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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: NA20OAR4320271
3. Project Title: Cooperative Institute for Climate, Ocean, and Ecosystem Studies (CICOES)	
4. Award Period of Performance Start Date: 07/01/2020	5. Award Period of Performance End Date: 07/31/2025
PRINCIPAL INVESTIGATOR/PROJECT DIRECTOR	
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REPORTING INFORMATION	
Signature of Submitting Official: Lester W Villaflor	
16. Submission Date and Time Stamp: 04/26/2022	17. Reporting Period End Date: 03/31/2022
18. Reporting Frequency: (●) Annual ( ) Semi-Annual ( ) Quarterly	19. Report Type: (●) Not Final ( ) Final
RECIPIENT ORGANIZATION	
20. Recipient Name: UNIVERSITY OF WASHINGTON	
21. Recipient Address: 4333 BROOKLYN AVE NE, SEATTLE, WA 98195-0001 USA	
22. Recipient UEI: HD1WMN6945W6	23. Recipient EIN: 916001537

ACCOMPLISHMENTS

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

Overall goals and objectives of the Cooperative Institute for Climate, Ocean, and Ecosystem Studies (CICOES) included: fostering collaborative research among scientists from the NOAA, the University of Washington, the University of Alaska Fairbanks, and Oregon State University; preparing the next generation of scientists; and educating the public on current scientific issues. CICOES strives to be an integrated Cooperative Institute among the three academic partners. Research scientists and faculty collaborate with scientists at our three NOAA partner laboratories (AFSC, NWFSC, PMEL), and faculty, staff, and students at partner universities. The CICOES research portfolio is comprised of nine research themes: Climate and Ocean Variability, Change and Impacts; Earth Systems and Processes; Environmental Chemistry and Ocean Carbon; Marine Ecosystems: Observation, Analysis, and Forecasts; Ocean and Coastal Observations; Environmental Data Science; Aquaculture Science; Human Dimensions in Marine Systems; and Polar Studies. Research objectives conducted under these themes include: collecting and analyzing data to better understand physical, biological, and chemical processes in the world's ocean; understanding climate variability and impacts; investigating ocean and atmospheric processes; quantifying how the ocean absorbs carbon dioxide and resulting increase in ocean acidity; examining hydrothermal vents, seeps, and volcanoes on the seafloor; characterizing interactions between human communities and natural ecosystems; developing tools and technology to sustain, restore, and protect marine organisms and their environments; improving prediction and forecasting of climate and tsunami impacts; measuring and modeling climate impacts in polar regions; understanding and improving mariculture best practices; and building IT support tools that facilitate collection, storage, analysis, and archiving of research data

25. What was accomplished under these goals?

See appendix 1 attached

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?

Here is a list of highlights of training and professional development at CICOES during the reporting period:

- CICOES has a dedicated professional development fund for research staff and postdocs for conference attendance and enrichment courses. An employee committee reviews applications and decides which applicants to fund

- Despite COVID-19 constraints, many groups pivoted to virtual professional interactions As an example, EcoFOCI personnel continued to gather and analyze information to refine understanding of the US arctic ecosystem, and presented these results at international conferences, workshops, and seminars. These activities included the development of new methods and skills among personnel, and have resulted in increased scientific capabilities of EcoFOCI personnel

- Individual groups, PIs, and research science staff also participated in many international and national remote conferences including American Geophysical Union, American Fisheries Society, Alaska Marine Science Symposium, and American Society for Limnology and Oceanography Ocean Sciences meeting.

- Approximately once per year, the CICOES Diversity, Equity and Inclusion (DEI) committee organizes a DEI-related training for CICOES staff—led by outside experts in the field. This year's training was Managing Conflict.

- Undergraduate students who participate in our summer Internship Program are invited to apply for CICOES funds to attend a research conference (often with their mentors) during the academic year following their internship.

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

CICOES scientists and affiliated faculty publish primary and popular literature and conduct public education events. The following list are representative highlights held during the reporting period:

- Results were disseminated through public talks, including the NOAA seminar series and scientist and student presentations at the ASLO Ocean Sciences meeting.

- Each year, the Innovative Technology for Arctic Exploration (ITAE) group works with its partners such as EcoFOCI to disseminate scientific information and continues to enhance and adapt how that information is shared. The group's approach targets the scientific community, local communities, and fishery management institutions: Science Community: Alaska Marine Science Symposium, the ASLO Ocean Sciences meeting, the North Pacific Research Board's Arctic Integrated Ecosystem Research Program (NPRB-AIERP); Local Communities: NPRB-IERP, Arctic Waterways Safety Committee, Alaska Eskimo Whaling Commission; Fishery management Institutions: Bering Sea and Arctic Ecosystem Status Reports

- In the Genetics and Genomics group, CICOES scientists work with intermediaries to inform local tribal partners and are actively establishing relationships with these communities

ACCOMPLISHMENTS *(cont'd)*

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

See appendix 2 attached

PRODUCTS

29. Publications, conference papers, and presentations

See appendix 3 attached

PRODUCTS *(cont'd)*

30. Technologies or techniques

Technological developments that enable new measurements in support of NOAA's mission are an integral component of CICOES' annual activities. Examples of technological development during the reporting period include:

- Large Eddy Simulation cloud-resolving model System for Atmospheric Modeling (SAM) version 6.10
- Environmental (e)DNA metabarcoding, whole-genome sequencing, nanopore long-read sequencing, Illumina NovaSeq and Illumina MiSeq sequencing, automated eDNA samplers
- Algorithm development in geospatial computation, machine learning, ordinary least squares regressions (with fixed effects), and logistic regression (with fixed effects)
- Mathematical, oceanographic and economic modelling
- Line-transect aerial survey methodology, aircraft belly mounted camera system.
- Passive acoustic monitoring and analysis techniques, including noise metrics and autodetection and classification
- Drones (hexacopters), aerial survey methodology, HD video cameras
- Machine Learning/AI project development currently in development for photo-id.
- Implantable satellite transmitter
- Environmental monitoring sensor packages for long term deployment at high latitudes (e.g. Prawler mooring for water profile sampling)
- Oculus autonomous underwater glider
-
- Pop-up floats for long term bottom deployments

31. Inventions, patent applications, and/or licenses

Nothing to Report

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

PRODUCTS *(cont'd)*

32. Other products

Examples of additional products that have been produced during the reporting period that support or are a direct science contribution include:

- web application that allows users to explore and download data from surveys of over 1,400 U.S. West Coast fishing vessel owners
- statistical model code for standardization of fishery-dependent data that were compiled as an annotated workflow are available through GitHub for use by NOAA-AFSC staff
- Genomic sequence data sets (i.e. RADseq) for Sleeper sharks: Somniosus antarcticus, Somniosus microcephalus, Somniosus pacificus
- Genomic sequence data set (i.e. lcWGS) for rockfish and sablefish: Sebastes alutus, borealis, ciliates, melanops, melanostictus, polyspinis, ruberrimus, variabilis and Anoplopoma fimbria
- Analytic software pipeline for lcWGS data genomic analyses

PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS

33. What individuals have worked on this project?

John Horne, PI
Uma Bhatt, Co-PI (lead UAF)
Roberta Marinelli, Co-PI (lead OSU)
Muyin Wang, Deputy Director
Joseph Resing Deputy Director
Ivonne Ortiz, Associate Director

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?

Nothing to Report

35. What other organizations have been involved as partners?

CICOES is a Cooperative Institute consortium with the University of Alaska Fairbanks (UAF) and Oregon State University (OSU)

PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS *(cont'd)*

36. Have other collaborators or contacts been involved?

Mike Alexander, Simone Alin, Aleksandr Araykin, Diego Arcase, Kerim Aydin, Dan Ayers, M.O. Baringer, Sonia Batten, Tamara Baumberger, S. Becker, Catherine Berchok, Bryan Black, Nicholas Bond, Peter Boveng, Charlotte Boyd, William Brazelton, J.L. Bullister, Randie Bundy, Eugene Burger, Michael Cameron, Antonietta Capotondi, C.A. Carlson, William Chadwick, Carolina Chambers, Guiwan Chen, Wei Cheng, Dezhang Chu, Kathryn Chumbley, Sarah Converse, Lee Cooper, Kelly Corbett, Jessica Crance, Jessica Cross, Shawn Dahle, Michael Dalton, Alison Deary, S.C. Doney, Stan Dosso, John Dunne, Marie Eble, Steven Emerson, Reagan Errera, Andrea Fassbender, Richard Feely, Megan Ferguson, Bridget Feris, R.A. Fine, E. Firing, Robert Foy, Nancy Friday, Thomas Gelatt, Christopher German, Georgina Gibson, Dan Goethel, Maxime Grand, Jackie Grebmeier, N. Gruber, Jen Hagen, Melissa Haltuch, Owen Hamel, D.A. Hansell, Ed Harrison, Alan Haynie, Tom Helser, Albert Hermann, Gaelle, Hervieux, Kevin Hiers, Anne Hollowed, Kirstin Holsman, Makio Honda, Julie Huber, Jim Ianelli, Katrin Iken, M.O. Ishii, Catherine Jeandel, G.C. Johnson, Ken Johnson, Isaac Kaplan, Stephen Kasperski, K. Katsumata, Yoshimi Kawai, Kelly Kearney, Julie Keister, R.M. Key, Peter Kiffney, Laura Kong, M.O. Kramp, Jason Kriesel, Arun Kumar, Edward Laman, Susan Lang, C. Langdon, Sim Larkin, Wes Larson, Marvin Lilley, Xiaopei Lin, Maeve Lohan, Josh London, Rick Lumpkin, Chris Lunsford, John Lupton, A.M. MacDonald, Nathan Marshall, J.T. Mathis, Beth Matta, Liz McCullough, E.L. McDonagh, S. Mecking, Chris Meinig, Susan Merle, Richard Methot, F.J. Millero, Dong-Ha Min, Christopher Moore, Erin Moreland, Danielle Naiman, T. Nakano, Julie Nielsen, Jan Newton, Jeff Nystuen, Eitarou Oka, James Orr, Christopher Paight, Surya Prakash, Sulagna Ray, Heather Renner, Marie Robert, Nora Rojek, Kenneth Rubin, Greg Ruggerone, Steve Rutledge, C.L. Sabine, Peter
Salameh, Beth Sanderson, Jorge Sarmiento, Ajda Savarin, Joe Schumacker, Roland Schweitzer, Sarah Seabrook, Peter Sedwick, Kim Shelden, Samantha Siedlecki, Bob Simons, B.M. Sloyan, W.M. Smethie, Matthew Snyder, Laura Spencer, Paul Spencer, Ingrid Spies, Phyllis Stabeno, Valentina Staneva, Timothy Stanton, Jeremy Sterling, William Stockhausen, Robert Stone, Adrienne Sutton, Rob Suryan, J.H. Swift, Cody Szuwalski, Alessandro Tagliabue, Lynne Talley, Dajun Tang, T. Tanhua, James Thorson, Eric Thorsos, Andrew Thurber, A.M. Thurnherr, Vasily Titov, Jason Toft, Verena Tunnicliffe, Henry Vanderploog, Morgan Varner, Paul Wade, Sharon Walker, Hu Wang, R.A. Wanninkhof, Eric Ward, Amanda Warlick, Mark Warner, Janet Watt, Wilbert Weijer, Tom Wilderbuer, Sarah Wise, Lixin Wu, Yan Xue, Jie Yang, Stephani Zador, Jeannette Zamon, Tonya Zeppelin, and J.-Z. Zhang.

IMPACT

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

See appendix 4 attached

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?

Impacts from studies conducted by CICOES scientists are not constrained within single research themes. Impacts on other disciplines from research conducted by CICOES scientists include:
• Development of the Biogeochemical Argo float shifts focus from physical oceanography to a now expanded sensor package that supports additional climate and atmospheric science investigations and modeling efforts.
• A conference organized to maximize benefits of the Biogeochemical Argo float array to fisheries scientists and modelers.
• Sea-air CO2 flux calculations from an ocean model enabled back calculations of CO2 fluxes between a terrestrial landscape and the atmosphere
• Potential effects of tsunami events on Antarctic ice shelf fractures may accelerate melting and result in sea level rise
• Forecasting models of ocean acidification predicted effects on fisheries and coastal communities from ocean observations, climate model predictions, and species response studies to calculate potential economic risks and community vulnerabilities for resource and governmental policy decision makers.
• Coordinated modeling efforts provide pathways to address ecosystem services and economic questions relevant to blue economy development.
• Integration of sensors and platforms provides new environmental data sampled in extreme environments that are used within and across biological, physical, and economic disciplines.
• Development of fisheries resource modeling techniques are transferable from aquatic to terrestrial ecosystems.
• Ocean measurements used by national prediction centers to improve weather and climate prediction, and allow researchers to study exchanges of heat, moisture, momentum, and carbon dioxide between the ocean and atmosphere. These data are used by elementary school children through Postdoctoral research associates and government scientists to validate satellite products, validate and improve weather and climate models, detect ocean and atmospheric interactions during typhoons and winter storms, and monitor longer term changes in the climate system.

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

In addition to the previously discussed DEI workshops, we continue efforts to encourage the hiring of underrepresented groups in all personnel hires. While the number of female PhD students and postdoc researchers in the sciences has increased in recent years, retention of female scientists beyond Postdoctoral Scholar appointments remains a challenge to CICOES as well as US Universities and Government agencies. CICOES has a dedicated HR Manager who works with the CICOES DEI committee to ensure fair and unbiased hiring.
Our outreach efforts include programs that reach out to students of all ages and levels, including talks on Career Day at elementary schools, and contributing support to three high school summer interns in collaboration with the Pacific Science Center, where the students trained in stomach sample analysis and data exploration – providing exposure to STEM careers.
Undergraduate students, graduate students, postdocs, and early career scientists are all active participants in our education, outreach, and mentoring programs. All students have access to the CICOESS community for help with their research and are encouraged by established scientists.
Two CICOES scientists recently had an INBRE Curriculum Development grant funded to introduce UAF undergraduate and graduate students to phylogenetics and transcriptomics bioinformatic techniques. Additional activities associated with the NSF RCN collaboration 'Seascape Genomics of North Pacific Forage Fishes' provided training to three graduate students across two universities and produced publicly available outreach/educational materials.

IMPACT *(cont'd)*

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

Numerous personnel were formally trained and or mentored in association with CICOES research projects during the reporting period:
Postdoc training: 27 (including partially supported postdocs)
Graduate students: 26 (including partial support)
Early career scientists: 8
Undergraduate interns: 13
We supported undergraduate student class activities and graduate students in their research, thesis/dissertation preparation, and provide field experiences through oceanographic expedition and/or research management surveys. Examples during the reporting period include:
Genomic data collected from Pacific cod have been used in an undergraduate Fisheries genetics class to enable students to develop a project idea, analyze appropriate data, and write results in a term paper. A graduate Introduction to Spatial Data Manipulation and Visualization class used the same data for problem sets and a student class project. This project provided hands-on learning for eDNA sample processing and utilizing new technological approaches.
Data analyses on the GTMBA web site are often used for teaching by institutions in the US and around the world.
Fisheries acoustic data were used in the development of echopype, an open-source Python software package that enables interoperable and scalable processing of fisheries acoustic data

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

Nothing to Report

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?

Technology transfer at CICOES continued through the reporting period despite COVID-19 impacting field tests and access to laboratories and workshops. Examples of technology transfer impacts in three research themes include:
Environmental Chemistry and Ocean Carbon
Miniaturization of sensor packages enabled unmanned aircraft systems to be used as sampling platforms in aerosol research instead of aircraft. The Unmanned Aircraft System with aerosol payloads effort advanced to a readiness level of 7.5, with development of payload packages including: PSD miniFlux to measure atmospheric thermodynamic state, turbulence, winds, and sky IR temperature; PMEL Clear Sky for measurement of aerosol microphysical, chemical, and optical properties; and PMEL Cloudy Sky for the measurements of aerosol–cloud interactions.
Analytic products developed through this effort (e.g. algorithms for calibration of core sensors and data interpretation software) are available to the community through GitHub repositories and supplementary materials to peer-reviewed publications. A Development of a CO2 sensor has also been transferred to private industry for deployment in a range of oceanographic applications.
Marine Ecosystems: Observation, Analysis, and Forecasts
The Innovative Technology for Arctic Exploration (ITAE) is a PMEL technology development program that transfers products to the research community and private industry. Examples of technology platforms and products that impacted technology transfer in this reporting period include : Oculus glider, PRAWLER mooring, Pop-up floats, ice-tracking beacons, primary productivity index, and machine learning with zooplankton imaging.
INSTINCT software package developed in the Marine Mammal Laboratory that enables users to create acoustic signal annotation, detection and analytic workflows.
Pix4D (for mobile and drone mapping) and VIAME (video and image analytics for multiple environments) are software suites designed to automate and decrease image and video processing time for application to the conservation and management of Steller sea lions and northern fur seals.
Determination of chinook salmon stock composition through genetic methods has been transferred to Sea State, a private fisheries data analytic firm, that reduces sample reporting time and enables fishers to reduce salmon bycatch.
Ocean and Coastal Observations
The Global Tropical Moored Buoy Array (GTMBA) observing program has significant impact on technology transfer through: capacity building with foreign partners, international coordination with cooperative panels, and advances in technology publications.
Technician training from institutions in France, Brazil, Indonesia, India, and Korea is an annual activity during refurbishment cruises.
Ocean Climate Stations (OCS) in conjunction with the NOAA National Data Buoy Center has improved real-time data transfer of the subsurface current measurements from the Tropical Atmosphere Ocean (TAO) Array. A partnership between Saildrone, Inc. and PMEL Engineering has increased the Saildrone from a RL 6 to a RL 9, making the Saildrone a capable and versatile air-sea interaction observing platform that could be incorporated into the next generation Tropic Pacific Observing System (TPOS).

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

Overall impacts of research on society beyond science and technology during the reporting period have increased our knowledge, understanding, and forecasting ability of atmosphere-ocean interactions, climate and climate-related modeling, and the understanding and better management of ecosystems and harvestable resources. Collectively, these results can be used to increase coastal community resilience, national and international food security, and to better enable civil planning and engineering for future climate changes. Education and outreach efforts increased public awareness of environmental issues and trained next generation of physical and biological scientists.
Specific examples include:
• Food habits modeling results were communicated to Alaska indigenous communities to build trust and understanding of changes in fishing regulations and catch quotas to sustain harvestable resources.
• Insight gained from technological-based sampling was shared among Arctic communities impacted by climate change.
• Ocean Acidification work was used as a framework for groups to plan community resilience that includes future change in the environment, economy, and food security.
• The Biogeochemical Argo Float Array initiated an "Adopt a Float" program to increase awareness of ocean research among school children.
• Marine mammal modeling results are used to inform local Arctic communities of cetacean and pinniped population abundances and distributions.
• Sampling and modeling results were used to improve sustainability and profitability of Alaskan fisheries, which were valued at over $90 million in 2020. Conservation and sustainable harvest of commercially important fish stocks including chinook salmon is culturally and economically important to indigenous and non-indigenous groups throughout the Pacific Northwest.
• Development of tsunami probabilistic-based, design zone maps are used to formulate national and international building codes that maximize building safety. Production of tsunami inundation maps for Caribbean Islands increases societal awareness and emergency planning in response to potential tsunami events.
• Climate variability impacts agriculture, public health, infrastructure, and economies. Empirical oceanic data were incorporated in climate analysis and forecast products to help to inform planning decisions for government, communities, businesses, and private citizens.

IMPACT *(cont'd)*

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

1 , Hard to determine exact amount; this is an estimate

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

COVID continued to delay and complicate field work. We continue to work with NOAA sponsors on individual issues as they arise.

47. Changes that had a significant impact on expenditures

Nothing 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 during the reporting period strengthened CICOES' infrastructure, and through research activities developed innovative hardware and software, communicated results to the scientific community and public, trained undergraduate and graduate students, and mentored Postdoctoral Scholars. Examples of research accomplishments and outcomes are listed in the answer and appendix to Question 25. Examples of CICOES infrastructure outcomes include:

- Continued development of a three-University, integrated, collocated and consortium Cooperative Institute, despite constraints to travel and in-person meetings during the COVID-19 pandemic. Annual cycles of leadership and all hands meetings, as well as consortium wide, internal funding initiatives are established and becoming predictable within the community.
- Formalized NOAA laboratory and University partner participation in CICOES advisory bodies and review panels. CICOES' internal initiatives has increased the need for committees to review initiative applications. As an example, the 2022 summer intern program received over 300 applications for 12 positions. We have increased the numbers participating in our advisory bodies and widened the participation of research scientists and faculty members on all review panels.
- CICOES Task I funded initiatives that are available to community members include: DEI committee, Professional Development Committee, Visiting Scientist program, Research Development Grant program, PostDoctoral Scholar program. The Research Development program and the Postdoctoral Scholar program is available to all consortium members and is funded using UW Task I funds (90% of Task I funds are returned to consortium members).
- The Graduate Student fellowship program awarded seven quarters that increased collaborative research with NOAA scientists, increased student publications, and supported dissertation and thesis completions.
- A 'Timely Opportunity' category was added to the Research Development Grant program during the reporting period, which resulted in the continuation of aircraft-based Arctic Heat program measurements to be expanded and the training of a new Research Scientist who will become the field program organizer and lead assuming additional funding is obtained for the Arctic Heat program.
- Given constraints of the ongoing COVID-19 pandemic, the Undergraduate Student Summer Intern program successfully pivoted to a hybrid schedule that combined virtual research for the first 10 weeks and an in person last week that included networking, additional scientific training, and video and poster presentations of intern research projects.
- CICOES continued the Environmental Health and Safety protocol plans for all field sampling programs during COVID-19 restricted conditions. Field plans were reviewed for remote location, vessel, and aircraft-based operations that were conducted throughout the world.
- CICOES co-sponsored the 12th Northwest Climate Conference to enhance attendance from underrepresented and under resourced communities.
- CICOES continued it support of the Bevan Seminar Series designed to expand communication of international living resource issues to a wider audience. The series features internationally recognized experts who examine current issues affecting fisheries and marine conservation, representing as many viewpoints as possible, focusing on solutions to pressing problems. All lectures are free and open to the public.

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.