NIMBioS EVALUATION REPORT

REPORTING PERIOD FIVE

SEPTEMBER 1, 2012-MAY 31, 2013

NATIONAL INSTITUTE FOR MATHEMATICAL AND BIOLOGICAL SYNTHESIS

JUNE 2013

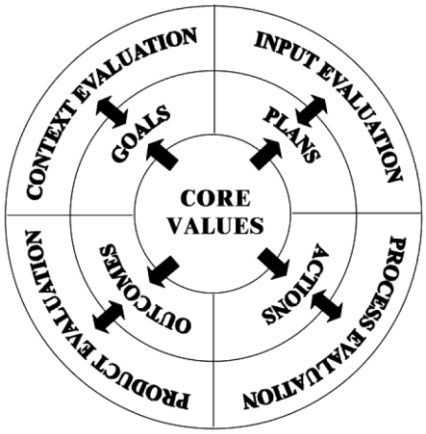
CONTENTS

NIMBIOS EVALUATION REPORT, REPORTING PERIOD FIVE

INTRODUCTION

This is an evaluation summary of NIMBioS activities during the fifth annual reporting period (RP 5) to the National Science Foundation. This report covers the period of September 1, 2012-May 31, 2013. The NIMBioS evaluation program follows the CIPP systems approach, which is based upon the premise that the most important purpose of evaluation is not to prove, but to improve. The evaluation addresses four main interconnected evaluation types 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.

[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.

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 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 5 included:

- 17 Working Group meetings
- 2 Tutorials
- 1 Investigative Workshop
- 30 Short-term visitors
- 18 Postdoctoral Fellows
- 34 Postdoctoral Fellow Mentorships
- 3 Sabbatical Fellows
- 6 Graduate Research Assistantships

Education and Outreach program activities during RP 5 included (see Annual Report for more details on these events):

- A NIMBioS Seminar Series
- Biology in a Box Program
- Research Experiences for Undergraduates Program
- Undergraduate Research Conference at the Interface of Biology and Mathematics
- Teacher Collaboration Program

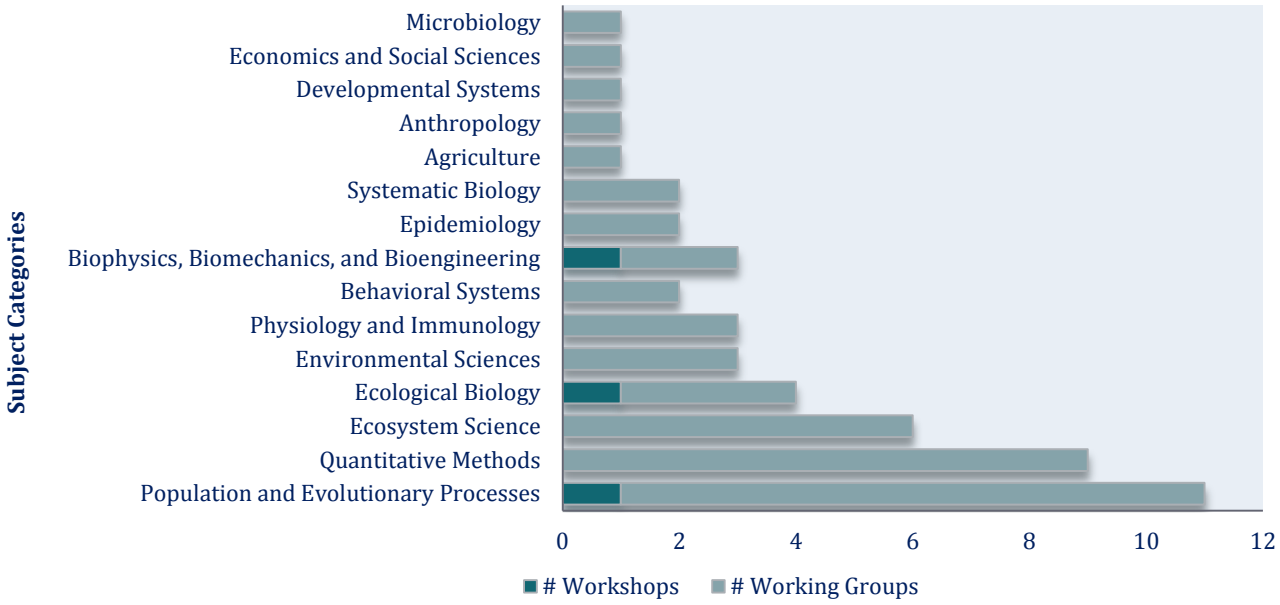
Other events included:

- 3 Advisory Board Meetings

DIVERSITY OF RESEARCH ACTIVITIES

NIMBioS is interested in supporting research activities from diverse subject areas. Working Group and 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 5 (each supported event may have up to three subject areas).

Figure 2. Diversity of Subject Areas of Working Groups and Investigative Workshops, RP 5



DIVERSITY OF PARTICIPANTS

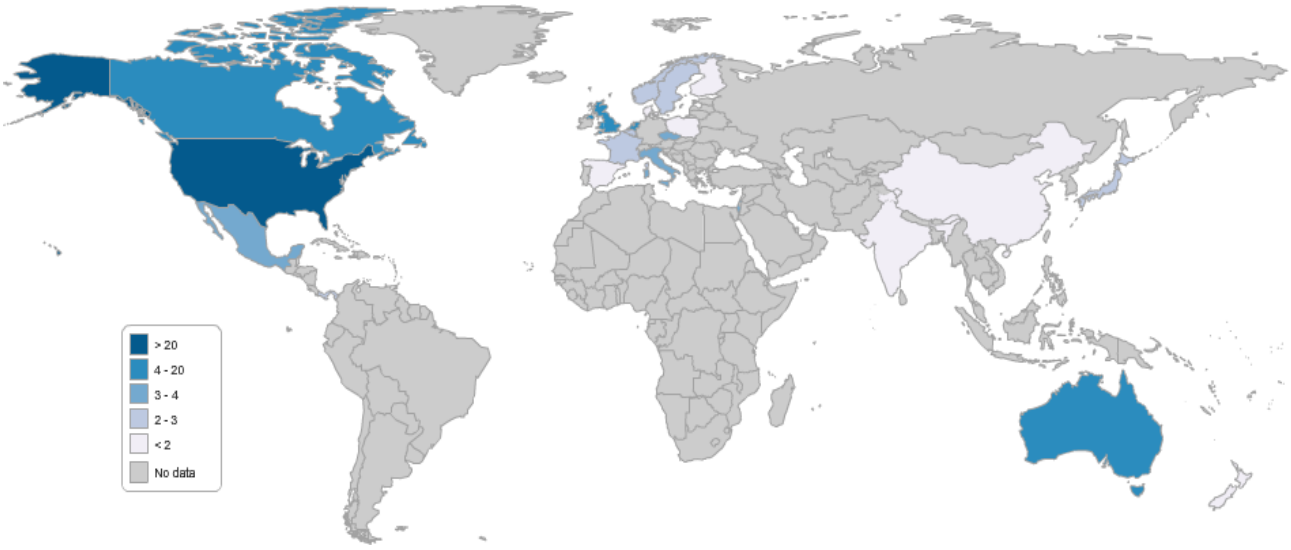
One of the core values of NIMBioS is to increase the diversity of researchers and educators at the interface of mathematics and biology. NIMBioS collects voluntary demographic data from event applicants to gauge whether our program is fairly reaching and benefitting everyone regardless of demographic 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 5 was 94%. 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

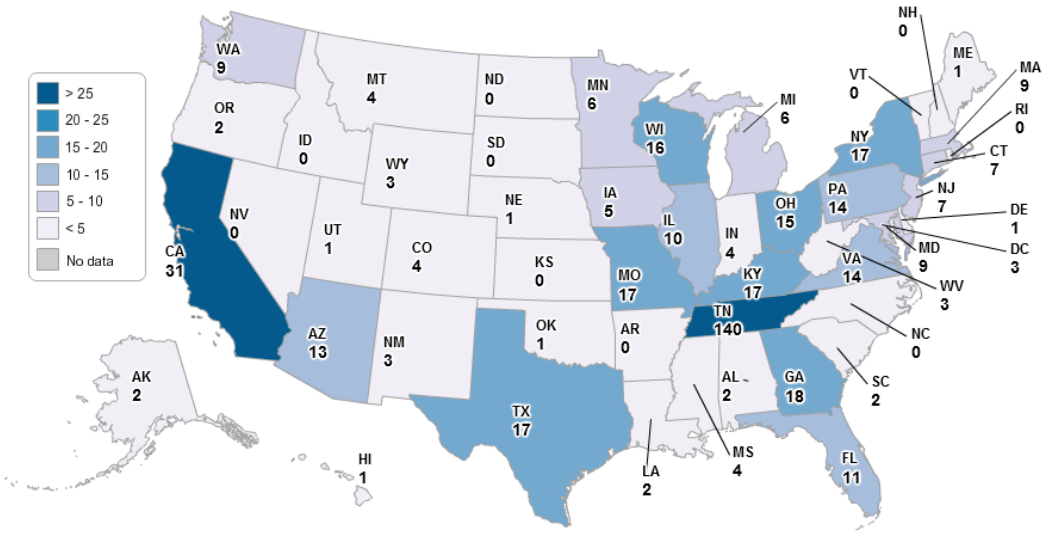
During RP 5, a total of 545 participants (428 different individuals) from 23 countries participated in NIMBioS events. Most participants came from the United States (86%), the United Kingdom (3%), and Canada (2%) (Figure 3).

Figure 3. NIMBioS RP 5 Participants by Country



Within the U.S., 41 different states were represented, as well as the District of Columbia and Puerto Rico. The largest percentage of participants came from within Tennessee (31%), followed by California (6%), Georgia (4%), North Carolina (4%), New York (4%), and Texas (4%), and Kentucky (4%) (Figure 4).

Figure 4. NIMBioS RP 5 Participants by U.S. State*

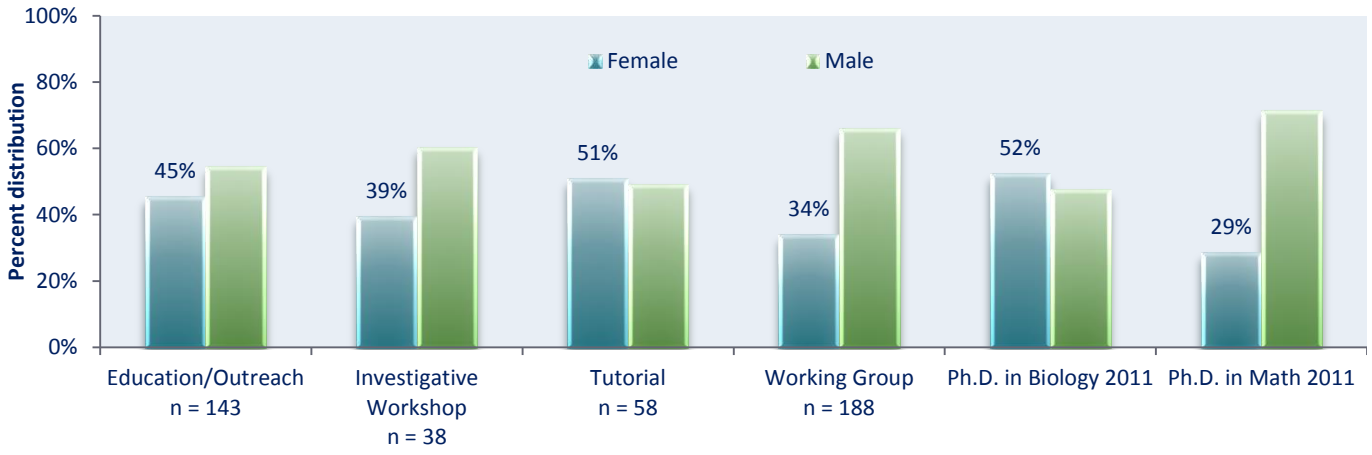


***Not shown, District of Columbia (3), Puerto Rico (2)**

GENDER, RACIAL, AND ETHNIC DIVERSITY

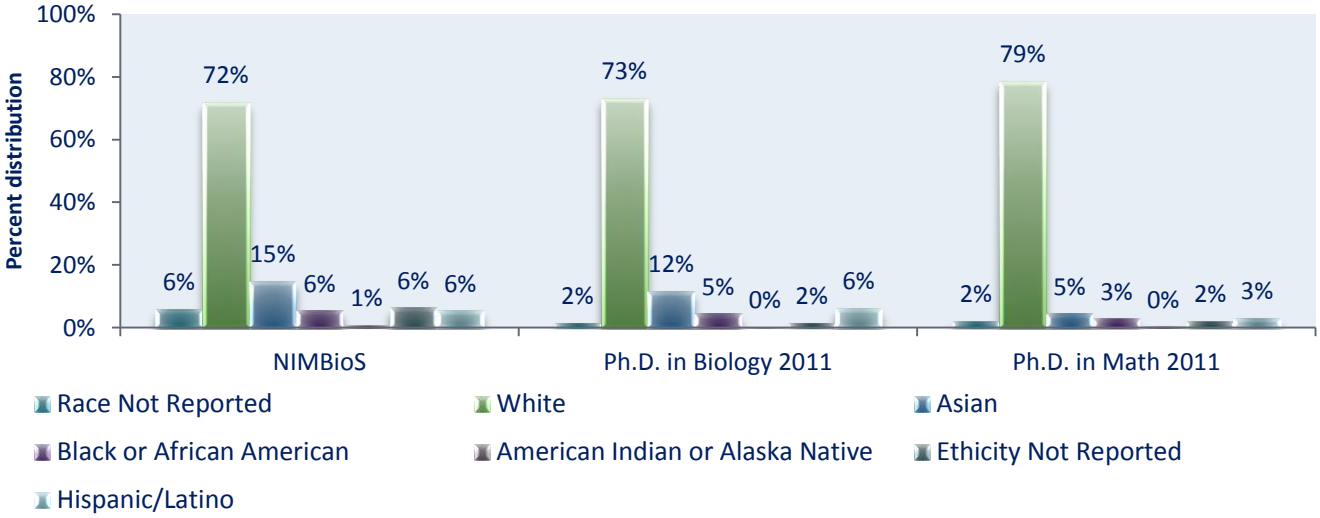
Across all events during RP 5, the gender ratio was 61% male to 39% female. Within specific activity types, the gender ratio varied slightly, with the greatest gender equity seen in Tutorial activities (Figure 5). Two comparison groups shown are all individuals receiving doctorates in biology and mathematics in the U.S. in 2011[2]. The 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[3] during RP 5 was around 11%. Representation of various minority categories was on par with current trends in minority representation for doctorial recipients in the biological sciences, and greater than that in the mathematical sciences (Figure 6). Two comparison groups shown are all individuals receiving doctorates in biology and mathematics in the U.S. in 2011[4].

Figure 6. Minority representation of NIMBioS participants (n = 545)



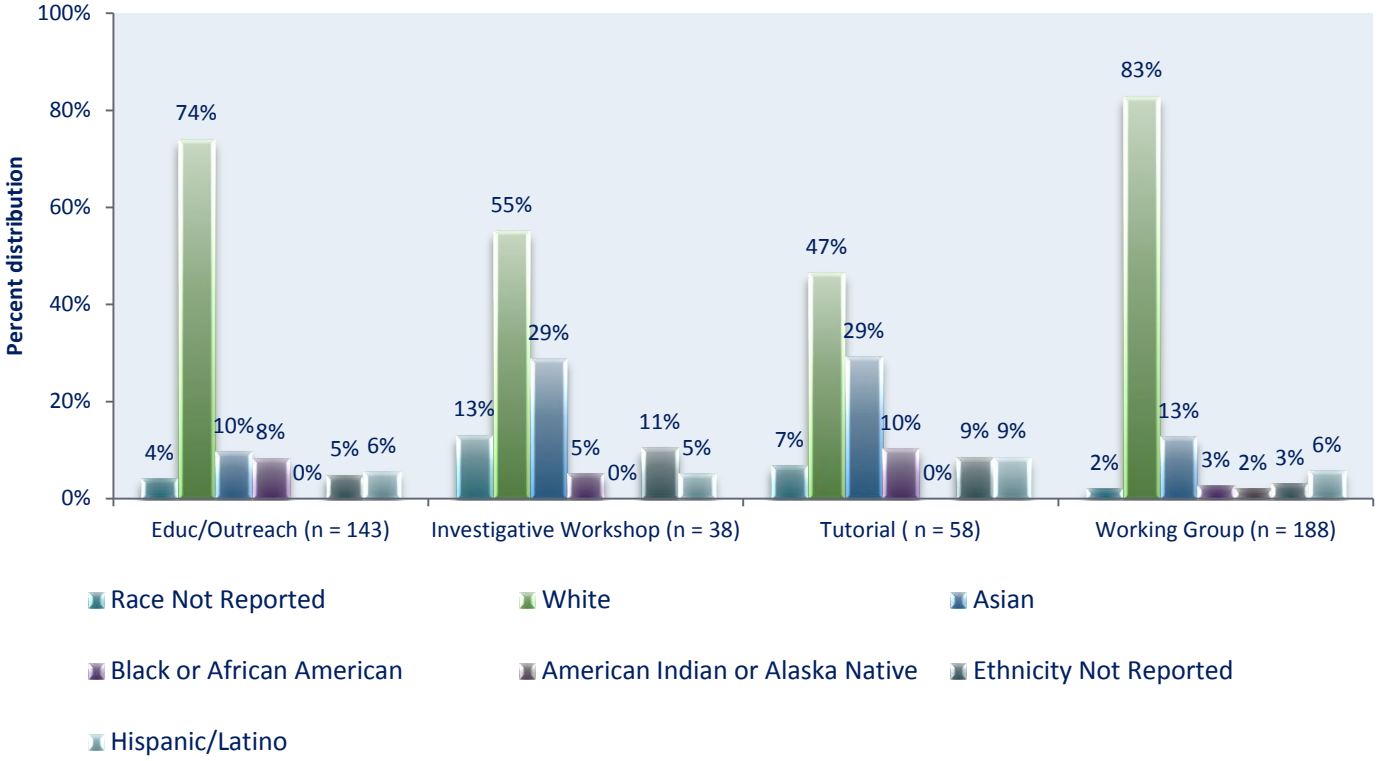
[2] Data from the 2011 NSF Survey of Earned Doctorates, http://www.nsf.gov/statistics/sed/2011/data_table.cfm

[3] For the purposes of this report, "underrepresented 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, 2011)

[4] Data from the 2011 NSF Survey of Earned Doctorates, http://www.nsf.gov/statistics/sed/2011/data_table.cfm

Minority representation varied considerably among programs. By event, Tutorials showed the 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 Tutorials (10%) and Education/Outreach Events (8%), while American Indian/Alaska Native individuals were only represented in the Working Group program (2%) (Figure 7).

Figure 7. Minority representation of participants, by event type (n = 545)



DIVERSITY BENCHMARKS

As 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**	Overall
PARTICIPANT DIVERSITY							
Gender	(Benchmark: approximately 30% female)						
	Working Groups	19%	22%	27%	34%	34%	27%
	Investigative Workshops	40%	40%	38%	39%	39%	39%
	All events	37%	42%	38%	39%	39%	39%
International	(Benchmark: approximately 10% outside USA)						
	Working Groups	20%	19%	19%	18%	24%	20%
	Investigative Workshops	10%	22%	21%	19%	5%	15%
	All events	7%	12%	14%	16%	14%	13%
URG	(Benchmark: increase proportion approximately 10% per year)						
	Working Groups	9%	9%	7%	8%	8%	8%
	Investigative Workshops	7%	10%	14%	14%	12%	13%
	All events	9%	11%	12%	12%	12%	11%
Local	(Benchmark: No more than 15% from UT/ORNL)						
	Working Groups	14%	15%	16%	18%	14%	15%
	Investigative Workshops	22%	23%	10%	7%	11%	15%
	All events	35%	20%	16%	13%	16%	20%
ORGANIZER DIVERSITY							
Gender	(Benchmark: approximately 30% female)						
	Working Groups	11%	13%	16%	28%	27%	19%
	Investigative Workshops	25%	29%	38%	39%	0%	26%
	All events	23%	28%	27%	34%	30%	28%
Local	(Benchmark: No more than 25% UT Faculty/Staff)						
	Working Groups	28%	22%	20%	28%	21%	24%
	Investigative Workshops	75%	36%	12%	17%	0%	28%
	All events	57%	42%	33%	27%	21%	36%

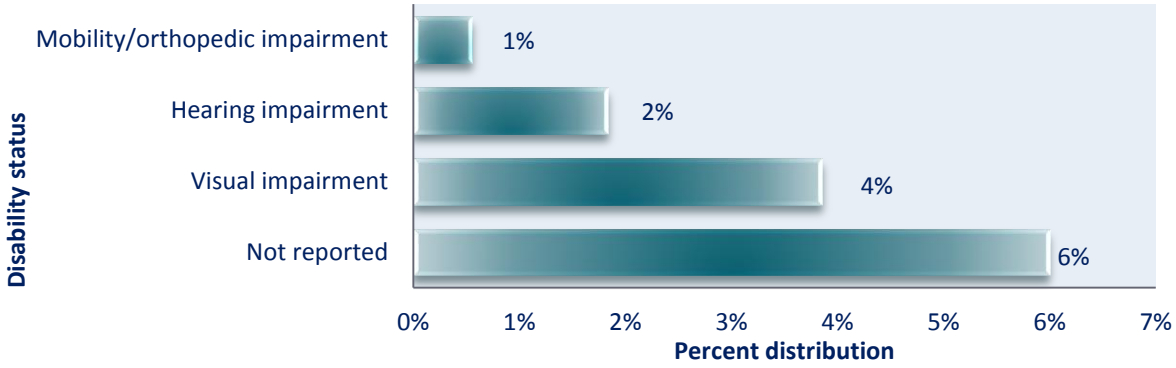
***Year 1 includes activities from March-August 2009**

**** Year 5 includes activities from September-May 2013; only one Workshop took place during RP 5**

DISABILITY STATUS

Disclosure of disability status by participants to NIMBioS is optional. Around 5% overall indicated having some sort of disability during RP 5. Nearly 4% indicated having some sort of visual impairment, while nearly 3% indicated having a hearing or mobility impairment (Figure 8).

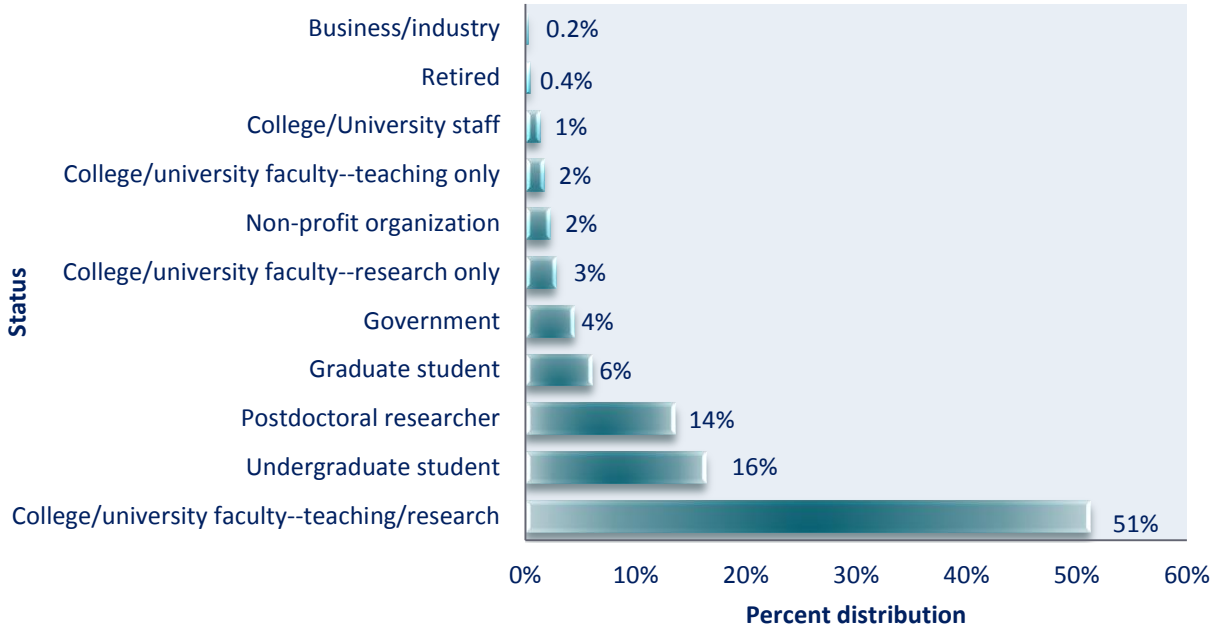
Figure 8. Disability status of participants (n = 545)



INSTITUTIONAL AND DISCIPLINARY DIVERSITY

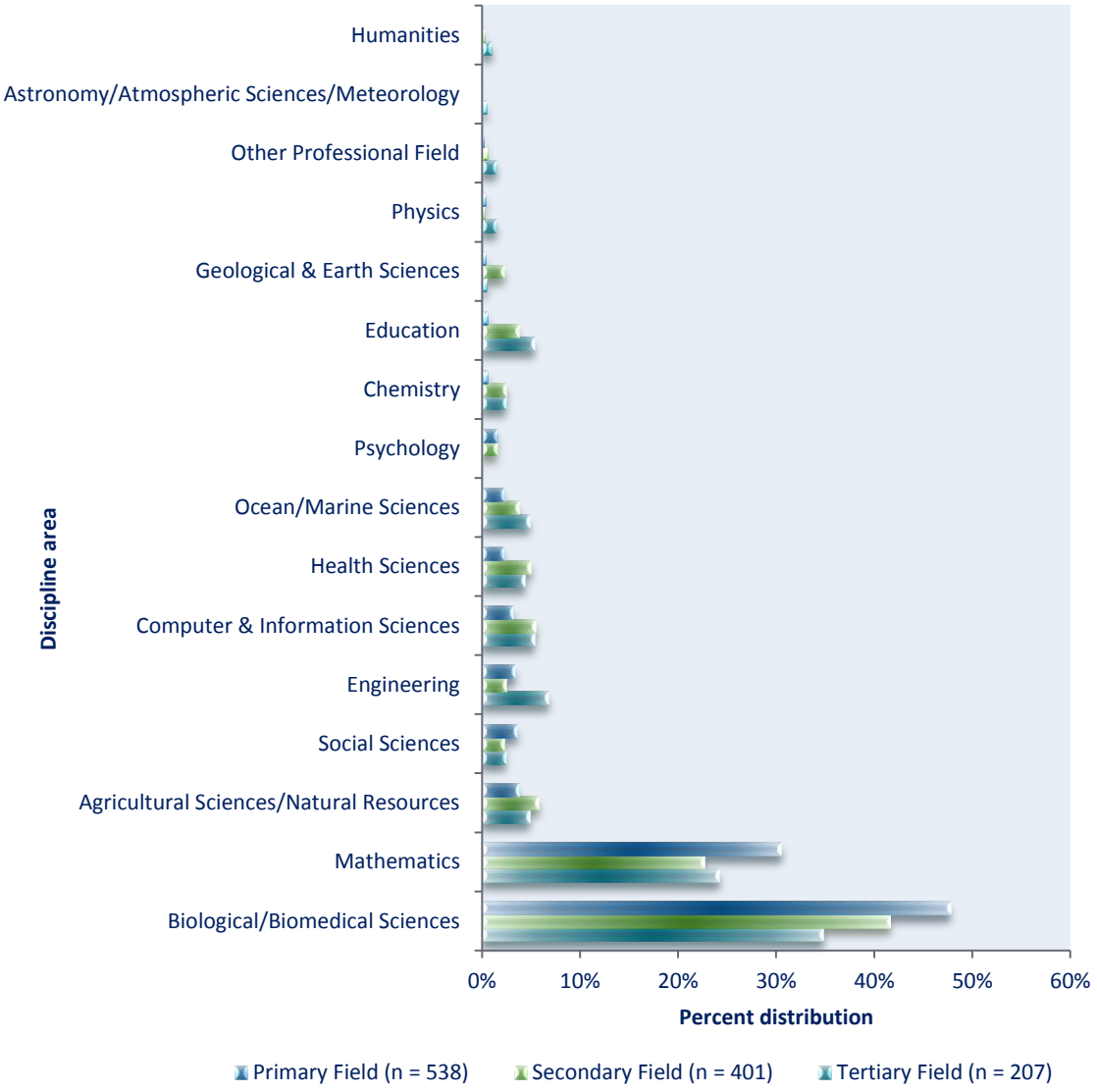
The majority of NIMBioS participants were college/university faculty or staff, undergraduate students, or postdoctoral researchers; however, participants came from government, non-profit, or other positions as well (Figure 9).

Figure 9. Employment status of participants (n = 545)



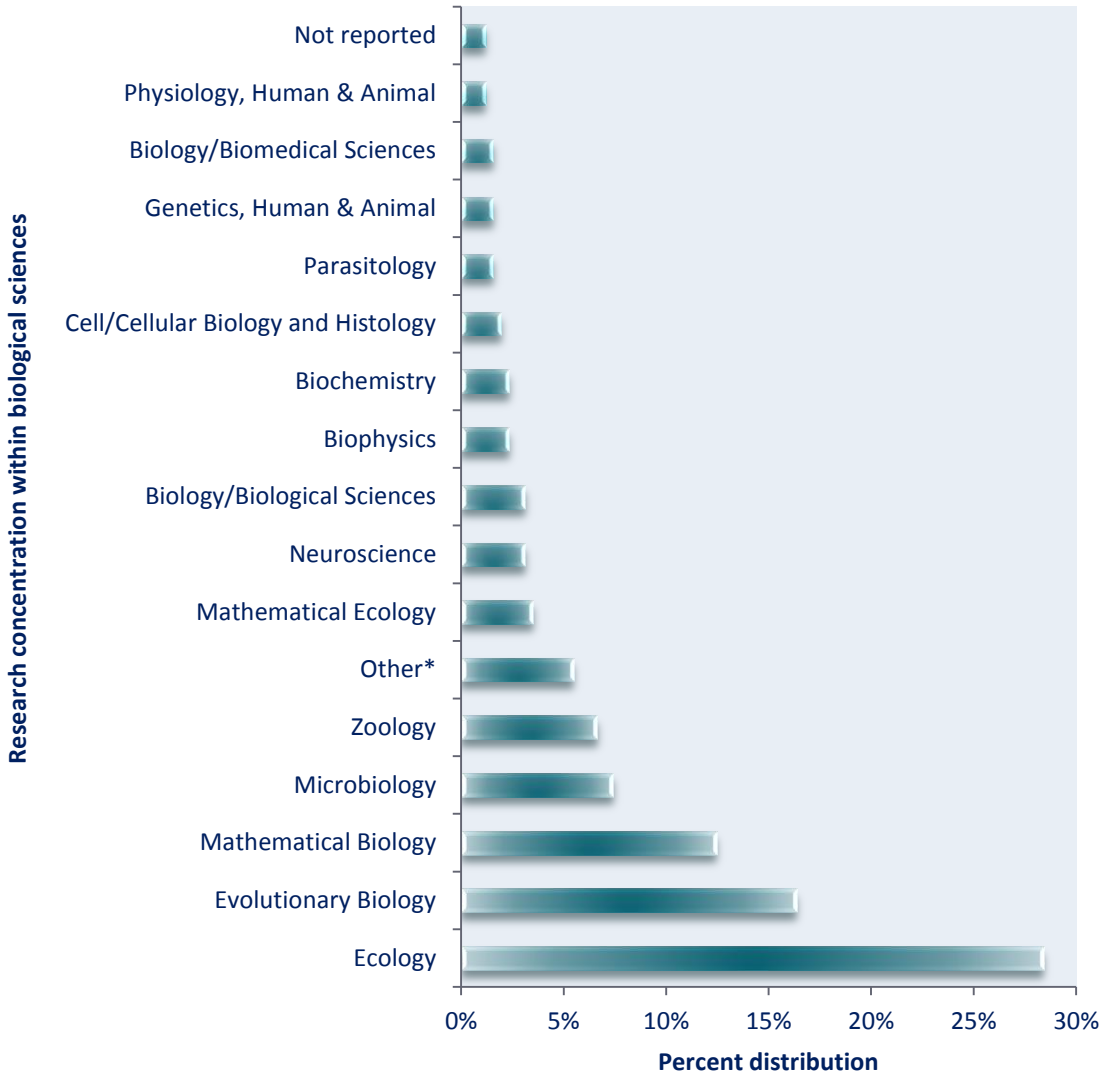
Most participants at NIMBioS indicated their primary fields of study, as well as areas of concentration within those fields. Many indicated their secondary and tertiary fields of study as well. The most commonly reported fields of study included biological/biomedical sciences, mathematics, and social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

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



The 257 participants naming Biological/Biomedical Sciences as their primary field of study indicated 25 different areas of concentration within which they would classify their primary areas of research/expertise. The most commonly indicated area of concentration was ecology (28%), followed by evolutionary biology (21%) and mathematical biology (12%) (Figure 11).

Figure 11. Participant research/expertise area concentrations within biological/biomedical sciences field of study (n = 257)



* Other concentrations having fewer than 1% of participants each: Anatomy, Immunology, Biology, Molecular Biology, Behavioral Ecology, Biometrics & Biostatistics, Bacteriology, Botany/Plant Biology, Plant Genetics, an Developmental Biology/Embryology.

Participants during RP 5 represented 204 different institutions, including colleges and universities, government institutions, private businesses, non-profits, and high schools (Figure 12). Of the colleges/universities represented, most were classified as comprehensive (having undergraduate and graduate programs) (Figure 13).

Figure 12. Types of institutions represented (n = 204)

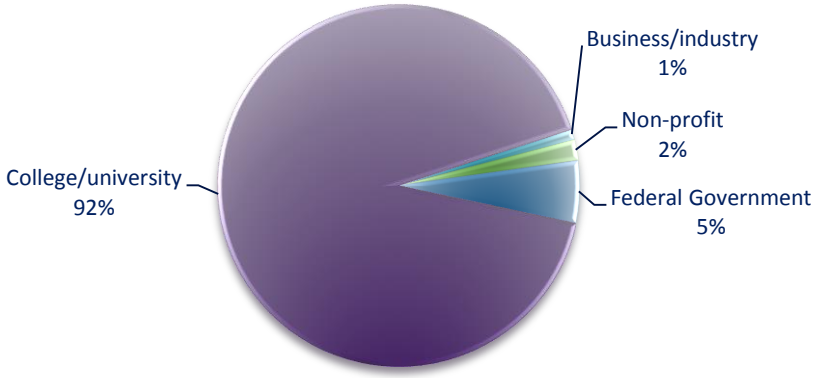
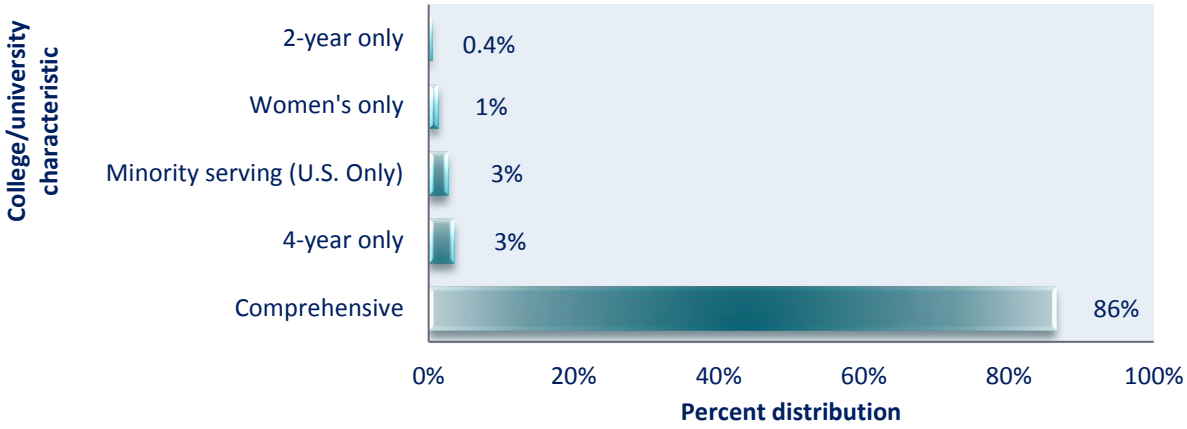


Figure 13. Characteristics of participants' colleges/universities



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. An evaluation of the Teacher Collaboration program is ongoing as well. 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 5.

Process Evaluation of Research Program Activities

Working Group and Tutorial evaluation highlights are aggregated across all events in their respective categories.

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.

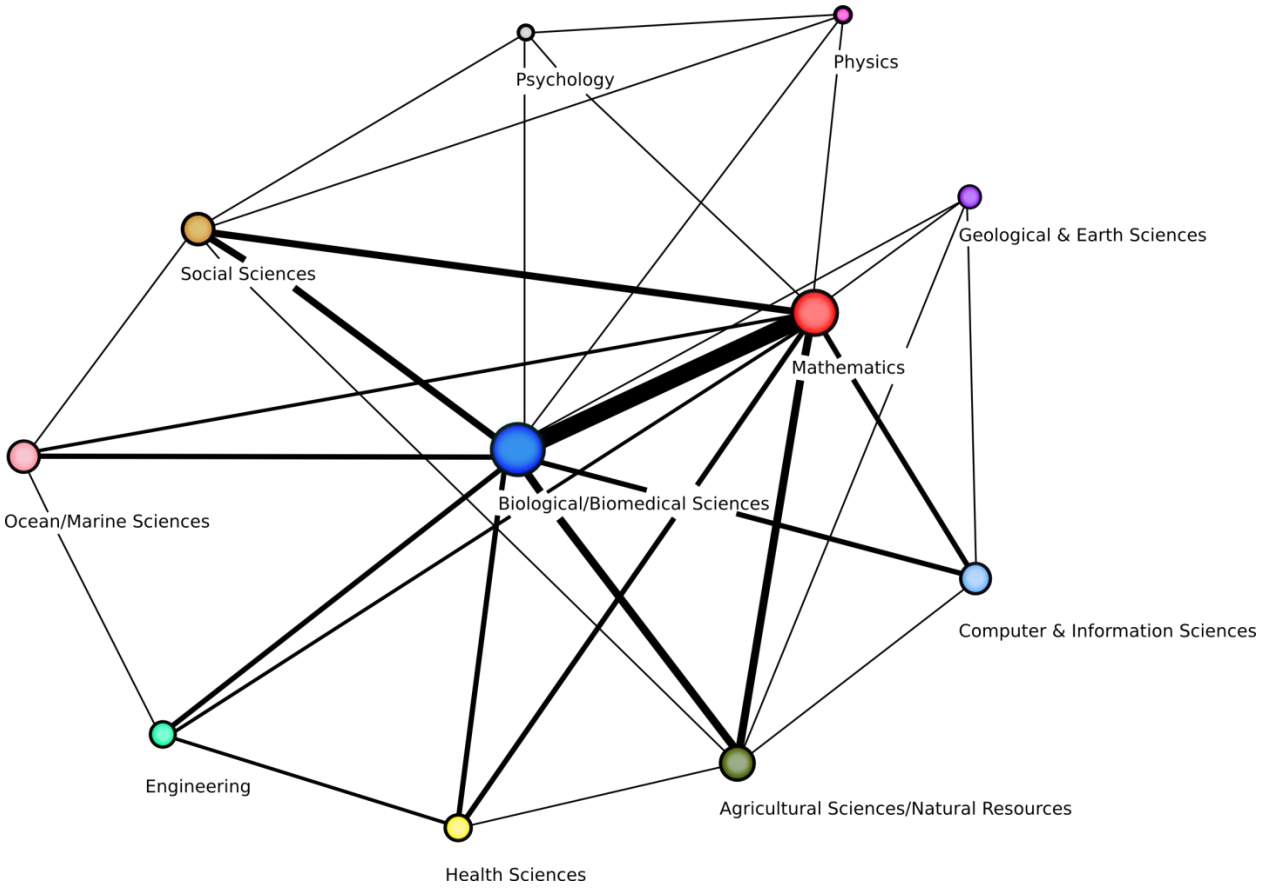
Working Groups are relatively small (10-12 participants, with a maximum of 15), focus on a well-defined topic and have well-defined goals and metrics of success (e.g., publications, databases, software). Selection of Working Groups is based upon the potential scientific impact and inclusion of participants 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 SUMMARY, RP 5

During RP 5, NIMBioS hosted a total of 17 Working Group meetings, including the start of four new groups. In addition to these new groups, RP 5 saw the return of 10 established groups, two of which met twice during the reporting period. A total of 199 participants from 103 institutions took part in the Working Groups. During RP 5, participants came together from 11 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. 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.

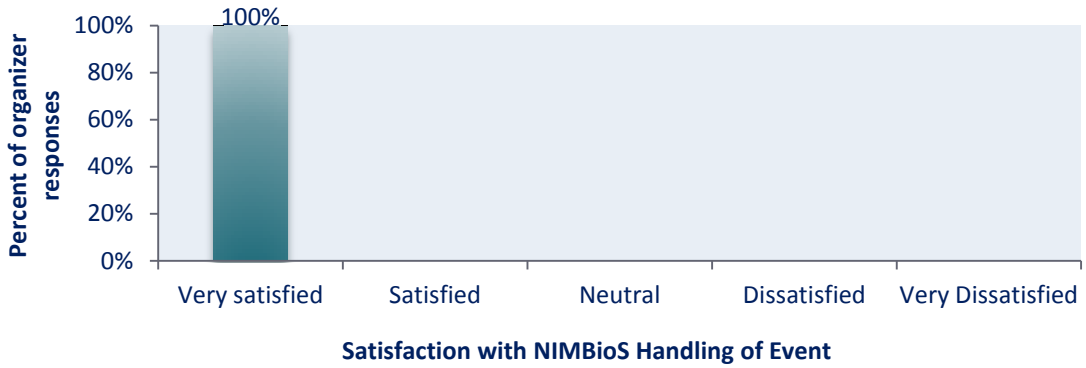
Figure 14. Working Group cross-disciplinary collaboration



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 (from the application process through the wrap-up of the event)? Figure 15 summarizes the responses to this question for RP 5 organizers of beginning Working Groups.

Figure 15. Working group organizer satisfaction with NIMBioS handling of event (n = 11)



FIRST MEETINGS

During RP 5, NIMBioS hosted the first meetings of four Working Groups, with a total of 52 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 41 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 well they felt NIMBioS managed their events.

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

Title of Working Group	Dates	# Participants
Biotic Interactions	Feb 1-4, 2013	14
Hierarchy and Leadership	Apr 25-27, 2013	12
Design and Analysis of Bat Population Monitoring	May 7-9, 2013	17
Nonautonomous Systems and Terrestrial C-cycle	May 13-17, 2013	9

SUMMARY OF WORKING GROUP FIRST MEETING EVALUATION RESPONSES

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

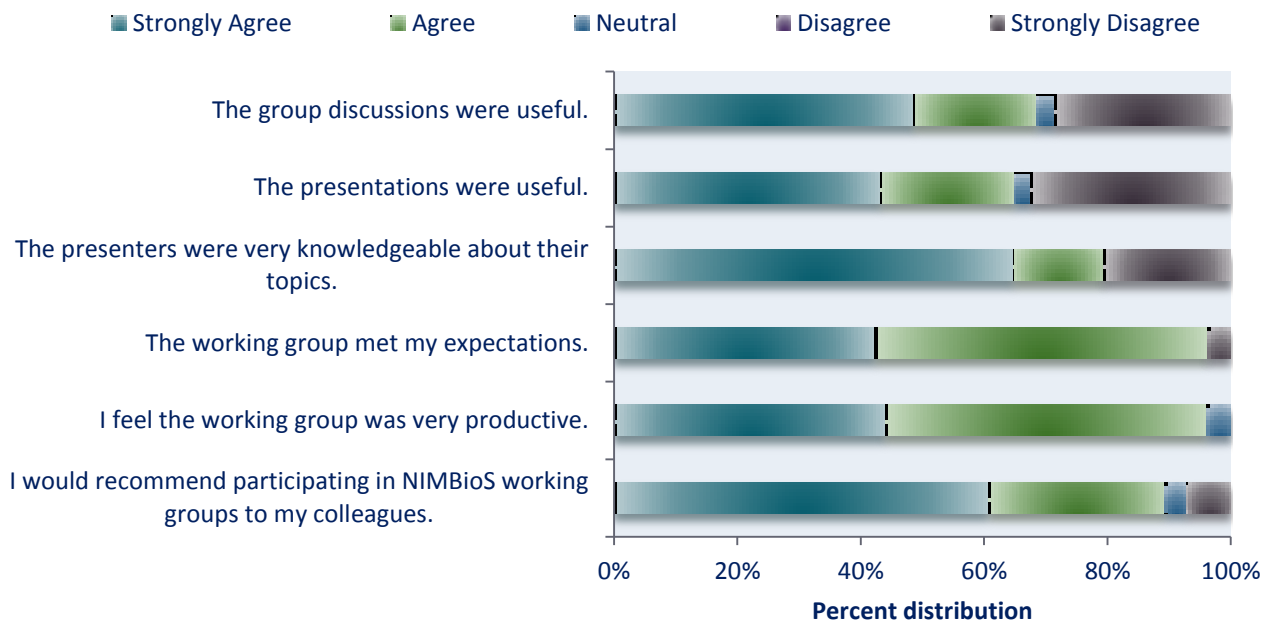


Figure 17. ***Participant responses to the following question--As a result of participating in this Working Group, I have a better understanding of:***

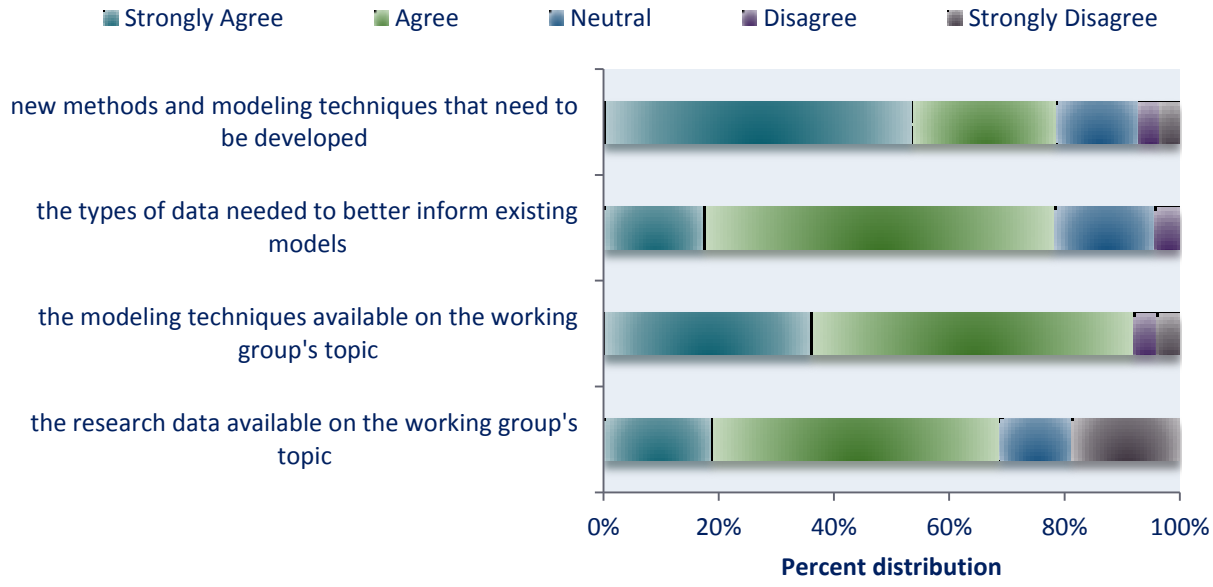


Figure 18. ***Satisfaction with Working Group accommodations***

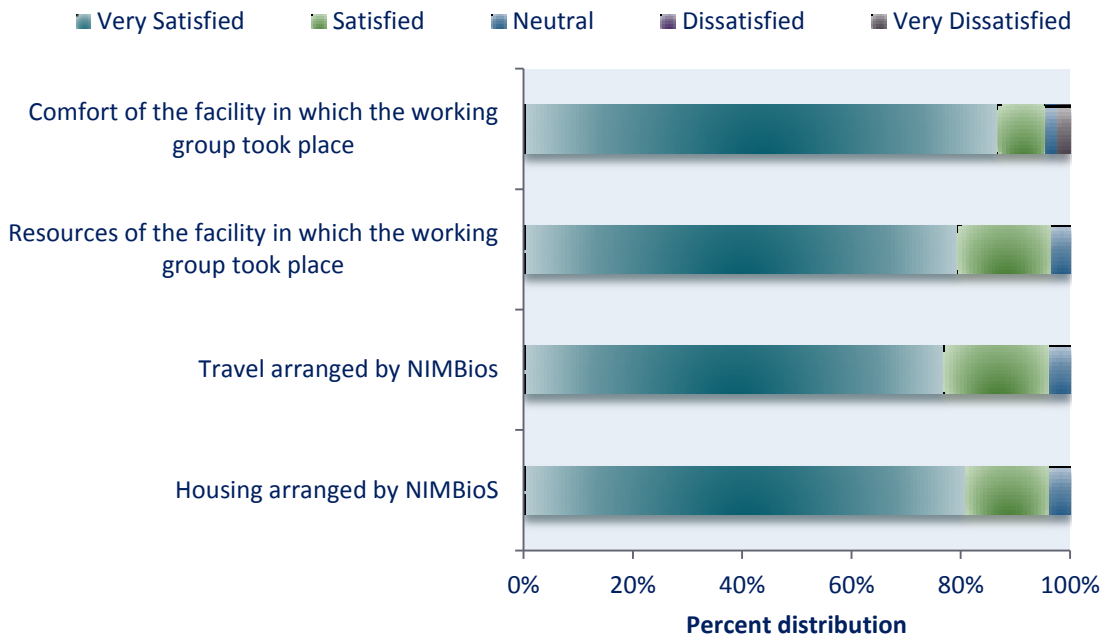


Figure 19. Percent of participants in first meetings of Working Groups who:

WORKING GROUP SECOND, THIRD, AND FOURTH MEETINGS

During the reporting period, NIMBioS hosted the second meetings of five Working Groups, with a total of 60 participants, and the third meeting of seven Working Groups, with a total of 77 participants. One group held its fourth meeting with 10 participants (Table 3). 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.

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

Title of Working Group	Dates	# Participants
Second Meetings		
Ocean Viral Dynamics	Oct 22-24, 2012	13
Play, Evolution, and Sociality	Oct 29-31, 2012	14
Suction Feeding Biomechanics	Oct 29-30, 2012	10
Modeling Anthrax Exposure	Nov 13-15, 2012	12
Within-host modeling of *Mycobacterium avium* subsp. *paratuberculosis* (MAP) infections	March 4-6, 2013	11
Third Meetings		
Gene Tree/Species Tree Reconciliation	November 26-29, 2012	12
Optimal Control for Agent-based Models	November 27-29, 2012	13
Food Web Dynamics	December 11-12, 2014	8
Multiscale Modeling of the Life Cycle of Toxoplasma gondii	December 17-19, 2012	13
'Pretty Darn Good' Control: extensions of optimal control for ecological systems	Jan 22-24, 2013	11
Modeling Anthrax Exposure	May 15-17, 2013	9
Suction Feeding Biomechanics	May 20-21, 2013	11
Fourth Meetings		
Cross-Topology Registration	May 1-3, 2013	10

CONCLUDING WORKING GROUPS

Toward the end of the reporting period, NIMBioS received notification that four Working Groups had reached their conclusions. It is the policy of NIMBioS to withhold sending the final evaluation survey to Working Group participants until the final meeting summary has been received from Working Group organizers. As NIMBioS is currently awaiting the final reports from these groups the final evaluation survey is still outstanding at the time of this report.

INVESTIGATIVE WORKSHOPS

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

NIMBioS hosted one Investigative Workshop during RP 5, **Systems and Synthetic Microbiology**, with a total of 38 participants. Evaluation surveys were sent to all Workshop participants. Workshop organizers and NIMBioS employees who were participating in the Workshops were excluded from the evaluation. A total of 35 participants took part in the evaluation of the Workshop.

SUMMARY OF WORKSHOP EVALUATION RESPONSES

Figure 20. Workshop organizer satisfaction with NIMBioS handling of event (n = 2)

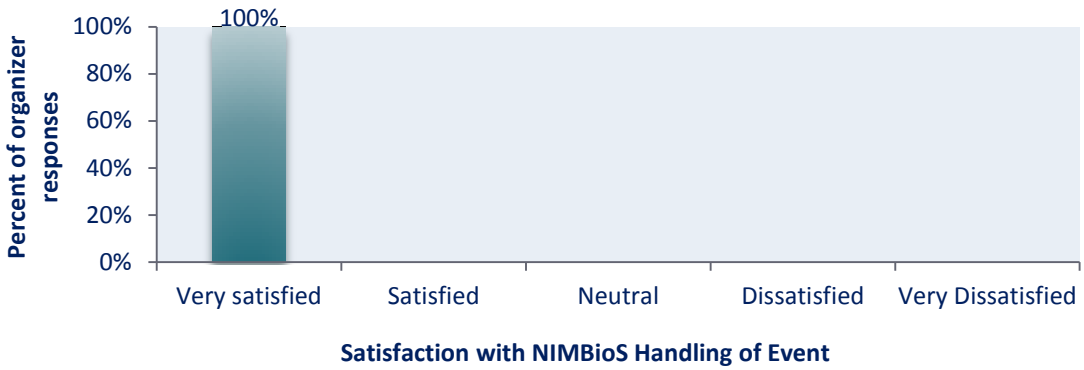


Figure 21. ***Overall satisfaction with the content and format of the Workshop***

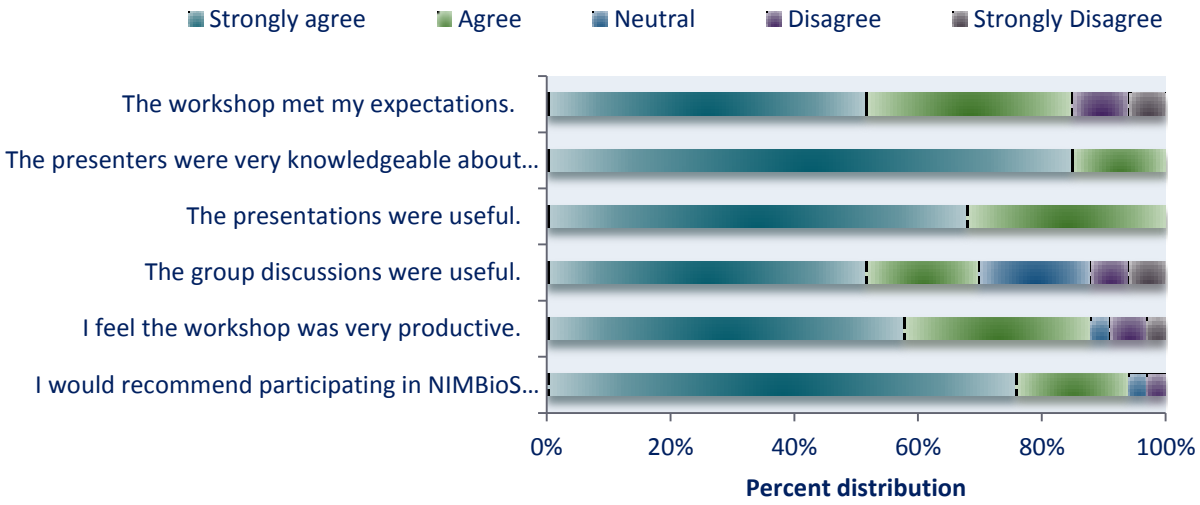


Figure 22. ***Participant responses to the following question-- As a result of participating in this Workshop, I have a better understanding of:***

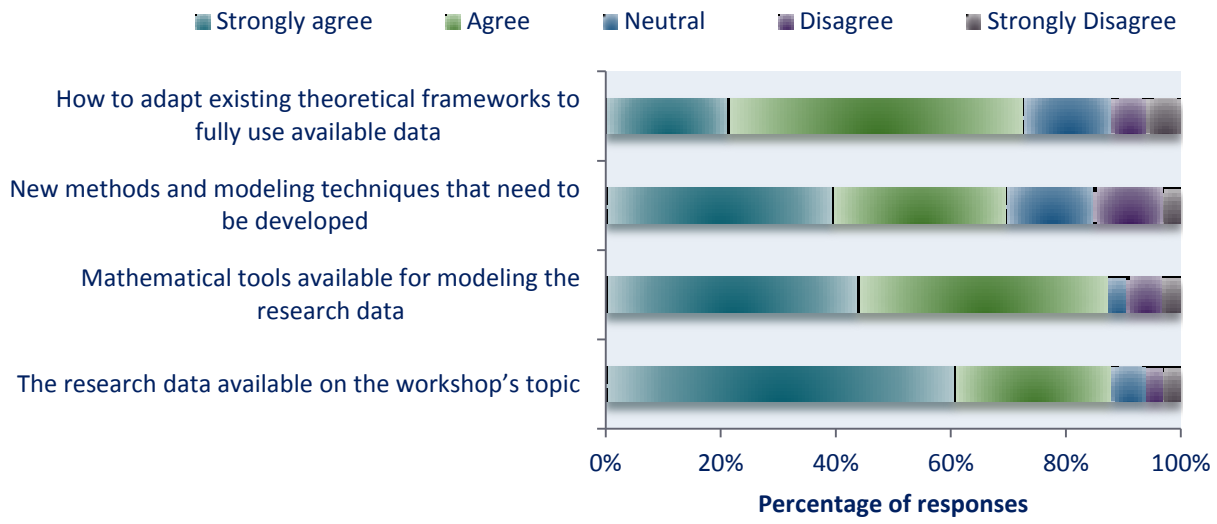
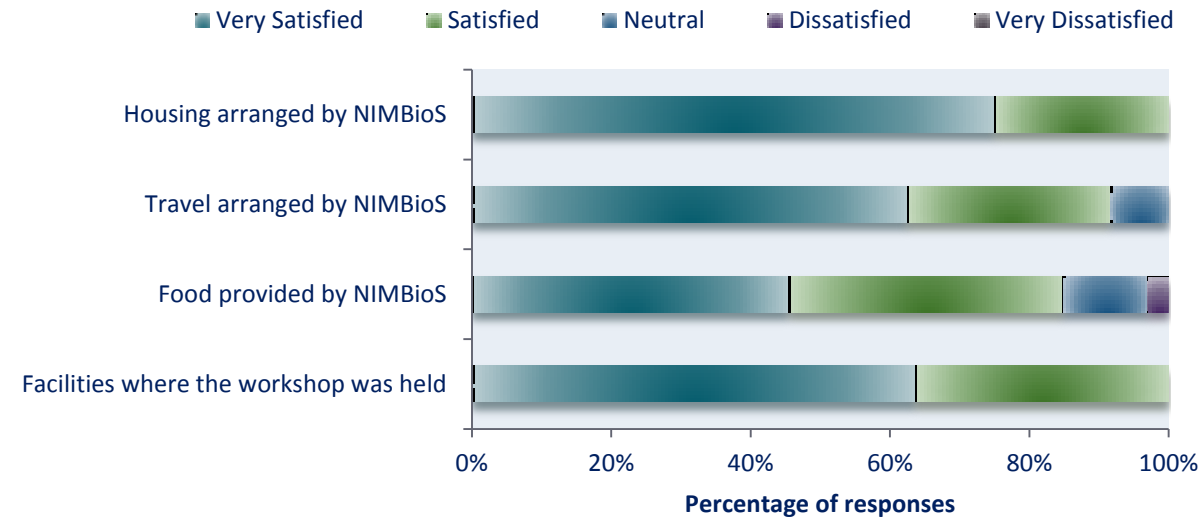


Figure 23. ***Satisfaction with Workshop accommodations***



Process Evaluation of Education and Outreach Program Activities

RESEARCH EXPERIENCES FOR UNDERGRADUATES STUDENTS

The NIMBioS *Research Experiences for Undergraduates* (REU) program took place on the University of Tennessee, Knoxville (UT) Knoxville campus June 11–August 3, 2012. Eighteen undergraduates were chosen to participate in the program. (While this REU program technically fell within the dates of reporting period four (RP 4), the REU program for 2013 will not conclude until after the RP 5 annual report is due, so results from the previous year's REU 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 2012 program included:

- Modeling the evolution of sexual imprinting,
- Modeling protein translation and genome evolution,
- Harnessing the arsenal of nature: Developing natural pesticides,
- Modeling Salmonella transmission in swine,
- Agent-based mathematical model for Johne's disease epidemiology and economy, and
- Modeling early evolution of human immunodeficiency virus.

Program organizers were Suzanne Lenhart (Dept. Mathematics/NIMBioS), and Kelly Sturner (NIMBioS). Mentors in the program included J.J. Chai (Mathematics, NIMBioS), Shigetoshi Eda (Wildlife Health), Heather Finotti (Mathematics), Vitaly Ganusov (Microbiology), Mike Gilchrist (Evolutionary Bioinformatics), Tucker Gilman (Biology, NIMBioS), Kimberly Gwinn (Plant Pathology), Andrew Kanarek (Biology, NIMBioS), Cristina Lanzas (Veterinary Medicine), Maud Lelu (NIMBioS), Suzanne Lenhart (Mathematics, NIMBioS), Calistus Ngonghala (Mathematics, NIMBioS), Tuoc Phan (Mathematics), Valdimir Protopopescu (Mathematics), and Dan Ryan (Mathematics, NIMBioS).

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.

SUMMARY OF REU EVALUATION RESPONSES

Figure 24. Overall satisfaction with the research experience

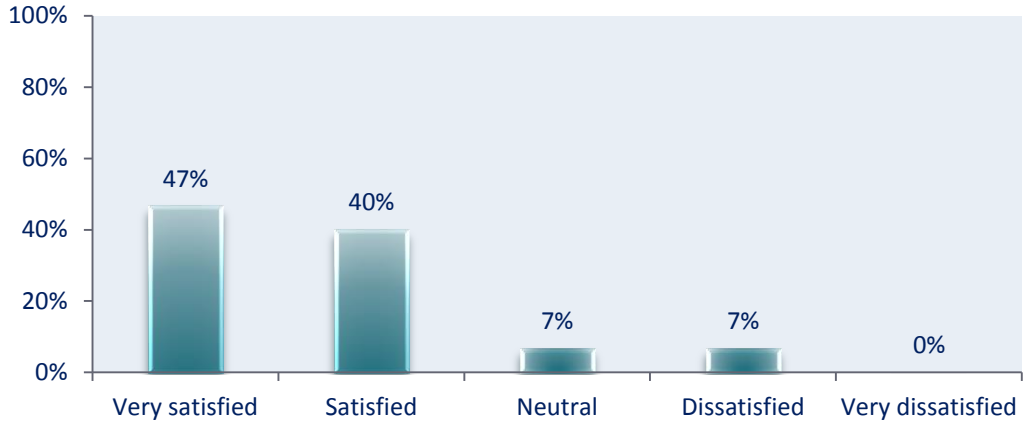


Figure 25. Participant pre-and post-program skills, response scale of -2 = extremely poor at the skill to 2 = excellent at the skill

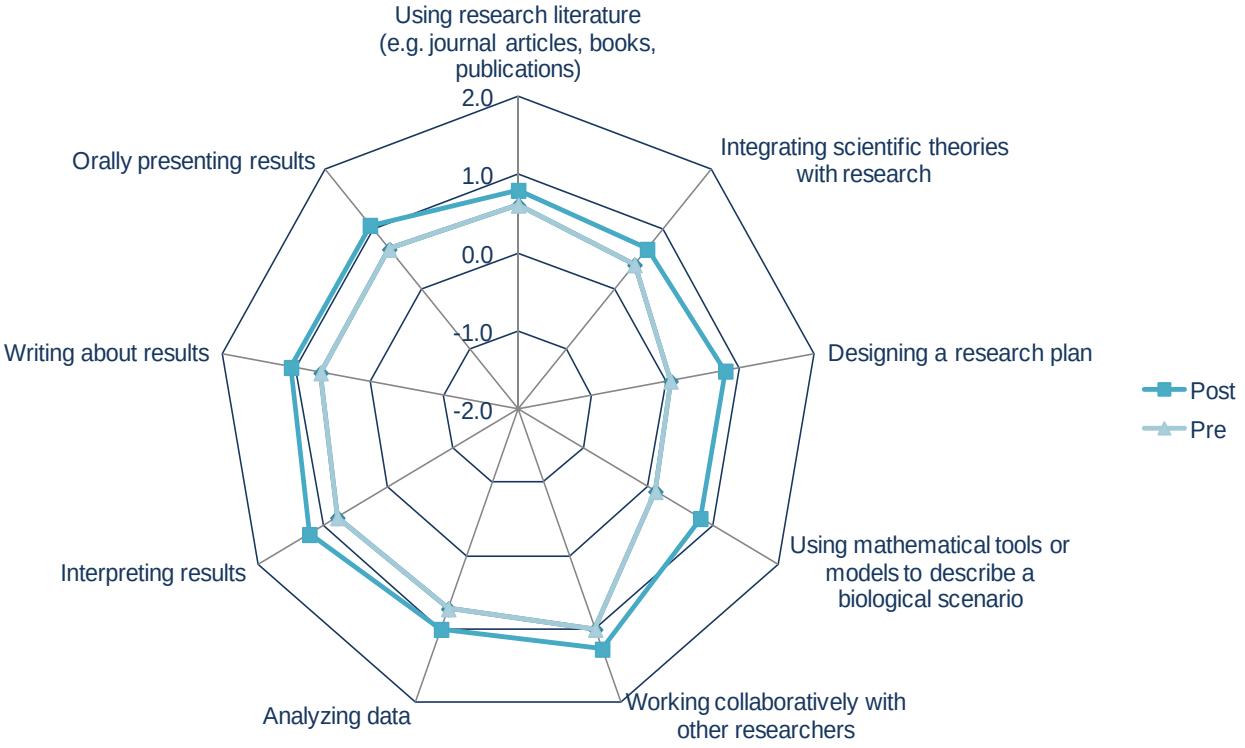
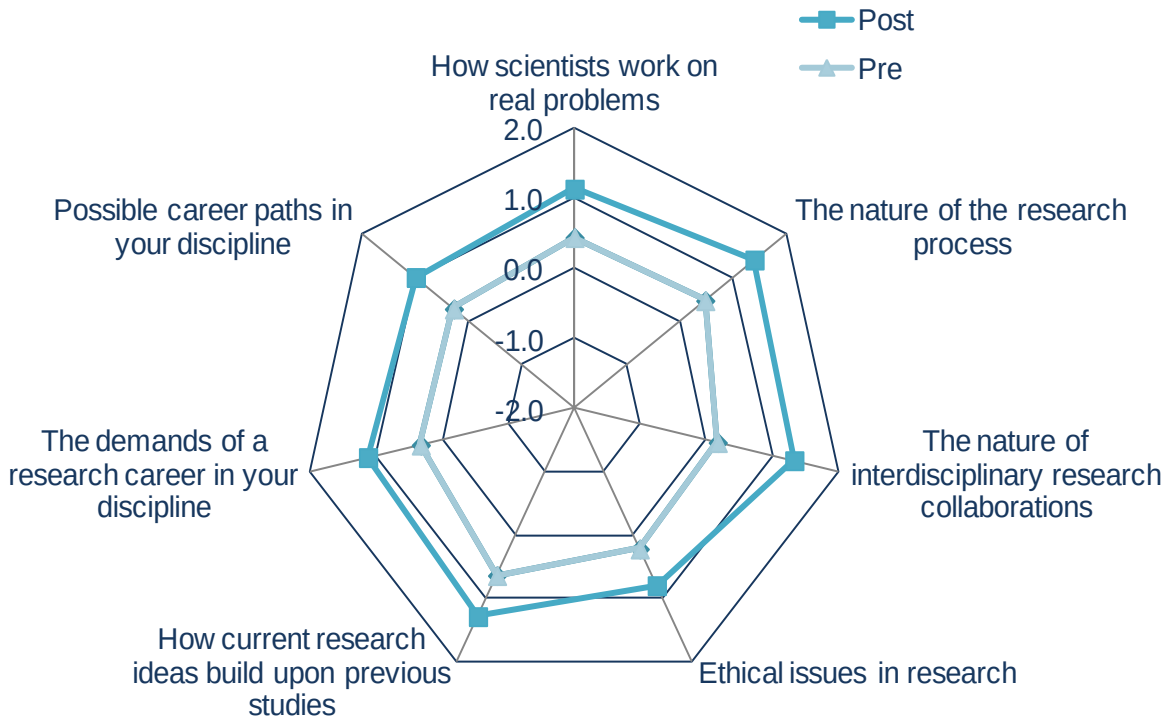


Figure 26. Participant pre- and post-program knowledge, response scale of -2 = extremely poor understanding to 2 = excellent understanding



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

The NIMBioS second 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 17-18, 2012. 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 Moran.

Nearly 115 participants from 45 institutions throughout the United States participated in the event. The fourth 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 NIMBioS affiliates and event organizers. A total of 76 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.

SUMMARY OF URC EVALUATION RESPONSES

Figure 27. ***Respondent agreement levels with statements about various aspects of the conference***

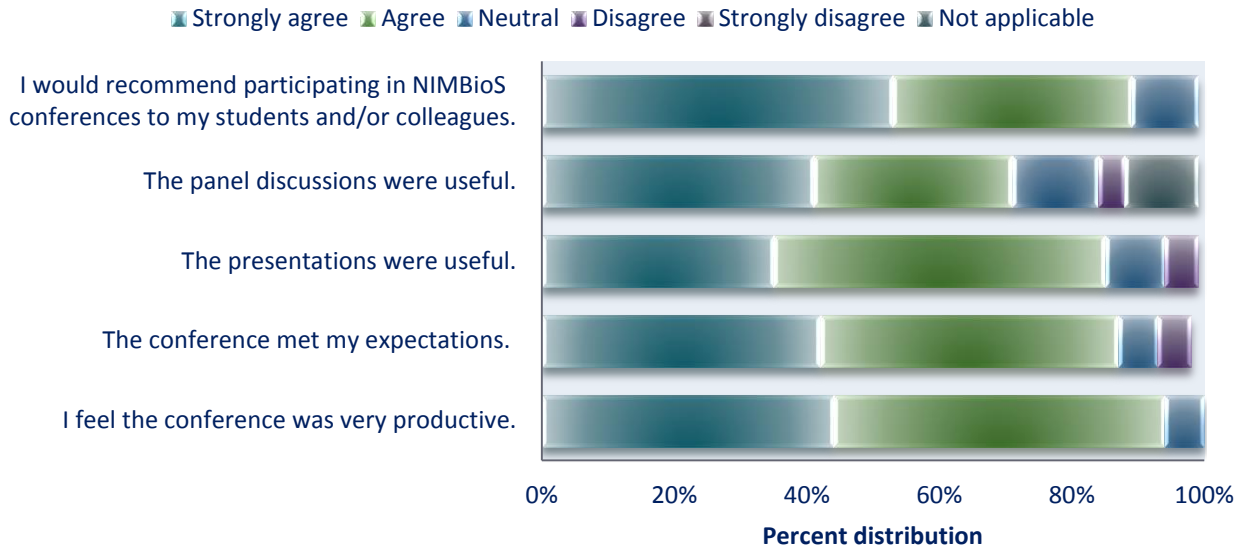
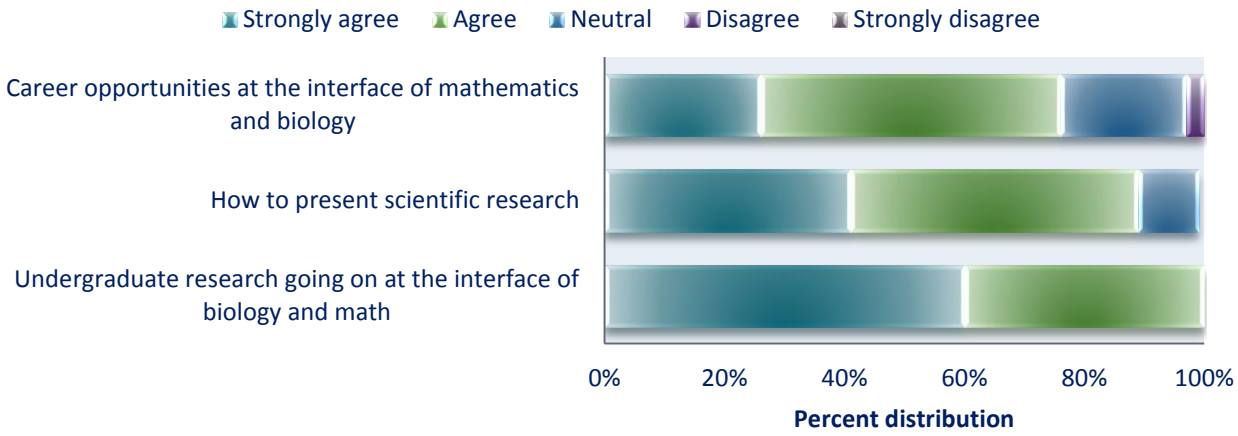


Figure 28. ***As a result of attending this conference, I have a better understanding of:***



NIMBIOS POSTDOCTORAL FELLOW EXIT SURVEY SUMMARY

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, all 11 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.

SUMMARY OF POSTDOCTORAL FELLOWSHIP PROGRAM RESPONSES

Figure 29. Postdoctoral fellow satisfaction with program mentors

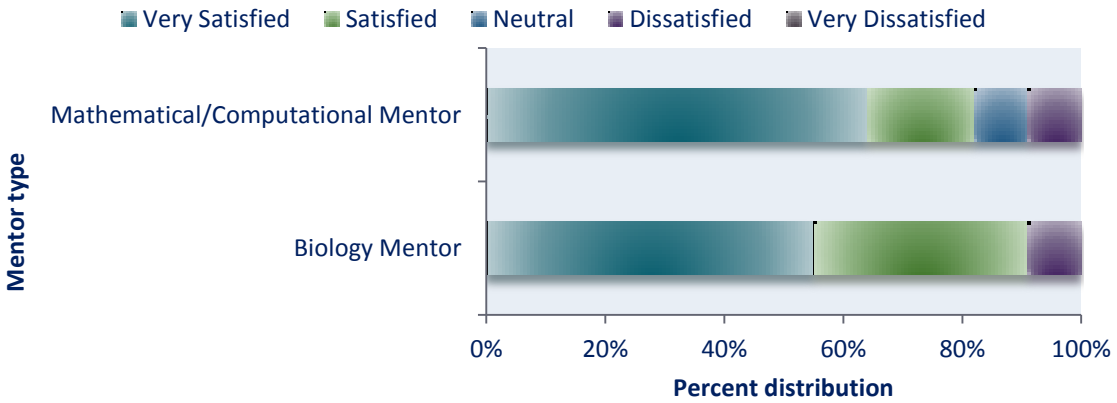


Figure 30. Postdoctoral fellow satisfaction with advice/assistance received from program mentors

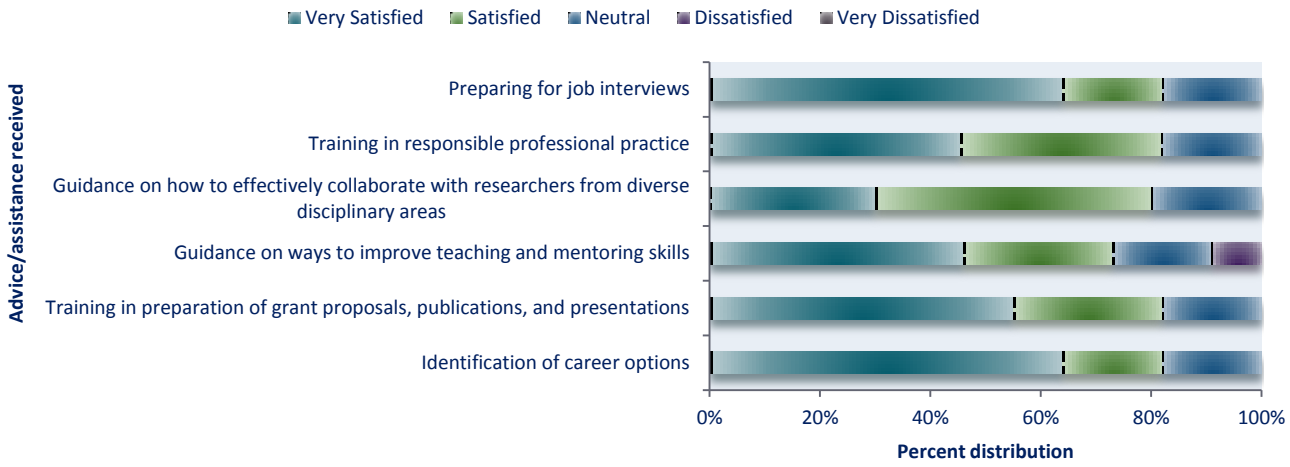
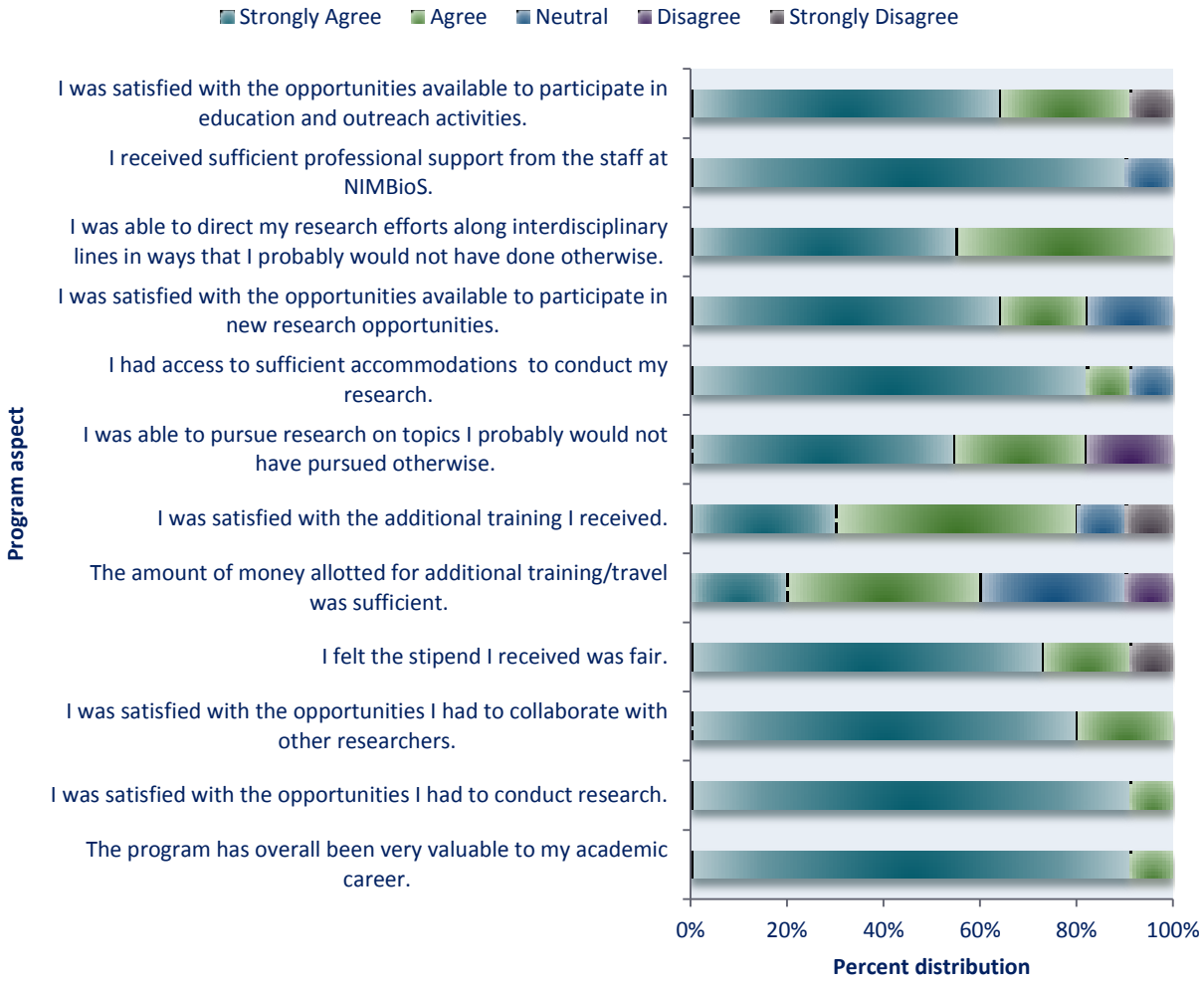


Figure 31. Postdoctoral fellow satisfaction with overall program experience



PRODUCT EVALUATION

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

CONTEXT

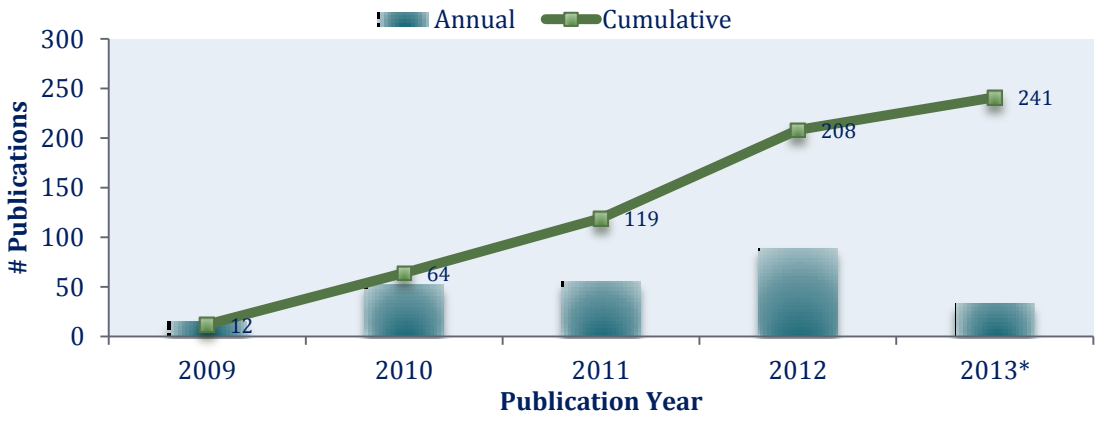
As it generally takes at least full years 5 years before a bibliometric study can show relevant citation data for a center such as ours, NIMBioS currently is not yet fully addressing goal 2. NIMBioS plans to fully address all goals for the entire center in the coming years as the data become available.

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 243 published journal articles from 2009-May 31, 2013 (Figure 32). An additional 17 articles are currently accepted for publication or in press, and 11 have been submitted for review. The articles cover research ranging across many areas of ecology, evolutionary biology, applied mathematics, and computational biology.

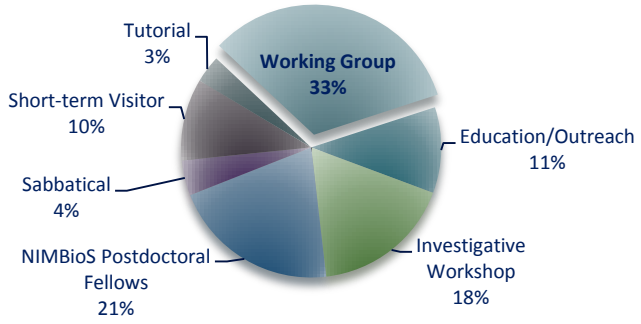
Figure 32. Number of publications reported from NIMBioS activities since 2009, by publication year



*2013 includes publications submitted by participants to NIMBioS through May 31, 2013

NIMBioS publications come from a variety of activities, although Working Group participants tend to publish the largest portion of journal articles (33%), followed by NIMBioS Postdoctoral Fellows (21%) (Figure 33).

Figure 33. Distribution of journal publications submitted to NIMBioS by participants



WEB OF SCIENCE DATA

Of the 243 journal articles reported by NIMBioS participants, 211 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 380 researchers from 265 unique institutions spanning 38 countries. These articles have appeared in 125 different publications, many of which are considered to have high-impact in the academic community (Table 4).

Table 4. Number of NIMBioS articles published in a selection of high-impact journals, sorted by journal 5-Year Impact Factor

Journal Title	5-Year Impact Factor	# of NIMBioS Publications in Year 5	# of NIMBioS Publications as of May 2013
Nature	38.159	1	2
Cell	34.366	1	1
Science	33.587	1	4
Ecology Letters	18.495	2	6
Trends in Ecology and Evolution	17.112	2	4
Systematic Biology	13.316	-	1
Proceedings of the National Academy of Sciences	10.583	3	9
PLoS Genetics	9.440	1	2
Nucleic Acids Research	8.055	-	2
Phil Trans of the Royal Soc B-Biological Sciences	7.298	1	2
Molecular Ecology	6.792	-	3
Ecology	6.372	2	4
PLoS Computational Biology	5.939	2	3
Proc of the Royal Soc B-Biological Sciences	5.832	3	5
Evolution	5.402	2	7
The American Naturalist	5.332	3	7
Journal of Animal Ecology	5.166	-	2
PLoS One	4.244	6	12
Animal Behaviour	3.405	3	5

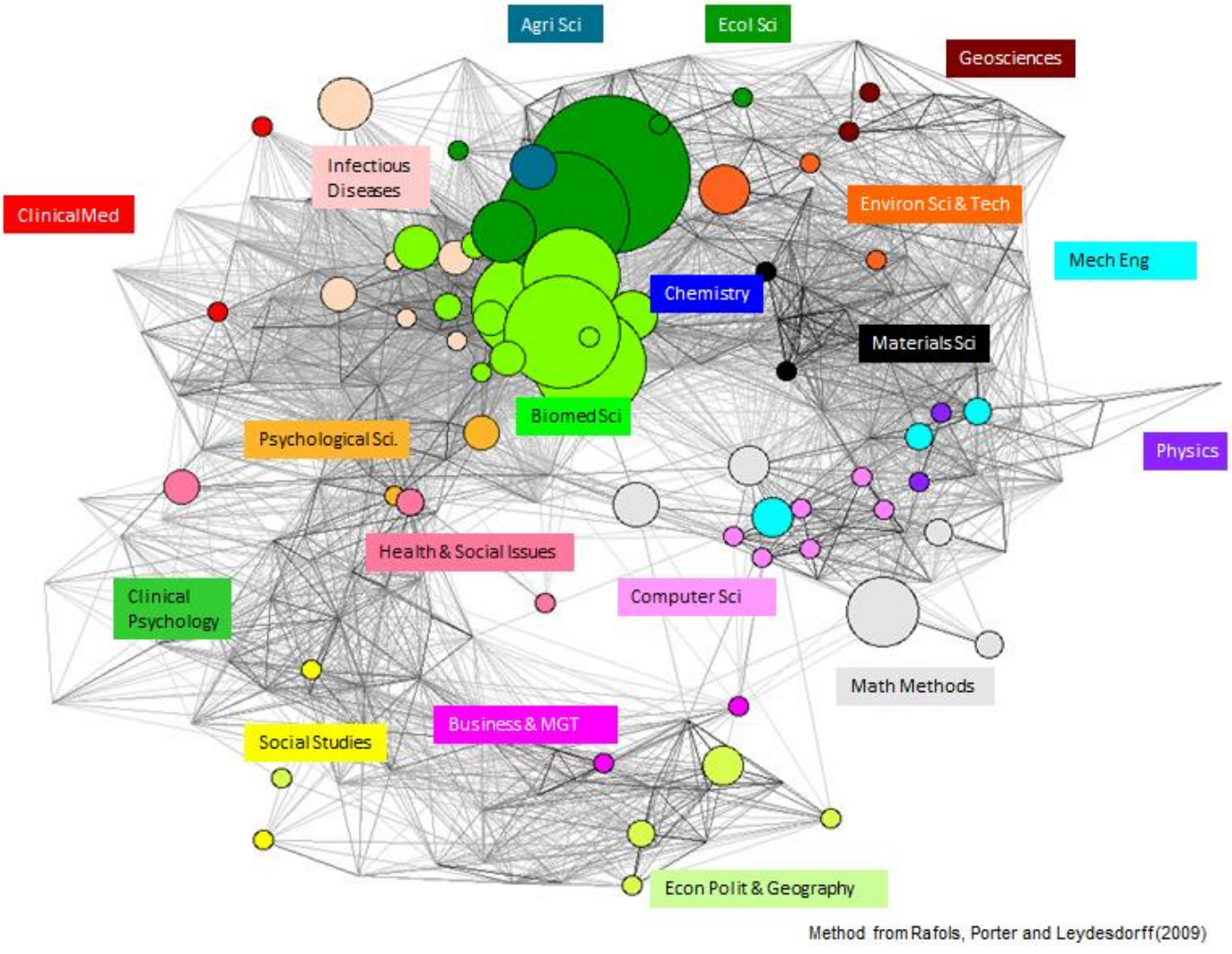
* The journal impact factor is a measure of the frequency with which the "average article" in a journal has been cited in a particular year. The impact factor is an indicator of a journal's relative importance, especially as compared to other journals in the same field. Impact factor calculation: cites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

DISCIPLINARY SPAN OF PUBLICATIONS

The 211 published articles span 69 discipline areas, as designated by the ISI WOS Subject Categories. Subject 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.

The most common subject category in which NIMBioS publications fell was Ecology (62), followed by Evolutionary Biology (41), Multidisciplinary Sciences (31), Biology (30), Mathematical & Computational Biology (30), and Genetics & Heredity (23). Figure 34 locates the subject categories of the 221 NIMBioS articles on a network map of the WOS Subject Categories. The gray background intersections are the 224 WOS Subject 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.

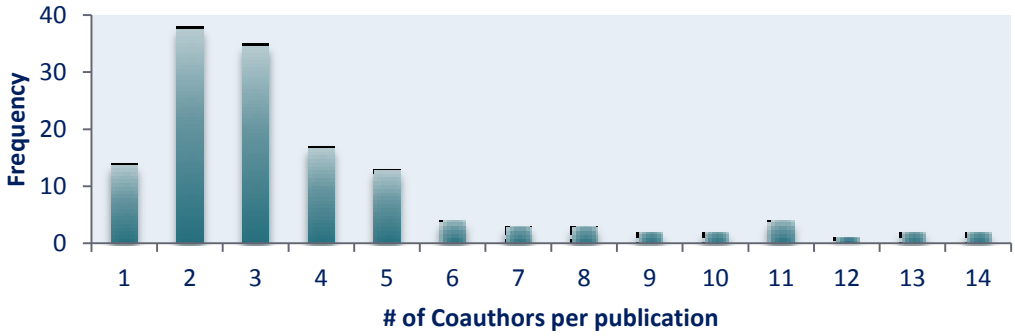
Figure 34. Web of Science Subject Categories for 221 WoS journal articles to date



COLLABORATION

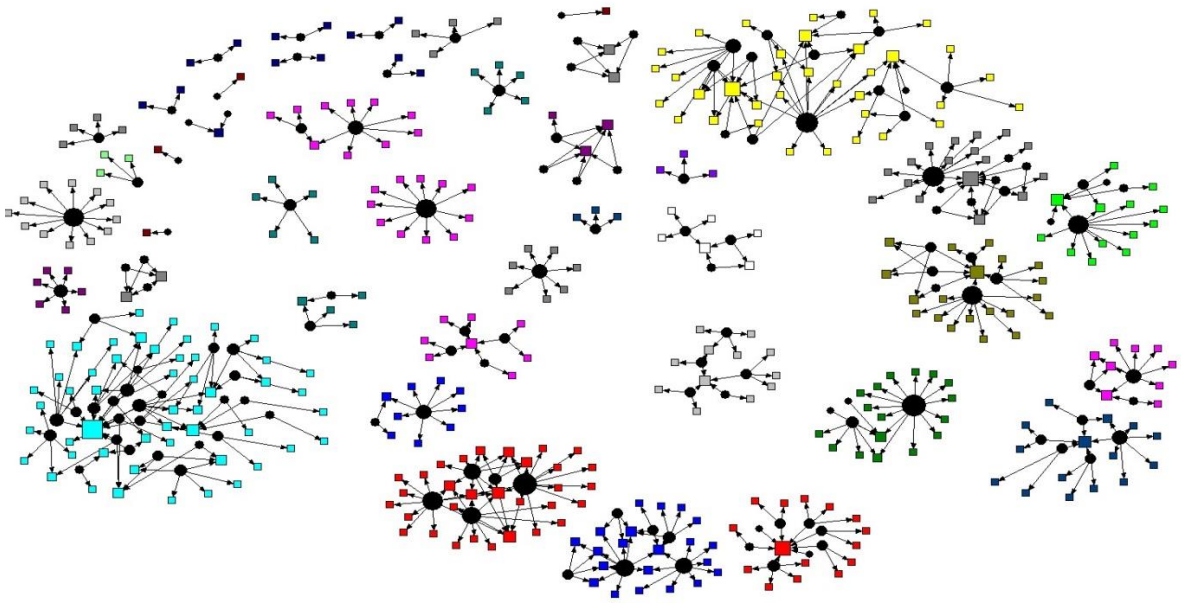
One of the core values of NIMBioS is to take a collaborative approach to science and science education. We are interested, therefore, in examining the number of co-authors on NIMBioS-related publications as one indicator of scientific collaboration. For the 211 publications reported thus far, the average number of co-authors per paper is 3.9 (Figure 35).

Figure 35. Coauthorship of NIMBioS publications



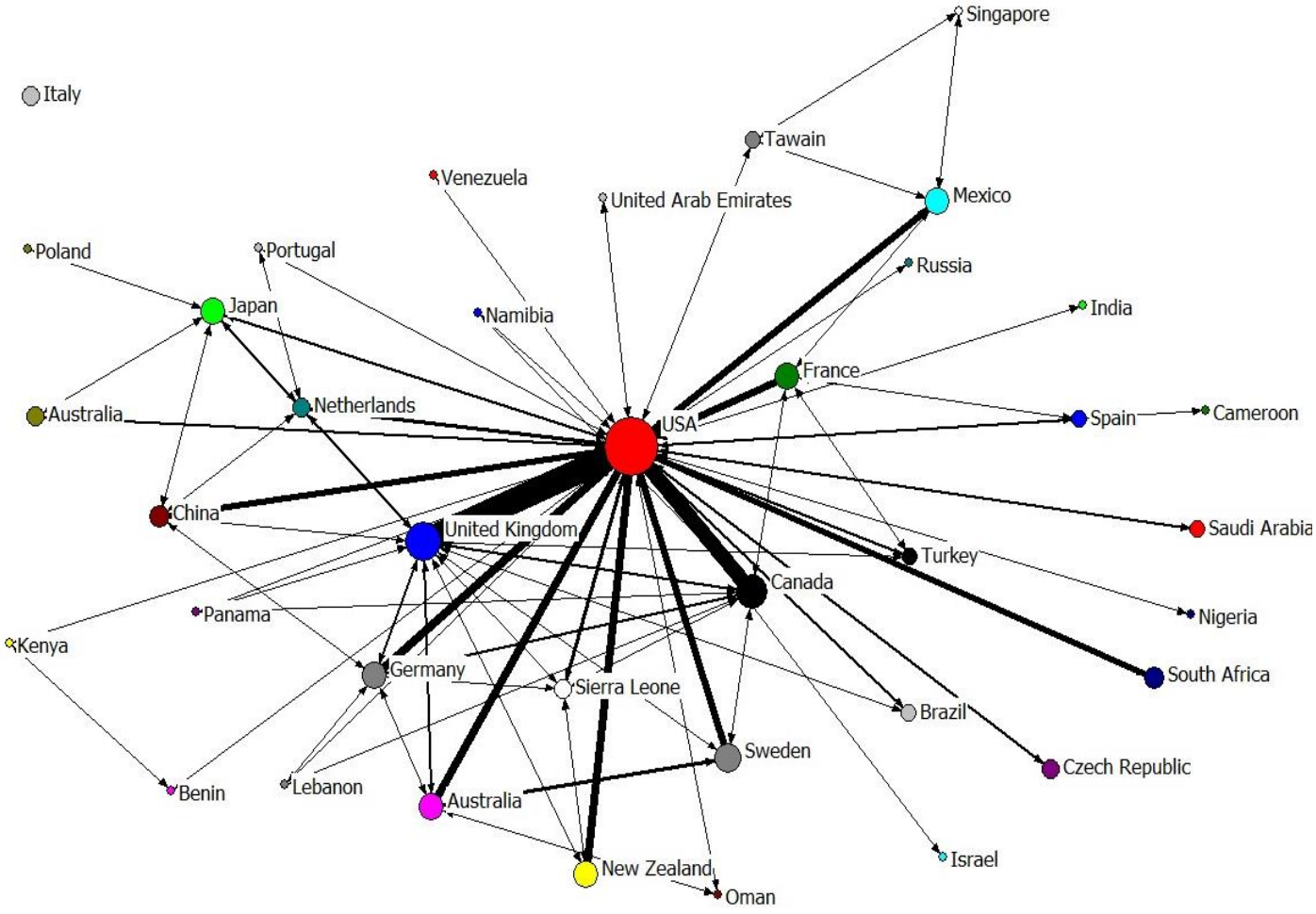
Analysis of the authorship network of NIMBioS journal articles for all events revealed 42 distinct "collaborative components" among products, each having between 1 and 52 coauthors involved. In the network graph below (Figure 36), coauthors are colored by main component. Black circles represent papers and colored squares represent coauthors of papers. Nodes are sized by numbers of ties within the graph (i.e. publications with more coauthors are larger and authors with more publications are larger). Coauthors may or may not be NIMBioS participants. Network analysis reveals key producers within the body of NIMBioS work as well. Three participants have authored eight or more papers, while nine have authored between five and seven. Future planned network analyses of NIMBioS products will examine the participant status of authors, and also the event from which each publication has arisen to examine cross-collaboration among events.

Figure 36. Participant paper collaboration network



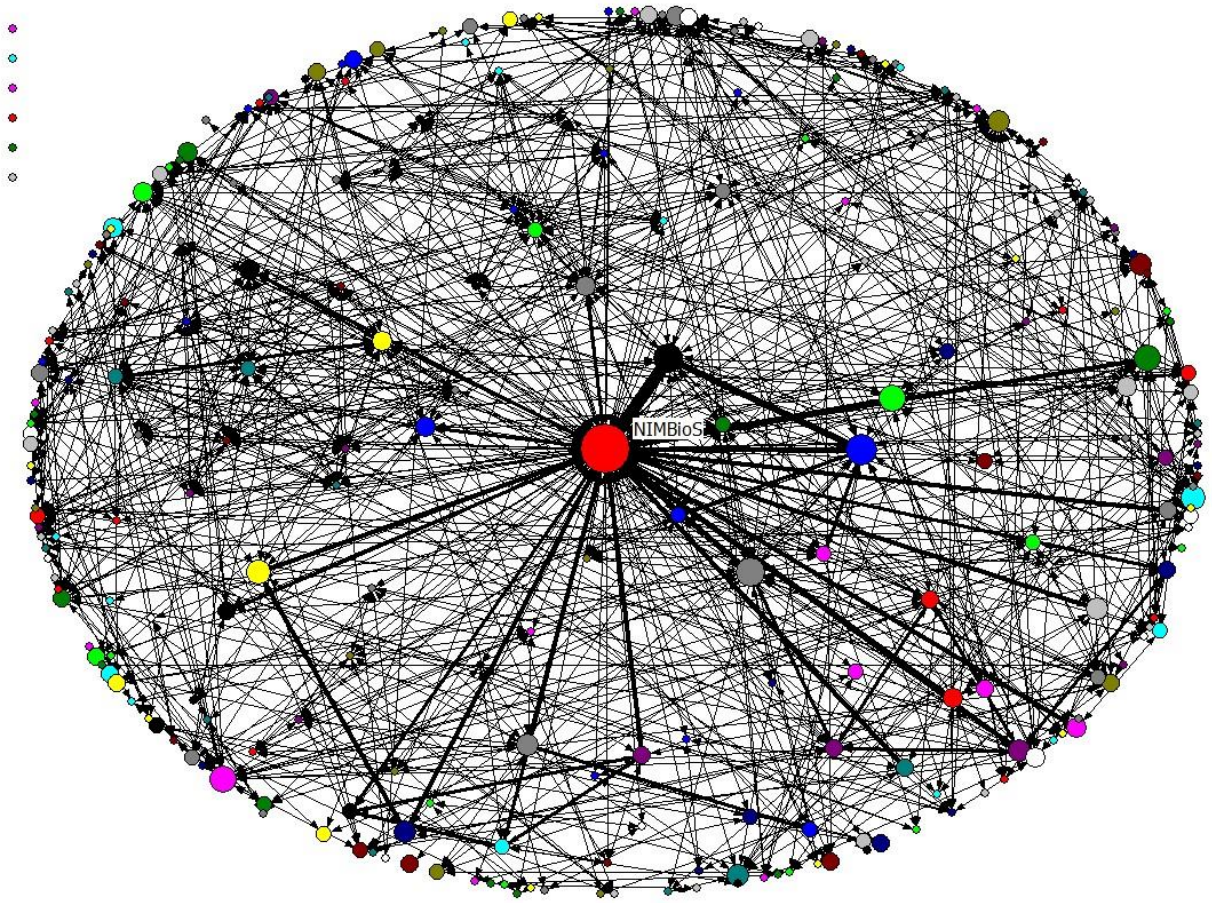
NIMBioS also fosters international collaboration among researchers. While 38 different countries have been represented by NIMBioS coauthorship through the current reporting period, the average number of countries of coauthors per paper is 1.7, with a range of 1-11 countries represented per paper. In Figure 37, 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 37. International collaboration of NIMBioS publications



Coauthors of NIMBioS publications through the current reporting period came from 265 unique institutions. The average number of institutions represented per paper was 2.70, with a range of 1-14 institutions per paper (Figure 38). In Figure 38, 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. NIMBioS is at the center of the graph.

Figure 38. 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 39 summarizes these types of products for the five-year period.

Figure 39. Non-journal publication products arising from NIMBioS events