



DEPARTMENT OF COMMERCE RESEARCH PERFORMANCE PROGRESS REPORT (RPPR)

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AWARD INFORMATION	
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Signature of Submitting Official: Susan Ferreira	
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RECIPIENT ORGANIZATION	
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ACCOMPLISHMENTS

24. What were the major goals and objectives of this project?

The Cooperative Institute for the North Atlantic Region (CINAR) was established in 2009, and renewed in 2014 with an "Outstanding" ranking by an external committee. This past reporting year encompasses year ten of our current award. Throughout its operation, CINAR has served as an essential component of NOAA's research and management capability in the Northeast region. Through our NOAA and academic partnerships, the CINAR consortium provided a mechanism for NOAA scientists to easily and rapidly obtain research assistance and facilities or infrastructure support for projects, and respond to technical needs through the development of instruments, models, and approaches that contribute to management decisions.

The overarching goal of CINAR is to dramatically improve predictive science that enables sound management, while informing the general public and stakeholders of the complexities and importance of ecosystem-based management of the Northeast Shelf Large Marine Ecosystem (NES LME) resources.

Working within the geographic framework of the NES LME, the specific goals of CINAR are:

- 1) To establish CINAR as a leader in promoting "rational ocean stewardship" and serve as a model for development of similar ecosystem approaches to management in other regions;
- 2) To coordinate research, education and outreach with NOAA scientists in support of responsible stewardship of coastal and marine resources in the region;
- 3) To conduct research that identifies and evaluates linkages among productivity, fish and fisheries, pollution, climate change and ecosystem health;
- 4) To conduct research and develop decision-support tools for sustainable fisheries management;
- 5) To conduct research and develop tools to restore degraded habitats and support restoration and rebuilding of protected species to healthy population levels;
- 6) To improve integration and availability of ocean observations from global to local scales;
- 7) To provide mechanisms for transition of predictive/forecasting and monitoring tools into operational use for management;
- 8) To improve ability to distinguish shifts in marine resource status caused by human impact from those due to climate and other natural forcings; and,

25. What was accomplished under these goals?

This CINAR award is entering its second no cost extension year; thus, a smaller number of research programs were active compared to prior years. Below we have highlighted select research activities and accomplishments of ongoing CINAR programs, organized according to our CI's major research themes:

Theme I – Ecosystem Forecasting. CINAR activities have developed state-of-the art ecological models that were applied to practical problems in the Northeast, including: 1) updating the OceanAdapt website (<https://oceanadapt.rutgers.edu>) with data on marine species ranges in North America (Fig. 1, Appendix 6); 2) hosting multiple workshops for NOAA personnel using the Regional Ocean Modeling System (ROMS; www.myroms.org) for operational forecasting; and 3) collecting data on Alexandrium dinoflagellate cysts from the Gulf of Maine (GOM) for forecasting models of this harmful algal bloom species.

Theme II – Ecosystem Monitoring. Highlights included efforts to: 1) assess nutrient concentrations in GOM waters for the NOAA ECOMON program to better understand the nature of water mass variability in the region and its influence on the nutrient field; 2) design and apply qPCR-based eDNA assays for multiple fish species in the Northeast to better characterize their range and habitats (Fig. 2, Appendix 6); and 3) determine hydrographic and sediment characteristics that influence benthic macrofaunal communities in the northern Bering and Chukchi Seas.

Theme III – Ecosystem Management. Major activities included efforts to: 1) further develop the capabilities of the Stock Synthesis (SS) generalized modeling framework to better accommodate and document tagging data used in fisheries stock assessment; 2) analyze historical data pertaining to the herring fishery in New England, including the role of management decisions in the transformation of this fishery over time; and 3) improve the use and interpretation of age data in fisheries stock assessments through an analysis of the effect of sample size on the diagnosis of accuracy and precision in paired age comparisons.

Theme IV – Protection and Restoration of Resources. Most research activities under this theme were completed prior to the current reporting period; one CINAR project completed over the past year evaluated the relationship between American Lobster Settlement Index and several environmental indicators (temperature and disease) as a predictive tool for forecasting trends in lobster fishery recruitment (Fig. 3, Appendix 6).

Theme V – Sustained Ocean Observations and Climate. Major activities included: 1) maintenance, analysis, and synthesis of longer-term records of air-sea interactions for the OAFflux research and data development project (Fig. 4, Appendix 6), 2) continued maintenance of the Atlantic Argo array, with an emphasis on increasing coverage of the Intra-Americas seas, and new deployments in the Arctic Ocean (Fig. 5, Appendix 6); and (3) sustained collection of climate-quality observations at three surface moorings in key trade wind sites; data are used to understand the way in which the atmosphere and ocean interact and how that interaction should be represented in models used to predict weather and climate (Fig. 6, Appendix 6).

Attach a separate document if more space is needed for #6-10, or #24-50.

ACCOMPLISHMENTS (cont'd)

26. What opportunities for training and professional development has the project provided?

Over the past year, CINAR investigators have provided research, training and professional development opportunities through direct participation of students, postdocs and early career scientists in research, as well as specific programs under Research Theme VI (Education and Outreach). Below we highlight and summarize selected achievements and programs:

1. The Marine Resource Education Program (MREP) fishery science and management workshop series: These workshops engage commercial and recreational fishermen, managers, and scientists in discussions about approaches to fisheries management, and help to foster collaboration among these groups. In 2019, the MREP program offered multiple workshops and events, which were held at locations in West, Southeast, and Northeast regions, as well as in the Caribbean. MREP workshops are developed by fishermen, for fishermen in a collaborative curriculum design process that is foundational to this program's success (Fig. 7, Appendix 6). Workshop content is developed by science and management experts with critical input from the fishermen on the MREP leadership teams. The MREP curriculum covered the components of a fishery management plan and plan amendments, describing the progression of plan development and identifying critical opportunities for participation and input. MREP Alumni now represent a growing proportion of the fishery management council appointments nationwide, a testament to this program's continued success (Fig. 8, Appendix 6).

2. Undergraduate summer student fellowships: For several years, CINAR has operated an undergraduate minority traineeship program, which provides funding to each CI partner institution in support of summer fellowships for students from underrepresented communities. These students work on a project selected in collaboration with a CINAR sponsor. This program has been highly successful, and is continuing under our new award, which commenced on June 1, 2019.

3. University of Maine Cooperative Education Program: This program engages undergraduate students interested in fisheries research with internship positions within the CINAR consortium, with a focus on projects benefiting Salmon and their ecosystem. In 2019 six summer research interns were recruited to work on new and continuing projects at UMaine, including one student who returned from the previous semester to continue research with his mentor.

4. Graduate student and postdoc participation in research: CINAR research programs offer a variety of opportunities to engage graduate students, postdocs, and early career scientists in research programs related to the aforementioned research themes, and provide career training to the next generation of marine scientists. Students are be introduced to an active and collaborative research environment, interact with scientific leaders in ecosystem research, start building a network of contacts for advanced studies and a career in science or resource management, and gain experience with ecosystem-scale research, proposal writing and presentation skills. In 2018, CINAR investigators included 4 graduate students and 3 postdocs in their research programs.

5. Quantitative Fisheries and Ecosystem Science faculty support: The goal of this program is to engage early career scientists in research to improve and enhance the assessment and management of fisheries resources in the region. With support provided by

27. How were the results disseminated to communities of interest?

In addition to the educational and outreach programs described in comment field #26, results were disseminated through the numerous peer-reviewed publications, websites, and public presentations. These are too numerous to list here, but are described and detailed in Appendices 4 and 5, and comment field #32.

ACCOMPLISHMENTS (cont'd)

28. What do you plan to do during the next reporting period to accomplish the goals and objectives?

This CINAR award was granted an extension of the period of performance until June 30, 2021 due to disruptions to research activities from COVID-19, and is entering its second no-cost extension year. These impacts are detailed comment field #46. Work will continue on active research programs, but no new programs will be funded. New research and educational programs will continue under CINAR's new award, which initiated on June 1, 2019.

PRODUCTS

29. Publications, conference papers, and presentations

A comprehensive listing of all publications, conference papers, and presentations by CINAR investigators associated with the current reporting period are provided as Appendix 4 and Appendix 5. Please note that DOI numbers are provided for each peer-reviewed publication.

PRODUCTS (cont'd)

30. Technologies or techniques

Technologies and techniques associated with CINAR research are listed below:

- Gallager (WHOI): HabCam technology for surveying benthic habitats and living resources.
- Baumgartner (WHOI): Near real-time detection of cetaceans using passive glider acoustic monitoring.
- Baumgartner (WHOI): Tag detection and passive acoustic monitoring of spawning cod near Stellwagen Bank using WHOI gliders.
- Anderson (WHOI): Imaging FlowCytobot for unprecedented resolution of the composition and abundance of harmful algal bloom species in the Gulf of Maine.
- Beardsley (WHOI): FVCOM forecast system with real-time ocean environmental conditions for marine health evaluation, navigations, ocean rescues and storm-induced coastal inundation.
- Jayne (WHOI): Argo floats for physical and biogeochemical sensing.
- Jensen (Rutgers): Model for assessing and estimating landed stocks.
- Rose (UMCES): A 3-D model simulating Gulf of Mexico conditions, with the basic stationary camera operational in the 3-D grid and the capability to perform side-by-side comparisons of different camera sampling methods under identical conditions.
- Stanley (WHOI): Research sites with active deployed hydrophones and acoustic telemetry receivers.
- Weller (WHOI): Deployment and maintenance of three Ocean Reference Stations (ORS). These ORS, which are well-equipped surface moorings, are deployed to provide sustained observations of a key region of the ocean – the trade wind region.

31. Inventions, patent applications, and/or licenses

None to report

PRODUCTS (cont'd)

32. Other products

Other products developed by CINAR PIs are listed below:

- Anderson (WHOI): Cyst cruise data supports NOAA harmful algal bloom forecasting and modeling: <https://products.coastalscience.noaa.gov/hab/gomforecast.aspx>
- Baumgartner (WHOI): The publicly accessible website <http://robots4whales.whoi.edu/> is used for displaying near real-time detections of whales from autonomous gliders and buoys.
- Beardsley (WHOI): Source code for FVCOM forecast system (v 4.0), FVCOM forecast system, which provides the public with real-time ocean environmental conditions for marine health evaluation, navigations, ocean rescues and storm-induced coastal inundation.
- Grebmeier (UMCES): Producing essential ocean variables (http://www.goosocean.org/index.php?option=com_content&view=article&id=14&Itemid=114) based on collection of benthic samples from 2017-2018 cruises. In addition, the Arctic webpage at UMCES (<http://arctic.cbl.umces.edu>) provides a platform for highlighting core research activities in the Pacific Arctic, including the DBO-NCIS activities.
- Jensen (Rutgers): A R-shiny GUI for a model of fisheries stocks landings is nearing completion and will be finalized and disseminated by August 2019.
- Fay (SMAST): A database of stock assessments that use Stock Synthesis and have or could make use of additional features developed during this project has been compiled. This will be turned into a short journal publication as well as a living document on the Stock Synthesis user community web page.
- Jayne (WHOI): Argo float data and metadata: <http://doi.org/10.17882/42182#64916>
- Pickart (WHOI): CTD data from the second cruise of the Distributed Biological Observatory – Northern Chukchi Integrated Study (DBO-NCIS) in 2018 have been processed, quality controlled, and posted to the project website <https://www2.whoi.edu/site/dboncis/>.
- Pinsky (Rutgers): Oceanadapt Website (<http://oceanadapt.rutgers.edu>), which provides information about the impacts of changing climate and other factors on the distribution of marine life to the National Climate Assessment, fisheries communities, policymakers, and to others.
- Stanley (WHOI): Websites describing project activities include:
(1) *Black sea bass and impacts of noise disturbances from pile driving*

PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS

33. What individuals have worked on this project?

The CINAR PIs include Donald M. Anderson, CINAR Director, Woods Hole Oceanographic Institution; Oscar Schofield, Director, Institute of Earth, Ocean, and Atmospheric Science, Rutgers University; Michael Roman, Director, Horn Point Laboratory, University of Maryland Center for Environmental Science; David Townsend, Associate Director of Research and Graduate Studies, University of Maine; and Andrew Pershing, Chief Scientific Officer, Gulf of Maine Research Institute. The CINAR PIs meet regularly in person or via conference call to discuss issues and to ensure that partner institutions are updated on CINAR activities. Additional CINAR personnel include Mindy Richlen (CINAR Associate Director), Claire Anacreon (Administrative Associate). A listing of the project investigators is provided in Appendix 1.

PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS (cont'd)

34. Has there been a change in the active other support of the PD/PI(s) or senior/key personnel since the last reporting period?

GMRI: In October 2019, GMRI program leadership was assumed by MREP Project Manager, Lauren O'Brien with support from GMRI Chief Community Officer, Jonathan Labaree, and regional MREP Steering Committees.

35. What other organizations have been involved as partners?

Consortium members and subawardees include Woods Hole Oceanographic Institution, University of Maine, Rutgers University, Gulf of Maine Research Institute, University of Maryland Center for Environmental Science, University of Massachusetts Dartmouth School for Marine Science and Technology, and the World Meteorological Organization.

PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS (cont'd)

36. Have other collaborators or contacts been involved?

Nothing to Report

IMPACT

37. What was the impact on the development of the principal discipline(s) of the project?

Below we have highlighted selected impacts of CINAR research on the principal discipline(s) of this cooperative institute, organized according to research theme. Impacts related to the education and outreach are summarized in comment boxes #39 and #40.

Theme I – Ecosystem Forecasting. Data collected by CINAR’s ocean observing assets and programs are being used by NOAA managers and the scientific community to understand and describe ecological and environmental parameters and processes in the Northeast U.S. Continental Shelf Large Marine Ecosystem (NEUS LME) and beyond. In addition, state-of-the art ecological models and data assimilation methods are being applied to practical problems. Selected examples include the Regional Ocean Modeling System (ROMS), and population and ecosystem-based models such as FVCOM. These activities advance research priorities outlined in the “NOAA Fisheries Ecosystem-Based Fishery Management (EBFM) Policy”, which established a framework of guiding principles for EBFM implementation.

Theme II – Ecosystem Monitoring. Monitoring activities undertaken by CINAR investigators have contributed valuable datasets to advance our understanding and stewardship of critical species and resources in the NEUS LME. These efforts advance research and techniques in the areas of ecosystem research, monitoring, and modeling, and address EBFM implementation by supporting surveys and stock assessment of fish and shellfish resources. In addition, the technologies and approaches pioneered by CINAR investigators for data collection have also helped to advance ocean observing technologies (see Theme V).

Theme III – Ecosystem Management. CINAR researchers are advancing multiple state-of -the-art approaches to study a broad range of topics directly relevant to EBFM in the NEUS LME. These include fisheries ecological studies and monitoring, assessing anthropogenic impacts to fisheries (e.g., noise disturbances), as well as the development of numerical modeling frameworks and data assimilation methods. As climate change has become more apparent in the region, understanding the impact of climate change on the ecosystem and incorporating this knowledge into fishery management and coastal adaptation have become central research themes.

Theme IV - Protection and Restoration of Resources. The unique capabilities of the CINAR consortium advance science, enhance monitoring and assessment, foster stakeholder engagement, and evaluate mitigation actions to support management of protected species. CINAR researcher are advancing prototype development of technology, research tools, and scientific approaches for species observations, assessments, status determinations, and recovery in the NEUS LME, including the critically endangered North Atlantic right whale, Atlantic salmon, and other species. Examples include use of autonomous vehicles for conducting passive acoustic surveys for baleen whales, and development of a near real-time passive acoustic monitoring system to monitor right whale presence in Canadian and U.S. waters.

Attach a separate document if more space is needed for #6-10, or #24-50.

IMPACT (cont'd)

38. What was the impact on other disciplines?

The impact and value of CINAR research extends beyond the scientific disciplines encompassed by this CI's research themes. Humans are an integral part of approaches to EBFM; therefore, human dimensions research is an important part of support EBFM and other ecosystem-based approaches to management. Data and analyses carried out by CINAR investigators support efforts to integrate human interactions and socioeconomic considerations, thereby promoting sustainable coastal development and community resiliency. For example, engagement of fisheries stakeholders through CINAR's Marine Resource Education Program (MREP) offers fishermen the opportunity to learn about the complex fisheries science and management processes, and equips these fishermen with tools to effectively participate in these processes. These programs promote the involvement and participation of the general public and commercial sector in fisheries science and management in a productive way. CINAR research is also contributing to better management of harmful algal blooms in the region, which contributes to environmental and human health disciplines. These activities provide a fuller understanding of interactions and interconnections within the NEUS LME, and support efforts to integrate economic, social, and cultural considerations in EBFM.

In addition, CINAR research is developing and applying frameworks and procedures to estimate and track over time the economic value generated by investments in oceanographic research and observations, with a specific focus on developing improved estimates of the societal and economic value of observing and research investments made by NOAA's Ocean Observing and Monitoring Division and NOAA's Ocean Acidification Program. Outcomes of this project to date include the development of a framework for tracing the economic value of OAR investments in oceanographic research, the partial population of that framework for ocean acidification and ocean carbon uptake projects, and the partial assembly of data to characterize the user decisions and economic value at risk in the areas of ocean carbon uptake, ocean acidification, and Arctic sea ice.

39. What was the impact on the development of human resources?

Over the past year, CINAR programs supported 66 research scientists and staff, postdocs, and administrative staff, as well as 4 graduate students and 7 undergraduate students. Of these, one Ph.D. level CINAR researcher was hired by NOAA over the past year. A complete personnel listing is provided in Appendix 3, and additional details regarding the impact of teaching and educational programs is described in comment field #40, below.

IMPACT (cont'd)

40. What was the impact on teaching and educational experiences?

CINAR research programs offer a variety of opportunities to engage graduate students, postdocs, and early career scientists in research programs related to the aforementioned research themes, and provide career training to the next generation of marine scientists. Students are engaged in an active and collaborative research environment, interact with scientific leaders in ecosystem research, start building a network of contacts for advanced studies and a career in science or resource management, and gain experience with ecosystem-scale research, proposal writing and presentation skills. Over the past year, CINAR investigators included 4 graduate students and 7 undergraduates in their research programs. In addition, CINAR continues to offer summer support for undergraduate students from underrepresented minority groups through a minority traineeship program, offered through our new award.

Over the past year, CINAR continued to support a full-time faculty position at the University of Massachusetts Dartmouth's School for Marine Science and Technology (SMAST) through funding from NOAA's Quantitative Ecology and Socioeconomics Training (QUEST) program. An important goal this program is to engage early career scientists in research to improve and enhance the assessment and management of fisheries resources in the region. Funding for early career faculty through QUEST will continue under CINAR's new award to further develop the capability for graduate student education and training for the next generation of stock assessment scientists, ecosystem scientists, and economists.

41. What was the impact on physical, institutional, and information resources that form infrastructure?

Contributions to physical, institutional, and information resources included the preparation and deployment of 73 Argo floats over the past year (See Fig 5 in in Appendix 6). The Argo float program continues to deploy floats in the Atlantic Basin with an emphasis on expanding coverage of the Intra-Americas seas. WHOI currently operates a fleet of 353 active floats. In addition, data produced by CINAR-supported Ocean Reference Stations are essential to critical climate assessments worldwide (See Fig. 6 in Appendix 6). These sites provide benchmark records that anchor fields, such as those of air-sea fluxes, quantify change and variability in ocean state and air-sea coupling, motivate model improvement, and calibrate/validate remote-sensing products. Additional contributions to infrastructure include gliders used for passive acoustic monitoring of cetaceans, and HABcam technology for assessing and characterizing shellfish, demersal fish, and their habitats in the Northeast. CINAR investigators maintain multiple websites and informational resources, which are listed in comment field #32.

IMPACT (cont'd)

42. What was the impact on technology transfer?

CINAR investigators are pioneering multiple new tools, models, and approaches to collecting, analyzing, modeling, and disseminating biological and physical data in the NEUS LME. Additional information on some of these technologies, techniques, and other products is provided in comment box #30. These include the efforts discussed in comment field #37, such as the ongoing expansion of Regional Ocean Modeling System (ROMS) to include coupled chemical and biological, and improvement of FVCOM ecosystem-based models. As mentioned above, CINAR investigators maintain multiple websites and informational resources, which are listed in comment field #32.

43. What was the impact on society beyond science and technology?

Data and analyses carried out by CINAR investigators are supporting efforts to integrate human interactions and socioeconomic considerations, thereby promoting sustainable coastal development and community resiliency. In addition, CINAR research is evaluating the economic value generated by NOAA's investments in ocean observing and research on ocean acidification projects. The frameworks and approaches being developed through this project can contribute to future efforts to better illustrate the economic value of NOAA oceanographic research programs and policies.

CINAR research programs are helping to improve forecasting and management of harmful algal blooms in the region, which benefits environmental and human health disciplines. Engagement of fisheries stakeholders by CINAR researchers promotes the involvement and participation of the general public and commercial sector in fisheries science and management in a productive way. These activities provide a fuller understanding of interactions and interconnections within the NEUS LME, and support efforts to integrate human interactions and socioeconomic considerations in EBFM.

IMPACT (cont'd)

44. What percentage of the award's budget was spent in foreign country(ies)?

5 , Our estimates indicate that <5% of our budget was spent in foreign countries.

CHANGES/PROBLEMS

45. Changes in approach and reasons for change

Multiple projects experienced significant and ongoing disruptions and delays due to the COVID-19 pandemic. These problems and delays are included in comment field #46 as well as below:

- Anderson (WHOI): Funding was included in this budget for a workshop on the Socioeconomic Impacts of Harmful Algal Blooms. This workshop was originally planned for 2019, but delayed until 2020 by the federal government shutdown. This workshop was rescheduled for June 2020, but has been postponed due to restrictions on meetings and travel. This workshop will now be held virtually in late July, 2020.
- Fay (SMAST): Due to COVID-19, an in-person meeting of the project and technical team scheduled for March 2020 in Seattle needed to be rescheduled as a virtual meeting.

CHANGES/PROBLEMS (cont'd)

46. Actual or anticipated problems or delays and actions or plans to resolve them

Multiple projects experienced significant and ongoing disruptions and delays due to the COVID-19 pandemic. These problems and delays are included in the descriptions provided in comment field #45 and below:

- Chen (UMaine): Additional time was needed for alternative model assessment, including an individual-based lobster simulator used to calculate growth transition matrices and conduct sensitivity analyses. In addition, there was a high turn-over rate of project participants, as several researchers were offered longer term positions and needed to be replaced; however, this does reflect the high quality of and demand for students trained in a project such as this one.
- Grebmeier (UMCES): All laboratory work was suspended in 2020 due to COVID-19 issues and the closure of the Chesapeake Biological Laboratory, which will delay completion of the remaining laboratory analyses. In addition, phytoplankton taxonomy from Poland is suspended due to COVID-19. Work will commence once these facilities open.
- Jayne (WHOI): Additional time for project completion was required due to the long lead time in sourcing floats, then putting them through technical testing and ballasting preparation, with up to a year between acquisition and deployment.
- Kinnison (UMaine): After some initial delays on the project regarding staffing and tissue sample availability, assay development has advanced extensively this year. The full set of assays and an associated summary report are nearing completion. However, restrictions related to COVID-19 are preventing the collection of field water samples and the accessibility of lab spaces on the UMaine campus to finish validating the remaining assays.
- Labaree (GMRI): MREP workshops scheduled for spring 2020 were cancelled due to COVID-19, and a 3-day MREP Fisheries Science and Management workshop series for fishermen in the Greater Atlantic region was postponed until October 2020. The Southeast Fisheries Management Workshop was postponed to November 2020 with the support of the regional fishermen leadership for MREP Southeast as well as the South Atlantic and Gulf of Mexico Fishery Management Councils, the NOAA Fisheries Southeast Regional Office, and presenters who had committed to the original workshop dates.
- Mills (GMRI): This project has been delayed due to the time needed to finalize growth data collection from multiple sets of salmon scales. In addition, delays were the result of key technical staffing issues. A new postdoctoral associate started on the project in June 2019 and a technician was hired in April 2019. A longer-term staff technician has also been providing support to complete analyses.
- Pickart (WHOI): Due to Visa issues, the Postdoctoral Investigator funded by the project could not start until a year after the project began, requiring additional time for completion of data analyses.

47. Changes that had a significant impact on expenditures

Impacts on expenditures are largely associated with the COVID-19 pandemic, and include cancelled travel reservations and expenditures associated with research cruises and other field work that was suspended (described in comment fields #45 and #46).

CHANGES/PROBLEMS (cont'd)

48. Significant changes in use or care of human subjects, vertebrate animals, biohazards, and/or select agents

Nothing to Report

49. Change of primary performance site location from that originally proposed

Nothing to Report

PROJECT OUTCOMES

50. What were the outcomes of the award?

Outcomes of this award are captured in the aforementioned "Accomplishments", "Products", and "Impact" sections, and in Appendices 1-6.

DEMOGRAPHIC INFORMATION FOR SIGNIFICANT CONTRIBUTORS (VOLUNTARY)

<p>Gender:</p> <p><input type="radio"/> Male</p> <p><input type="radio"/> Female</p> <p><input type="radio"/> Do not wish to provide</p>	<p>Ethnicity:</p> <p><input type="radio"/> Hispanic or Latina/o Not</p> <p><input type="radio"/> Hispanic or Latina/o Do not wish to provide</p>
<p>Race:</p> <p><input type="radio"/> American Indian or Alaska Native Asian</p> <p><input type="radio"/> Black or African American</p> <p><input type="radio"/> Native Hawaiian or other Pacific Islander</p> <p><input type="radio"/> White</p> <p><input type="radio"/> Do not wish to provide</p>	<p>Disability Status:</p> <p><input type="radio"/> Yes</p> <p>[] Deaf or serious difficulty hearing</p> <p>[] Blind or serious difficulty seeing even when wearing glasses</p> <p>[] Serious difficulty walking or climbing stairs</p> <p>[] Other serious disability related to a physical, mental, or emotional condition</p> <p><input type="radio"/> No</p> <p><input type="radio"/> Do not wish to provide</p>

Attach a separate document if more space is needed for #6-10, or #24-50.