NOSB Longitudinal Tracking Report Fall 2014

Introduction and Method

The Consortium for Ocean Leadership annually implements the National Ocean Sciences Bowl as a regional and national competition based program for high ability secondary students in the United States. Annually, a tracking survey has been implemented to follow students after high school graduation, through college and, for some, graduate school, and into the workplace. Beginning in 2000 and continuing annually since that year, Drs. Tina Bishop and Howard Walters have developed the surveys associated to this now longitudinal tracking study, as well as numerous other instruments and data collection procedures. This year, in Fall 2014, a revised tracking survey was prepared and, with review and input from COL staff, disseminated to past participants as an electronic survey using existing databases. Funding variations over the past year created a gap in the longitudinal tracking for the spring semester in 2014, and likely explains the loss of momentum in maintaining communications with past participants, this resulted in a decline in participation numbers from 2013. Nevertheless, from what is believed to be an active database of approximately 250 individuals, a sample of 50 responses were obtained from post-secondary and graduate students, and from a number of post-graduate respondents who are in the STEM employment fields already. Summary results follow, with interpretations and discussion at the end.

Data Summary

Items 1 through 5 of the survey were demographic items that allow the researchers the ability to disaggregate responses and to compare the response group to other survey data from the past fifteen years of tracking responses.

In response to the electronic survey that was disseminated in October 2014, a total of 50 past participants provided complete or near complete responses. Of this number, 32 are undergraduates and 18 are in graduate school. From within this group, 17 respondents (34%) indicated that their career will ultimately include an emphasis on marine, aquatic or ocean sciences. The respondents were asked whether NOSB preparation activities and competition in high school were of benefit in college, and 47 respondents (96%) indicated a Yes response.

A total of 23 respondents (70%) reported that they either obtained, or were still on track to obtain, their college degrees in the area that they intended when they completed high school. This is a significantly larger proportion of students than the average for this age of student, but may suggest that higher ability students are less likely to change academic majors. Nevertheless, it should be considered that perhaps the response pattern here reflects a self-selection bias: many NOSB students select into the competition because of STEM interest, which persists through college and into career selection. And finally, it may also be possible that an overall selection bias exists for those respondents who are still interested enough in the NOSB to complete this current survey.

As with other tracking surveys over the past fifteen years, nearly 64% of respondents indicate that they remain in communication with NOSB participants from their high school team (this will be discussed further below). This seems to indicate, as prior tracking research has concluded, that the NOSB is creating a persistent and durable social relationship among the participants that carries over into collegiate and post-collegiate life.

Beginning with item 6 on the survey, a selection of narrative response items were provided to the respondents, based on a set of items, which have been developed and used over the past fifteen years tracking the program. These items have proven helpful in illustrating and describing the impacts of the NOSB program.

Item 6 asked the students to identify courses taken in college or graduate school over the current or immediately past semester which were STEM-related. The specificity of the responses has been found consistently over the years to be an excellent indicator of the reliability of the survey findings. Courses submitted included:

Molecular Biology
Cytoskeleton Dynamics
Oceanography
Cellular Biology
Microbial Pharmacology
Cell Biology
Physics
Organic Chemistry
Inorganic Chemistry
Statistics
Animal Physiology
Physical Chemistry
Physics
Cellular Engineering
Marine Biology
Freshwater Ecology
Humans and the Environment
Advanced Ecology
Genomics
Biology of the Immune System
Biophysics
Physical Chemistry
Physiological Systems
Coastal Law
Socioeconomics of Fisheries
Chemical Oceanography
Marine Conservation
Ecology
Intro to Environmental Engineering
Earth Resources and the Environment
Computer Science
Evaluation of Chemical Hazards
Environmental Impact Assessment
Energy Markets
Energy Politics
Intro to Nanoscience
Surface Physics
Cell Biology
Neurobiology
Mammalian Biology
Immunology
Chemistry Lab
Statistics
Genetics
Linear Algebra
Heat and Waves
Biological Oceanography
Weather Radars and Satellites
Ecology and Evolution
Mathematical Models in Biology
Rotating Fluid Dynamics
Solid State Physics
Physics of Measurement
Kinetic Processes in Materials
Calculus 1 and 2
Physics 1 and 2

Entomology
Molecular Biology
Geography
Cultural Geography
Microbiology
Chemistry 1 and 2
Organic Chemistry 1 and 2
Human Physiology
The Cell
Organic Chemistry Lab
Nutrition
Introduction to Statistics
Cell Biology
Microbiology
General Chemistry
Organic Chemistry
Calculus
Physics
Aquaculture
Tropical Marine Ecology
Paleontology
Invert Zoology
Geophysics
Limnology
Modern Physics
Polymer Physics
Electromagnetic Systems
Cyber-Crime
Fisheries Science and Management
Multivariate Statistics
Scientific Writing
Spatial Ecology

Item 7 asked if respondents had returned to the NOSB regional competition(s) to serve as a volunteer. It was interesting to note that five respondents had volunteered at multiple, different regional NOSB competitions, suggesting a broader, social commitment to the program that transcended the relationship with their own, local competition. The respondents listed fourteen different regional competitions where they had volunteered, which included:

Bay Scallop Bowl
Great Lakes Bowl
Blue Lobster Bowl
Blue Heron Bowl
Manatee Bowl
Nor' Easter Bowl
Chesapeake Bay Bowl
Trout Bowl
Orca Bowl
Aloha Bowl
Quahog Bowl
LA Surf Bowl
Grunion Bowl
Blue Crab Bowl

Item 8 asked respondents if, and how, the NOSB competition in high school had benefitted them in college in some way. The responses emerged in three fairly distinct clusters: knowledge related, thinking and study skill related, and life skill related. Example responses for the knowledge related set included: increased content knowledge, understanding of the ocean was deeper, my first college science classes were very easy, and multiple responses about having prior understanding of the content of college science classes from NOSB study. In the area of study skills, numerous respondents indicated that the NOSB preparation increased their self-discipline to study, their ability to study difficult materials, an ability to work on their own in independent study, and an enhanced ability to communicate in public. The life skills area was, as with the earlier years of the tracking study, rich and encouraging. Respondents wrote that NOSB helped them develop a network of friends who they remain connected to. Another respondent wrote that NOSB allowed them to see other people who were also interested and passionate about

science. Others wrote that the program enhanced career interest and awareness, strengthened critical thinking skills, gave them experience in high pressure situations, and even helped them learn to think and respond quickly—a skill that helped one respondent in a job interview.

Items 9 through 13 asked respondents to delineate the type and content area of any degree obtained, the institution from which the degree was obtained, whether the degree was in the content area they intended when they completed high school, or whether the content area had changed, and whether the degree included an emphasis in marine, ocean or aquatic sciences. Respondents reported a total of 49 degrees completed, i.e. 25—B.S., 10—B.A.; 9—M.S.; 2—M.A.; and 3—Ph.D. degrees. Interestingly, 23 of the students reporting degrees indicated that the degree obtained was in the content area they intended at the end of high school, while 9 indicated it was not. This aligns with other data over the years of the tracking that these students have a higher proportion of correlation between end of high school anticipation and end of college completion. Of the respondents answering the question, 13 reported degrees with some relationship to ocean or marine sciences, while 21 indicated their degrees did not include that content. Nevertheless, 38 of the degrees reported were in the science, mathematics, or technology areas, continuing to suggest that NOSB is attracting high ability students who will frequently matriculate into STEM fields of study. The universities from which these students are reporting degrees include:

Stony Brook University
William and Mary
Arizona State University
UNC-Wilmington
MIT
University of Michigan
Queen's University
Boston University
University of New Hampshire
University of California-Davis
Davidson College
MGH-Institute of Health Professions
University of South Carolina
University of Washington
Louisiana State University
Texas A&M
Colorado School of Mines
University of Colorado
UC-San Diego
University of Rhode Island
California Institute of Technology
Eugene Lang College-The New School
Rice University
McGill University
University of Florida – St. Petersburg
Ohio Wesleyan
Washington College
Hochschule Ludwigshafen
University of Virginia
University of Rochester
Mississippi University for Women
St. Mary's
Virginia Tech

The content areas or degree specializations reported by the students who have completed degrees are:

Biology
Chemistry
Public Policy
Environmental Studies

Computer Engineering
Marine Biology
Chemical Engineering
Geological Engineering
Molecular Biology
Geology
Physical Therapy
Geography
Ecology
Geophysics
Aerospace Engineering
Atmospheric and Oceanic Science
Computer Science
International Economics
Oceanography
Mathematics
Genetics
Earth Science
Marine Geology
History
Zoology
Political Science
German Studies
Environmental Science
Business

Items 14 and 15 asked respondents whether they had remained in communications with their high school NOSB teams and with their NOSB Coaches. Of the 33 respondents, 64% (n=21) indicated that they were still in communications with fellow team members. A total of 14 students (42% of respondents) indicated that they remained in communications with their NOSB high school Coaches. As noted in previous tracking studies, these relatively high response values suggest that NOSB supports the creation of a durable, social network of individuals with common interests in science. While the proportion of this current group who are still in communication with their coaches is lower than observed in years past, this level of communication continues to indicate the importance of the high school teacher in the lives of these gifted young adults.

Items 16 and 17 were related to past participant employment. Item 16 collected the name or type of employer, and item 17 asked respondents to describe the nature of their work or anticipated career path and goals if they have not yet begun their careers. Many of the respondents are still in college, limiting the number of named employers provided by respondents. Additionally, four respondents chose to identify the type of employer instead of naming the employer to protect anonymity. This list did include the following:

Biological and Environmental Consulting
Raytheon
NOAA
University of Alabama—Birmingham
TestAmerica (medical testing)
Peace Corps
Harborview Medical Center
A Public School System
EPA
Microsoft
A Finance Company
A University School of Oceanography
MIT
An HIV Care Company
Shell Oil
CVA Home Health Care Agency
Self-Employed (Obstetrics)
URS Corporation (Environmental Consulting)
Booz Allen Hamilton Consulting (Engineering)
University of Mississippi Law School
Americorp

A number of the respondents chose, in Item 17, to describe the nature of the work they were currently doing. Again, while there is likely a strong self-selection bias in the individuals who chose to respond to the survey toward those inclined to science, nevertheless, these are authentic responses from past participants in the NOSB program who have in fact obtained professional careers in the STEM fields. These responses included:

Medicine
Environmental Monitoring
Software Engineering
Research (Science)
Academia (not specified)
Environmental Engineering
Civil Engineering
Physiological Research
Lab Analyst
Physical Therapist
Research Technician (Oceanography)
Graduate Assistant (Atmospheric)
Software Engineer
Data Analyst
Research Logistics
Graduate Students (Nanomaterials)
Graduate Student (Engineering)
Public Health Research
Exploration Geologist
Graduate Student (Ecology)
Political Communications
Patient Relations (Health Care)
Midwifery/Obstetrics
Environmental Scientist
DOD Research
Law
Graduate Student (Fisheries)
Program Leader for Americorp

Item 18 asked respondents how participation in the NOSB may have contributed to their education and career paths. Among the ideas suggested from respondents were being pushed or motivated to select ocean or science related career paths, encouragement to study the ocean, and learning self-discipline in their study skills and problem solving. Importantly, many respondents indicated the program resulted in an increase in content knowledge in ocean related science. Key quotes included: "NOSB solidified the track I'm on. Without NOSB, I don't know that I would have pursued science. I don't know that that pursuit would have been as passionate without NOSB." "It got me interested in environmental science and how it could be an actual career path, then it led me towards environmental education and finally teaching." "It furthered my knowledge of the oceans and its impacts on other aspects of the global economy."

Item 19 was a modified, leading question that asked: Some students particularly loved learning about science while in high school, college or graduate school. If this describes you, what was it about learning science that so interested you? Responses were varied, but were illustrative of the much of what we know about gifted learners in science areas. Responses included an interesting set of key terms, concepts, and characteristics of science learning that appealed or stood out to these respondents: exploration, discovery, problem solving, challenging. Other respondents mentioned the "magic" of science, its basic organization or practicality. One respondent wrote about the "relevance to me about how the world we live in

works." Another wrote about future discoveries, a constant supply of new information, and understanding.

Item 20 asked respondents to describe a teacher who was particularly able to engage students with interesting and exciting materials or class experiences, and to describe the class where they encountered this teacher. Respondents described teachers who encouraged curiosity, who allowed them to work at their own pace. Other respondents described teachers who encouraged creativity and questioning, who emphasized hands-on activities and exploration, real-world applications, and social justice. The characteristics most associated with these excellent teachers were enthusiasm, openness, engaging, love of nature, and an ability to clearly communicate. Finally, some respondents mentioned field studies, authentic experiences, and outdoor learning. One key quote seems key to capturing the flavor of these responses: "My favorite high school science teacher, and NOSB coach was amazing. She made everything exciting, and also really pushed us to do real science, not toy experiments. We did field studies, and for the first time felt what it was like to know things, even if they were very small things, that no-one had ever known before. We did labs every week, sometimes twice a week. I also had a wonderful math teacher—he explained everything clearly, but challenged us, and expected us to challenge ourselves, and each other. Quiz results were posted and became a competition to be the best at math. We were encouraged to work through things, even if we didn't really know where to start, and to enter math competitions. He would never grade on a curve, but at the same time, he was always happy to help you learn."

Conclusions

While these data summaries have not yet been contextualized within a literary framework (this task is ongoing in this current year's research effort), there are commonalities between these data summaries and other data collected through the extensive tracking efforts over the past 16 years. These are important observations, as they frame the broader contexts of the NOSB program.

First, it seems clear that the NOSB program is able to impact and affect a group of high ability secondary students, who ultimately persist in STEM related education. Some of these young adults then ultimately enter the STEM workforce. The question of causality, i.e. does the NOSB cause an increase in the number of STEM workforce professionals, has proven less helpful to program monitoring—as the far larger set of curricular and programmatic variables that influence these young people are simply beyond control. Nevertheless, the simple association of the NOSB program to a robust number of high ability secondary students with an interest in STEM content areas, an ability to pursue that content at a post-secondary and graduate level, is an important and demonstrated strength of the NOSB organization. NOSB has developed a capacity to identify, recruit, motivate, challenge, educate, and communicate with a pool of these students consistently over time. Further, these students continue to communicate with each other and with their high school coaches after high school, college, and graduate education—and in

some cases persist as adult volunteers in the program after career entry. For this reason, NOSB remains a credible and viable vector for funding agencies that have an interest in promoting, sustaining, and expanding the STEM education and career pipeline. At a basic level, it is noteworthy that so many of these past participants, so many years out of high school, continue to so value the NOSB program that they are willing to commit time to completing a survey about its impact on them years later.

Second, over the years of the NOSB program, funding reductions coupled with slight growth in the size of the program might suggest that there would be difficulty recruiting high quality secondary teachers to the Coaching positions (high school team leaders) across the country. This is in fact not observed. Past participants in this survey and earlier ones describe the high quality of the Coaches, their passion for teaching and their ability to instill knowledge, study skills, leadership characteristics, and team cohesion in students. In an era where little tangible support is provided for high school teachers to participate in programs such as the NOSB, the NOSB has developed, sustained, and captured the attention and imaginations of a quality cadre of secondary teachers. This suggests several mechanisms through which the NOSB program is contributing to high quality education in America's secondary schools. These teachers do not teach only the five students attached to the school's NOSB team. The enhanced content knowledge for ocean and aquatic science these teachers obtain through preparation and work with the NOSB team is knowledge available for transfer and integration in a wide array of courses, and with hundreds of additional students annually. This communications capability that fosters knowledge growth and transfer is an important characteristic of the NOSB program. Additional, follow-up study of the coaches themselves has begun this current fall, and additional data summaries and reporting will be available early in 2015 to describe these teacher accomplishments.

Finally, as has emerged since the earliest tracking efforts, NOSB is clearly more than "just a competition or quiz bowl." The past participants who describe this program in fact describe a robust network of learners, of friends, fellow-students, and in later stages, of co-workers and professionals. Many of these young people find in the NOSB, as one of them described in this most recent survey, an "awareness that there are other people who are passionate about science." They find they are not alone in their intellectual curiosity nor their willingness to devote long hours of study to STEM content. This group of past participants represents a growing network of STEM professionals with a common background: deep commitment to ocean science. Few STEM education programs have *documented* such an accomplishment for such a sustained period.