NIMBioS Evaluation Report
Reporting Period Four
September 1, 2011-March 31, 2012

National Institute for Mathematical and Biological Synthesis
March, 2012

Contents

NIMBioS Evaluation Report, Reporting Period Four

Introduction

This is an evaluation summary of NIMBioS activities during the fourth annual reporting period (RP 4) to the National Science Foundation. This report covers the period of September 1, 2011-March 31, 2012. 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
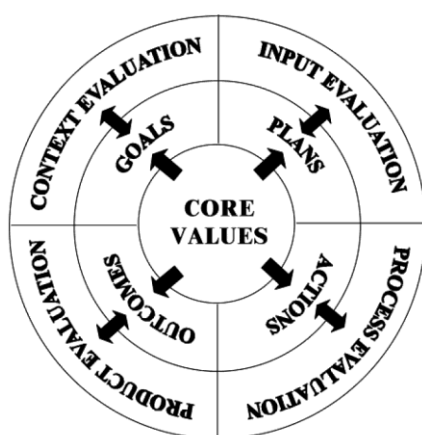
For all parts of the system, the NIMBioS evaluation process is grounded in its core values of (1) taking a collaborative approach to science and science education, and (2) increasing the diversity of researchers and educators at the interface of mathematics and biology.

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 funded requests for support. At this phase, several goals comprise the context for the input evaluation:

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[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.

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

Process

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

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

Products

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

1. NIMBioS publications will be highly interdisciplinary.
2. NIMBioS publications will be highly cited.
3. NIMBioS publications will 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 funded requests for support.

Context

1. NIMBioS participants will represent diverse gender, racial, ethnic, institutional, career, disciplinary, and geographic backgrounds.
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4. NIMBioS will support Working Group and Investigative Workshop requests from a range of discipline areas.

Summary of Activities

Research program activities during RP 4 included:
- 9 Working Group meetings
- 4 Investigative Workshops
- 21 Short-term visitors
- 9 Postdoctoral Fellows
- 2 Sabbatical Fellows
- 5 Graduate Research Assistantships

Education and Outreach program activities during RP 4 included (see Annual Report for more details on these events):
- A NIMBioS Seminar Series
- Research Experiences for Undergraduates/Veterinary Students Program
- Undergraduate Research Conference at the Interface of Biology and Mathematics
- Teacher Collaboration Program

Other events included:
- 2 Advisory Board Meetings

Diversity of Research Activities

NIMBioS is interested in supporting research activities from diverse subject areas. Working Groups and Investigative Workshops are categorized into major research subject areas by NIMBioS leadership to ensure that a broad range of these types of events are supported. Figure 2 shows the diversity of subject areas associated with NIMBioS Working Groups and Investigative Workshops during RP 4 (each supported event may have up to three subject areas).

Figure 2. Diversity of Subject Areas of Working Groups and Investigative Workshops, RP 4
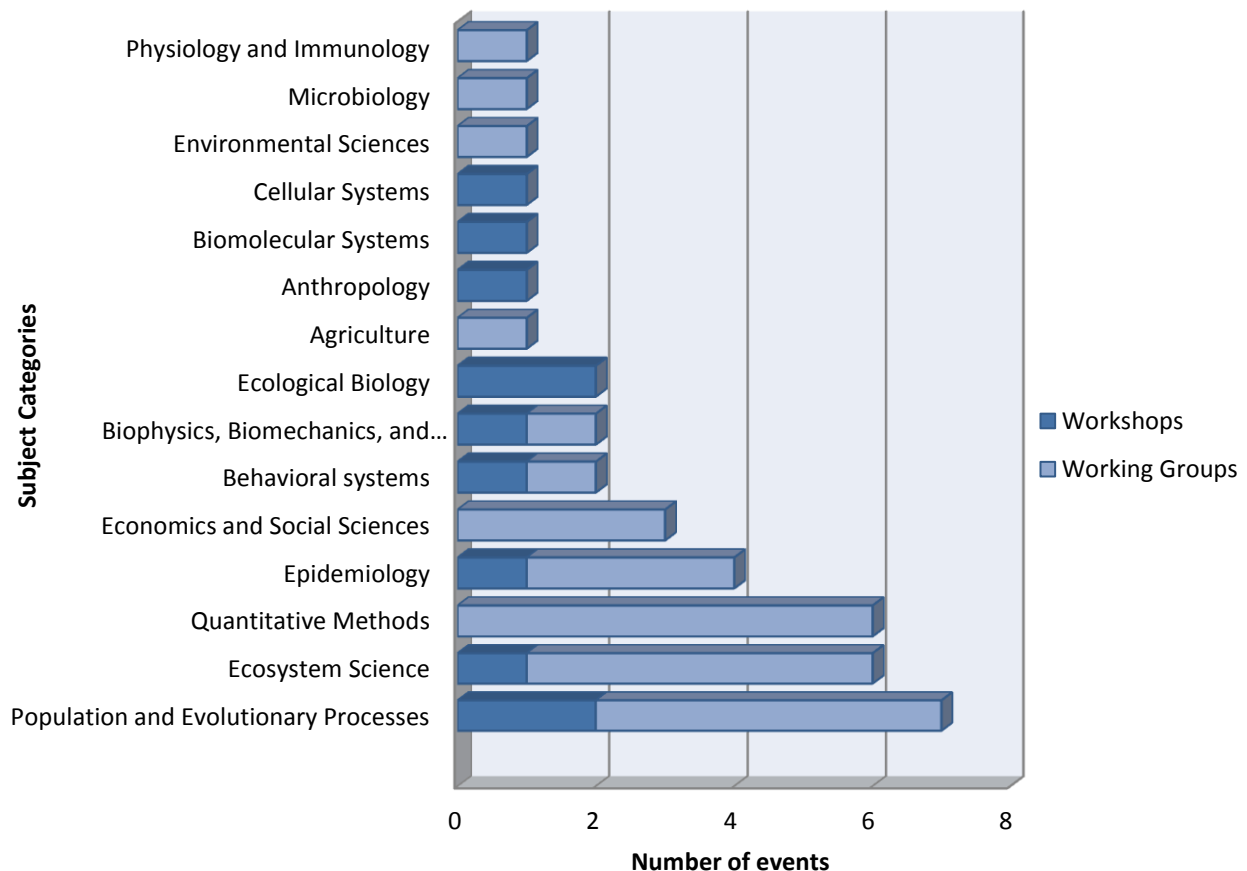
Diversity of Participants

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 in an attempt to ensure representation of all demographic categories at NIMBioS events. 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 4 was 90%. 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 4, a total of 474 participants (407 different individuals) from 23 countries participated in NIMBioS events.   Most participants came from the United States (87%), the United Kingdom (3%), and Canada (2%) (Figure 3).

Figure 3. NIMBioS RP 4 Participants by Country
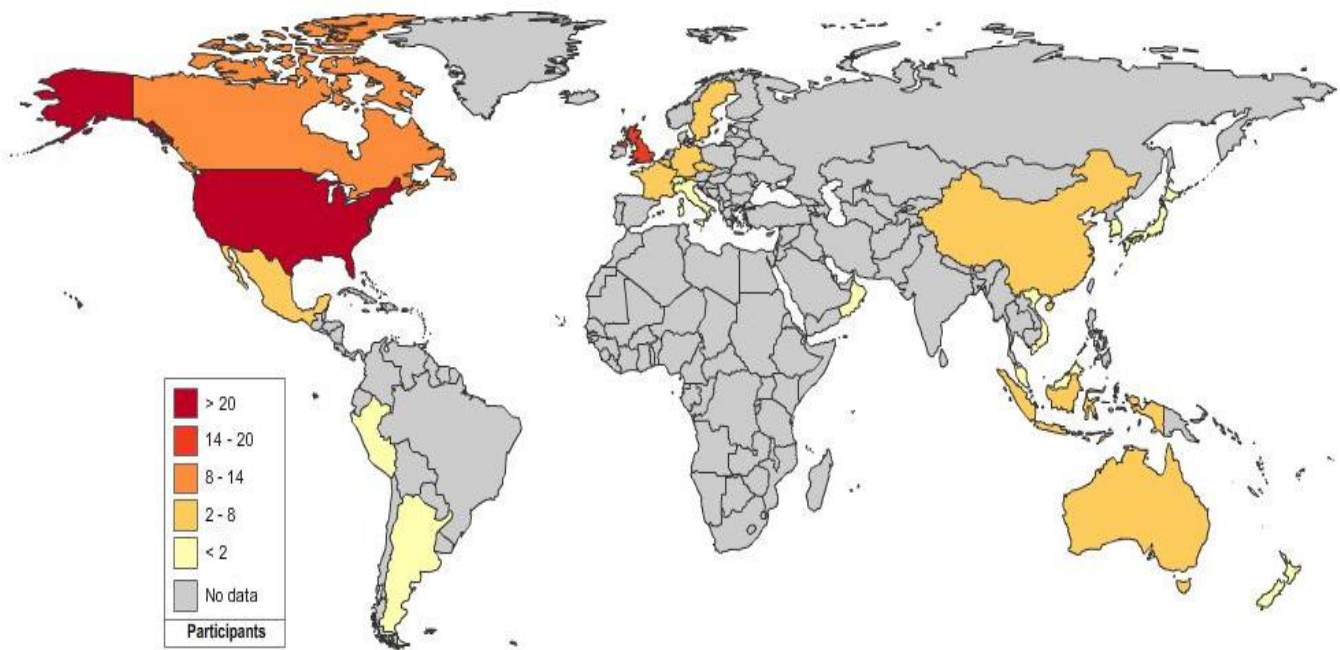
Within the U.S., 39 different states were represented, as well as the District of Columbia and Puerto Rico. While many participants came from within Tennessee (31%), several other states were represented by a relatively large percentage of the total participant pool, including California (10%), Wisconsin (5%), and New York (4%) (Figure 4).

Figure 4. NIMBioS RP 4 Participants by U.S. State*
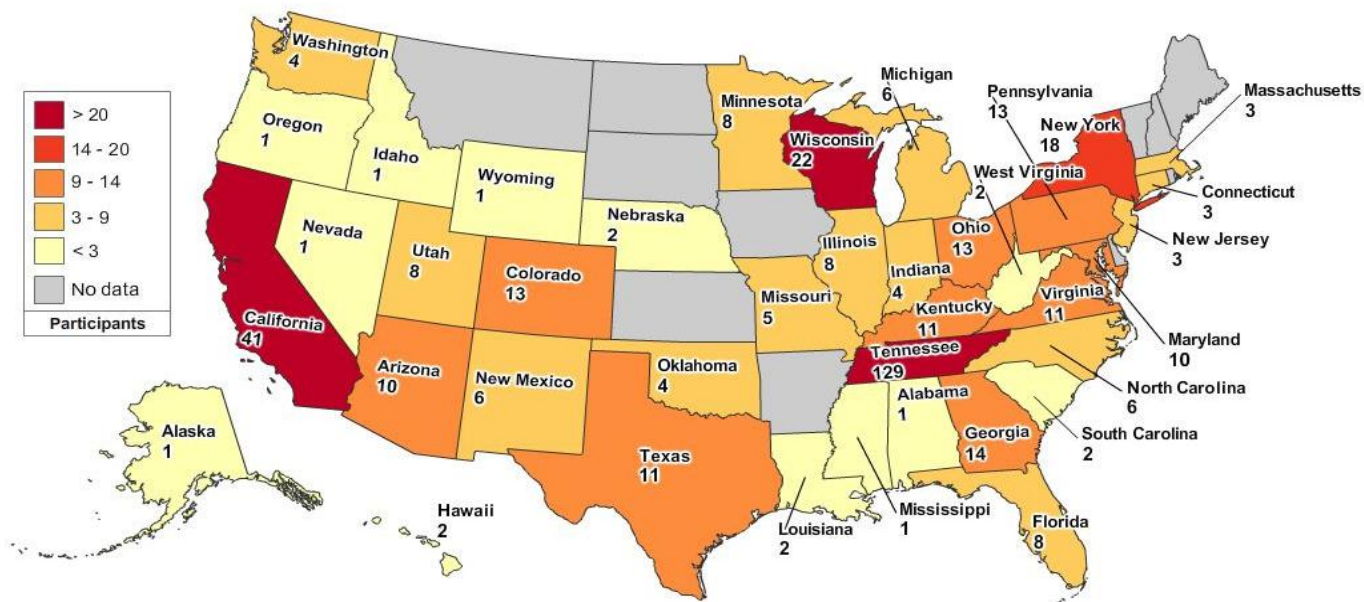
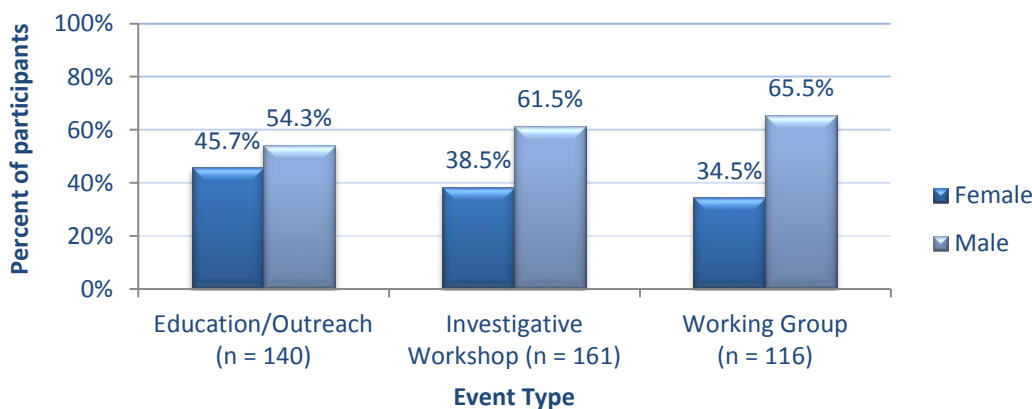***Not shown, District of Columbia (3), Puerto Rico (1)**

Gender, Racial, and Ethnic Diversity

Across all events during RP 4, the gender ratio was 61% male to 39% female. Within specific activity types, this gender ratio varied slightly, with the greatest gender equity seen in Education and Outreach activities (Figure 5).

Figure 5. Gender composition of participants by event type

Of the 407 participants who opted to report their ethnicity status, 6.3% indicated they were Hispanic/Latino. Of the 413 who reported their racial status, the majority (66.2%) indicated they were white; however, Asian, black or African American, native Hawaiian/Pacific islander, and Native American races were also represented (Figure 6).

Figure 6. Ethnic and racial status of participants (n = 474)
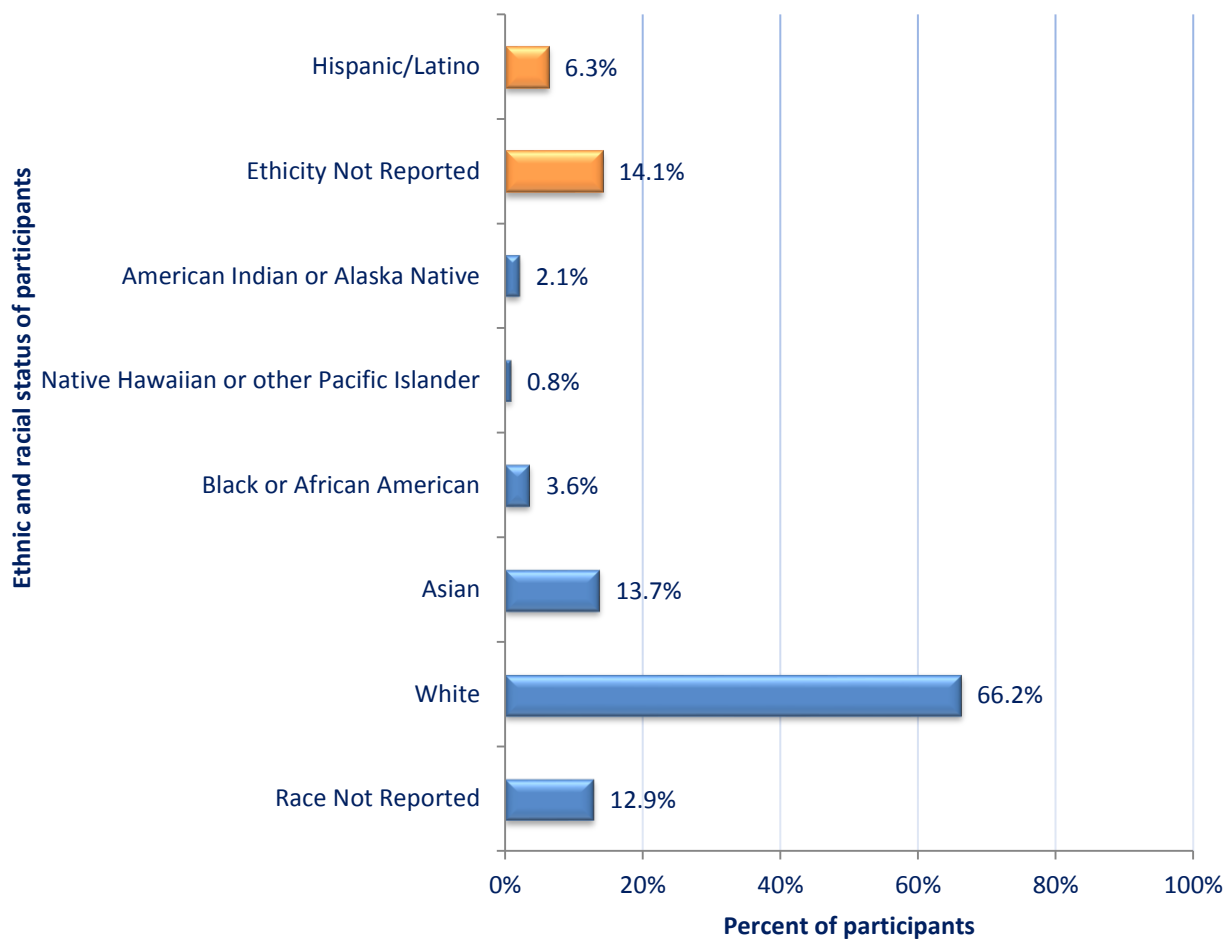
By event, Investigative Workshops showed the greatest percentage of Hispanic/Latino participants (7.5%), followed by Education and Outreach (5.7%). Among the different event types, participants self-identifying racially as white were always in the majority, followed by Asian and black or African American (Figure 7).

Figure 7. Ethnic and racial status of participants, by event type
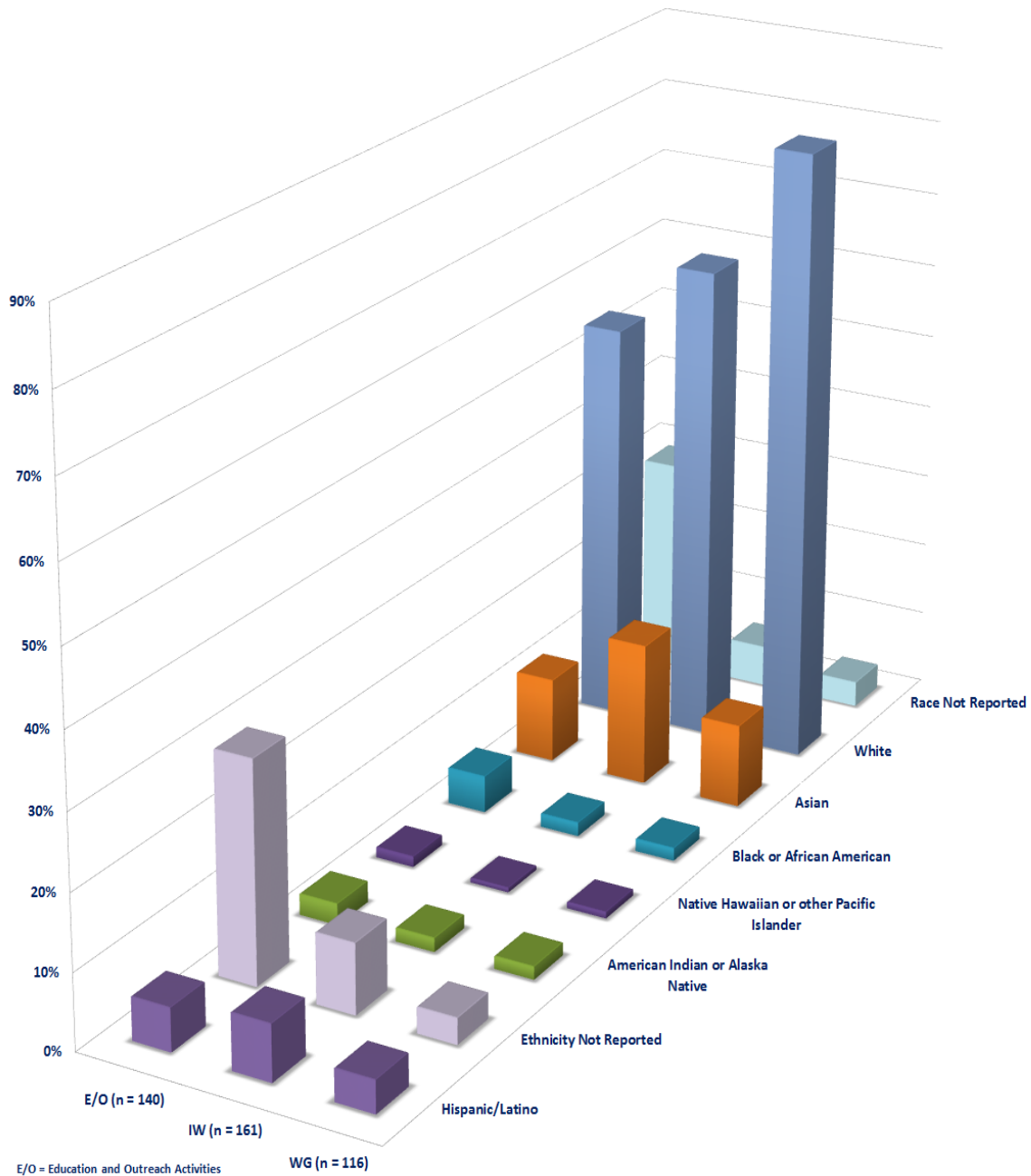
E/O = Education and Outreach Activities
IW = Investigative Workshops
WG = Working Groups

	E/O (n = 140)	IW (n = 161)	WG (n = 116)
Hispanic/Latino	5.7%	7.5%	4.3%
Ethnicity Not Reported	29.3%	9.3%	3.4%
American Indian or Alaska Native	2.9%	1.9%	1.7%
Native Hawaiian or other Pacific Islander	1.4%	0.6%	0.9%
Black or African American	5.0%	1.9%	1.7%
Asian	11.4%	19.3%	11.2%
White	54.3%	64.6%	82.8%
Race Not Reported	29.3%	5.6%	3.4%

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): Comparably 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 outreach and education activities in addition to working groups and workshops) by year

|		Year 1*	Year 2	Year 3	Year 4*	Overall
Participant diversity						
Gender	(Benchmark: approximately 30% female)					
	Working groups	19%	22%	27%	34%	25%
	Workshops	40%	40%	38%	39%	39%
	All events	37%	42%	38%	39%	39%
International	(Benchmark: approximately 10% outside USA)					
	Working groups	20%	19%	19%	18%	19%
	Workshops	10%	22%	21%	17%	17%
	All events	7%	12%	14%	13%	11%
URG	(Benchmark: increase proportion approximately 10% per year)					
	Working groups	9%	10%	7%	6%	8%
	Workshops	7%	10%	14%	11%	10%
	All events	9%	11%	11%	11%	11%
Local	(Benchmark: No more than 15% from UT/ORNL)					
	Working groups	14%	15%	16%	22%	17%
	Workshops	22%	23%	10%	7%	16%
	All events	35%	20%	16%	18%	22%
Organizer diversity						
Gender	(Benchmark: approximately 30% female)					
	Working groups	11%	13%	16%	30%	17%
	Workshops	25%	29%	38%	33%	31%
	All events	23%	28%	27%	34%	28%
Local	(Benchmark: No more than 25% UT Faculty/Staff)					
	Working groups	28%	22%	20%	30%	25%
	Workshops	75%	36%	12%	25%	37%
	All events	57%	42%	33%	32%	41%

*Year 1 includes activities from March-August 2009

**Year 4 includes activities from September 1, 2011-March 31, 2012.

Disability Status

Of the 410 participants indicating disability status, 3% indicated having some sort of visual impairment, while nearly 1% indicated having a hearing or mobility impairment (Figure 8).

Figure 8. Disability status of participants (n = 474)
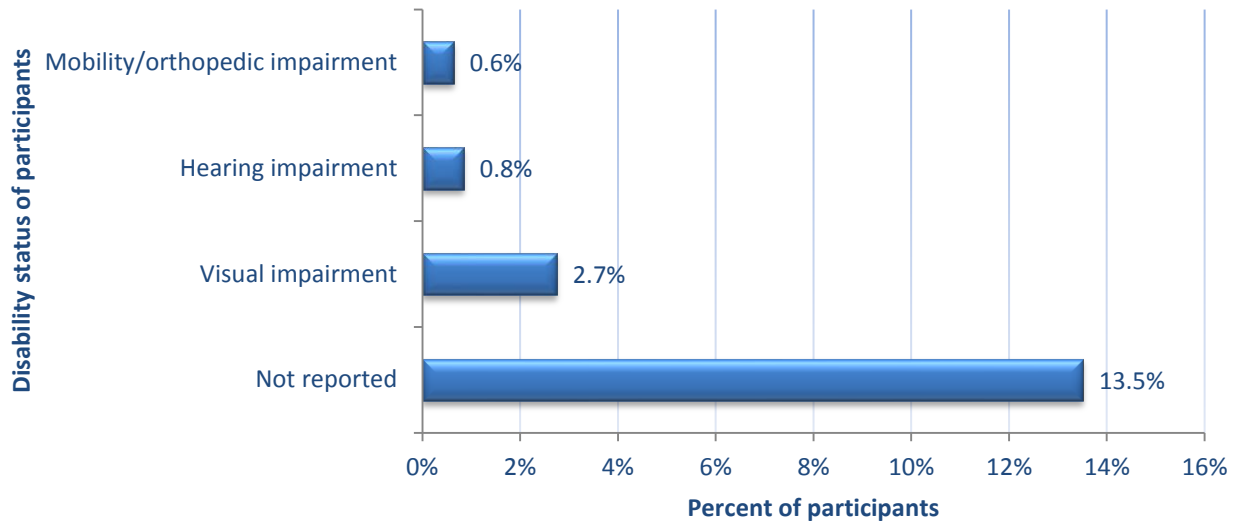
Institutional and Disciplinary Diversity

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

Figure 9. Employment status of participants (n = 474)
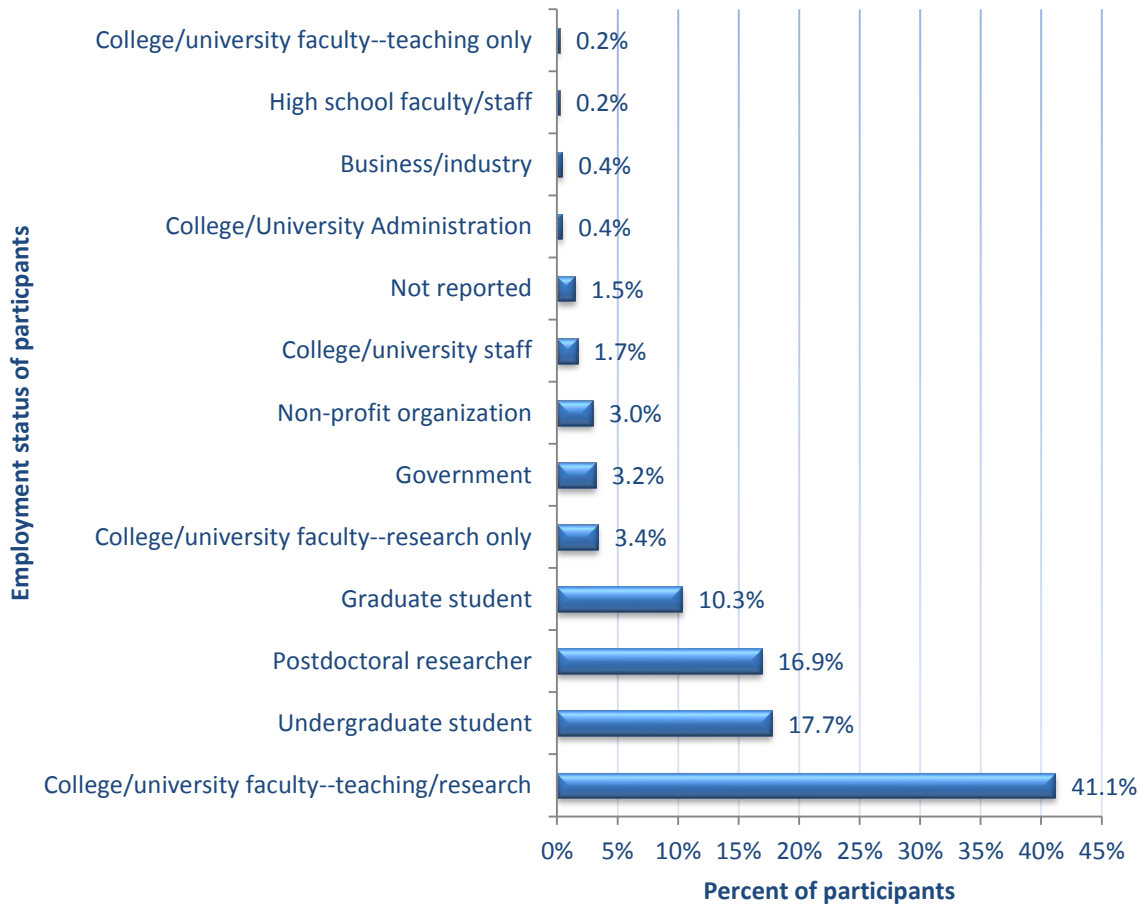
Participants at NIMBioS indicated primary, secondary, and tertiary fields of study, as well as areas of concentration within those fields.   The most commonly reported fields of study included biological/biomedical sciences, mathematics, and social sciences, although many other disciplines were represented (Figure 10).

Figure 10. Primary, secondary, and tertiary discipline areas of participants
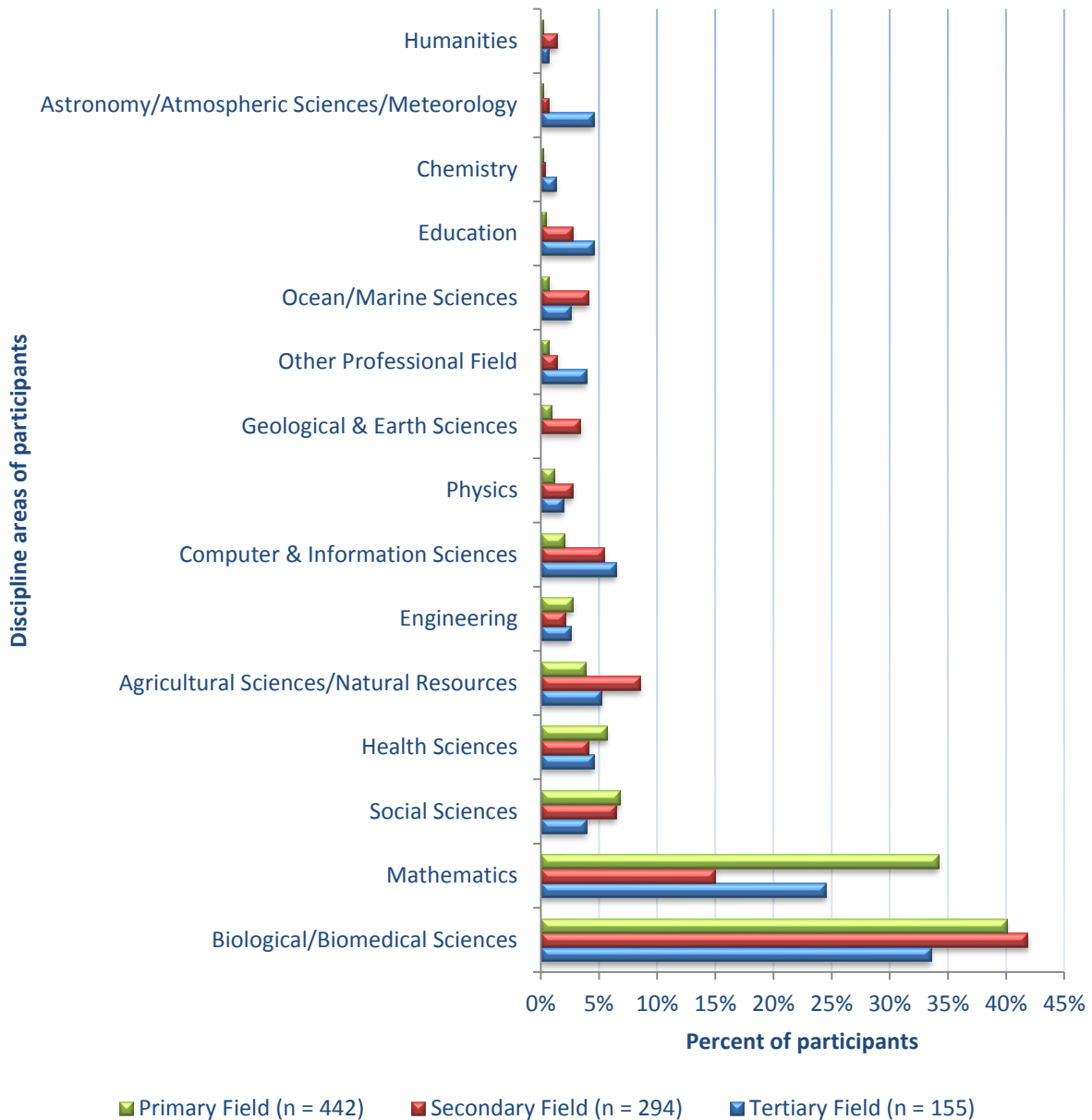
The 177 participants naming Biological/Biomedical Sciences as their primary field of study indicated 22 different areas of concentration within which they would classify their primary areas of research/expertise. The most commonly indicated area of concentration was ecology (25%), followed by evolutionary biology (21%) and mathematical biology (14%) (Figure 11).

Figure 11. Participant research/expertise area concentrations within biological/biomedical sciences field of study (n = 177)
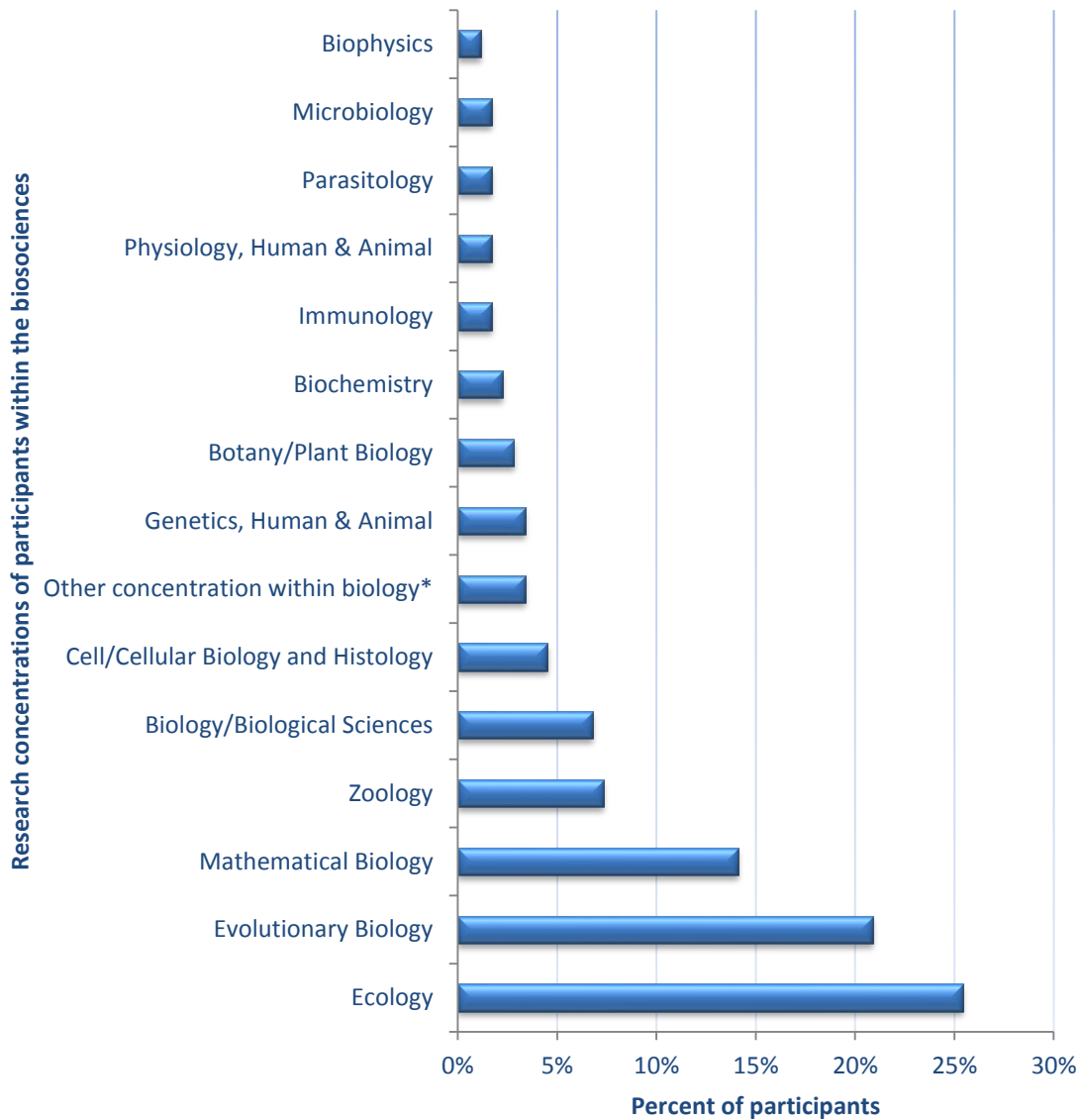
* Other concentrations having only one participant: Molecular biology, Plant physiology, Biotechnology, Neuroscience, Entomology, and Anatomy

Participants during RP 4 represented 202 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 = 202)

Federal
Government
3.6%

High school (9-12)
0.2%

Non-profit
3.9%

State Government
0.2%

Business/industry
1.5%

College/university
90.6%

Figure 13. Characteristics of participants' colleges/universities

College/university characteristic

Women's only — 0.5%

4-year only — 4.0%

Minority serving (U.S. Only) — 4.6%
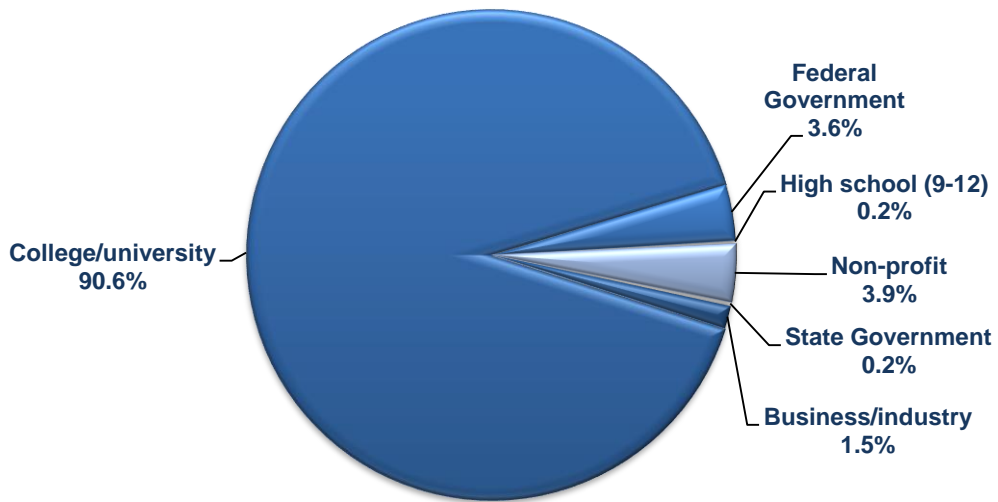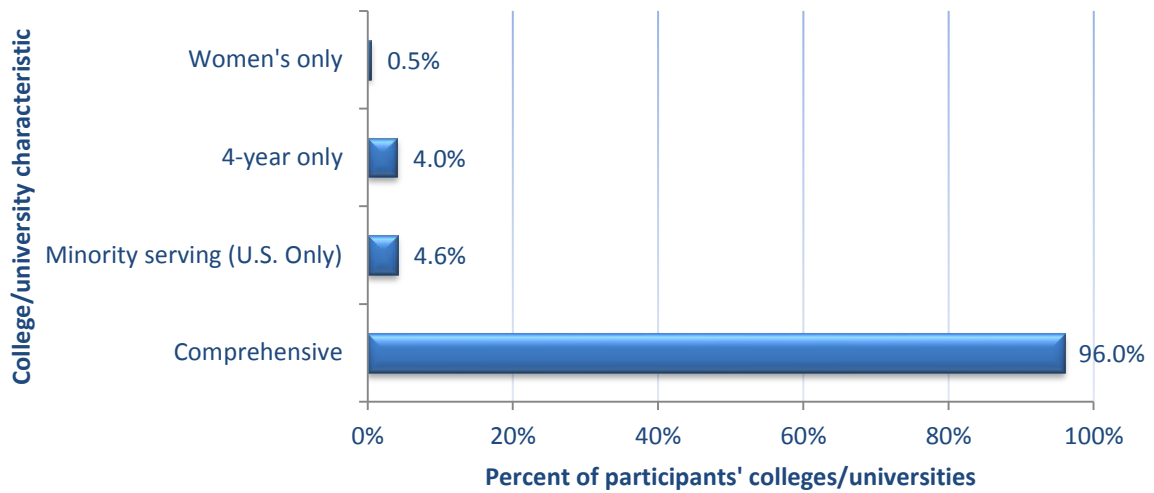
Comprehensive — 96.0%

0%   20%   40%   60%   80%   100%

Percent of participants' colleges/universities

Process Evaluation

The process evaluation seeks to evaluate congruence between goals and activities. This type of evaluation is situated in monitoring and judging activities at NIMBioS, mainly through periodic evaluative feedback surveys from participants and organizers. Other process evaluation data sources include evaluation case studies which look more closely at what factors of NIMBioS participation contribute to positive changes in participants' research and/or 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 synopsis of the evaluations of NIMBioS' major activities during RP 4.

Process Evaluation of Research Program Activities

Working Group and Investigative Workshop 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.

Organizer feedback, all meetings

Beginning in November 2011, NIMBioS began collecting satisfaction feedback from working group organizers to the following question after each meeting: As a workshop 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 1**Figure 14 summarizes the responses to this question.

Figure 14. Working group organizer satisfaction with NIMBioS handling of event (n = 12)
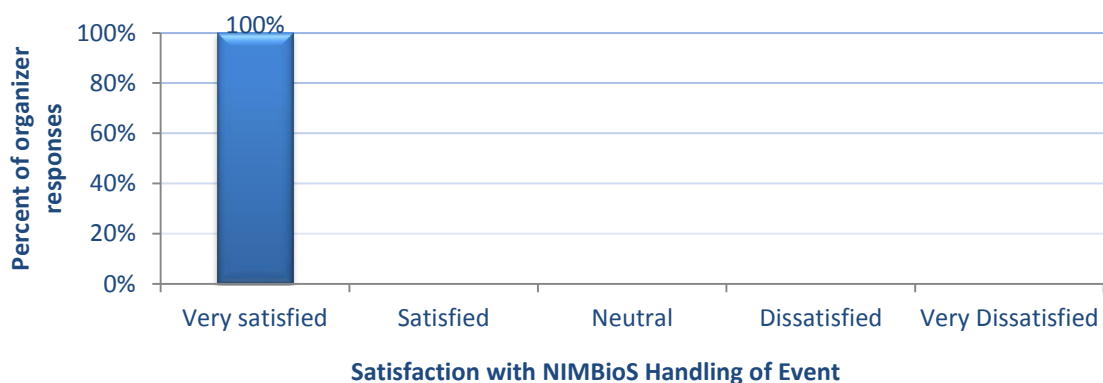
First Meetings

During RP 4, NIMBioS hosted the first meetings of three Working Groups, with a total of 40 participants (Table 2) (See http://www.nimbios.org/workinggroups/ for more details about specific Working Groups). Evaluation surveys were sent to all participants, with the exception of Working Group organizers and NIMBioS employees who were participating in the Working Groups. A total of 20 participants took part in the evaluation of the first meetings of their Working Groups.

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

Title of Working Group	Dates	# Participants
'Pretty Darn Good' Control: extensions of optimal control for ecological systems	9/12-15/11	11
Suction Feeding Biomechanics	9/26-27/11	15
Play, Evolution, and Sociality	11/30-12/2/11	14

**Synopsis of First Meeting Evaluation Results**

Of the 20 respondents to the evaluation survey:

- 95% felt that participating in the working group helped them understand research happening in other disciplines in the group's topic area.
- 100% felt that their group made adequate progress for their first meeting toward finding a common language across disciplines in their respective research areas.
- 100% felt the format of their working groups were effective for achieving their goals.
- 100% felt that the exchange of ideas that took place during the working group would influence their future research.
- 80% said they developed unanticipated plans for collaborative research with other working group participants.

Figure 15. *Overall satisfaction with the content and format of the working groups, responses on a scale of -2 "strongly disagree" to 2 = "strongly agree"*
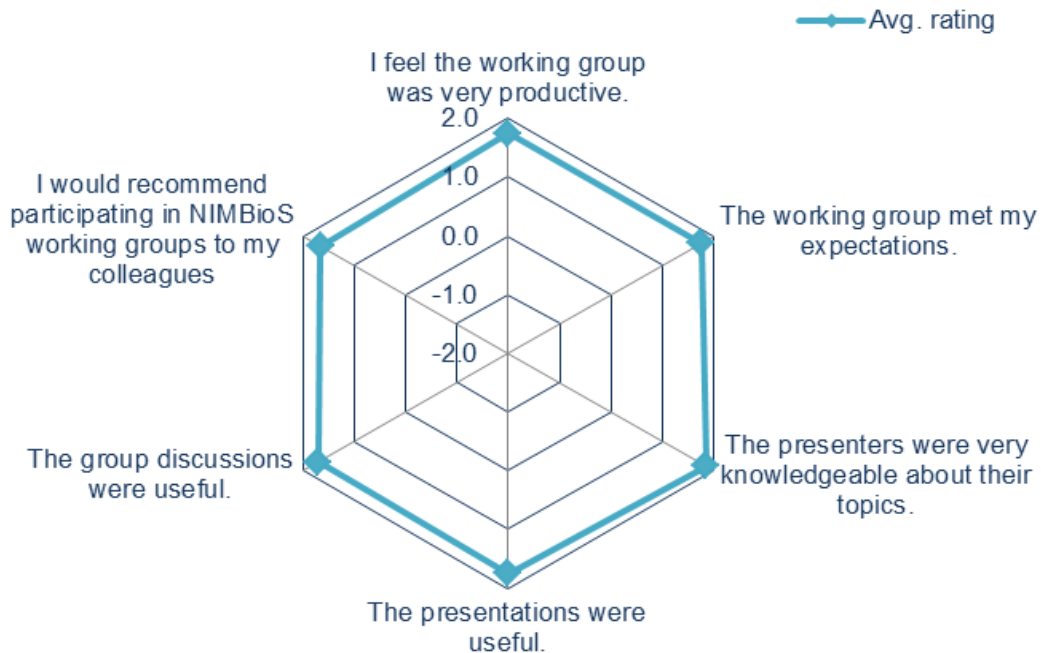
Figure 16. *Participant responses to the following question--As a result of participating in this working group, I have a better understanding of: (response scale -2 = "strongly disagree" to 2 = "strongly agree")*
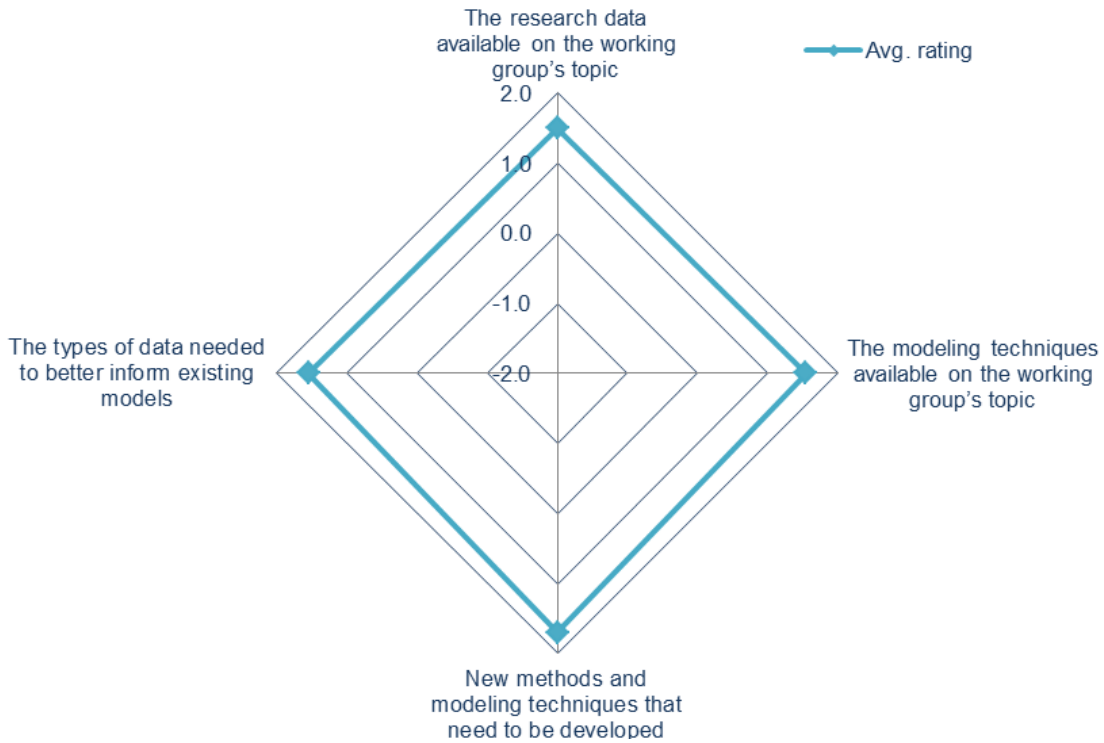
Figure 17. *Satisfaction with working group accommodations, response scale -2 = "very dissatisfied" to 2 = "very satisfied"*
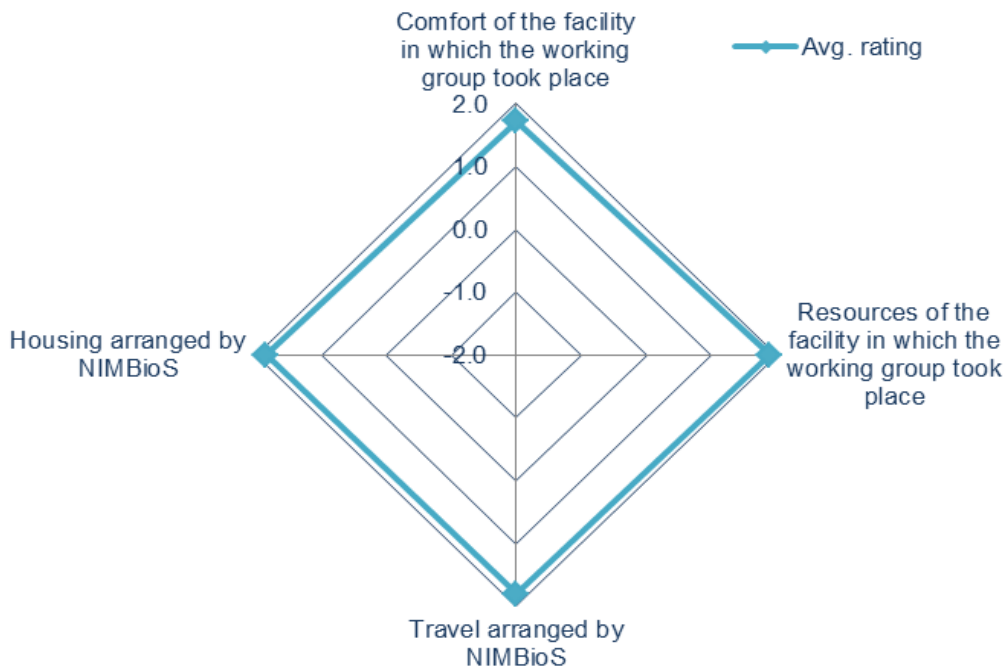
Second and Third Meetings

During the reporting period, NIMBioS hosted the second meetings of three Working Groups, with a total of 42 participants, and the third meeting of one Working Group, with a total of 13 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		
Species Delimitation	9/22-24/11	15
Optimal Control for Agent-based Models	12/19-21/11	13
Multiscale Modeling of the Life Cycle of Toxoplasma gondii	3/12-14/12	14
'Pretty Darn Good' Control: extensions of optimal control for ecological systems	3/13-15/12	11
Third Meetings		
Modeling Bovine Tuberculosis	12/13-14/11	13

Fourth Meetings

During the reporting period, NIMBioS hosted the fourth (and final) meeting of one Working Group, with a total of 10 participants (Table 4). 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 recently received the final summary from the Forest Insects Working Group, final evaluation survey is still outstanding at the time of this report.

Table 4. *Working Group Fourth Meetings Hosted by NIMBioS*

Title of Working Group	Dates	# Participants
Synthesizing Predictive Modeling of Forest Insect Dynamics Across Spatial and Temporal Scales	10/13-17/11	10

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 4, with a total of 161 participants (Table 5). Evaluation surveys were sent to participants of all workshops. Workshop organizers and NIMBioS employees who were participating in the workshops were excluded from the evaluation. A total of 117 participants took part in the evaluation of the workshops.

Table 5. *Investigative Workshops Hosted at NIMBioS*

Title of Workshop	Dates	# Participants
Modeling Intracellular Movements	10/26-26/11	38
Modeling Free-roaming Cats and Rabies	11/9-11/11	39
Modeling Social Complexity	2/6-8/12	43
Disturbance Regimes and Climate-Carbon Feedback	2/13-15/12	43

Error! Reference source not found.Synopsis of Investigative Workshop Evaluation Results

Of the 117 respondents to the evaluation survey:

- 100% felt that participating in the working group helped them understand research happening in other disciplines in the workshop's topic area.
- 93% felt that the workshop made adequate progress for their first meeting toward finding a common language across disciplines in their respective research areas.
- 98% felt either "satisfied" or "very satisfied" with the opportunities provided during the workshop presentations and discussions to ask questions and/or make comments.
- 72% felt that the exchange of ideas that took place during the working group would influence their future research, while 26% said it "possibly" would.
- 39% said they developed unanticipated plans for collaborative research with other working group participants, while 51% said they had "possibly" developed plans for collaborative research with other participants.

Figure 18. *Overall satisfaction with the content and format of the workshops, responses on a scale of*

I feel the Workshop was very productive.

— Avg. rating

I would recommend participating in NIMBioS Workshops to my colleagues.

The Workshop met my expectations.

The group discussions were useful.

The presenters were very knowledgeable about their topics.

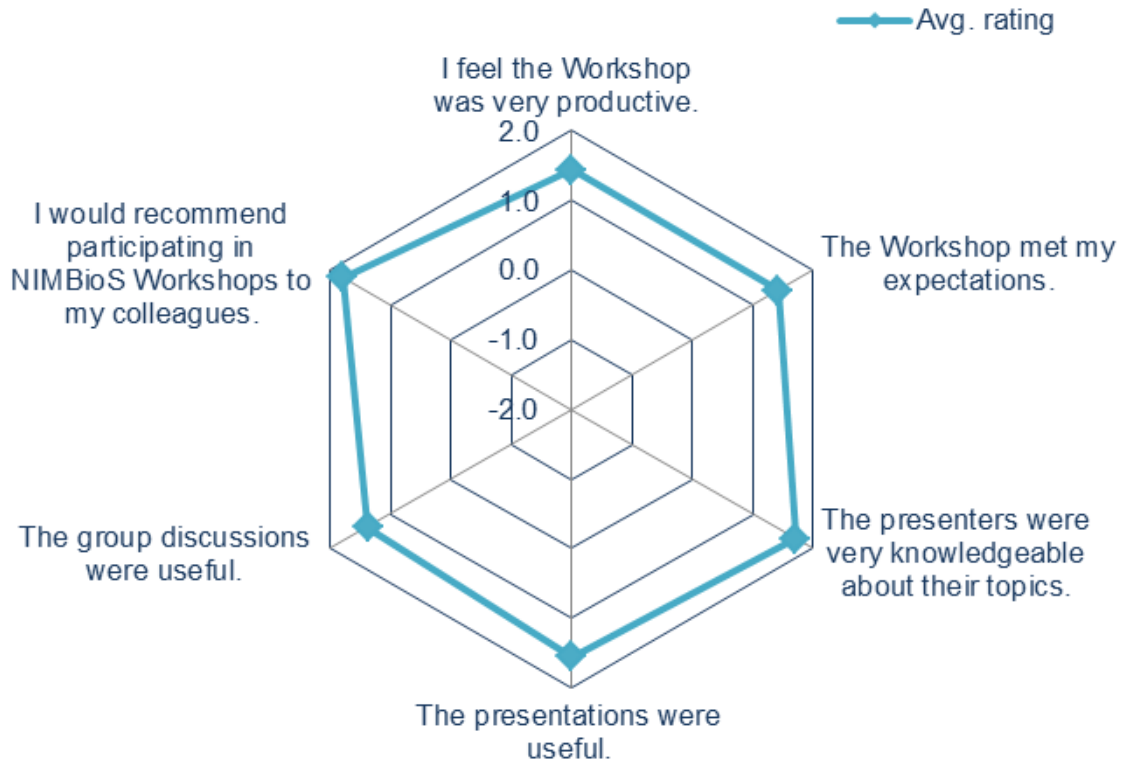The presentations were useful.

Figure 19. *Participant responses to the following question-- As a result of participating in this workshop, I have a better understanding of: (response scale -2 = "strongly disagree" to 2 = "strongly agree")*

The research data available on the workshop topic

— Avg. rating

How to adapt existing theoretical frameworks to fully use available data

Mathematical tools available for modeling

New methods and modeling techniques that need to be developed
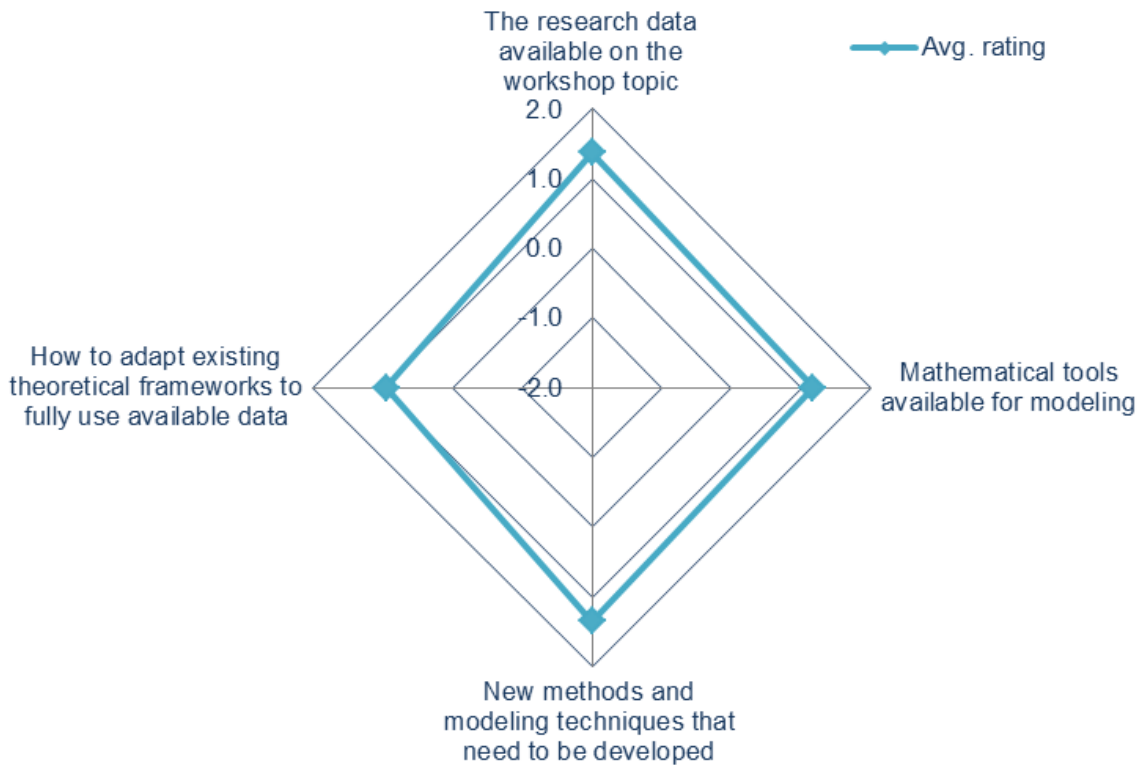
Figure 20. *Satisfaction with workshop accommodations, response scale -2 = "very dissatisfied" to 2 = "very satisfied"*
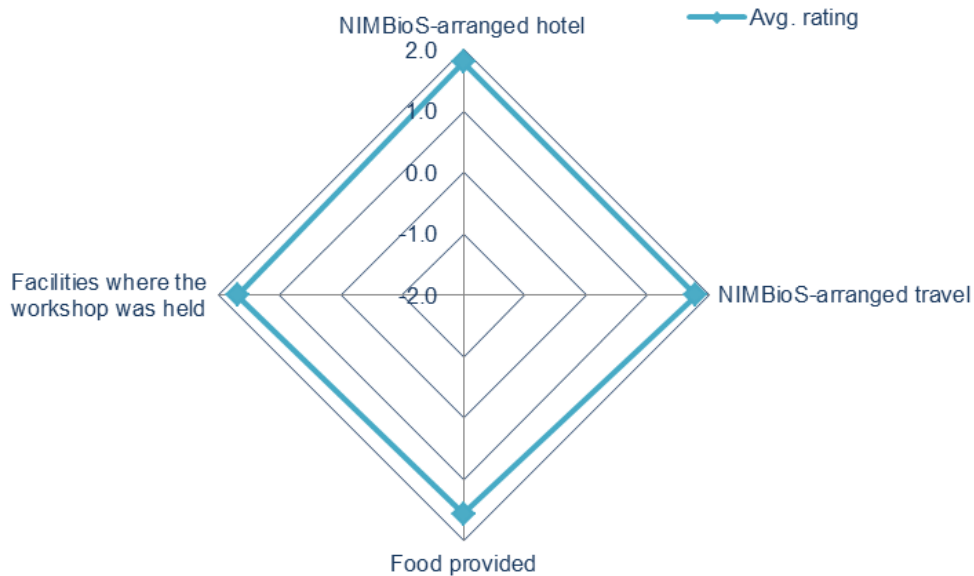
Process Evaluation of Education and Outreach Program Activities

Research Experiences for Undergraduates/Veterinary Students (REU/REV)

The NIMBioS *Research Experiences for Undergraduates* (REU) and *Research Experiences for Veterinary Students* (REV) programs took place simultaneously on the University of Tennessee, Knoxville (UT) campus May 31-July 22, 2011. (While this REU/REV program technically fell within the dates of reporting period three (RP 3), the REU program for 2012 will not occur until after the RP 4 annual report is due, so results from the previous year's REU/REV evaluation are provided each year.) Sixteen undergraduates, five veterinary students and one high school teacher were chosen to participate in the program.

During the eight-week long program, participants lived on campus at the University of Tennessee, Knoxville, and (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 2011 program were modeling feral cat populations, modeling *E. coli* in cattle, investigating maternal investment in the offspring of bird species, modeling intracellular movements in plants, modeling the effect of essential oils on a biocontrol fungus, and modeling the early dynamics of simian immunodeficiency virus. Program organizers were Suzanne Lenhart (Dept. Mathematics/NIMBioS), and Kelly Sturner (NIMBioS). Mentors in the program included Judy Day (Dept. Mathematics), Vitaly Ganusov (Dept. Microbiology), Tucker Gilman (NIMBioS), Kim Gwinn (Dept. Entomology and Plant Pathology), Tom Ingersoll (NIMBioS), Teresa Jennings (Dept. Comparative Medicine, Veterinary College), Tony Jhwueng (NIMBioS), Cristina Lanzas (Dept. Comparative Medicine,

Veterinary College), Vasileios Maroulas (Dept. Mathematics), Andreas Nebenführ (Dept. Biochemistry/Cellular/Molecular Biology), John New, Jr. (Dept. Comparative Medicine, Veterinary College), Xavier Thibert-Plante (NIMBioS), Yiding Yang (Dept. Microbiology), Vladmir Protopopescu (Oak Ridge National Laboratory), and Heidi Weimer.

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.

Synopsis of REU/REV Evaluation Results

Of the 21 respondents to the evaluation survey:

- 75% of participants said most or all of their expectations were met or exceeded during the program, while 13% of participants said only "some" of their expectations were met.
- The majority of participants (88%) thought the overall workload during the program was "just about right," while 12% thought either "too much" or "too little" work was assigned.
- Overall, participants were highly satisfied with their mentors, indicating that they were very helpful and supportive during the research experience. Participants rated their mentors highly, with the average mentor rating at 1.21 (on a scale of -2 to 2, with 2 being the most favorable).
- Participants rated the usefulness of the 12 lectures and instructional sessions an average of 0.006 on a scale of -1=not useful to 1=very useful.
- Gains in several research-related skills were reported by participants, with an average rating for all skills of 0.46 on the pre-survey and .90 on the post-survey (on a 5-point Likert scale from -2=extremely poor at the skill to 2=excellent at the skill, see
- Figure 22. Participant pre-and post-program skills, response scale of -2 = extremely poor at the skill to 2 = excellent at the skill).
- Participants reported gains in knowledge regarding several research-related topics. Before the program, participants on average rated themselves 0.50 on a 5-point Likert scale from -2=extremely poor understanding to 2=excellent understanding of the topics. After participation, the average rating was 1.12 (see
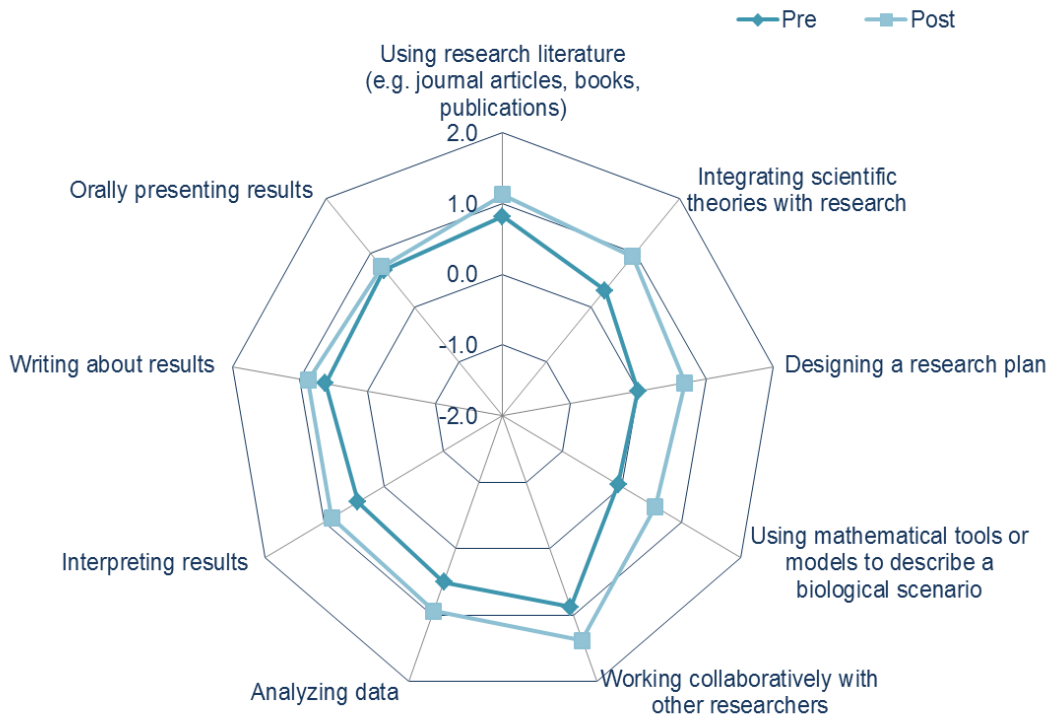
Figure 23).

- 64% of participants said that participating in the program impacted their plans to go to graduate school in some way. Some participants said that the experience reinforced their previous decisions to attend graduate school, while others said that the experience made them more interested in integrating math and biology into their graduate school plans.
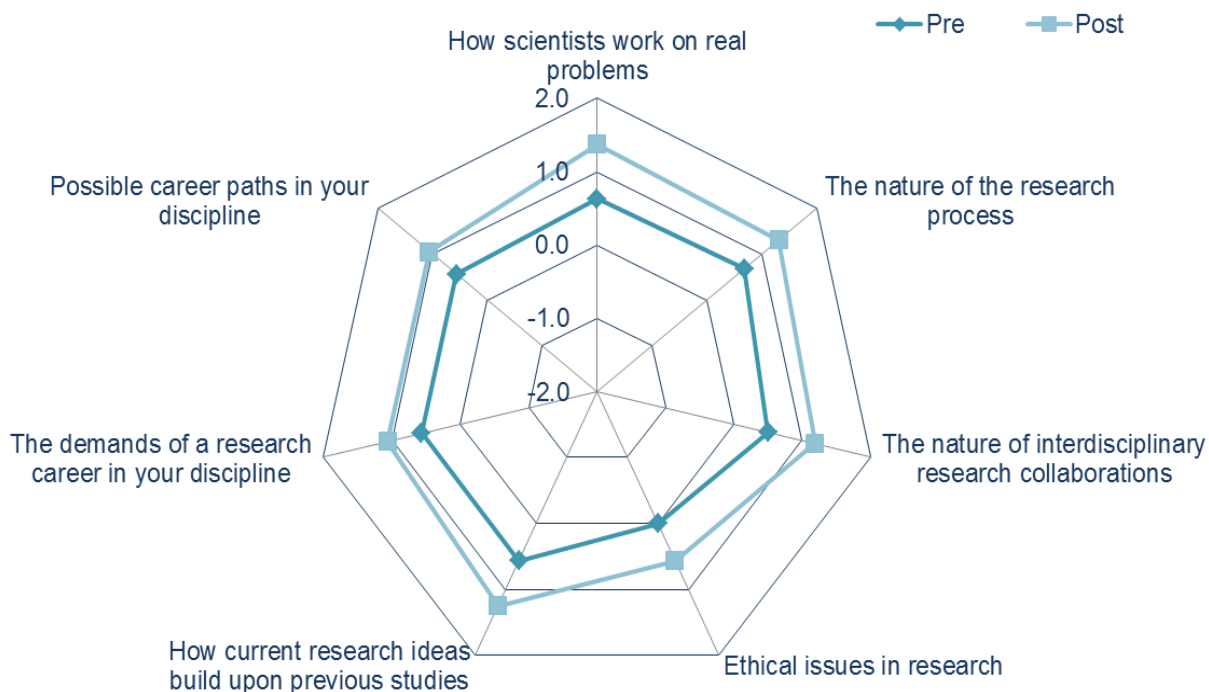
Figure 21. Overall satisfaction with the research experience
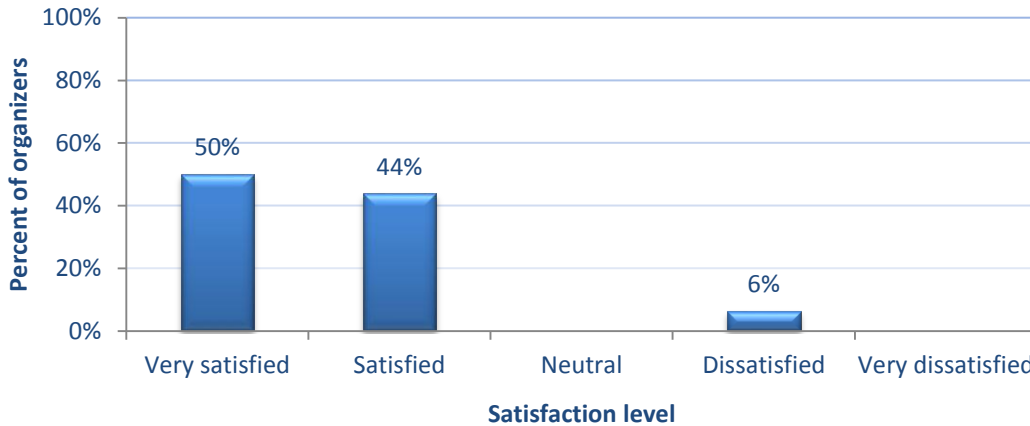
Figure 22. Participant pre-and post-program skills, response scale of -2 = extremely poor at the skill to 2 = excellent at the skill

Figure 23. 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 October 21-22, 2011. 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 120 undergraduate students and faculty mentors participated from more than 46 institutions throughout the United States. The third 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. Faculty and students were invited to attend. Middle and high school teachers were also invited to attend. Evaluation surveys were sent to all participants in the conference, with the exception of NIMBioS affiliates and event organizers. A total of 81 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.

Synopsis of URC Conference Evaluation Results

Of the 81 respondents to the evaluation survey:

*   100% agreed that the conference was successful in achieving its goal of creating a forum through which undergraduates could present research and make new connections at the interface of math and biology.
*   93% said they felt that participating in the conference helped them make connections with others within the interdisciplinary field of math and biology.
*   38% of undergraduate respondents (n = 68) said they felt that the exchange of ideas that took place during the conference would influence their career plans, while 46% said it "possibly" would influence their career plans.
*   Most respondents felt the most useful aspect of the conference was the student presentations, followed by the networking opportunities and grad school career panel.

Figure 24. *Respondent agreement levels with statements about various aspects of the conference, scale: -2 = "strongly disagree" to 2 = "strongly agree"*
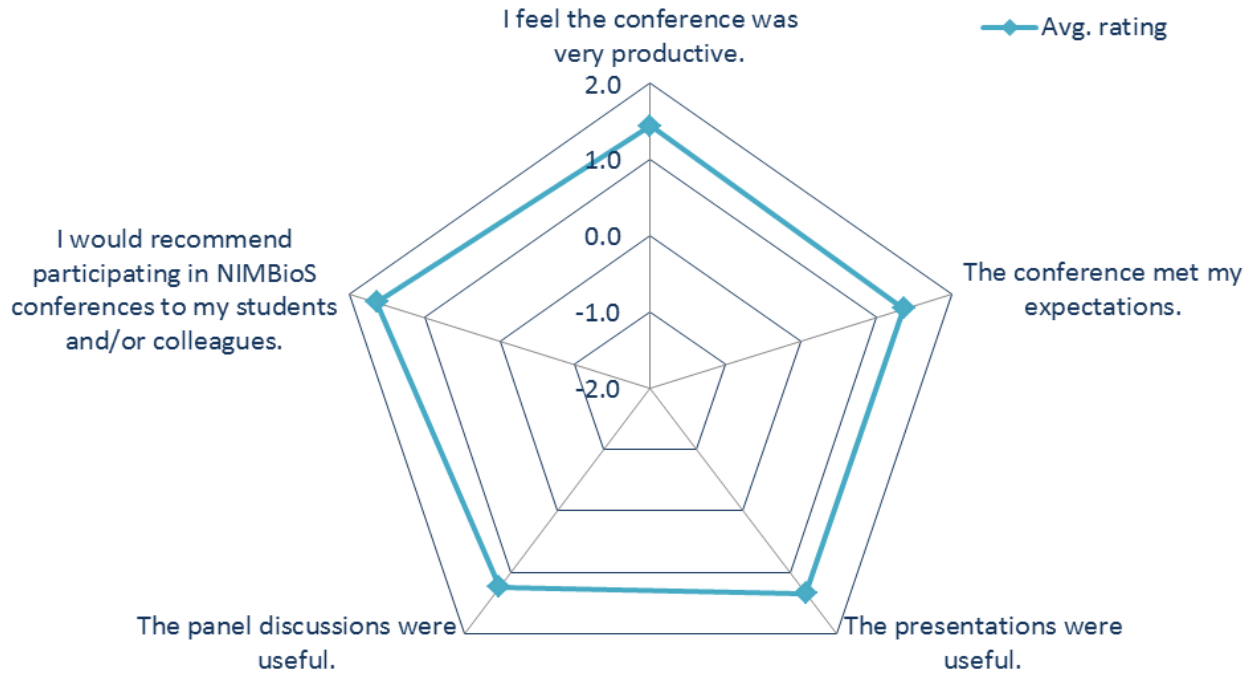
Figure 25. *Undergraduate respondent learning levels (n = 68), Scale: -2 = "strongly disagree" to 2 = "strongly agree"*
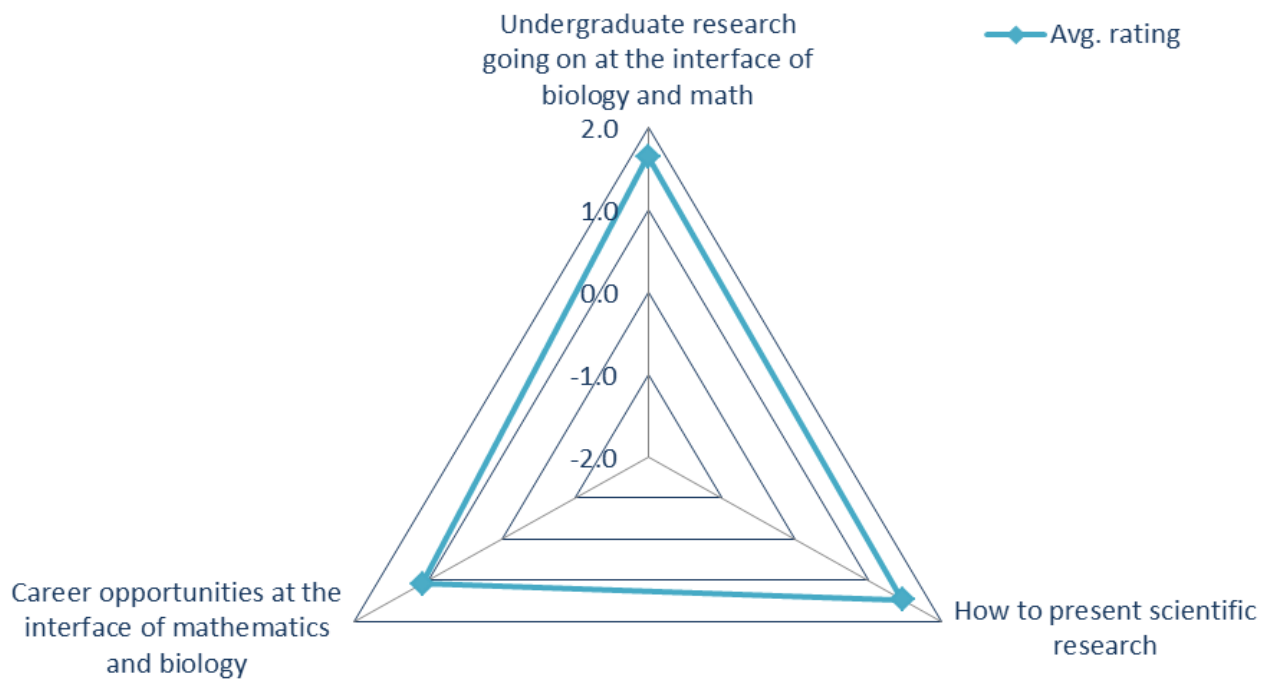
NIMBioS Postdoctoral Fellow Exit Survey Summary

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.

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.

Synopsis of Postdoctoral Fellowship Program Evaluation Results

Figure 26. Postdoctoral fellow satisfaction with program mentors
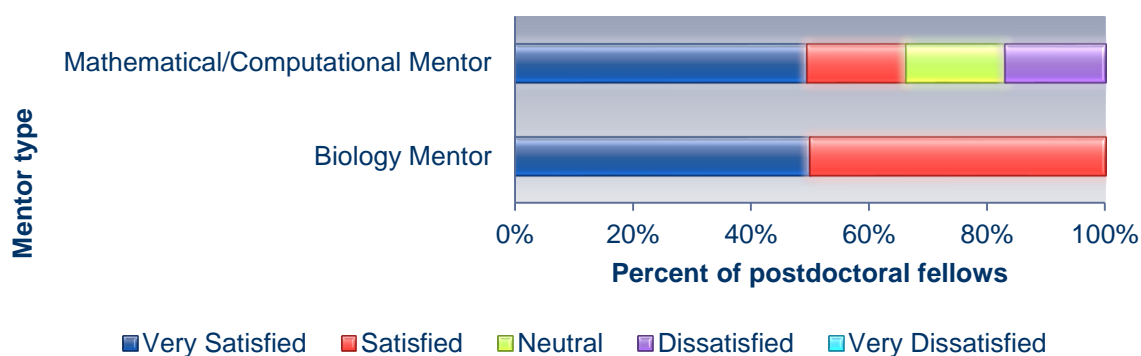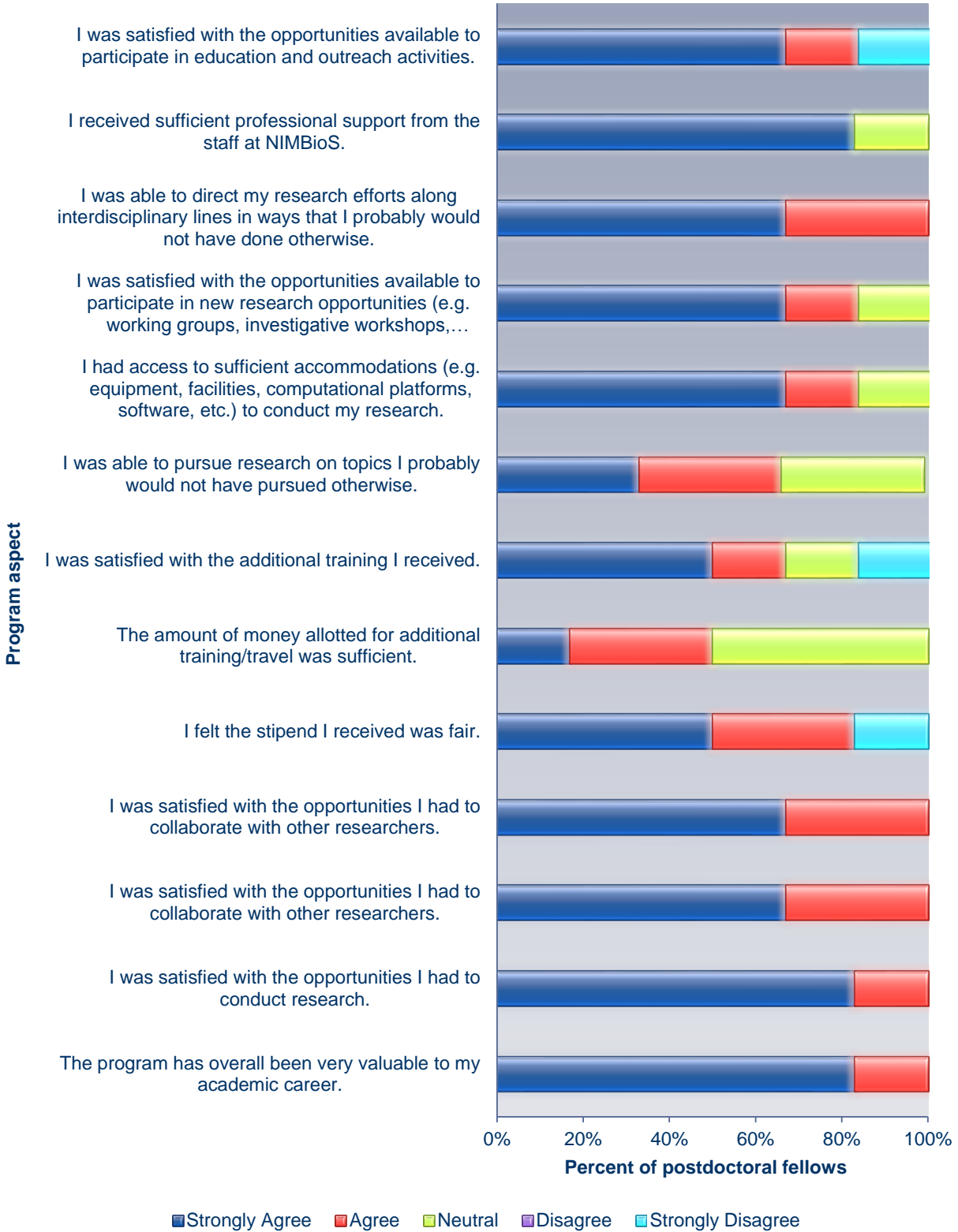
Figure 27. Postdoctoral fellow satisfaction with advice/assistance received from program mentors

Figure 28. Postdoctoral fellow satisfaction with overall program experience

Program aspect (y-axis)

- I was satisfied with the opportunities available to participate in education and outreach activities.
- I received sufficient professional support from the staff at NIMBioS.
- I was able to direct my research efforts along interdisciplinary lines in ways that I probably would not have done otherwise.
- I was satisfied with the opportunities available to participate in new research opportunities (e.g. working groups, investigative workshops,…
- I had access to sufficient accommodations (e.g. equipment, facilities, computational platforms, software, etc.) to conduct my research.
- I was able to pursue research on topics I probably would not have pursued otherwise.
- I was satisfied with the additional training I received.
- The amount of money allotted for additional training/travel was sufficient.
- I felt the stipend I received was fair.
- I was satisfied with the opportunities I had to collaborate with other researchers.
- I was satisfied with the opportunities I had to collaborate with other researchers.
- I was satisfied with the opportunities I had to conduct research.
- The program has overall been very valuable to my academic career.

Percent of postdoctoral fellows (x-axis): 0%, 20%, 40%, 60%, 80%, 100%

Legend: ■ Strongly Agree ■ Agree □ Neutral □ Disagree ■ Strongly Disagree

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. 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, and software), Web of Science data, and data collected from participant evaluation forms and follow-up surveys.

Context

As it generally takes 3-5 years before a bibliometric study can show relevant results for a research center, NIMBioS currently not yet fully addressing goals 1-3 of the context for the evaluation of its scholarly products. NIMBioS is currently working on a case study in evaluation that further examines goals 1-3, and plans to fully address these 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 103 published articles since 2009 (Figure 29) on research ranging across many areas of ecology, evolutionary biology, applied mathematics, and computational biology. An additional 10 articles are currently under review, submitted, or in press.

Figure 29. Number of publications reported from NIMBioS activities since 2009, by publication year
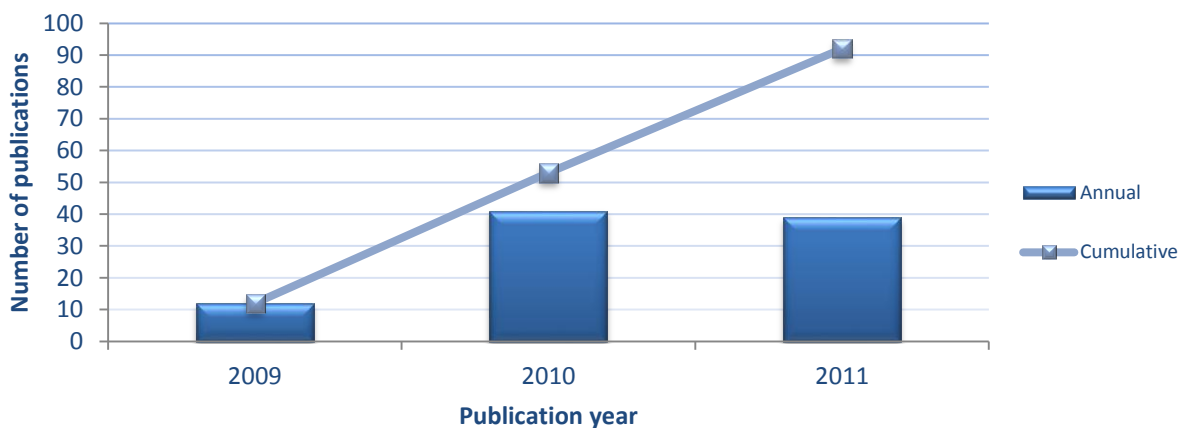
NIMBioS-related publications involved 257 researchers from 134 unique institutions spanning 24 countries. These articles have appeared in 71 different publications, many of which are considered to have high-impact in the academic community (

Table 6).

Table 6. Number of NIMBioS articles published in a selection of high-impact journals, sorted by journal Impact Factor

Journal Title	2008 Impact Factor*	2009 Impact Factor	2010 Impact Factor	# of NIMBioS Publications as of March 2012
Science	28.103	29.747	31.364	3
Ecology Letters	9.392	10.318	15.253	4
Trends in Ecology and Evolution	11.904	11.564	14.448	2
Proceedings of the National Academy of Sciences	9.98	9.432	9.771	5
PLoS Genetics	8.883	9.532	9.543	1
Systematic Biology	7.883	8.48	9.532	1
Nucleic Acids Research	6.878	7.479	7.836	2
Molecular Ecology	5.325	5.96	6.457	2
Evolution	4.737	5.429	5.659	4
Philosophical Transactions of the Royal Society B-Biological Sciences	4.258	4.857	5.064	1
American Naturalist	4.67	4.796	4.736	6
Journal of Animal Ecology**	4.22	3.714	4.457	2
PLoS One	NA	4.351	4.411	3
Animal Behaviour**	2.828	2.89	3.101	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).

**Impact factors in the field of zoology are low relative to many other fields. Animal Behaviour and Journal of Animal Ecology are ranked #5 and #2, respectively, out of 145 indexed journals in zoology by Web of Science.

Disciplinary Span of Publications

The 103 published articles span 32 discipline areas, as designated by the Institute for Scientific Information's (ISI) Web of Science (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 (27), followed by Evolutionary Biology (22), Biology (15), Genetics & Heredity(13), Multidisciplinary Sciences

(10), Mathematical & Computational Sciences (9), and Mathematics, Applied (7). Figure 30 locates the subject categories of the 103 NIMBioS articles on a network map of the WOS Subject Categories. The gray background intersections are the 221 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 30. Web of Science Subject Categories for 103 published journal articles to date**

Method from Rafols, Porter and Leydesdorff (2009)
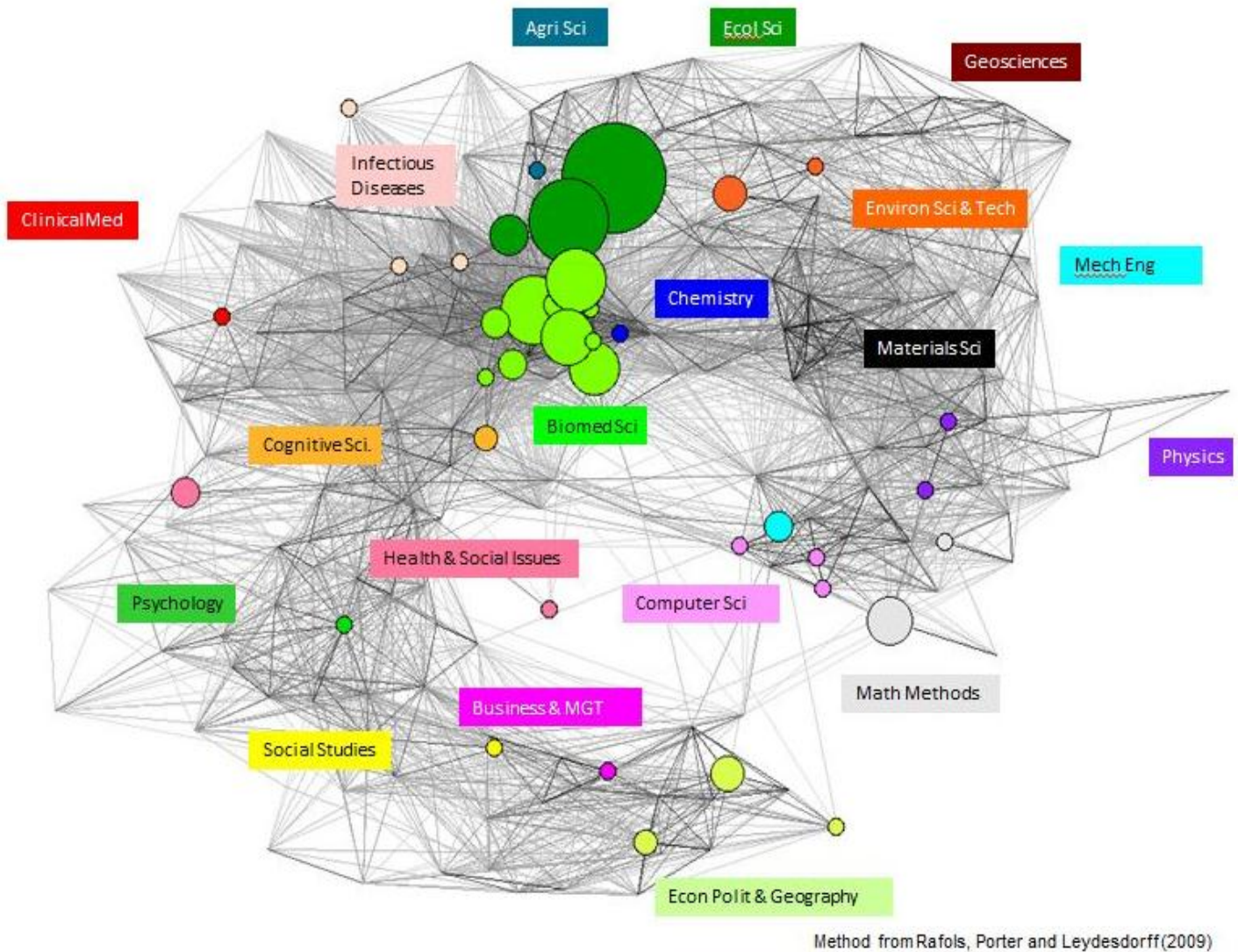
Collaboration

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 103 publications reported thus far, the average number of co-authors per paper is 3.5 (Figure 31).

Figure 31. Coauthorship of NIMBioS publications
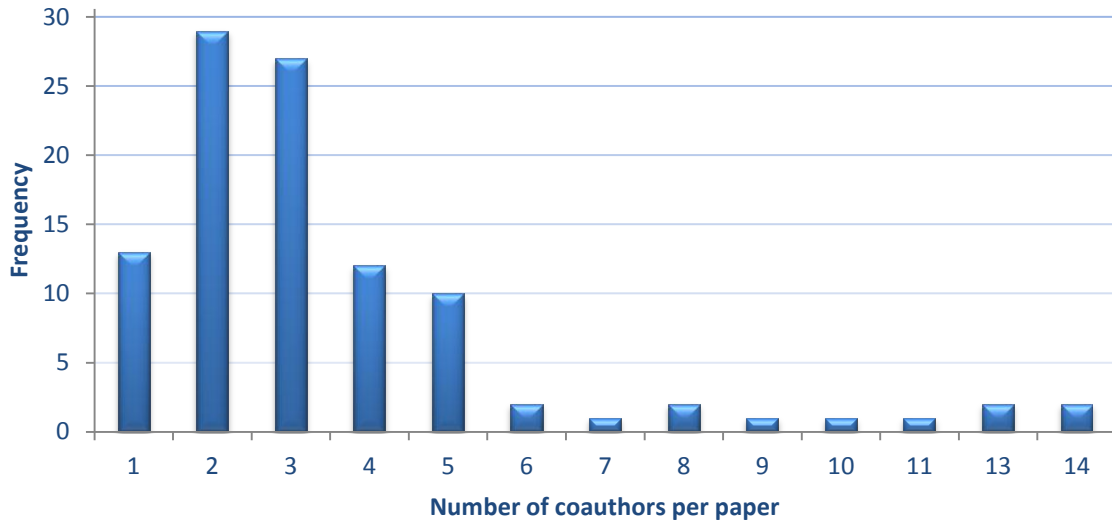
While 24 different countries were represented by NIMBioS authorship, the average number of countries of coauthors per paper was 1.41, with a range of 1-4 (Figure 32).

Figure 32. International collaboration of NIMBioS publications
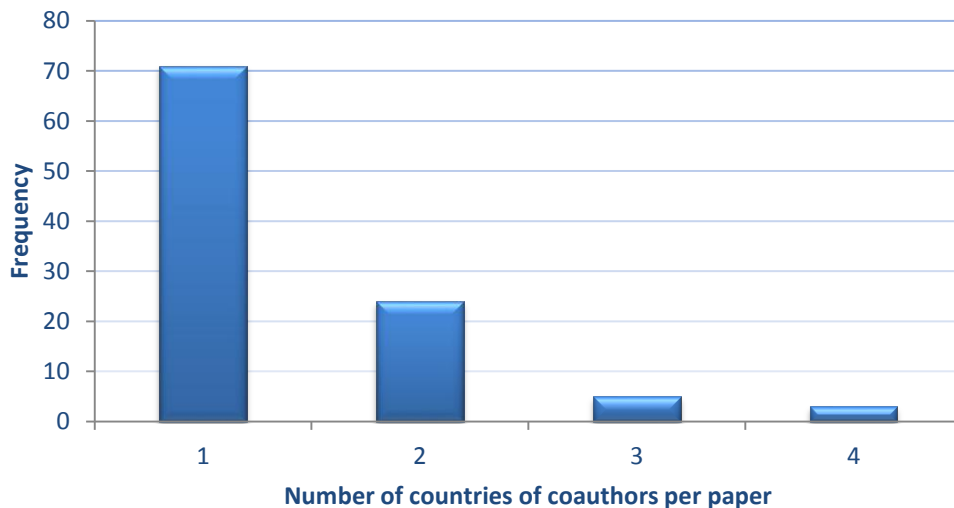
Coauthors on NIMBioS publications came from 134 unique institutions. The average number of institutions represented per paper was 2.59, with a range of 1-12 institutions per paper (Figure 33).

Figure 33. Cross-institutional collaboration of NIMBioS publications
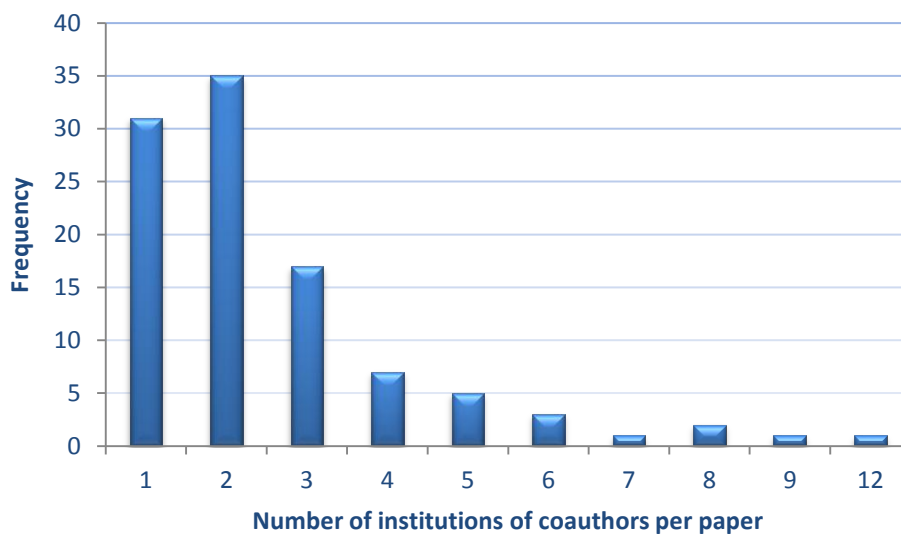
Other Scholarly Products

In addition to journal publications, participants report other types of products that have resulted from their activities at NIMBioS. Figure 34 summarizes these types of products for the four-year period.

Figure 34. Non-journal publication products arising from NIMBioS events