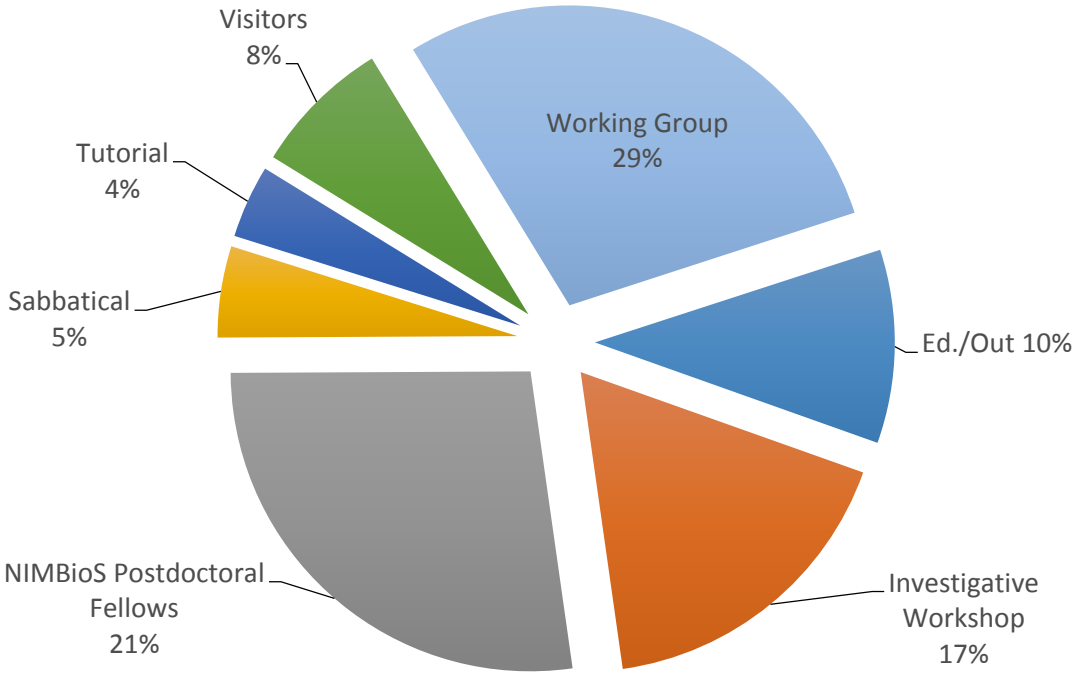
* The journal impact factor is a measure of the frequency with which the "average article" in a journal has been cited in a particular year. The impact factor is an indicator of a journal's relative importance, especially as compared to other journals in the same field. Impact factor calculation: cites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

** Number of publications in Year 7 includes all publications reported since compilation of the previous Annual Report (June 2014) through April 2015.

*** September 2008 – April 2015

NIMBioS publications come from a variety of activities, although Working Group participants tend to publish the largest portion of journal articles (29%), followed by NIMBioS Postdoctoral Fellows (21%) (**Figure 36**).

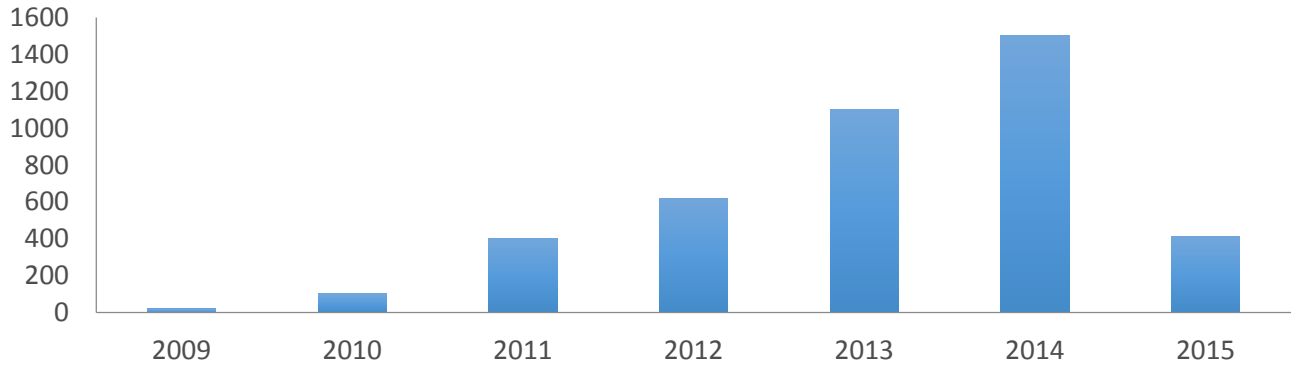
Figure 36. Distribution of journal publications submitted to NIMBioS by participants



BIBLIOMETRIC INDICATORS

Of the 501 journal articles reported by NIMBioS participants, 438 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 1,210 researchers from 531 unique institutions spanning 49 countries. These articles have appeared in 196 different publications, many of which are considered to have high-impact in the academic community. These articles have been collectively cited 4,309 times, with an average of 9.82 cites per article, 612 citations per year, and an h-index of 30 (**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 (3.65 citers/paper) and biology (15.65 cites/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

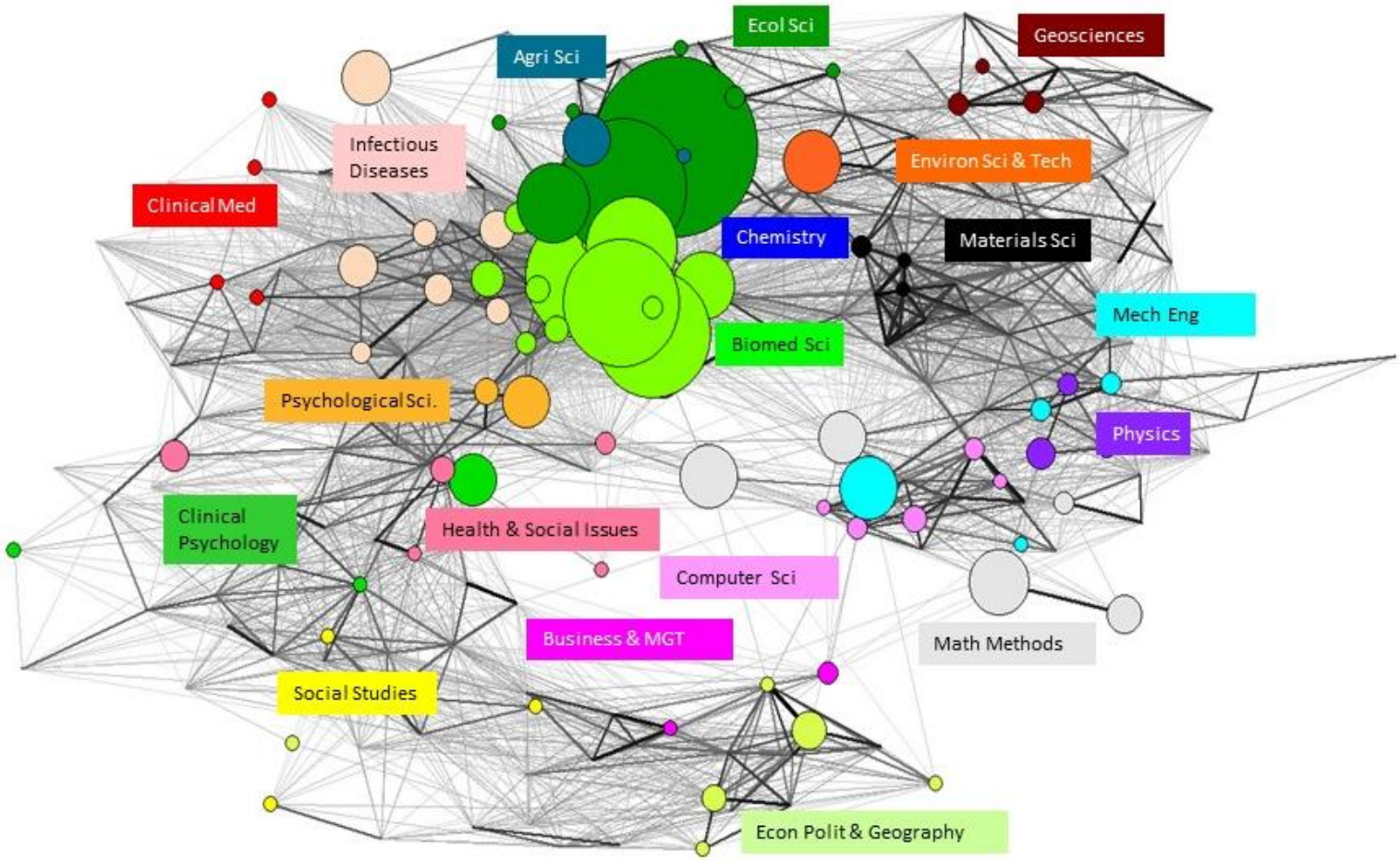


DISCIPLINARY SPAN OF PUBLICATIONS

The 438 published articles span 87 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 438 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 (126), followed by Evolutionary Biology (76), Multidisciplinary Sciences (64), Mathematical & Computational Biology (64), Biology (60), and Genetics & Heredity (39).

Figure 38. Web of Science Categories for 439 WoS journal articles to date



COLLABORATION

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

Figure 39. Coauthorship frequency of NIMBioS publications

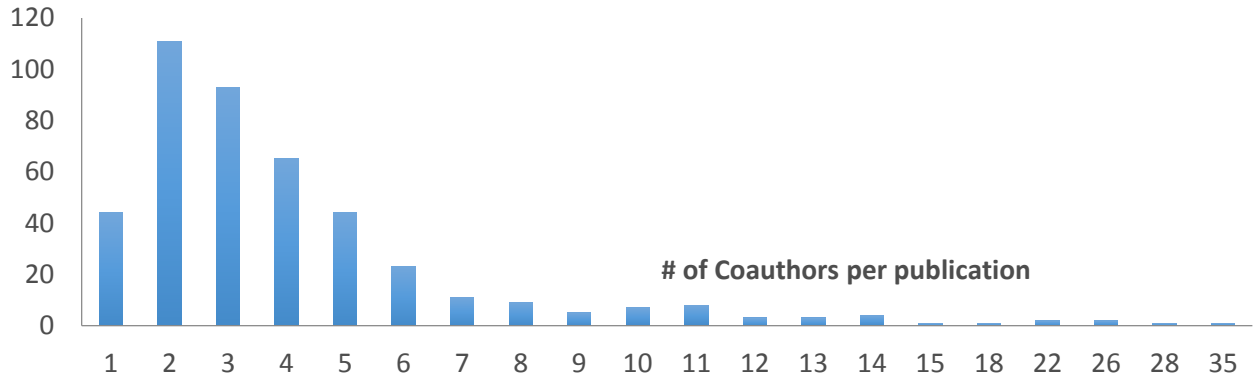
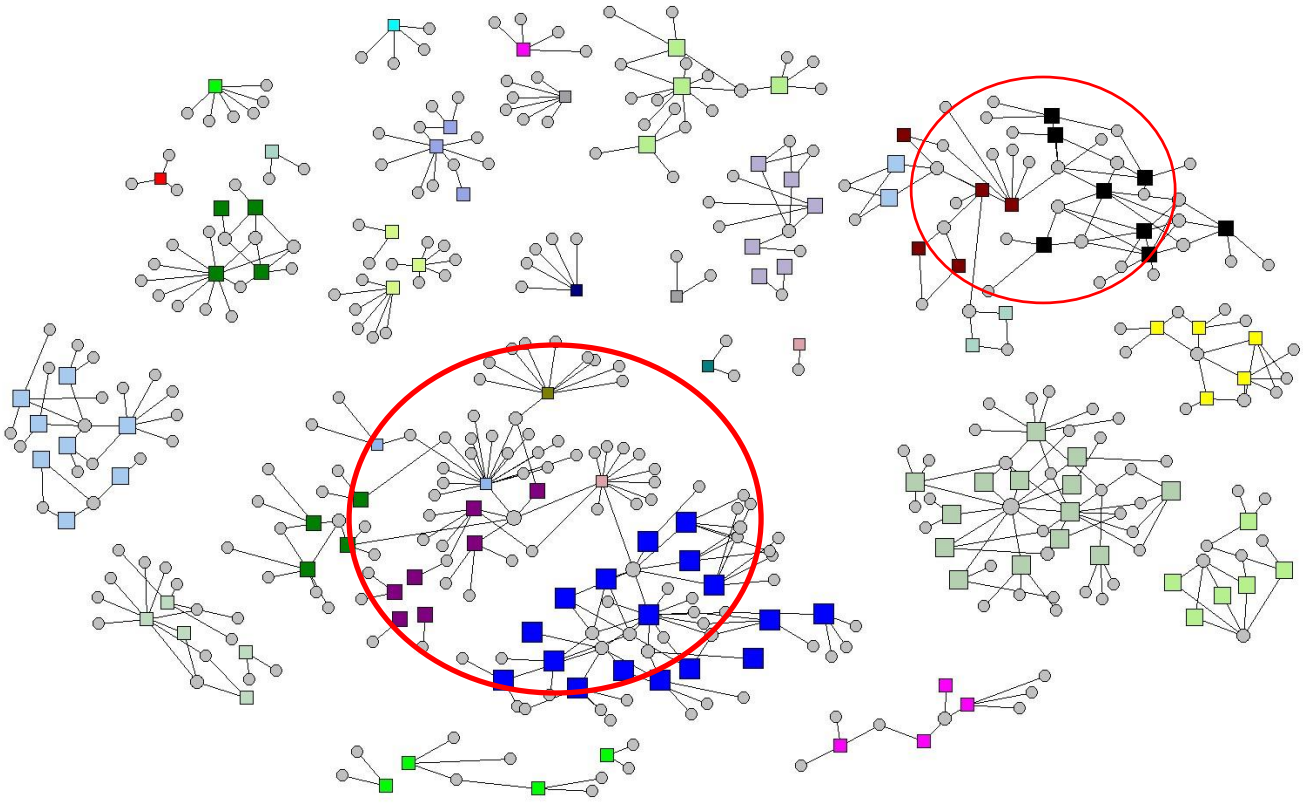


Figure 40 shows the paper-author network for Working Groups only. Twenty-four Working Groups have reported 124 publications related to their NIMBioS work. Grey circles represent authors and colored squares represent papers, colored by Working Group affiliation. Nodes are sized by numbers of publications for each group (squares) or a person's total number of NIMBioS affiliated publications (circles). The Synthesizing and Predicting Infectious Disease (SPIDER) Working Group (large royal blue cluster, started in 2009), has been the most prolific group with 17 publications, followed by Population and Community Ecology Consequences of Intraspecific Niche Variation (large light green cluster, started 2009), with 14 publications. Most Working Groups do not co-author across groups, however, some members who participate in multiple groups do author papers with members of two or more groups, as is the case with the two circled clusters in the figure. This cross-group authorship is becoming more prevalent as the institute matures.

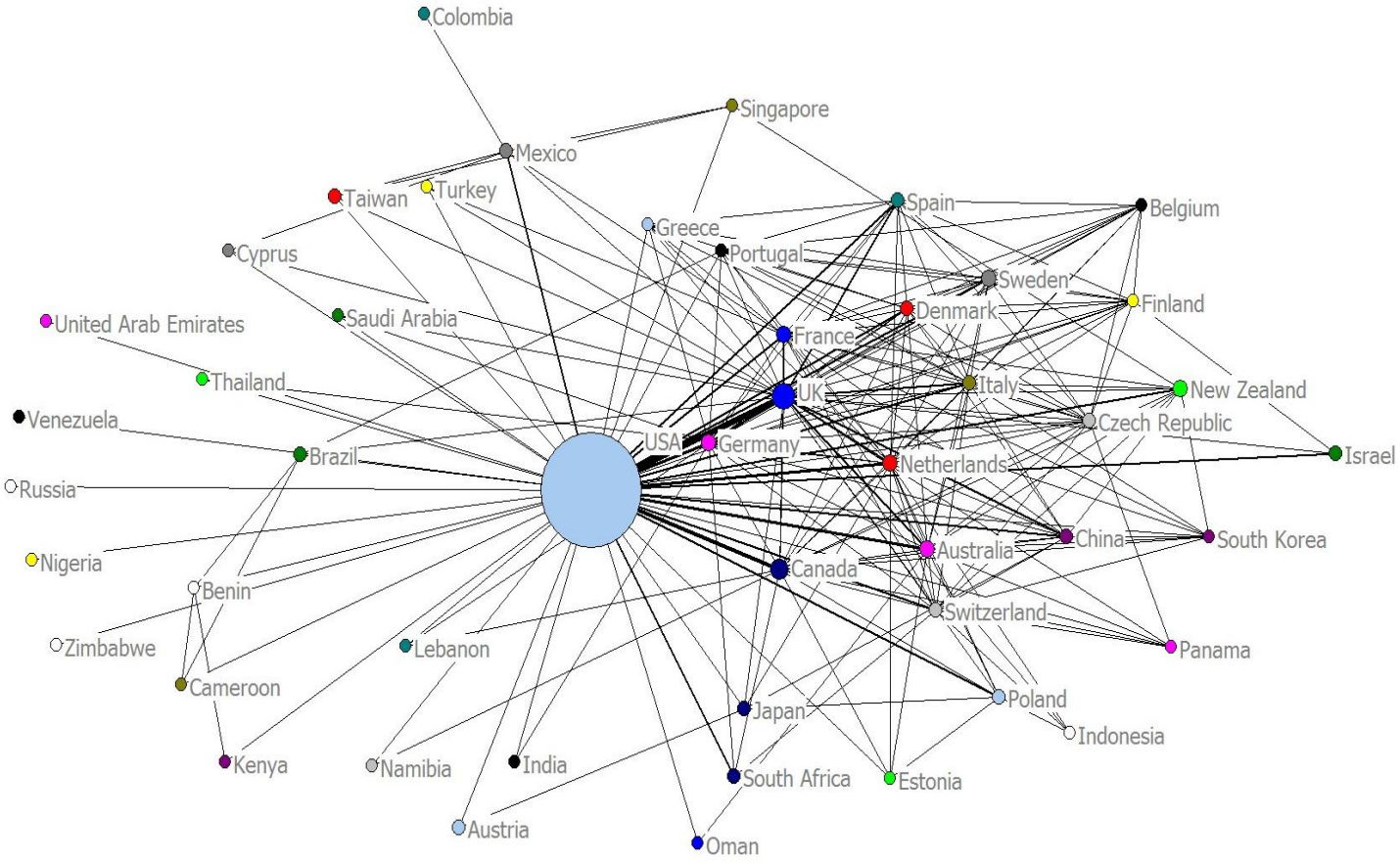
Figure 40. Participant paper collaboration network for all Working Groups



NIMBioS also fosters international collaboration among researchers. While 49 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 1-10 countries represented per paper (**Figure 41**).

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.

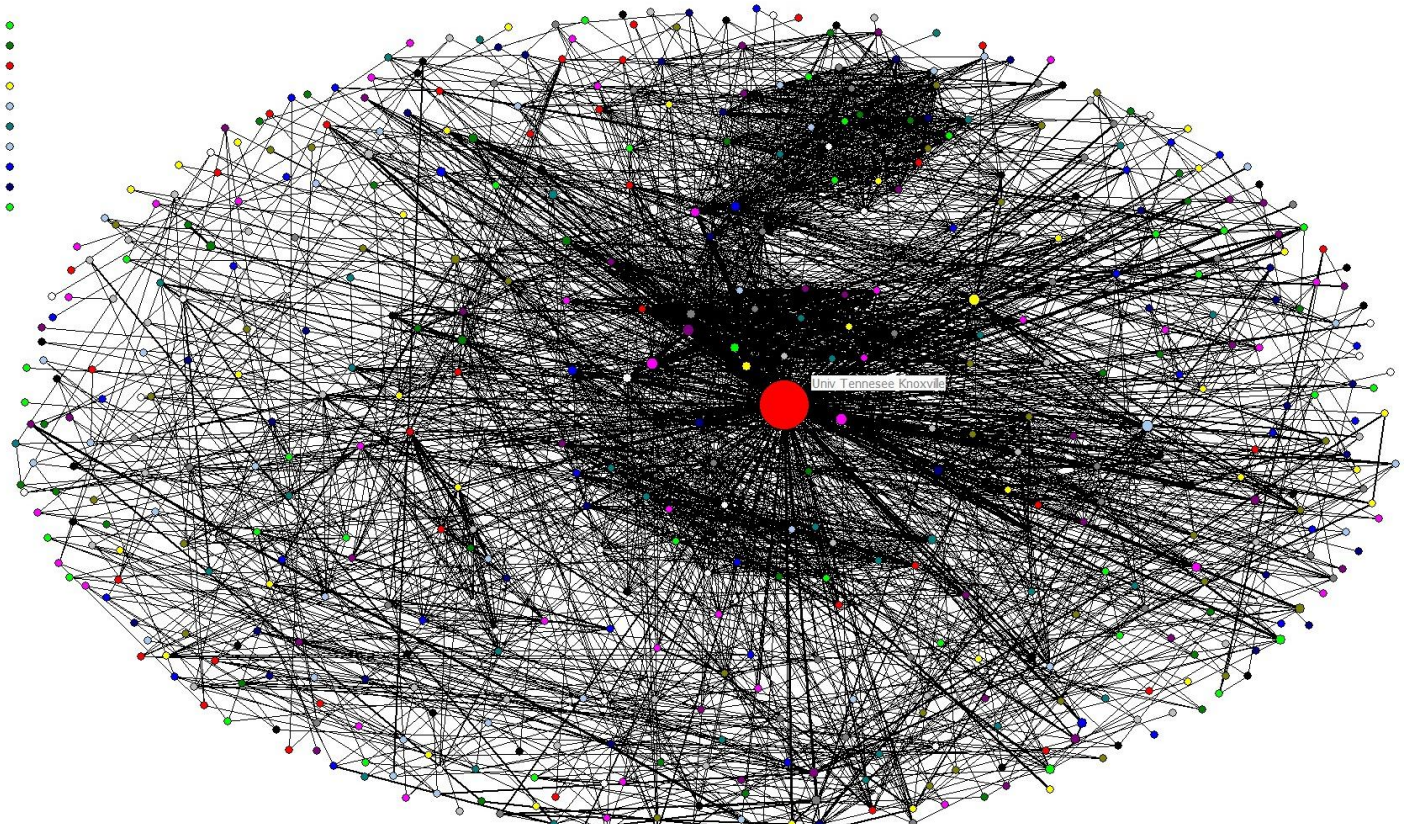
Figure 41. International collaboration on NIMBioS publications



Coauthors of NIMBioS publications through the current reporting period came from 531 unique institutions (Figure 42). The average number of institutions represented per paper was 3.0, with a range of 1-31 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 10 of the 531 institutions represented have published single-institution papers. The University of Tennessee is at the center of the graph.

Figure 42. 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 43** summarizes these types of products for the six-year period. In addition to the items listed in Figure 43, NIMBioS participants have reported 520 conference presentations related to NIMBioS affiliation.

Figure 43. Non-journal publication products arising from NIMBioS events