DEPARTMENT OF COMMERCE
RESEARCH PERFORMANCE PROGRESS REPORT (RPPR)

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AWARD INFORMATION	
1. Federal Agency: Department of Commerce / NOAA	2. Federal Award Number: NA14OAR4320158
3. Project Title: Renewal: Cooperative Institute of the North Atlantic Region	
4. Award Period of Performance Start Date: 07/01/2014	5. Award Period of Performance End Date: 06/30/2021
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REPORTING INFORMATION	
Signature of Submitting Official: Susan Ferreira	
16. Submission Date and Time Stamp: 06/28/2019	17. Reporting Period End Date: 03/31/2019
18. Reporting Frequency: ◉ Annual ◯ Semi-Annual ◯ Quarterly	19. Report Type: ◉ Not Final ◯ Final
RECIPIENT ORGANIZATION	
20. Recipient Name: WOODS HOLE OCEANOGRAPHIC INSTITUTION	
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22. Recipient DUNS: 001766682	23. Recipient EIN: 042105850

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?

Research accomplishments are summarized under each of CINAR's major research themes:

Theme I – Ecosystem Forecasting. CINAR activities developed state-of-the art ecological models that were applied to practical problems in the NES LME, including efforts to: 1) expand the Regional Ocean Modeling System (ROMS) to include coupled chemical and biological models allowing hindcast/forecast simulation studies; 2) collect data on Alexandrium dinoflagellate cysts for forecasting models of this harmful algal bloom species in the Gulf of Maine; 3) redesign the OceanAdapt website and augment data accessed through this portal; and 4) further improve the FVCOM ecosystem based models.

Theme II – Ecosystem Monitoring. Highlights included efforts to: 1) conduct glider missions in the Gulf of Maine and the mid-Atlantic to survey for the highly endangered North Atlantic right whale; 2) further development and deployment of Habcam, a stereo optical and acoustic imaging system used by NOAA to survey scallops along the northeast continental shelf; (3) analyze nutrients dynamic for the NOAA ECOMON program, and 4) develop a three-dimensional model that simulates fish movement within a hydrodynamics model (ROMS).

Theme III – Ecosystem Management. Research highlights included: 1) characterization of behavioral responses of black sea bass and longfin inshore squid to noise disturbances originating from offshore renewable energy construction; 2) investigation of how ocean temperature patterns are affecting golden tilefish spawning behavior or larval survival; and 3) analysis of lobster bait use in Maine's lobster fishery and impacts to management of this fishery.

Theme IV – Protection and Restoration of Resources. Research highlights included: 1) work to evaluate and model how changes in the northwest Atlantic ecosystem affect Atlantic salmon; and 2) demonstration of DTAG technology as an effective approach to non-invasively study the behavior of cetaceans in the NES LME, including cryptic and endangered species.

Theme V – Sustained Ocean Observations and Climate. Major activities included: 1) establishing and supporting Ocean Reference Stations (ORS) to provide sustained, climate-quality observing of the trade wind region (see Fig. 1 & 2); 2) operating the Argo fleet of active floats that collect systematic global observations of subsurface ocean temperature, salinity, and circulation; and 3) continued characterization and quantification of air-sea interactions for the OAFlux research and data development project, which serves the needs of the ocean and climate communities on the characterization, attribution, modeling, and understanding of variability and long-term change in the atmosphere and the oceans.

Theme VI – Education and Outreach. Accomplishments under this theme are described in comment field #26, below.

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 summarized 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 2018, the MREP program offered 11 workshops and events. We convened a total of 256 fisherman participants and 102 presenters. The Fishery Science workshop provided participants with grounding in the fundamentals of commercial and recreational fisheries science. The workshop helped relate fishing effort to stock assessments, showing how fishermen's knowledge can be incorporated in collection of critically needed data, and how this data flows into development of regulations. In addition, the fishery management workshop provided an overview of entities that manage commercial and recreational fisheries with emphasis on the structure of the Regional Fishery Management Councils. The 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.

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 their sponsor that provides results during a 10 to 12 week period. This program has been highly successful, and funded summer students at WHOI and other CINAR partner institutions in 2018.

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 2018 eight summer research interns were recruited to work on new and continuing projects. Two of the interns were returning from the previous summer. Four of these summer interns continued into the academic year for both Fall 2018 and Spring 2019 semesters. One of the Fall 2018 interns began a new project with a new mentor which continued into the spring.

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 17 postdocs in their research programs.

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

In addition to the educational and outreach programs described in comment box #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.

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

ACCOMPLISHMENTS *(cont'd)*

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

CINAR is entering its no-cost extension year under this award. Work on all existing research programs will continue, but no new programs will be funded. New research and educational programs will continue under CINAR's new award.

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. Listing of publications has been submitted to the NOAA Repository on 09 July 2019.

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

PRODUCTS *(cont'd)*

30. Technologies or techniques

Technologies and techniques associated with CINAR research are listed below:

• Gallager (WHOI): HabCam for surveying benthic habitats and living resources
• Baumgartner (WHOI): Near real-time detections 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 primary producers in ecosystems.
• 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 (RSHINY GUI is in progress).
• Rose (UMCES): A 3-D model simulating Gulf of Mexico conditions is in development, 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): During the last year all sites had active deployed hydrophones and acoustic telemetry receivers.
• Weller (WHOI): The Ocean Climate Observations and Analyses effort supports 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

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

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:
https://www.nefsc.noaa.gov/psb/acoustics/psbAcousticsWindEnergyEffects.html; and (2) SanctSound: Soundscape monitoring program:
https://www.nefsc.noaa.gov/psb/acoustics/psbAcousticsSoundscapeNMS.html
https://sanctuaries.noaa.gov/science/monitoring/sound/
• Weller (WHOI): Multi-year time series of surface meteorology and air-sea fluxes, merged into the longest possible continuous time series in answer to requests from the modeling community; these are known as Reference Data Sets and are available at http://uop.whoi.edu/ReferenceDataSets/index.html

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), Ann Stone (Administrative Associate). A listing of project investigators is provided in Appendix 1.

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

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?

Oscan Schofield replaced Lynne Trabachino as the PI for Rutgers University, and David Townsend replaced Rebecca Van Beneden as the PI for University of Maine. During the past year, Claire Anacreon joined the CINAR administrative staff.

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 Meterological Organization.

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

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?

Impacts of CINAR research on the principal discipline(s) of this cooperative institute are summarized below, organized according to research theme (impacts related to the education and outreach theme are summarized in comment box #39).

Theme I – Ecosystem Forecasting. Researchers are using data collected by CINAR's ocean observing assets and programs to understand and describe ecological and environmental parameters and processes in the NES LME. State-of-the art ecological models and data assimilation methods developed by CINAR investigators have been 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 this theme's research priorities, and also help to address research priorities outlined in the "NOAA Fisheries Ecosystem-Based Fishery Management (EBFM) Policy", which established a framework of guiding principles for implementation of EBFM in NOAA fisheries.

Theme II – Ecosystem Monitoring. CINAR activities have contributed valuable datasets to advance our understanding of critical species and resources in the NES LMS, which are used for effective management and resource stewardship in the region. The approaches pioneered by CINAR investigators for data collection have also helped to advance ocean observing technologies (see comment field #30). Data collection activities outside of the NES LME included characterization of hydrographic and biological characteristics of Arctic ecosystems in the northern Bering and Chukchi Seas. 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 scallop and groundfish resources.

Theme III – Ecosystem Management. CINAR researchers are studying a broad range of topics directly relevant to EBFM in the NES LME. 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. In addition to climate change, CINAR investigators are conducting research on other anthropogenic impacts to fisheries (e.g., noise disturbances from offshore construction), and developing theoretical and empirical modeling frameworks that describe these interactions.

Theme IV - Protection and Restoration of Resources. CINAR activities under this theme are developing new technologies, research tools, and approaches for the assessment and recovery of protected species in the NES LME, including the critically endangered North Atlantic right whale, Atlantic salmon, and other species. These research efforts span the spectrum from basic to applied research on protected species, and are contributing new datasets and approaches to better define, protect, and restore essential habitat. Examples include demonstration of DTAG technology to non-invasively study the behavior of cetaceans in the NES LME, which can be applied by investigators elsewhere in the study and endangered species.

Theme V – Sustained Ocean Observations and Climate. CINAR data and activities under this theme support multiple NOAA research and priorities and goals related to fisheries Climate Science and EBFM, including the "NOAA Fisheries Climate Science Strategy". CINAR research includes supporting the global array of Argo floats, which samples the temperature and salinity of ocean waters, and produce sustained and systematic global observations of subsurface ocean temperature, salinity, and circulation.

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. In addition, CINAR research is contributing to better management of harmful algal blooms in the region, which contributes to 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 NES LME, and support efforts to integrate economic, social, and cultural considerations in EBFM.

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

Over the past year, CINAR programs supported 38 research scientists and staff, postdocs, and administrative staff, as well as 4 graduate students and 17 undergraduate students. 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.

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

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. In 2018, CINAR investigators included 4 graduate students and 6 postdocs in their research programs.   In addition, CINAR programs for undergraduate research provided summer fellowships for 15 students, including support for undergraduate students from underrepresented minority groups.

Over the past year, CINAR supported 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. Faculty funding 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 61 Argo floats over the past year (See Fig 3 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, and 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 Figs. 1 & 2 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. CINAR investigators maintain multiple websites and informational resources, which are listed in comment field #32.

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

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 NES LME. Additional information on some of these 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?

As mentioned previously, 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 contributing to better management of harmful algal blooms in the region, which contributes to 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 NES LME, and support efforts to integrate human interactions and socioeconomic considerations in EBFM.

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

IMPACT *(cont'd)*

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

0 , <5%

CHANGES/PROBLEMS

45. Changes in approach and reasons for change

Nothing to report.

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

CHANGES/PROBLEMS *(cont'd)*

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

All projects that were extended beyond their originally scheduled project end date are listed below. Multiple projects experienced delays due to the partial federal government shutdown in early 2019.

• Bowen (WHOI): The project was delayed by manufacturing and testing issues relative to the fiber optic cable that will be installed onto the winch used in operations. These issues are being resolved.
• Grebmeier (UMCES): Additional time needed to complete phytoplankton and macrofaunal taxonomic identification, which is extremely time intensive.
• Jensen (Rutgers): The R-Shiny GUI was delayed due to issues regarding personnel availability, which have been resolved.
• Fay (SMAST): Hiring of staff on the project in 2018 was delayed because the graduate student identified to fill the role decided to attend another school/program. A new Technical Associate was hired in April 2019.
• Kinnison (UME): Deliverables on the project were delayed due to an unexpected change in lab staffing and because of difficulties obtaining seasonally dependent fish tissue samples and field water samples needed to validate assays for multiple diadromous species. Arrangements were made with the NMFS Maine Field Office to coordinate sample and water sampling and personnel are lined up to complete this work.
• Kite-Powell (WHOI): Meetings with OAR staff wwere delayed during partial federal government shutdown in early 2019.
• Mooney (WHOI): Additional time needed for data collection and analyses.
• Mills (GMRI): The Atlantic Salmon project has been delayed throughout its duration by the time needed to finalize growth data collection from multiple sets of salmon scales. Delays were also associated with turnover of a key technical staffing position. This has since been resolved.
• Nesslage (UMCES): Data delivery and collaborative work with federal partners were delayed due to hurricane Florence and the federal shutdown.
• Pinsky (Rutgers): Additional time is needed for data collection and analyses.
• Rose (UMCES): Additional time is needed for data collection and analyses.
• Saba (Rutgers): Additional time is needed to complete experiments and data analyses.
• Stanley (WHOI): Additional time is needed for data collection and analyses.
• Stoll (UME): Project was delayed because of the government shutdown, which temporarily restricted access to confidential landings data from the Northeast Fisheries Science Center.
• Townsend (UME): Additional time is needed for data collection and analyses.
• Weller (WHOI): Additional time needed for instrument updates and maintenance.
• Wilkin (Rutgers): Additional time needed to support for the development and implementation of Operational Forecast Systems (OFS) for sea ports, estuaries, the Great Lakes, and coastal waters.

47. Changes that had a significant impact on expenditures

None to report

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

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

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

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)

Gender:

◯ Male

◯ Female

◯ Do not wish to provide

Ethnicity:

◯ Hispanic or Latina/o Not

◯ Hispanic or Latina/o Do not

◯ wish to provide

Race:

◯ American Indian or Alaska Native Asian

◯ Black or African American

◯ Native Hawaiian or other Pacific Islander

◯ White

◯ Do not wish to provide

Disability Status:

◯ Yes

[ ] Deaf or serious difficulty hearing

[ ] Blind or serious difficulty seeing even when wearing glasses

[ ] Serious difficulty walking or climbing stairs

[ ] Other serious disability related to a physical, mental, or emotional condition

◯ No

◯ Do not wish to provide

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