Evaluation Report of the NOAA Teacher at Sea Program: 2005-2009

Final Report
May 2010

Submitted by:
Bora Simmons, PhD

Prepared for:
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
NOAA Teacher at Sea Program

The data collection, analysis, and reporting of this material were conducted in accordance with OMB 0648-0600.

Table of Contents

Executive Summary

The NOAA Teacher at Sea Program was initiated in 1990, with the first teacher participating in a cruise in 1991. Since that time 600 educators have participated in oceanographic research along side of NOAA scientists. Given program history and growth, NOAA Teacher at Sea staff determined that it was appropriate to document how well the program works and whether stated goals are being met. As a consequence, a systematic evaluation of the NOAA Teacher at Sea Program was designed. Recognizing, however, that resources are limited to support a comprehensive evaluation, a three phased approach was followed:

- Phase I - In-depth Pilot Interviews (Completed August 2008)
- Phase II - Classroom Implementation Survey (Completed March 2010); and
- Phase III - In-depth Follow-up Interviews (Completed April 2010).

Phase I Interviews

Five NOAA Teacher at Sea past participants were randomly selected to be interviewed about their experiences while on the cruise and how they followed up when back in the classroom. Phase I evaluation results were overwhelmingly positive. Teachers spoke enthusiastically about their experiences and praised the program. The results from this set of interviews indicate that:

- Teachers use the NOAA Teacher at Sea experience back in the classroom.
- The NOAA Teacher at Sea experience impacts how teachers teach.
- The NOAA Teacher at Sea experience impacts participants on a very personal level.
- Participants share their NOAA Teacher at Sea experiences with others (i.e., students, community members, other teachers).
- On a somewhat limited basis, participants talked with others, including students and other teachers, about possible NOAA-related career opportunities.

Phase II Survey

Building off of the Phase I interview results, an 87 item on-line survey was constructed and administered to educators who participated in the program during 2005-2009. A total of 83 educators completed the survey which represents a 72.8% response rate. Phase II evaluation results were positive. Teachers rated the experience as extremely worthwhile (mean=6.6 on a 1-7 scale). In open-ended responses, they offered enthusiastic endorsements of the program and what it has done for their teaching. The survey results indicate that that the NOAA Teacher at Sea experience impacts *how* and *what* teachers teach:

- Teachers report that they have increased their understanding of NOAA science, especially as it relates to the world's oceans.
- Teachers report increased confidence in their abilities to teach about the world's oceans, use NOAA research data and other resources, and to integrate NOAA-related science lessons into the curriculum.
- As compared to their teaching before they participated in the NOAA Teacher at Sea Program, educators are significantly more likely to use NOAA resources and data, teach about ocean-related topics, use inquiry to teach science concepts and skills, and engage their students in a long-term study.
- As compared to their teaching before they participated in the NOAA Teacher at Sea Program, educators are significantly more likely to talk with students and teachers about NOAA-related career opportunities.

Phase III In-depth Follow-up Interviews

The final phase involved interviewing nine randomly selected participants from the 2005-2009 seasons. Educators were asked to describe the single most important outcome of their participation in the NOAA Teacher at Sea experience, how the experience has impacted their long-term interest in teaching, the most important impact of the experience on their students, and suggestions related to the NOAA Teacher at Sea Alumni Association. The interviews provide additional qualitative evidence that the NOAA Teacher at Sea Program is impacting science teaching and learning:

- Teachers identify participation in real world science and the opportunity to learn science directly from research scientists as the major outcome of the NOAA Teacher at Sea experience.
- Teachers report that the NOAA Teacher at Sea experience rejuvenated their interest in teaching.
- Teachers report both tangible and intangible impacts of the NOAA Teacher at Sea experience on their students' science learning and their interest in science careers.
- Teachers use the NOAA website for background information, as a resource for lesson ideas, and as a resource for data.
- Teachers welcome opportunities to remain active in the NOAA Teacher at Sea Program.

Addressing NOAA Teacher at Sea Program Goals

The NOAA Teacher at Sea program has articulated a set of short-, mid- and long-term goals:

Short-term Goals (Skills and Knowledge)

Teachers will:

- Understand how NOAA oceanic and atmospheric research is linked to National Education Science Standards and Ocean Literacy Principles.
- Understand the education and training paths that lead to NOAA-related careers.

Mid-term Goals (Behavior and Action)

Teachers will:

- Use NOAA data and resources in classroom activities.
- Use NOAA-related career information in classroom activities, when mentoring students and when working with colleagues.

Long-term Goals (Social, Environmental, and Economic)

The NOAA Teacher at Sea Program will:

- Build an understanding of NOAA-related sciences among teachers and students.
- Build a workforce for NOAA-related careers.

Quantitative and qualitative evaluation results across all three phases indicate that the NOAA Teacher at Sea program is addressing both its short-term and

mid-term goals. Educators understand how NOAA research efforts link to the National Science Education Standards. In addition, they express an increased understanding of NOAA career pathways. The NOAA Teacher at Sea participants have taken their experiences back to their classrooms. They use NOAA data, lesson plans and website resources. They use NOAA-related career information in classroom activities and when working with colleagues and community members.

Finally, evaluation results indicate that the NOAA Teacher at Sea Program is addressing its long-term goal: Build an understanding of NOAA-related sciences among teachers and students. Educators report that their own understanding of NOAA sciences has increased. In addition, the educators report that their students are more engaged in their science learning, know more about science as it applies to the world's oceans/atmosphere/climate, and have an appreciation for the relevance of scientific research.

Measuring success on the final goal, "Build a workforce for NOAA-related careers," requires a longitudinal approach not within the scope of this survey.

Introduction

NOAA's Teacher at Sea Program has a rich history. Since its inception in 1990, the NOAA Teacher at Sea Program has served 600 educators. Depending on available funding, approximately 20-30 educators participate annually. Educators are given the opportunity to participate first hand in research, working directly with scientists and research vessel crew. As alumni they are expected to take their experiences back to their classrooms and communities.

NOAA's Teacher at Sea Program is designed to meet the following set of goals:

Short-term Goals (Skills and Knowledge)

Teachers will:

- Understand how NOAA oceanic and atmospheric research is linked to National Education Science Standards and Ocean Literacy Principles.
- Understand the education and training paths that lead to NOAA-related careers.

Mid-term Goals (Behavior and Action)

Teachers will:

- Use NOAA data and resources in classroom activities.
- Use NOAA-related career information in classroom activities, when mentoring students and when working with colleagues.

Long-term Goals (Social, Environmental, and Economic)

The NOAA Teacher at Sea Program will:

- Build an understanding of NOAA-related sciences among teachers and students.
- Build a workforce for NOAA-related careers.

Over the last five years, NOAA has increased its investment in the NOAA Teacher at Sea Program. Although participant on-board costs have always been covered, travel to the host ship is now also paid from program funds. Previously, participants paid their own travel costs to the host ship. In addition, NOAA staff members have been able to commit time and other resources to the support of the educators before, during and after their shipboard experience.

With this increased investment, the NOAA Teacher at Sea staff determined that it was appropriate to document how well the program works and whether stated goals are being met. As a consequence, a systematic evaluation of the NOAA Teacher at Sea Program was designed. Recognizing, however, that resources are limited to support a comprehensive evaluation, a three phased approach was followed:

- Phase I - In-depth Pilot Interviews (Completed August 2008)
- Phase II - Classroom Implementation Survey (Completed March 2010); and
- Phase III - In-depth Follow-up Interviews (Completed April 2010).

Phase I - In-depth Pilot Interviews

The primary purpose of Phase I of the evaluation strategy was to determine *how* participants talk about their NOAA Teacher at Sea experience. These data are useful in of themselves, allowing NOAA Teacher at Sea Program staff to gain a snap shot of participant perceptions, experiences and post cruise activities. Additionally, the results of these interviews were used to inform the design of the Classroom Implementation Survey (Phase II).

In-depth Pilot Interview Methodology

To facilitate the interview process, NOAA Teacher at Sea Program staff provided a list of all participants and their contact information for the previous three seasons (2005-2007). Using a random number table, five participants were selected for interview. These teachers were contacted by email and asked if they would be willing to participate in a 30 minute phone interview. The general purpose of the interview was outlined in the email invitation (Appendix A). All five of the teachers consented and mutually agreed upon times for the phone interview were established.

Each interview followed the same protocol. Participants were called at the appointed time. After a short introduction and explanation of the purpose of the interview, participants were asked a series of open-ended questions (see Appendix B). The questions were designed to allow participants the opportunity to talk freely about their experiences on the cruise as well as how they used their NOAA Teacher at Sea experience back in the classroom. One closed-ended and like-type question was asked at the end of the interview. The five interviews were all conducted in June - July 2008.

In-depth Pilot Interview Results

Interview results from Phase I of the evaluation were positive, suggesting that the NOAA Teacher at Sea Program is achieving its goals. Participants expressed a great deal of satisfaction with the NOAA Teacher at Sea Program in general as well as with specific experiences on their individual cruises. All of the teachers reported taking their NOAA Teacher at Sea experiences back to their classrooms and their communities. In addition, all five of the teachers indicated that the

NOAA Teacher at Sea Program had a positive impact on them both personally and as an educator.

Participant Demographics

Interview participants ranged from those who were experienced teachers (24 years in the classroom) to relatively new teachers (5 years in the classroom). Two participants teach primarily at the high school level (grades 9-12), two teach primarily at the middle school level (grades 5-8), and one teaches at the upper elementary level (4th grade). Only one participant teaches in a self-contained classroom (i.e., teaches subjects across the curriculum). The other four participants all teach science. Specific science courses include: biology, AP biology, anatomy and physiology, general science, environmental science, AP environmental science, oceanography, and honors biology. All of the participants reported that they teach students with a range of ability levels and interests in science.

Use of the NOAA Teacher at Sea Experience Back in the Classroom

All five of the participants reported using their NOAA Teacher at Sea experiences back in the classroom to one degree or another. For one of the teachers, this integration began while onboard ship. She was able to communicate with her students on a regular basis which meant that the students felt a "more meaningful connection"[1] to her experience. While onboard, the students started a mapping project that was continued for two years. "Students made their own personal tracking maps. We also had a huge map in the hall that we shared with the rest of the school. We would add to this map track each week. In the classroom, we had a big map and tracked each day, placing a sticker in the proper locations. The kids learned a lot about map reading and how maps work. To be perfectly honest, I wouldn't have taught this before my cruise."

Another teacher used GPS, GIS, distance probes and conductivity probes to explore a number of different questions with his students. Through these lessons students were able to "Think about information at a different level – what is the best way for you to understand the material? Where am I and how do I know that? How can you use photo mosaics to know where something is? How

[1] Participant quotes are used throughout this report. These are direct quotations and are meant to provide concrete imagery and context. In addition to providing data on teachers' experiences, quotations from the pilot interviews were also used to formulate questionnaire items since they reflected the participants own words or descriptions of their experiences.

different materials corrode in the water? What grows on objects on the ocean floor? We could see the stuff growing and catalogue what was seen (Kingdom, phylum). We could also ask questions about meteorology and air flight. "

In one case, the cruise and onboard experience with an ROV led to collaboration with the physics teacher. Ultimately, students built their own PVC ROV and "competed at the regional level at the scout or basic level. In the 2nd year, the students competed at the ranger level and received the best overall score for regional level. This led to being able to compete at the international level (SCRIPS) – where they won one of the events. Not bad."

Additionally, teachers used cruise experiences to craft lessons on measurement, symmetry, the scientific way of knowing, and global issues as well as "adding a section on ecology and fisheries. We looked at how fisheries have changed and why. We also looked at invasive species, the global warming impact on island species and issues such as breeding temperatures. We've looked at rights of native populations and the impacts of a national sanctuary." Participants often reported using pictures and other artifacts from their cruises to illustrate lessons and one teacher reported integrating her cruise experience into reading and literature. Finally, at least one of the teachers has introduced the students to the NOAA website so that they might "find various types of data for their projects."

As one teacher summed it up "I used it a lot more than I thought I would. I've used it a hundred times more than I thought I would."

How the NOAA Teacher at Sea Experience Has Impacted Their Teaching

All five of the teachers reported that the NOAA Teacher at Sea experience had changed their teaching at least to some degree. Most often teachers suggested that the NOAA Teacher at Sea experience had impacted their understanding and appreciation of science and scientific research and that they brought that back into the classroom. This is particularly remarkable since four of the five participants teach science as their primary responsibility: "I am more aware or become more aware of the real science instead of just depending on the textbook. We access the weather service every day. We track every hurricane during hurricane season through the NOAA hurricane center – even though we aren't really impacted by hurricanes and they aren't covered in our standards. … a lot of changes in technology – Teacher at Sea opened my eyes of what is available." Another participant offered, "I was a Bio major. I was taught about research, but as a teacher, you're not researching. I got out of it [Teacher at Sea

program] as a teacher – it got me back into doing real science – it was a chance to re-connect to research and actually work on a research study."

All of the teachers commented on how important it was that the NOAA Teacher at Sea program provided first hand or real world experiences for their students. One participant commented: "My kids know that they have a teacher who loves science - someone who goes out and tries to answer the big questions." Other representative comments included: "The program … establishes better credibility of who is teaching the kids – it enhances my teaching. I'm looking for and seeking out ways to helping kids to love science. The real value is the first hand experiences – that's the change in me and my teaching. I have students write an evaluation of class – they said things like, 'I think it is interesting that you go on boats and work with explosives' – the students take away ideas about these wonderful opportunities - ways that we can learn – first hand experiences." "It really increased my ability to go back to my classroom and give examples from first hand experiences. I went into Teachers at Sea in my 3rd year [of teaching]. I had a list of questions in back of my head, but what was really cool was that I could tell the students - I talked to a scientist who studied this and this is what they say. The students appreciate that." "It's all about science in action in the classroom – showing them how science really works." "It has changed how I teach a little bit – there's a higher level of what I want the kids exposed to-exposed to real life science expeditions. I continue to watch Ocean Live portal and we are a host school for Earthwatch expedition (in the Arctic and Bahamas). It makes it more real for them – gives a first-hand experience rather getting just out of a textbook."

Finally, one of the participants mentioned inquiry specifically. "I do try to do a lot more inquiry-based instruction – students drive the instruction. With inquiry based instruction you show students – they get to collect their own data. Because I was on the ship collecting data – we could talk about how the questions are more important than answers. It's good to get out and do research – students take more ownership of research. They see the global perspective – not just memorization."

Workforce Recruitment

Participants were asked to what extent they talked with others, including students and other teachers, about possible NOAA-related career opportunities. Two of the participants admitted that this had not been a focus of their post-cruise activities and that other than a few casual conversations they had not discussed

career-related topics with others. One teacher reported sharing information primarily with friends who have older children with identified interests in the sciences. However, the two remaining participants did make some effort to introduce career-related information to their students. In both cases the teachers invited a guest speaker to their classes. “One of my goals is to help kids understand that if they have a passion or interest, they should explore that passion. I had an oceanographer come and talk to the students. He showed the students pictures of the ocean and a video.” In addition, one teacher introduced his students to the website oceancareers.com so that they could “figure out what opportunities are out there.”

Sharing NOAA Teacher at Sea Information with Colleagues and Community Members

All five of the participants reported sharing some aspect of their NOAA Teacher at Sea experiences with others outside of the classroom. Examples included making presentations to local community service organizations (e.g., Rotary, Kiwanis), specialty interest groups (e.g., gem & mineral club), science groups (e.g., biology association), teacher’s groups (e.g., NSTA, reading association), school parents, school board members, and college-level science students. In addition, participants reported displaying cruise photos at the local library and being interviewed on radio and TV.

Personal Impact

Each of the five participants described his/her cruise in very personal terms. Relationships with researchers and other ship personnel were highlighted. Not only did the participants indicate a high level of respect for these individuals because of the work they do, but they each expressed gratitude that ship personnel had been willing to freely share their areas of expertise. As one participant explained “I met wonderful people – even the crew – the cooks, engineers and skilled fishermen. I developed a deep respect across the board for all people on the boat.” Other participants added to this theme: “I had a wonderful experience. The captain and the crew – everyone was wonderful.” “I was very impressed with NOAA on-board my ship. This experience broadened my horizons.” “Every day – I learned so much. I was intrigued by the scientists and the engineers.”

Participants also reported a heightened respect for the ocean. The following are representative quotes from various participants: “I was awed by the numbers [of

animals] and what the survey represented. It is mind boggling." "I have much more respect for the ocean now." "I'm far more aware of the environmental impacts on the ocean. I've even bought a cook book on sustainable fishing." "I have much more respect for the ocean!" "Personally I have much more respect for the fisheries and how they work and a better understanding of the politics – the hoops the people who work in government have to jump through."

Primary Challenges of Participating in the NOAA Teacher at Sea Program

Participants were asked "What, if any, were the biggest challenges?" Interestingly, each participant identified a unique set of challenges. It must be noted that none of the participants expressed distress or any particular level of concern over these challenges. As might be expected, one participant discussed the challenge of working 12 hours shifts and indicated that, at times, it was difficult to "keep up with the college kids." Another participant reported difficulty with understanding the science and that although he felt he had a strong general science background "each discipline has its own language." In the end, this challenge was lessened because "scientists were great at trying to explain things to me." Trying to find different ways of connecting the experience to the classroom in a landlocked state was identified by one teacher. In this case, the answer seemed to be to "make connections between the ocean and local lakes and rivers."

Overall Rating of NOAA Teacher at Sea Experiences

The last question of the interview asked participants to rate how worthwhile their NOAA Teacher at Sea experience was on a 7 point scale. All five of the participants rated the experience as a "7" (extremely worthwhile). One participant responded that she would rate it as an "8" if allowed and two offered, in response to this question, that they would like to apply for another cruise.

General Comments

Throughout the interview, participants offered overwhelmingly positive comments about the NOAA Teacher at Sea experience. The following are a few of those comments:

"Oh wow – this was the best Teacher at Sea experience of anyone in the history of Teacher at Sea."

"I just didn't have a clue – everything was new to me! I was pretty nervous about being out to sea for three weeks and not seeing land. I was thankful that I enjoyed it. It was too exciting not want to be there."

"I highly recommend the program to everyone I meet. NOAA is reaching so many people. I've attended many other teacher programs, but Teacher at Sea ranks at the top."

"The Teacher at Sea experience was wonderful."

"I hope the program continues for educators and their students!!! It's our responsibility to share this with students – to inspire some learning. Magnificent! I had a wonderful time."

"Even my parents who watch PBS have learned something. Now they tell me – I read this about NOAA. Before they knew what NOAA was, but didn't pay attention. Now they do."

"It was entirely positive – fantastic – from the initial contacts to the research people. All of the follow up – I couldn't have asked for a better cruise to be involved with."

Summary

Phase I evaluation results are positive. Teachers spoke enthusiastically about their experiences and praised the program. The results from this set of interviews indicate that:

- Teachers use the NOAA Teacher at Sea experience back in the classroom.
- The NOAA Teacher at Sea experience impacts how teachers teach.
- The NOAA Teacher at Sea experience impacts participants on a very personal level.
- Participants share their NOAA Teacher at Sea experiences with others (students, community members, teachers).
- On a somewhat limited basis, participants talked with others, including students and other teachers, about possible NOAA-related career opportunities.

Phase II - Classroom Implementation Survey

NOAA Teacher at Sea participants for the 2005-2009 seasons were asked to complete an on-line survey. Participants completing the survey have been back in their classrooms for a minimum of one semester and up to 4 ½ years. By surveying these individuals, NOAA staff members gain a better idea of *how* and to *what degree* participants are using their experiences in their own classrooms (e.g., using NOAA data and resources in classroom activities), the degree to which they are impacting other formal and non-formal educators (e.g., sharing NOAA science with other educators), and the degree to which they share information about NOAA careers (e.g., talking to students individually about career opportunities, incorporating a career component into classes). The results of the survey conducted in Phase II were used to inform the design of the Follow-up In-depth Participant Interviews (Phase III) completed in April 2010.

Classroom Implementation Survey Methodology

Using NOAA Teacher at Sea Program staff priorities and the results of Phase I In-depth Pilot Interviews, an 87 item survey instrument was designed (see Appendix C). Once the NOAA Teacher Survey was approved by OMB it was administered via the Internet using Survey Monkey. To facilitate the survey process, NOAA Teacher at Sea Program staff provided a list of all participants and their contact information for the previous five seasons (2005-2009). Email invitations to participate in the survey were sent to 137 NOAA Teacher at Sea participants. Some NOAA Teacher at Sea participants had previously opted out of the Survey Monkey system. In other cases, email addresses were no longer good and bounced back. A total of 114 individuals received the invitation to participate. Four reminder emails were sent at one week intervals to non-respondents. After six weeks, the survey was closed. A total of 83 responses were received which represents a 72.8% response rate.

Classroom Implementation Survey Results

Participant Demographics

The following summarizes the background of respondents: location of the cruise, grade level(s) taught, number of years in teaching, subject(s) taught, and science background. It should be noted that most (97.1%) of the educators identified

themselves as science teachers. It should also be noted that less than half (44.5%) of the teachers had earned a major or minor in a science discipline.

Location of NOAA Teacher at Sea Cruise		
Region	**Number Responding**	**Percentage**
Alaska	28	31.5%
North Atlantic	20	22.5%
Pacific Islands	15	16.9%
Western Region	10	11.2%
Florida	16	18.0%

***** Some respondents participated in more than one cruise.

Number of Years Taught

Range: 6-37 years
Mean: 16.5 years

Subject Taught	Number Responding	Percentage
Science	68	97.1%
Math	21	30.0%
Social Studies	18	25.7%
English	15	21.4%
Reading	16	22.9%
Fine Arts	4	5.7%
Other	20	28.6%

Some respondents teach more than one subject.

	Number Responding	Percentage
College major of minor in science discipline	37	44.5%
College major in science education	6	7.2%
Research experience (other than TAS)	24	28.9%
Participation in other teacher-researcher programs	9	10.8%

Grade Level(s) Currently Teaching		
Grade Level	**Number Responding**	**Percentage**
K	5	6.6%
1	7	9.2%
2	9	11.8%
3	12	15.8%
4	17	22.4%
5	17	22.4%
6	18	23.7%
7	15	19.7%
8	16	21.1%
9	20	26.3%
10	22	28.9%
11	23	30.3%
12	23	30.3%
College	10	13.2%
Other	9	11.8%

Some respondents teach more than one grade level.

Satisfaction with the NOAA Teacher at Sea Program

Participants were asked to rate their NOAA experience on a scale of 1 to 7, with 1 being not at all worthwhile and 7 being extremely worthwhile. The mean rating of 6.6 indicates that the participants believe the NOAA Teacher at Sea program to be extremely worthwhile.

Impact of the NOAA Teacher at Sea Program

Participants were asked a series of questions to gauge the impact that the NOAA Teacher at Sea Program had on teachers and their students. For much of the survey, educators were asked to reflect back on their experiences and report the degree to which they felt the NOAA Teacher at Sea Program had increased their level of understanding and confidence. In order to provide a more direct measurement of impact, some survey questions were designed using a retrospective pre/post format. That is, in answering a series of questions, teachers were asked to consider their teaching before their participation in the NOAA Teacher at Sea Program. They were then asked the same series of

questions, but asked to consider their teaching after their participation in the NOAA Teacher at Sea Program. By comparing the two answers (before and after), it is possible to gauge the impact of the NOAA Teacher at Sea Program on educators' practice.

Teacher Understanding and Confidence

If educators are going to change their teaching behavior and increase the degree to which they engage their students in real world science, they must first understand the science content and feel confident in their teaching abilities. Two sets of questions on the survey addressed these issues.

As can be seen in Table 1, teachers consistently report increased understanding across a range of topics. As might be expected, the two highest rated items relate directly to the understanding of science as it applies to the world's oceans and understanding of ocean-related environmental issues.

Table 1: Teacher Understanding **Rating scale**: 1=Strongly disagree 6=Strongly agree	**Mean Score**
Science as it applies to the world's oceans	5.6
Science as it applies to the world's atmosphere	4.9
Science as it applies to the world's climate	4.9
How NOAA research efforts can be linked to the National Science Education Standards	5.2
How NOAA research efforts link to the Ocean Literacy: Essential Principles and Fundamental Concepts	4.9
How NOAA research efforts link to the Climate Literacy: essential Principles and Fundamental Concepts	4.7
The key education and training paths that lead to NOAA-related careers	4.9
Ocean-related environmental issues	5.4
Climate-related environmental issues	5.0
How to access NOAA research data that can be incorporated into my classroom lessons	5.1
The range of educational resources offered by NOAA	5.2

Similarly, educators report an increased confidence in their abilities (Table 2). It is noteworthy that the lowest rated items relate specifically to confidence in teaching science as it applies to the world's atmosphere and the world's climate.

Given the focus of the NOAA Teacher at Sea Program, these results are not surprising. Although a few of the participants conducted research involving climate (e.g., La Nina and El Nino) or the atmosphere, most conducted fisheries research (e.g., Alaska Pollock, Scallop, clams), phytoplankton research, or hydrographic surveys.

Table 2: Teacher Confidence **Rating scale**: 1=Strongly disagree 6=Strongly agree	**Mean Score**
Teach science as it applies to the world's oceans	5.3
Teach science as it applies to the world's atmosphere	4.8
Teach science as it applies to the world's climate	4.9
Incorporate NOAA education resources in my classroom(s)	5.3
Integrate NOAA-related science lessons into the curriculum	5.3
Research a NOAA-related environmental issue with my students	5.2
Use NOAA research data and other resources with my students	5.3

NOAA Science

NOAA education and research programs focus much of their attention on the atmosphere, ocean and climate. Through the NOAA Teacher at Sea Program, educators are given the opportunity to participate first hand in oceanographic and fisheries research. As can be seen in Table 3, educators consistently report a statistically significant pre/post increase in their likelihood of teaching NOAA science. As might be expected given the specific experiences gained on the research ships, teachers report a greater increase in teaching about the ocean as compared to the atmosphere or climate. Importantly, these teachers report that they are doing more than including the content of NOAA science in their classrooms. They are engaging their students in research and inquiry activities. Many are engaging their students in a long-term study of a NOAA-related topic (e.g., tracking hurricanes, mapping an expedition, graphing ocean water temperature). As a result of the NOAA Teacher at Sea Program, educators are changing their teacher behavior related to NOAA science.

Table 3: NOAA Science **Rating scale:** 1= Extremely Unlikely 6= Extremely Likely	**Mean Score BEFORE**	**Mean Score AFTER**
Teach about atmosphere-related topics	4.1	5.2**
Teacher about ocean-related topics	4.6	5.7**
Teach about climate-related topics	4.6	5.4**
Research a climate/ocean/atmosphere-related environmental issue with your students	4.0	5.3**
Talk with your students about the relevance of climate/ocean/atmospheric research	4.3	5.6**
Engage your students in a long-term study of a NOAA-related topic (e.g., tracking hurricanes, mapping an expedition, graphing ocean water temperature).	2.8	4.9**
Integrate lessons about climate/ocean/atmospheric sciences into your curriculum	4.3	5.5**
Use inquiry to teach science concepts and skills	5.3	5.8 *

* Statistically different at the .01 level

* Statistically different at the .001 level

NOAA Resources

Like many government agencies and not-for-profit organizations, NOAA provides a range of resources designed to inform the public and assist educators. The results suggest that the teachers use these resources significantly more after their NOAA Teacher at Sea experience than before (Table 4). Before their NOAA Teacher at Sea experience, educators report that they were *unlikely* to use NOAA specific resources such as data or research examples (mean = 2.8), website (mean = 3.2) or educational resources (mean = 3.1). After their NOAA Teacher at Sea experience, however, they are *very likely* to use these resources (means = 5.3, 5.5, and 5.4 respectively). It is interesting to note that the teachers also report using more real world examples as well as graphics to teach about research. This seems to indicate a broadening of how they are engaging their students in the subject matter.

Table 4: NOAA Resources **Rating scale:** 1= Extremely Unlikely 6= Extremely Likely	**Mean Score BEFORE**	**Mean Score AFTER**
NOAA data or research examples in your lessons	2.8	5.3*
NOAA websites as a resource in your lessons	3.2	5.5*
NOAA educational resources in your classroom instruction	3.1	5.4*
The Ocean Literacy: Essential Principles and Fundamental Concepts when designing lessons/units	2.4	5.0*
The Climate Literacy-Essential Principles and Fundamental Concepts when designing lessons/units	2.3	4.8*
Real world examples of research studies/results to teach science	4.1	5.8*
Photos, maps. Graphs, etc. to illustrate how scientists conduct research.	4.4	5.8*

* Statistically significant at the .001 level

Career Development

With the aging of the baby boomer generation, resource and conservation agencies are particularly concerned about workforce development. Although school programs often work to prepare students for future careers in general, career path information targeted specifically to NOAA must be consciously included by a motivated educator. As can be seen in Table 5, *before* their NOAA Teacher at Sea experience educators were unlikely to engage in activities with students or colleagues that support NOAA career development. *After* the cruise, however, teachers report a statistically significant increase in their likelihood of talking with colleagues about NOAA careers, encouraging students to consider NOAA careers, using NOAA career information, and arranging for students to meet scientists.

Table 5: Career Development **Rating scale:** 1= Extremely Unlikely 6= Extremely Likely	**Before Mean Score**	**After Mean Score**
Talk with colleagues about NOAA-related career paths	1.9	4.9*
Encourage students to consider NOAA-related careers	2.2	5.3*
Use NOAA-related career information to mentor students	1.9	4.9*
Arrange for your students to meet scientists or read about possible NOAA-related careers	2.3	5.0*
Talk with your students about what scientists do	4.8	5.9*

* Statistically significant at the .001 level

Student Impact

Of course, the ultimate purpose of any educational program is the improvement of student learning. The teachers believe that their students are better prepared to use science, are more engaged in science learning, know more about science, and have a greater appreciation of science *because* of their participation in the NOAA Teacher at Sea Program.

Table 6: Student Impact **Rating scale**: 1=Strongly disagree 6=Strongly agree	**Mean Score**
Are better prepared to use the results of real world science	5.0
Are more engaged in their science learning	5.2
Know more about science as it applies to the world's oceans/atmosphere/climate	5.2
Have an appreciations for the relevance of scientific research	5.1
Are familiar with NOAA and what NOAA scientists do	5.1
Are more likely to act to protect the environment	4.9
Understand that NOAA provides research-based information that they can use to make important decisions	5.0

Suggestions for Improvement

Finally, participants were asked how this NOAA program could be improved to better prepare educators to teacher about climate/ocean/atmospheric sciences. Most of the participants took this opportunity to express their gratitude and pleasure with the NOAA Teacher at Sea experience.

Sample comments included:

"I think NOAA does a fantastic job reaching out to educators about the research being conducted on the climate, ocean and atmosphere."

"I would change nothing!"

"They all do a really great job and are flexible! They gave me two chances at a truly fantastic experience!!"

"Amazing program!!!"

"TAS program is a wonderful experience…"

"Expand TAS for more teachers."

"I think NOAA does a great job!"

"…I can't state how highly impressed I was with the whole experience."

"Send out more people! It is a wonderful program that has brought more to my teaching than I can ever tell you."

"I think the program is fantastic."

"Teacher at Sea is an excellent program without compare. This program gave a land locked teacher the ocean experience of a lifetime. Because of this opportunity ALL my students have benefitted and for that I say Thank You."

"NOAA does an outstanding job. It is our responsibility as creative teachers to find ways to tie our experiences into our curricula. The blogs are fantastic. I think they are very powerful in the classroom."

Many of the participants also took this opportunity to make suggestions. Most of these suggestions fell into four categories:

1. Increased opportunities for *collaboration* amongst NOAA NOAA Teacher at Sea educators.

Sample comments included:
"My only suggestion would be to create an avenue for continual collaboration amongst TAS alumni particularly as it pertains to the networking of people teaching similar grade levels. As an instructor at a junior college I work amid a demographic that is very different from K-12 and I would love nothing more than to join forces with another TAS alum who is also keeping the TAS experience alive both in the class room and laboratory. That being said, I hope that NOAA realizes that the TAS experience has been a shaping force for the development of our colleges first Marine biology course. My connection to NOAA and participation in their various programs has not only legitimized my efforts to bring ocean literacy to our landlocked community college but has given me a tremendous sense of confidence which for me comes only with real life experience."

"It is strictly up to the individual. A Google Group to share lessons and communicate between us would be the only addition. I appreciate that the responsibility is up to the individual, however I would like to be able to maintain contact with others to perhaps share images and resources learned."

"One of the best things about my experience was that two of us from my school were selected in the same year. I know our teaching was enhanced by the collaboration that grew out of our shared experience. Perhaps some consideration could be given to offering space when possible to two or three person teams from one school or school system. My only other thought is that I had to work very hard to transfer my new knowledge in a practical way to an elementary school setting. My students certainly benefited from a teacher with more depth of knowledge, and they really enjoyed and learned a lot from tracking the drifter buoy we released."

2. Access to increased information *before* the cruise.

Sample comments included:
"Having a short "course" to front load teachers about the science they will be participating in while at sea. Other than that, the actual experience itself is the best preparation."

"Provide resources and background prior to sailing about the work/projects related to the research that participants will be involved in to help them be more prepared."

"Possibly have some pre-work teachers must do before they leave. Like the ARMADA project does."

"Expand what you are currently doing. It wouldn't hurt to have a bit more teacher training before the research project."

"Would have love some advance resources about hydrographic surveying. On the ship I was exposed to s video detailing the history etc. This would have been great to have in advance. Excerpts from the HIC workbook would have also given some advance knowledge especially about how to start thinking about incorporating it into the classroom."

3. Access to increased resources/data/professional development *after* the cruise.

These requests tended to focus on four areas: access to lesson plans, access to data gathered while they were at sea, professional development and availability of scientists to speak at schools.

<u>Access to Lesson Plans</u>

Sample comments included:
"I wish I could have access to the classroom units that previous Teacher at Sea participants produced after their tours."

"Easier way to locate lesson plans and activities."

"Provide a database for collecting lessons/ ideas used by TAS alumni."

"More feedback about lesson plans created after the experience is over. Provide a venue for TAS alumni to share classroom resources they create or obtain related to the experience."

"If we are trying to reach all teachers attempting to provide instruction in climate/ocean/atmospheric sciences/increase instruction in these areas, I have these suggestions:

1. Assemble groups of NOAA Teacher at Sea Alumni to collaborate in developing lesson modules to address National Standards for various grade levels and topics. These teachers could meet in Maryland or other NOAA location for one to two weeks during the summer.

2. Existing lesson plans could be distributed to TAS alumni for review by grade level and topic. The reviewing teachers could make suggestions for additional plans to add to these plans in an attempt to create a complete learning module or unit. The next step would be to "assign" a topic for each teacher to create a plan. The teachers could assemble as a group to edit and extend these plans/modules and produce this excellent resource for other educators to utilize.

I also believe the nature of NOAAs resources lend themselves to interdisciplinary work - It would be great to create an online site and activities like the JASON Project - for students to interact - it may be a good place for Teachers at Sea to take data, picts and video and create curriculum that can be used by students all over. NOAA also has a place on Second Life - this would be great in an online site that is a little better accessible for younger students."

Access to Data

Sample comments included:
"I also wish real data, gathered while at sea, could be accessible to teachers, with lesson plans showing how to analyze and interpret the data. I also wish there was some way to know what happened to the data we collected."

"Provide access to specific data and other resources that will make lesson planning based on the experience easier."

Professional Development

Sample comments included:
"The experience has been very beneficial and productive for my school and me personally. The hands-on on site learning is invaluable to teacher and students alike. My students are able to go the NOAA TAS website and share my experiences. I have participated in NOAA twice at sea and once as a contributor to the Teacher at NOAA program while in Silver Springs, MD. This program is outstanding and needs little tweaking, however, a yearly week long workshop to

show teachers how to teach literacy principles or ocean concepts using inquiry could be beneficial for teachers. Many teachers need some professional development to help take their experiences into the classroom with a hands-on approach for their students and relate them to other related topic areas in marine biology, geography, or other ocean sciences. Overall the program is very successful and should be funded even further to allow more teachers to experience and bring the experience into their classrooms."

"One final thought would be for NOAA to host teacher workshops that align with state standards where teachers can learn/plan/develop a unit to take back to the classroom."

NOAA Scientists

Sample comments included:
"Also setup video conferencing with scientists."

"Offer to come to schools to do presentations."

"NOAA could send a person to schools to speak on behalf of their work, resources, and opportunities available to encourage schools and teachers to use NOAA's resources more effectively. A traveling assembly for school groups or education workshops would be a great way to bring NOAA to schools and encourage teachers to teach about climate/ocean/atmospheric sciences. "

4. Expanded Communication *During* the Cruise

Sample comments included:
"TAS program is a wonderful experience as technology improves communications between teacher and students would be a plus for the program. For instance, via satellite classroom! I was able to briefly chat online with my students while on my cruise and they were able to ask the scientists questions which made it a very realistic experience for my students. As technology develops I would enjoy seeing other teachers at sea with video feedback classrooms. Thank you NOAA for the experience and for all you do!"

"My experience almost could not have been better. The only thing I could say was if I could have reported back to the classroom live from the ship. Overall it was a very worthwhile experience that I will never forget."

Relevance of Ocean/Atmosphere/Climate Topics to Standards

Most educators in K-12 public schools are held accountable to meeting specific state and local student standards. Participants were asked to indicate whether NOAA topics (i.e., world's oceans, atmosphere, and climate) were part of the required science curriculum in their school, district, and state. In addition, they were asked if their NOAA research topic was part of the required curriculum. As can be seen in the following tables, there seems to be a reasonable amount of overlap between NOAA topics and the required curriculum.

Are topics related to the world's oceans part of the required science curriculum for your:

	Yes	No	N/A
School	69.2 %	26.9%	3.8%
District	67.5%	19.5%	13.0
State	72.7%	15.6%	11.7%

Are topics related to weather and atmosphere part of the required science curriculum for your:

	Yes	No	N/A
School	81.8%	14.3%	3.9%
District	75.3%	11.7%	13.0%
State	77.6%	10.5%	11.8%

Are topics related to the world's climate part of the required science curriculum for your:

	Yes	No	N/A
School	79.2%	16.9%	3.9%
District	71.1%	14.5%	14.5%
State	77.6%	9.2%	13.2%

In reference to your experience with NOAA, are the research topics you learned about part of the required science curriculum for your:

	Yes	No	N/A
School	64.1%	33.3%	2.6%
District	57.1%	28.6%	14.3%
State	58.4%	29.9%	11.7%

Summary

Phase II evaluation results are positive. Teachers rated the experience as extremely worthwhile (mean=6.6). In open-ended responses, they offered enthusiastic endorsements of the program and what it has done for their teaching. The survey results indicate that that the NOAA Teacher at Sea experience impacts both *how* and *what* teachers teach:

- Teachers report that they have increased their understanding of NOAA science, especially as it relates to the world's oceans.
- Teachers report increased confidence in their abilities to teach about the world's oceans, use NOAA research data and other resources, and to integrate NOAA-related science lessons into the curriculum.
- As compared to their teaching before they participated in the NOAA Teacher at Sea Program, educators are significantly more likely to use NOAA resources and data, teach about ocean-related topics, use inquiry to teach science concepts and skills, and engage their students in a long-term study.
- As compared to their teaching before they participated in the NOAA Teacher at Sea Program, educators are significantly more likely to talk with students and teachers about NOAA-related career opportunities.

Phase III – In-depth Follow-up Interviews

Building directly off of the survey results, the primary purpose of Phase III of the evaluation strategy was to provide an expanded understanding of how the program impacts teachers and their students. In addition, these follow-up interviews afforded an opportunity to explore questions related to NOAA website use and interest in the NOAA Teacher at Sea Alumni Association.

In-depth Follow-up Interview Methodology

Using a list of all participants and their contact information for the previous five seasons (2005-2009) and a random number table, participants were selected for interview. These teachers were contacted, in order, by email and asked if they would be willing to participate in a 30 minute phone interview. The general purpose of the interview was outlined in the email invitation (Appendix D). When nine of the teachers consented, mutually agreed upon times for the phone interview were established.

Each interview followed the same protocol. Participants were called at the appointed time. After a short introduction and explanation of the purpose of the interview, participants were asked a series of open-ended questions (see Appendix E). The questions were designed to allow participants the opportunity to talk freely about the impact of their NOAA Teacher at Sea experiences on themselves and their students as well as how they use NOAA resources. The interviews were all conducted in March-April 2010.

In-depth Follow-up Interview Results

Interview results from Phase III of the evaluation were positive. Participants described ways in which the NOAA Teacher at Sea experience had impacted them, their teaching and their students.

Participant Demographics

Interview participants were, for the most part, experienced teachers, ranging from 8 years in the classroom to over 25 years. Although most of the interviewees teach science at the middle school or high school levels, one teaches in a self-contained third grade classroom and another teaches at a university.

Teacher Impact

Interview participants were asked two questions that were designed to gauge how the program has impacted them:

- What do you think was the single most important outcome of your participation in the NOAA Teacher at Sea program?
- In what ways, if at all, has your NOAA Teacher at Sea experience affected your long-term interest in teaching?

Responses to both of these questions were overwhelmingly positive. Only one individual expressed some disappointment in how the cruise was organized and thus, did not feel that she gained as much as could have been possible.

Single Most Important Outcome

The educators expressed impact in very personal terms, but a common theme centered on being part of a real world research experience and learning science directly from scientists. As one teacher said, the most important outcome was "seeing science in action - first hand." Others focused specifically on what they learned from the crew: "I think it is fair to say that I gained an appreciation for the kind of work NOAA scientist do and the important role they play. For someone who started out wanting to be Jacque Cousteau – anything on the ocean is/was interesting. Learning and doing and preserving the oceans was a thrill. Learning the crew's stories and how they got into it their careers was fascinating and a life altering experience." Another participant offered this, "I walked away really understanding the whole process of how the climate data is collected. I gained such a good understanding of the efforts of collecting data to predict El Nino and La Nina. I really don't think other people understand it. I certainly didn't." One participant said that meeting a visiting scientist from Japan was a highlight of the experience, "It was particularly interesting talking to him and learning what he was doing as a scientist in his country."

Finally, one participant focused on the importance of documenting her experience through photographs and how that allows her to "bring the whole experience back home – make it come alive." Having taken over 1000 photographs, she has been able to create "…a time line from day one to the end. I'm able to show my students how we lived and how we did surveys. I have pictures of all the NOAA employees. My students got to meet the cook, and the executive officer. The greatest outcome of all is watching their little faces when I share my experiences in these photos."

For one participant, the major outcome was quite tangible. She was able to earn "…three graduate credits, put something on her resume, and gain some credibility with colleagues."

Long-term Interest in Teaching

Participants describe the NOAA Teacher at Sea Program experience as "once in a lifetime," "rejuvenating," and "a motivator, each and every day." Although most didn't describe it as a defining reason for staying in teaching, they did see the experience as reinforcing. As one teacher said, "…I hit the 25 year mark – you know – I thought, how many more years do I have? This totally rejuvenated me. It had me look at the impact of what I'm doing, how I'm doing it, how I'm impacting students, and how my passion is impacting students' interest in science." Another teacher said, "It was a very nice and welcomed spark or refresher or reminder of why I got involved in science in the first place." For one participant, the NOAA Teacher at Sea was such an eye-opening experience that she expressed the desire to work fulltime for NOAA: "I loved the experience so much it makes me want to quit teaching. I want to go out and do a NOAA career – I would like to get outside of the classroom on a day-to-day basis. I'd love a career opportunity where I could go around to different schools and teach them what NOAA has to offer. Teaching is so important and what NOAA is doing is so important. Wouldn't it be great to continue teaching, but do it outside of the classroom and tell others about what NOAA is doing."

Student Impact

The participants were asked about the impact their NOAA Teacher at Sea experience has had on their students and their students' interest in science. Again, the responses were positive. All of the educators spoke of ways they were sharing what they learned with their students. They described bringing real world science into the classroom through photographs, stories, lesson plans and NOAA data. They talked about how the NOAA Teacher at Sea Program has impacted what and how their students learn. For most, there was an expression of "intangibles – the look on their faces" or "a sense of excitement every time I bring it up." One participant summed the impact up by saying: "I don't think it is the specific details of my lesson plan, but the enthusiasm that they get to see. They get to see how the real world works. They say to me 'We got to hear about this really cool thing.' 'Maybe I can be a marine biologist.' The real strength of TAS is the qualitative experience I can share with my students – I can see it in their eyes when I talk with them."

For some of the educators, there was tangible evidence that the NOAA Teacher at Sea Program had made a difference to their students. One educator who described her school as far from the ocean in a rural area said "My Teacher at Sea experience sparked their interest – I was shocked – my students were begging to go to the library to learn about ocean animals and careers. These are lower socio-economic kids who have never been exposed. It is pretty amazing how interested they are and how peaked to learn." Another teacher said that being able to show her students how science really works brought her credibility, "When I tell them – take a look at these pictures of real scientists – this is what they do. They are recording data. They are concerned with safety. It all ties into together – teamwork, shared data, people work together to problem-solve. I can show them that this is what scientists really do – I know this is what they do – because I was there."

Increased Interest in Science Careers

There seemed to be a general consensus that exposure to the NOAA Teacher at Sea Program helped peak students' interest in science careers. At one teacher's school they hold a yearly career day, "For the past two years at least a couple of my students have dressed like a marine biologist. They want to be marine biologists. These kids haven't ever even seen the ocean."

Use of NOAA Website

Participants were asked how they used the NOAA websites and what types of information or resources they are typically trying to find or access. The NOAA website is used by all of the educators to one degree or another. Some of the teachers report using the website to access information for specific lessons (e.g., meteorology), for their own reference ("I use it at select points – mostly for my own education."), or when searching for lesson ideas ("Mostly I'm looking for activities - ideas I can steal modify or spark something new.").

Some of the educators are active users of the website, "There are a jillion ways I use the website. The general home page is where I start off. Then, I go to the TAS page – to check on others to see what people are doing. I'm getting my department involved in the Adopt a Drifter program. Since I am a department chair I'm always looking for good stuff I can pass on to others – links to climate and buoy data. My kids love the NOAA games." Another educator said that "There's not just one reason to go to the website. It's a tossup between going after lesson activities or real time data. Sometimes I have an idea and am looking for the raw data that supports the activity. Sometimes I'm out of ideas

and looking for what someone else has done." Finally, one teacher wanted to emphasize that the website could be used for other subjects in the curriculum: "I use it for a lot of things – not just science. For example, we use it for every day math. We record sunrise and sunset on a chart to compare."

NOAA Teacher at Sea Alumni Association

The final interview question asked participants: What services would you like to see the TAS alumni association support and provide in the future? For the most part, participants wanted increased or easy to use avenues for sharing information, lesson ideas and experiences with one another. Participants took this opportunity to offer a number of suggestions:

- Searchable data base of lesson ideas
- Interactive on-line community where participants could participate in threaded discussions and work collaboratively
- Opportunities to share with future Teachers at Sea
- Strategies for using NOAA data effectively
- Hints and tips for setting up labs
- Easy access to data from a number of different surveys
- Information about grant opportunities

Additionally, participants expressed a strong interest in remaining engaged with NOAA and the NOAA Teacher at Sea Program. Participants suggested that they would welcome opportunities to:

- Participate in expanded programs such as Teacher in the Air and Teacher in the Lab
- Participate a second time in the NOAA Teacher at Sea Program
- Serve as an ambassador for NOAA and the NOAA Teacher at Sea Program at other schools in their regions
- Maintain an on-going relationship with research scientists
- Work on novel ways of using NOAA science and data in lessons and units
- Serve as ambassadors to school administrators and school boards to help them understand the benefits of allowing a teacher to participate

Summary

Overall results of Phase III are consistent with past findings of the evaluation study. Participants are supportive of the program and describe positive outcomes for themselves as educators and for their students. The interviews provide additional qualitative evidence that the NOAA Teacher at Sea Program is impacting science teaching and learning:

- Teachers identify participation in real world science and the opportunity to learn science directly from research scientists as the major outcome of the NOAA Teacher at Sea experience.
- Teachers report that the NOAA Teacher at Sea experience rejuvenated their interest in teaching.
- Teachers report both tangible and intangible impacts of the NOAA Teacher at Sea experience on their students' science learning and their interest in science careers.
- Teachers use the NOAA website for background information, as a resource for lesson ideas, and as a resource for data.
- Teachers welcome opportunities to remain active in the NOAA Teacher at Sea Program.

Discussion and Recommendations

Discussion

Across all three phases of the evaluation study, educators consistently report positive impacts of the NOAA Teacher at Sea Program experiences on their teaching and student learning. Satisfaction levels are high. When survey participants were asked to rate the NOAA Teacher at Sea experience an overall mean rating of 6.6 (on a seven point scale) was given; educators consider the NOAA Teacher at Sea program to be "extremely worthwhile." The qualitative and quantitative results described throughout this report offer specific insight into why teachers rate the program highly.

For overall program planning, however, it is most instructive to consider these findings in relation to the short-, mid- and long-term goals of the NOAA Teacher at Sea Program:

Short-term Goals (Skills and Knowledge)

Teachers will:

- Understand how NOAA oceanic and atmospheric research is linked to National Education Science Standards and Ocean Literacy Principles.
- Understand the education and training paths that lead to NOAA-related careers.

Mid-term Goals (Behavior and Action)

Teachers will:

- Use NOAA data and resources in classroom activities.
- Use NOAA-related career information in classroom activities, when mentoring students and when working with colleagues.

Long-term Goals (Social, Environmental, and Economic)

The NOAA Teacher at Sea Program will:

- Build an understanding of NOAA-related sciences among teachers and students.
- Build a workforce for NOAA-related careers.

When evaluation results from all three phases are synthesized they indicate that the NOAA Teacher at Sea program is addressing both its short-term and mid-term goals as well as the first long-term goal[2].

Short-term Goals (Skills and Knowledge)

Teachers understand how NOAA research efforts link to the National Science Education Standards and Ocean Literacy Principles.
When asked to compare their pre and post NOAA Teacher at Sea experiences, teachers consistently report increased understanding across a range of NOAA related topics. In particular, teachers report an increased understanding of how NOAA research efforts can be linked to the National Science Education Standards (mean = 5.2 on a 6 point scale) and the Ocean Literacy: Essential Principles and Fundamental Concepts (mean = 4.9). Additionally, a majority of the teachers report that topics related to NOAA science are included in their required state, district and local standards.

Teachers express an increased understanding of NOAA career pathways.
When asked to compare their pre and post NOAA Teacher at Sea experiences, teachers report an increased understanding of key education and training paths that lead to NOAA-related careers (mean = 4.9). In addition, teachers report incorporating career-related activities into their instruction such as inviting guest speakers to their classes to talk about careers and sharing career-oriented websites with their students.

Mid-term Goals (Behavior and Action)

Teachers use NOAA data, lesson plans and website resources.
Teachers report that the NOAA Teacher at Sea experience positively impacted their understanding and appreciation of science and scientific research and that they brought that increased understanding back into the classroom. In addition, they express increased confidence in their abilities to incorporate NOAA education resources into their classroom, integrate NOAA-related science lessons into the curriculum and use NOAA research data with their students. The teachers report a statistically significant pre/post increase in their likelihood of teaching NOAA science.

[2] It should be noted that measuring success on the final goal, "Build a workforce for NOAA-related careers," requires a longitudinal approach not within the scope of this evaluation.

Enhanced levels of understanding and confidence have resulted in increased use of NOAA data and resources in lesson preparation. The teachers report using NOAA resources for background research and to access and create lesson plans. In addition, they use NOAA data and website pages *with* their students. Importantly, the teachers report that they are doing more than including the content of NOAA science in their classrooms. They are engaging their students in research and inquiry activities. Many are engaging their students in a long-term study of a NOAA-related topic (e.g., tracking hurricanes, mapping an expedition, graphing ocean water temperature). As a result of the NOAA Teacher at Sea Program, educators are changing their teacher behavior related to NOAA science.

Teachers use NOAA-related career information in classroom activities and when working with colleagues and community members.

Survey results suggest that *before* their NOAA Teacher at Sea experience educators were unlikely to engage in activities with students or colleagues that support NOAA career development. *After* the cruise, however, teachers report a statistically significant increase in their likelihood of talking with colleagues about NOAA careers, encouraging students to consider NOAA careers, using NOAA career information, and arranging for students to meet scientists.

Long-term Goal (Social, Environmental, and Economic)

An understanding of NOAA-related sciences is being built among teachers and students.

Educators report that their own understanding of NOAA sciences has increased significantly as a result of participating in a cruise. In addition, the educators report, at statistically significant levels, that their students are more engaged in their science learning, know more about science as it applies to the world's oceans/atmosphere/climate, and have an increased appreciation for the relevance of scientific research *because* of their participation in the NOAA Teacher at Sea Program. Teachers use cruise experiences to craft lessons on a variety of topics, including measurement, symmetry, the scientific way of knowing, ecology, fisheries, weather and climate, and global issues.

Participants often reported using pictures and other artifacts from their cruises to illustrate lessons and to share information with others at their school and in their community. In addition, they report sharing lesson plans, NOAA data and NOAA resources with colleagues.

The results of this evaluation indicate that the NOAA Teacher at Sea Program is meeting its short-, mid, and long-term goals. The program impacts teacher and student learning.

Recommendations

The NOAA Teacher at Sea Program enjoys high rates of satisfaction amongst past participants. Consequently, most of the recommendations derived from this evaluation relate to the on-going professional development and involvement of NOAA Teacher at Sea alums.

1. Opportunities for *collaboration* amongst NOAA Teacher at Sea educators. Teachers expressed a desire for resources such as an interactive on-line community where participants could participate in threaded discussions, share lesson ideas and teaching strategies, and work collaboratively.

2. Increase opportunities for NOAA Teacher at Sea alum to *participate in another* NOAA Teacher at Sea experience or to participate in new programs such as Teacher in the Air and Teacher in the Lab.

3. Facilitate opportunities for NOAA Teacher at Sea alums to *communicate with NOAA scientist*, especially those research scientists involved with NOAA Teacher at Sea surveys.

4. Increase *access to resources* (e.g., lesson plans, data, information about grants, teaching strategies).

5. Provide additional background information, particularly related to the scientific focus of the survey, *before* the cruise.

Appendices

Appendix A – Participant Phase I In-depth Interview Invitation

Dear _____,

During 200X you participated in NOAA's Teacher at Sea Program. NOAA is very interested in learning more about your experiences as a NOAA Teacher at Sea and how you have used these experiences in your own classroom. Jennifer Hammond, TAS Program Manager, and I have designed a three phased evaluation plan, involving interviews and surveys of program participants. As part of the first phase of the evaluation, I would like to interview you. Your assistance would be invaluable.

If you agree, I would like to set up a time to talk with you by phone during June or July. The interview would take no longer than 30 minutes. Your responses will be kept confidential.

Taking a few minutes to share some of your thoughts about being a NOAA Teacher at Sea will help to improve the program and make it a better experience for everyone.

Please let me know if you are interested in participating. We can set up a time for the interview that is mutually convenient.

Thank you in advance.

Bora Simmons

Appendix B – Phase I In-depth Pilot Interview Questions

NOAA Teacher at Sea Initial Interview

Thank you for taking the time to talk with me. Your responses will help NOAA design effective, efficient educational opportunities for teachers like you. Please answer the following as completely as possible. Your comments will remain confidential.

Background:

Number of years in teaching:
Grade levels taught:
Subjects taught:
Ability level?

NOAA Teacher at Sea Experience:

What are the 2-3 main things that you gained from being a NOAA Teacher at Sea?

What, if any, were the biggest challenges?

Back in the classroom:

How have you used your NOAA Teacher at Sea experience back in your classroom(s)?

How has your teaching changed as a result of your NOAA Teacher at Sea experience?

If you have not been able to use your NOAA Teacher at Sea experience yet, do you have any plans? If so, could you tell me about those plans?

Have you had the opportunity to share your experiences with others (e.g., teachers, parents, community members)? How?

One of NOAA's long term concerns relates to what they call workforce recruitment. To what extent have you talked to others (students, other teachers) about possible NOAA-related career opportunities?

Were there any unexpected results from your participation as a NOAA Teacher at Sea?

How has this program impacted you as an educator? Person?

Overall, if you were going to rate (on a 7 point scale) how worthwhile your NOAA Teacher at Sea experience was, how would you rate it? Not at all Worthwhile =1/ Extremely Worthwhile=7

Additional comments?

Appendix C - Classroom Implementation Survey

See attached.

NOAA Teacher Survey

1. NOAA Teacher at Sea Program Alumni Survey

OMB Control No.: 0648-0600
Expires 12/31/12

Participation in this survey is completely voluntary. As a past participant of a NOAA sponsored professional development program, your opinions are important. Survey responses will be used to improve this and other programs sponsored by NOAA. It is estimated that the survey will take 30 minutes to complete. Please be completely honest in your responses. YOUR RESPONSES WILL BE ANONYMOUS.

1. In which NOAA professional development program (e.g., Teachers at Sea, Teachers in the Air) did you participate?

2. Where was your NOAA program located?

- ◯ Alaska
- ◯ Central (e.g., ND, SD, IA, OK, WV)
- ◯ Great Lakes
- ◯ North Atlantic
- ◯ Pacific Islands
- ◯ Southeast & Caribbean
- ◯ Gulf of Mexico
- ◯ Western
- ◯ Colorado & Wyoming
- ◯ Florida
- ◯ New York & Pennsylvania

Other (please specify)

3. What grade(s)/level(s) do you currently teach? (Check as many as apply)

☐ K ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12

Other (please specify)

4. What subject(s) do you teach? (Check as many as apply)

☐ Science ☐ Math ☐ Social Studies ☐ English ☐ Reading ☐ Fine Arts

Other (please specify)

5. How many years have you been teaching?

NOAA Teacher Survey

6. Describe the research you were involved in or learned about during your experience with NOAA (e.g., fisheries research, hydrographic survey, marine mammal or bird survey, climate or atmospheric research, ecosystem monitoring, archaeological expedition).

NOAA Teacher Survey

2. Before Your NOAA Experience

We would like to know something about your teaching BEFORE you participated in this NOAA program. Please answer all of the questions to the best of your ability. If a particular question does not apply to your teaching situation, check the N/A box.

1. BEFORE your participation in this NOAA program, how likely or unlikely WAS IT that you would _____ during the school year:

	Extremely unlikely 1	2	3	4	5	Extremely likely 6	N/A
Teach about atmosphere-related topics.							
Teach about ocean-related topics.							
Teach about climate-related topics.							
Research a climate/ocean/atmosphere-related environmental issue with your students.							
Talk with your students about the relevance of climate/ocean/atmospheric research.							
Engage your students in a long-term study of a NOAA-related topic (e.g., tracking hurricanes, mapping an expedition, graphing ocean water temperature).							
Integrate lessons about climate/ocean/atmospheric sciences into your curriculum.							
Use inquiry to teach science concepts and skills.							

NOAA Teacher Survey

2. BEFORE your participation in this NOAA program, how likely or unlikely WAS IT that you would USE _____ during the school year:

	Extremely unlikely 1	2	3	4	5	Extremely likely 6	N/A
NOAA data or research examples in your lessons.	○	○	○	○	○	○	○
NOAA websites as a resource in your lessons.	○	○	○	○	○	○	○
NOAA educational resources in your classroom instruction.	☐	○	○	○	○	○	○
The Ocean Literacy: Essential Principles and Fundamental Concepts when designing lessons/units.	☐	○	○	○	○	○	○
The Climate Literacy: Essential Principles and Fundamental Concepts when designing lessons/units.	☐	○	○	○	○	○	○
Real world examples of research studies/results to teach science.	☐	○	○	○	○	○	○
Photos, maps, graphs, etc. to illustrate how scientists conduct research.	☐	○	○	○	○	○	○

3. BEFORE your participation in this NOAA program, how likely or unlikely WAS IT that you would _____ during the school year:

	Extremely unlikely 1	2	3	4	5	Extremely likely 6	N/A
Talk with colleagues about NOAA-related career paths.	○	○	○	☐	☐	☐	☐
Encourage students to consider NOAA-related careers.	○	○	○	○	○	○	○
Use NOAA-related career information to mentor students.	☐	○	○	○	○	○	○
Arrange for your students to meet scientists or read about possible NOAA-related careers.	☐	○	○	○	○	○	○
Talk with your students about what scientists do.	☐	○	○	○	○	○	○

NOAA Teacher Survey

3. After Your NOAA Experience

Now, we would like to focus on your teaching since participating in this NOAA program. Again, if a particular question does not apply to your teaching situation, please check the N/A box.

1. AFTER your participation in this NOAA program, how likely or unlikely IS IT that you will _____ during the school year:

	Extremely unlikely 1	2	3	4	5	Extremely likely 6	N/A
Teach about atmosphere-related topics.	é	é	é	é	é	é	é
Teach about ocean-related topics.	é	é	é	é	é	é	é
Teach about climate-related topics.	é	é	é	é	é	é	é
Research a climate/ocean/atmosphere-related environmental issue with your students.	é	é	é	é	é	é	é
Talk with your students about the relevance of climate/ocean/atmospheric research.	é	é	é	é	é	é	é
Engage your students in a long-term study of a NOAA-related topic (e.g., tracking hurricanes, mapping an expedition, graphing ocean water temperature).	é	é	é	é	é	é	é
Integrate lessons about climate/ocean/atmospheric sciences into your curriculum.	é	é	é	é	é	é	é
Use inquiry to teach science concepts and skills.	é	é	é	é	é	é	é

NOAA Teacher Survey

2. AFTER your participation in this NOAA program, how likely or unlikely IS IT that you will USE _____ during the school year:

	Extremely unlikely 1	2	3	4	5	Extremely likely 6	N/A
NOAA data or research examples in your lessons.							
NOAA websites as a resource in your lessons.							
NOAA educational resources in your classroom instruction.							
The Ocean Literacy: Essential Principles and Fundamental Concepts when designing lessons/units.							
The Climate Literacy: Essential Principles and Fundamental Concepts when designing lessons/units.							
Real world examples of research studies/results to teach science.							
Photos, maps, graphs, etc. to illustrate how scientists conduct research.							

3. AFTER your participatiion in this NOAA program, how likely or unlikely IS IT that you will _____ during the school year:

	Extremely unlikely 1	2	3	4	5	Extremely likely 6	N/A
Talk with colleagues about NOAA-related career paths.							
Encourage students to consider NOAA-related careers.							
Use NOAA-related career information to mentor students.							
Arrange for your students to meet scientists or read about possible NOAA-related careers.							
Talk with your students about what scientists do.							

NOAA Teacher Survey

4. Because of my involvement with this NOAA program, I have an increased understanding of:

	Strongly disagree 1	2	3	4	5	Strongly agree 6
Science as it applies to the world's oceans.						
Science as it applies to the world's atmosphere.						
Science as it applies to the world's climate.						
How NOAA research efforts can be linked to the National Education Science Standards.						
How NOAA research efforts link to the Ocean Literacy: Essential Principles and Fundamental Concepts.						
How NOAA research efforts link to the Climate Literacy: Essential Principles and Fundamental Concepts.						
The key education and training paths that lead to NOAA-related careers.						
Ocean-related environmental issues.						
Climate-related environmental issues.						
How to access NOAA research data that can be incorporated into my classroom lessons.						
The range of educational resources offered by NOAA.						

NOAA Teacher Survey

5. Because of my involvement with this NOAA program, I feel more confident about my ability to:

	Strongly disagree 1	2	3	4	5	Strongly agree 6
Teach science as it applies to the world's oceans.						
Teach science as it applies to the world's atmosphere.						
Teach science as it applies to the world's climate.						
Incorporate NOAA education resources in my classroom(s).						
Integrate NOAA-related science lessons into the curriculum.						
Research a NOAA-related environmental issue with my students.						
Use NOAA research data and other resources with my students.						

6. As a result of my NOAA experience, my students:

	Strongly disagree 1	2	3	4	5	Strongly agree 6
Are better prepared to use the results of real world science.						
Are more engaged in their science learning.						
Know more about science as it applies to the world's oceans/atmosphere/climate.						
Have an appreciation for the relevance of scientific research.						
Are familiar with NOAA and what NOAA scientists do.						
Are more likely to act to protect the environment.						
Understand that NOAA provides research-based information that they can use to make important decisions						

NOAA Teacher Survey

7. Overall, how would you rate your NOAA experience?

1 Not at all worthwhile	2	3	4	5	6	7 Extremely worthwhile
◯	◯	◯	◯	◯	◯	◯

8. Are topics related to the world's oceans part of the required science curriculum for your:

	Yes	No	N/A
School	◯	◯	◯
District	◯	◯	◯
State	◯	◯	◯

9. Are topics related to weather and atmosphere part of the required science curriculum for your:

	Yes	No	N/A
School	◯	◯	◯
District	◯	◯	◯
State	◯	◯	◯

10. Are topics related to the world's climate part of the required science curriculum for your:

	Yes	No	N/A
School	◯	◯	◯
District	◯	◯	◯
State	◯	◯	◯

11. In reference to your experience with NOAA, are the research topics you learned about part of the required science curriculum for your:

	Yes	No	N/A
School	◯	◯	◯
District	◯	◯	◯
State	◯	◯	◯

12. Please tell us about your science background (e.g., undergraduate courses or degree(s), graduate courses or degree(s), professional development experiences, previous research experiences):

NOAA Teacher Survey

13. How could this NOAA program be improved to better prepare educators to teach about climate/ocean/atmospheric sciences?

Thank you for participating in this survey. Your responses are important. The results will be used by NOAA to improve their professional development programs.

Public reporting burden for this collection of information is estimated to average 30 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other suggestions for reducing this burden to Jennifer Hammond, Director NOAA's Teacher at Sea Program, 1315 East West Hwy Division F, Room 14250, Silver Spring, MD 20910. Notwithstanding any other provisions of the law, no person is required to respond to, nor shall any person be subjected to a penalty for failure to comply with, a collection of information subject to the requirements of the Paperwork Reduction Act, unless that collection of information displays a currently valid OMB Control Number.

Appendix D - Phase III: NOAA Teacher at Sea Follow-up Interview Invitation

Dear _____,

You participated in NOAA's Teacher at Sea Program. NOAA is very interested in learning more about your experiences as a NOAA Teacher at Sea and how you have used these experiences in your own classroom. Jennifer Hammond, TAS Program Manager, and I have designed a three phased evaluation plan, involving interviews and surveys of program participants. As part of the final phase of the evaluation, I would like to interview you. Your assistance would be invaluable.

If you agree, I would like to set up a time to talk with you by phone during the end of March or April. The interview would take no longer than 30 minutes. Your responses will be kept confidential.

Taking a few minutes to share some of your thoughts about being a NOAA Teacher at Sea will help to improve the program and make it a better experience for everyone.

Please let me know if you are interested in participating. We can set up a time for the interview that is mutually convenient.

Thank you in advance.

Bora Simmons

Appendix E - Phase III: NOAA Teacher at Sea Follow-up Interview

Thank you for taking the time to talk with me. Your responses will help NOAA design effective, efficient educational opportunities for teachers like you. Please answer the following as completely as possible. Your comments will remain confidential.

Background

Number of years in teaching:
Grade levels taught:
Subjects taught:
Year of TAS experience:

Teacher Impact

What do you think was the single most important outcome of your participation in the NOAA Teacher at Sea program?

How do you use the NOAA web site? What types of information or resources are you typically trying to find or accessing?

Do you go to the NOAA web site to access information/resources on topics other than the world's oceans, such as climate change or the atmosphere?

In what ways, if at all, has your TAS experience affected your long-term interest in teaching?

Student Impact

What do you think was the most important impact, if any, that your participation in the NOAA Teacher at Sea program has had on your students?

What do you think was the most important impact, if any, that your participation in the NOAA Teacher at Sea program has had on your school or school system?

In what ways, if at all, has your participation in the NOAA Teacher at Sea program affected your students' interest and motivation to learn science?

Other:

What services would you like to see the TAS alumni association support and provide in the future?