PACIFIC ISLANDS
CLIMATE ADAPTATION SCIENCE CENTER

PI-CASC Consortium 2020 Annual Report

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KEY ELEMENTS OF THE
USGS-UNIVERSITY OF HAWAIʻI (ET AL.)
COOPERATIVE AGREEMENT FOR THE HOSTING OF
THE PACIFIC ISLANDS CLIMATE ADAPTATION SCIENCE CENTER

EXPECTATIONS & DELIVERABLES

- Pacific Islands Climate Adaptation Science Center (PI CASC) lead university will host an annual half to one-and-a-half-day cooperators meeting coordinated by the National Climate Adaptation Science Center (NCASC) to highlight the past year's accomplishments in science, regional dialogue, capacity building, and communications
    - Meetings will also identify and discuss any administrative issues to be addressed
    - The first and third annual cooperator meetings will be conducted in-person in a one or one-and-a-half-day meeting
    - The second and fourth annual cooperator meetings will be conducted via a half-day video teleconference
- A standalone annual report, as required by the cooperative agreement, will be provided two weeks prior to the annual review and include the following elements:
    - Specific examples of actionable science, including quotes, stories, and links to policy- and decision-making, as applicable
    - List of students, post-docs, and Fellows, their major accomplishments during their time associated with the PI CASC (e.g., publications, presentations), and how their work relates to PI CASC and DOI priorities and Science Agenda at the time the student, post-doc, or Fellow was engaged.
- All PI CASC projects will comply with NCASC data management policies [https://casc.usgs.gov/data-policies-and-guidance] and USGS Fundamental Science Practices, where appropriate.
- University of Hawai‘i will report on any federally-funded projects for which data management activities are deficient based on project agreements
- Quarterly meetings, led by the federal science coordinator will be held with the PI CASC Data Steward regarding progress on data management
- All PI CASC products will comply with the CASC Communication Guidelines
- Work to help implement recommendations as relevant from the prior five-year review report. Five year review report recommendations can be found in Appendix I.
- The University of Hawai‘i will submit the following communication products to NCASC:
    - During the first year of the cooperative agreement:
        - At least three USGS Mission Area Highlights
        - At least three items for the Climate Adaptation Insights Newsletter
    - On a semi-annual basis, beginning the second year of the cooperative agreement onward,:
        - At least three Mission Area Highlights
        - At least three items for the Climate Adaptation Insights newsletter
        - At least one resource management--relevant success story from the CASC, to be used in promoting the CASC's work
- PI CASC University consortium (herein referred to as "consortium") program/communications and/or program staff will attend the majority of monthly CASC Network Staff calls.
- As funding and USGS guidance allows, all PI CASC University consortium members will attend the annual CASC-wide meeting.
- At the conclusion of the cooperative agreement, the University of Hawai‘i will:

- Produce a final report summarizing actionable science activities, scientific achievements, capacity building accomplishments, and communications highlights from the 5-year period of performance
- Host a multi-day in-person 5-year comprehensive review of the PI CASC that will be coordinated by NCASC.
- Deliver website and other products to NCASC (in the event of a change in the PI CASC host at the end of the agreement period)

INSTITUTIONAL ARRANGEMENTS

➢ **Leadership Team**

- Principal Investigator - University Consortium Director, Darren T. Lerner
- Co-Investigators - University Consortium Deputy Director: Bradley M. Romine
- UHH Lead - Sharon Ziegler-Chong
- UOG Lead - Romina King

➢ **Management**

- The University Consortium Director Lerner, Deputy Director Romine, and Co-leads Ziegler- Chong, and King will serve as the Leadership Management Team (LMT) on the university side responsible for overall administration of the hosting agreement including oversight, budget, reporting, outreach and communications, data management, and supervision of staff.
- The consortium Administrative Support Team (AST), consisting of a co-production coordinator (Laursen), a communications specialist (Lentz), and a program manager, will bring added capacity to the LMT in support of executing programmatic activities.
- The LMT will have monthly teleconference calls to discuss overall project coordination and progress and will include the USGS director, USGS deputy director (proposed), USGS Science Coordinator, and the AST.
- All PI CASC staff (university and USGS) have a responsibility to provide support and coordination of efforts between the consortium and federal staff to increase cohesion and overall effectiveness of the PI CASC enterprise.
- The LMT will also hold two formal meetings annually with the Senior Science Advisors (below) consisting of appropriate scientists across UHM, UHH and UoG to set the direction and progress of the university research engagement, student engagements, and co-production activities.
- The LMT, AST, and all activities will be coordinated with federal PI CASC staff.

➢ **Senior Science Advisors**

- Senior Science Advisors will serve as subject experts that advise the PICASC on the overall science direction within the scope of the Five-Year Science Agenda and support the coproduction of research and engagement.
- Members of the Senior Science Advisors (SSA) will have each demonstrated their capacity to engage in multi-, inter-, and transdisciplinary approaches; have demonstrated their willingness to mentor graduate and undergraduate students in related disciplines; and have shown a commitment to developing actionable science related to the PI CASC Science Agenda.

SCIENCE

➢ **Science Agenda Themes - Future Research**

- Research activities will address the appropriate PI CASC Five-Year Science Agenda that is in place at the time of the comittment of funds in support of the research; the science agenda should be approved by NCASC prior to full implementation.
- Funding to meet these needs will be directed toward the generation of climate adaptation science data and information, including:
  - support of graduate student research and undergraduate research;
  - development and execution of co-production workshops bringing researchers and natural and cultural resource managers together to guide and refine research activities;
  - establishment of a regular climate adaptation science symposium series and an annual student research symposium; and communications and outreach products on behalf of the entire PI CASC.

REGIONAL DIALOGUE AND INFORMATION SHARING

➢ The PI CASC will continue to bring existing university, government, and community networks together to conduct research and training on climate adaptation challenges identified jointly.

➢ **Co-Production Model**

- The three-level approach to this work will consist of:

  1) co-produced adaptation research is the core effort conducted in collaboration with partners and resource manager focused on regional adaptation research needs,
  2) those research efforts serve as the base for all capacity building efforts to prepare the adaptation workforce of the future, and
  3) communication and sharing of information across the region will build stronger networks, responses, and strategies to our changing world. Regardless of overall approach, each project will include four overarching principles shown in Figure 2.
  - The goal is to utilize these four elements to build adaptive capacity locally by identifying existing professional networks and expanding them through research projects driven by researcher-manager partnerships and collaborative forums that bring together natural and cultural resource managers, policy professionals, university faculty, and graduate students.

Figure 2. Overarching principles driving research, education and outreach.

EDUCATION, TRAINING AND CAPACITY BUILDING

- **PI CASC Graduate Scholars**
  - Graduate Scholars are expected to participate in research and outreach that provide them with valuable opportunities to further their education and progress toward their degree.
  - Graduate Scholars will participate in co-production workshops and other activities to further their understanding and future capacity as climate adaptation scientists serving our nation's resource managers.
  - Graduate Scholar opportunities will be developed with the SSA and collaborative partners with a focus on requisite knowledge needed for each specific project.
  - The consortium will engage Graduate Scholars in presenting their research at conferences and symposia throughout Hawai‘i and the USAPI as funding allows.
  - The PI CASC federal director will participate in all aspects of the Graduate Scholars Program from selection to matriculation.

- **PI CASC Summer Undergraduate Research Fellowship**
  - Proposed is the partnership of Summer Undergraduate Research Fellowship (SURF) with Pacific Internship Program for Exploring Science (PIPES) to provide an additional pipeline for students from Hawai‘i and the USAPI to focus on climate adaptation science, adding capacity and partnership for the PI CASC program.
  - Students will be paired with research laboratories and mentors based on their stated interests or provided with rotational experiences as funding and interest allows.
  - The consortium will seek to engage ten or more undergraduates annually in research projects for eight to ten weeks each summer.
  - PI CASC university leads and federal staff will meet annually to discuss and provide input into the selection of student projects.
  - Fellows will benefit from the hands-on experience of working on climate adaptation research in the field and laboratory, but will work closely with the PIs, PI CASC graduate students and postdocs, be provided opportunities to engage in co-production workshops, and become part of a cohort of SURF and PIPES undergraduates sharing similar experiences from across the Pacific as conditions permit.

- **Cross-Disciplinary and Cultural Knowledge Sharing Through Regional Collaboration**
  - The university and federal PI CASC staff will work to engage other CASCs in the creation of a summer experiential program that shares science, cultural, and indigenous practices and resource management issues between these two (or more) regions.

- **Co-Production Trainings, Workshops, and Symposia**
  - *Kūlana Noi‘i (research standards) and Manager Climate Corps*
    - The Kūlana Noi‘i workshops will utilize the co-production process to bring together university research faculty, students, resource managers, and PI CASC administration (university and federal) to develop strong partnerships for actionable science research.
    - The Manager Climate Corps will be broadened to other Hawaiian islands and the USAPI to the extent funding permits.
  - *Early Career Trainings*
    - All of the interactive forums will involve PI CASC Graduate Scholars as equal participants alongside natural and cultural resource managers, policy professionals, and researchers.

- *Interactive Co-Production Forums and Workshops*
  - PI CASC will continue to develop key networking opportunities between managers and researchers in the coming five years.
  - The consortium will seek opportunities/venues (e.g., National Adaptation Forum), to engage and collaborate with other regional CASCs in presenting examples of co-produced research and in leading a panel discussion.
- *Actionable Science Summit*
  - The consortium will organize and execute actionable science summits to bring people together across the region to form and strengthen networks, provide capacity building opportunities for researchers and resource managers, share results, and evaluate progress, challenges, and opportunities in developing, delivering, and utilizing co-developed, actionable science. All activities will be coordinated with the PI CASC federal staff.
  - At least two actionable science summits will be held during the five-year cooperative agreement and will incorporate presentations from research faculty, students, and resource managers. The summits will feature breakout sessions on targeted issues, and keynote presentations from international and national leaders in climate adaptation science and co-production.
- *Geographic Information Systems (GIS) and Remote Sensing (RS) Workshops*
  - PI CASC has prioritized the GIS/RS training needs and fulfillment of data gaps to build much needed technical capacity in Guam and the USAPI.
  - The consortium will continue to coordinate with federal and local agencies to organize GIS/RS workshops to fill data gaps (e.g., elevation datasets for the small USAPI atolls).

COMMUNICATIONS AND DATA MANAGEMENT

- The consortium, in coordination with federal PI CASC staff, will develop, finalize, and execute a Communications strategy as part of an overall PI CASC strategic plan.
- Each member of the consortium maintains local capacity for communications activities, which will be coordinated by Dr. Rachel Lentz, the PI CASC communications specialist, in service to the entire regional center. Regular provision and compliance of products with NCASC is necessary as described above.
- The consortium will consolidate and develop a single PI CASC website.

SPACE

- Hawai‘i Sea Grant will be providing office space for the federal PI CASC Science Coordinator and proposed federal hire (Deputy Director). UH Manoa will work with UH Hilo to secure office space for the Federal PI CASC Director on the UH Hilo campus.
- Proportional space is also provided “in kind” for those members of the Consortium that receive PI CASC funding support (Consortium Deputy Director Romine, Communications Specialist Lentz, Co-Production Coordinator Laursen, GIS Specialist Kottermair, HR Specialist Ching).
- Meeting and small conference space will also be provided as needed.
- Total dedicated and shared space at UHM is approximately 850 square feet.
- Space allocations at UHH and UOG as described in the proposal narrative total approximately 150 square feet each.

ADMINISTRATIVE

- The consortium will track and evaluate all outcomes for the PI CASC inclusive of directed funding from the federal PI CASC budget to ensure that our collective activities are aligned with

and advance DOI, USGS, NCASC, and PI CASC priorities established at the onset of the cooperative agreement for each year.

- ➢ UHM will utilize eProjects, an online system developed by Hawai‘i Sea Grant which serves to manage the entire competitive research process from RFP to review and award; data management; project tracking, reporting and evaluation; publications; and as a student, employee, and volunteer alumni and workforce development tracking system. UHM will work with NCASC to upload project information into USGS ScienceBase.
- ➢ All information will be readily accessible to the federal PI CASC director and staff and for communication to NCASC (see Communications, above).
- ➢ The NCASC requirements for data management planning are understood and the consortium is committed to working with the federal director and staff to implement accordingly.

DIRECT & INDIRECT COSTS

- ➢ The budget will be executed as stated in the proposal's budget narrative submitted and subsequently revised by the University of Hawai‘i. If there is a need by the University to re-budget after an award has been made (see 2 CFR 200.308 Revision of budget and program plans), a revised budget narrative and justification will be submitted to USGS OAG for consideration.

ADMINISTRATIVE DETAILS

PI Contact	Darren T. Lerner, PhD PI-CASC University Consortium Director 2525 Correa Rd., HIG 238 Honolulu, HI 96822 Email: lerner@hawaii.edu Phone: (808) 956-7031 Fax: (808) 956-3104
Institution	University of Hawai‘i Systems

Project Title	Pacific Islands Climate Adaptation Science Center
Award #	G19AC00087
Date of Report	August 3, 2020
Time covered	October 1, 2019 - September 30, 2020

PURPOSE and OBJECTIVE

This report describes Year 1 progress made towards the objectives as agreed upon in "Key Elements of the USGS-University of Hawai'i (et al.) Cooperative Agreement for the Hosting of The Pacific Islands Climate Adaptation Science Center" and our Five-year Science Agenda including organization and approach, results, outreach and communications, next steps, and budget.

A note about re-envisioning and adjusting due to the coronavirus pandemic
The new five-year Pacific Islands Climate Adaptation Science Center (PI-CASC) host agreement had only been in effect for five and half months when the severity of the coronavirus pandemic required university employees and our USGS partners to work remotely and postpone all regional and national travel. With the shutdown we took time to re-envision our efforts, moving consortium, stakeholder, researcher, students, and partner interactions completely on-line. While this has slowed productivity compared to business as usual on some fronts, we continue to make progress on all key elements of our cooperative agreement.

Progress to date
PI-CASC has continued to pursue actionable science according to focus areas defined in our Five-year Science Agenda with the commencement of seventeen new research projects between fall 2019 and fall 2020 (Appendix A). Consortium-led research efforts at the University of Hawai'i at Mānoa (UHM), University of Hawai'i at Hilo (UHH), and University of Guam (UOG) supported more than 20 PI-CASC Graduate Scholars (details can be found in Appendix A), while 2020 also saw the first cohort of our Summer Undergraduate Research Fellowship (SURF) Program.

Network facilitation brought researchers, stakeholders, natural and cultural resource managers, and government entities together both in-person (pre-pandemic) and virtually (following the onset of the pandemic). The PI-CASC Manager Climate Corps (MCC) program began the year (Nov 2019) by organizing and hosting a successful needs-assessment event for resource managers and researchers on Hawai'i Island. PI-CASC was also instrumental in the formation last fall of the Pacific Regional Invasive Species and Climate Change (Pacific RISCC) Management group, which has already held several successful virtual community events. We are modifying plans to host our first Climate Adaptation Science Summit, originally planned for September 2020, to be a virtual engagement on November 17/18, 2020. The Summit will bring more than 150 researchers, managers, and partners together from across the Pacific region to share their latest science and discuss research needs to support cultural and natural resource management and adaptation.

We worked consistently leading up to and throughout this last year, through in-person and virtual meetings and discussions, to advance our partnership with AK CASC sharing commonalities in science, resource management challenges, and indigenous practices. A third organizational meeting was held in Juneau, AK (Oct 2019) and a joint RFP announced in May solicited research proposals due in August 2020. Independently, a joint project between University of Alaska (UA) Juneau and UHH researchers and a separate project between UA and UHM were chosen for FY20 funding. Both projects will engage in collaborative and comparative research

over the coming year in these two regions while supporting graduate student research and degree advancement.

Improving coordination and communication within the PI-CASC consortium, and between the consortium and federal parts of the center, is an essential goal of this host agreement, and we have begun well, with regularly scheduled meetings for leadership and staff. Unfortunately, a full in-person staff meeting planned for March in Guam was cancelled due to the coronavirus pandemic.

In addition to regular communications efforts, we finalized a communications strategy plan, and have completely overhauled PI-CASC's digital presence, integrating three consortium websites into a single one on a content management system (WordPress) that will be live in fall 2020. We have also initiated a regular social media presence.

ORGANIZATION and APPROACH

Table 1. Personnel funded by PI-CASC award and their roles

Name	Institution	Title	Role/Responsibilities	FTE
Dr. Bradley Romine	UH Mānoa	Consortium Deputy Director	Award co-PI, assists the director in consortium coordination	.35-.50
Sharon Ziegler-Chong	UH Hilo	University Lead UHH	Leads UH Hilo partnership and collaboration efforts	.25
Dr. Romina King	U of Guam	University Lead UOG	Leads and Coordinates PI-CASC activities at UOG	0.1
Scott Laursen	UH Hilo	Co-production Specialist	Coordinates co-production project development through MCC activities	1.0
Rachel Lentz	UH Mānoa	Communications Specialist	Coordinates communications efforts for consortium	.40-.60
Una Ching	UH Mānoa	Administrative Officer	Human Resources	.15
Dr. Mark Lander	UOG	PEAC Researcher	Data support especially for PIRCA contribution. Coordinates and writes PEAC Newsletter	.10
Marcel Higgs	UOG	Administrative Staff	Provided administrative support	.10
Various communications personnel	UOG	Communications specialists	Coordinated integration of UOG projects and materials with the PI-CASC-UOG website and social media	.25

Table 2. Personnel contributing "in kind" support to PI-CASC efforts

Name	Institution	Title	Role/Responsibilities
Dr. Darren Lerner	UH Mānoa	Consortium Director	Award PI, administers PI-CASC program, coordinates all consortium efforts with Federal partners
Dr. Bradley Romine	UH Mānoa	Coastal Processes Specialist	Provides in-kind climate extension services
Dr. Romina King	U of Guam	University Lead UOG	Coordinates PI-CASC UOG efforts; liaises with local and USAPI natural resource managers
Darcy Yogi	UH Mānoa	Communications Intern	Supports communications efforts
Dr. Hal Richman	UH Mānoa	IT Specialist	IT support for consortium and USGS PI-CASC personnel

Katy Hintzen	UH Mānoa	Hawai‘i Sea Grant Coastal Resilience Specialist	Co-production and community engagement practices
Dana Tamashiro	UH Mānoa	Hawai‘i Sea Grant Administrative Officer	Administrative and fiscal support including processing consortium research funding
Kristin Pada	UH Mānoa	Hawai‘i Sea Grant Program Management Specialists	Administrative support including scheduling, travel and workshop coordination/support
Dr. Rosie Alegado	UH Mānoa	Assoc. Professor of Oceanography	Co-production and community engagement practices
Maya Walton	UH Mānoa	Hawai‘i Sea Grant Program Leader and Fellowship Coordinator	Co-production, community engagement practices, and fellowships

Consortium Operations

PI-CASC is fiscally administered by the Sea Grant College Program (Hawai‘i Sea Grant) at UHM within the School of Ocean and Earth Science and Technology. This enables substantial leveraging of office and meeting space and personnel time, including from the University Consortium Director, administrative officers, and other administrative and extension personnel. This is particularly helpful with the additional capacity needed to meet the new requirement that UHM run fiscal management and administration of all federal CASC grants to university researchers.

Collaboration and communication throughout PI-CASC has included an increase in regular video conference meetings while adjusting for remote work and inability to travel inter-island. We hold bi-monthly virtual meetings for full center staff (USGS, UHM, UHH, and UOG), and separate bi-monthly meetings for the federal and consortium directors with the deputy director and USGS PI-CASC science coordinator. The federal and consortium directors have a standing weekly meeting. In addition, *ad hoc* meetings occur frequently between the directors and between the consortium director and deputy director, as well as between other staff working on joint efforts. Of note is PI-CASC's Charter for Maintaining Effective Communications and Right Relations (Appendix B) established prior to this reporting period in October of 2018.

The only personnel changes during this timeframe were in PI-CASC communications staff at UOG. For cost savings and efficiency, the consortium lead at UOG has leveraged the presence of various communicators engaged with other programs and organizations at UOG, including Guam Sea Grant, the Guam Center for Island Sustainability, and EPSCoR programs. In this way, John Borja, Kyle Santos, and Ken Quintanilla each contributed to PI-CASC communication efforts for 3-5 month periods as UOG PI-CASC communications staff over the course of this year.

RESULTS

Representative activities and results supporting the PI-CASC Five-year Science Agenda are presented below. These activities are reported within the following requested categories: partnerships, science, capacity building, and products/tools. We recognize, however, that many of PI-CASC's activities and engagements fall within multiple categories, successfully blending these goals.

Partnerships

PI-CASC staff facilitate and support diverse and effective partnerships with a wide range of researchers and natural and cultural resource managers, as briefly described below. PI-CASC's capacity to leverage its strong long-term partnerships with regional organizations is also fundamental to the center's success. Not the least of these are our own federal partners at PI-CASC. It must be said, that the last year has seen incredible positive development of this partnership and connectivity and a welcomed increase in federal capacity for PI-CASC. As such it can be difficult to tease apart some of the activities as wholly "consortium" vs "federal."

Heather Kerkering, PI-CASC USGS science coordinator, and Darcy Yogi, a PI-CASC USGS communications intern and Hawai'i Sea Grant communications staff, have led a partnership effort with the East-West Center, the US Fish and Wildlife Service, the Hawai'i Invasive Species Council, and the Coordinating Group on Alien Pest Species to establish a Pacific Regional Invasive Species and Climate Change (Pacific RISCC) management group. Modelled on the Northeast RISCC, this management group is a collection of researchers, managers, and other local stakeholders concerned with the interconnected problems of climate change and invasive species in the islands. To date, they have conducted a needs survey of stakeholders in the region, held two webinar discussions (in May and July, 2020) with nearly 100 attendees at each, and are planning a virtual forum at the 27th Annual Hawai'i Conservation Conference in September.

PI-CASC staff have also supported researchers and resource managers with Kua'āina Ulu 'Auamo (KUA) in partnership with traditional fishpond practitioners in conducting the Loko I'a Climate Needs Assessment on various project components, from data collection to compilation of ideas into a pending comprehensive report. These community engagement meetings generated better understanding for how PI-CASC can better serve local and indigenous communities.

PI-CASC leveraged Hawai'i Sea Grant's biennial competitive research program by providing funding in support of graduate research scholars as "match" to Hawai'i Sea Grant's research project funding (three projects ending and four projects starting within this reporting period). Stakeholder outreach to produce actionable science is a significant component of each of these projects. As examples, Alisha Summers, working with PI Dr. Daniele Spirandelli, worked closely with the West Kaua'i community, state and county officials from numerous departments, and community members and local organizations to produce a vulnerability assessment of coastal hazard threats from sea-level rise and to identify best actions to address them. In another project, Anna Mikkelson, working with PI Dr. Charles Fletcher, engaged in a novel beach observing system along Waikīkī Beach using high resolution survey equipment as well as drones to enable weekly beach and near-shore monitoring to characterize long and short-term erosion trends that may be increasing with sea-level rise. Throughout this project, ties were strengthened with key stakeholder groups, including the Office of Conservation and Coastal Lands in the

Hawai‘i Department of Land and Natural Resources, which is the lead agency for beach and coastal resource management in the State, the Waikīkī Beach Special Improvement District Association Board, and a Waikīkī Beach management advisory group.

PI-CASC consortium staff at UHH, Scott Laursen, and consortium lead, Sharon Ziegler-Chong, have continued to work via the Manager Climate Corps (MCC) program to create and support new and existing relationships between researchers and resource managers. In November 2019, a highly successful workshop brought together new and established partners to assess Hawai‘i Island research and management needs and to structure an RFP framework. By design, the workshop enabled researcher-manager collaborations to begin early in the process to help inform proposal development, encouraging stakeholder involvement throughout each research project and ensuring development of actionable science products. Statements of Interest (SOIs) were submitted and reviewed for actionable science elements and relevance to the PI-CASC Science Agenda. Six collaborative projects were chosen and are set to start in August 2020, with two of them jointly funded through the US Fish and Wildlife Service Science Applications office.

Dr. Romina King, UOG consortium lead, has been leading an innovative approach to the traditional university workforce development model. With a parallel to the “flipped classroom” approach, PI-CASC at UOG has recruited local natural resource managers to pursue degrees that engage them in the science and research needed by their respective agencies. This unique approach to research co-production simultaneously benefits the researcher and agency partners and assists local practitioners in furthering their careers. Dr. King also partners with many organizations as the vice-chair of the Government of Guam Climate Change Resilience Commission, leading the production of a Climate Change Vulnerability assessment for Built-Infrastructure, having previously engaged experts to participate in the Fourth National Climate Assessment (NCA4) and the Pacific Islands Regional Climate Assessment (PIRCA) through collaboration with the East-West Center.

An exciting development moving forward, which may serve as a model for cooperation across the CASCs, is the developing partnership between PI-CASC and AK CASC. Beginning with two in-person meetings in 2019 in Honolulu, HI, and Juneau, AK, teams led by the federal and consortium directors explored areas of common focus for research collaboration and programmatic approaches to co-production methodologies. Our regional centers have defined a comparative research path forward that takes a holistic approach to considering similarities and differences in the structure and function of whole, integrated watersheds and the impacts of a changing climate from ridge to reef, in the Pacific context, and ice to ocean, in the Alaska one. This collaboration seeks to develop research partnerships that engage resource managers in both regions while sharing in cultural exchanges among researchers, managers, and students. To date, two projects have been identified for funding, while a small RFP for two more projects was jointly issued in the summer of 2020 and is in process at the time of the writing of this report.

Science

Working with researchers and resource managers across the region, PI-CASC research seeks to understand the impacts of climate change on fish, wildlife, plants, water, land, and people in order to deliver actionable science tailored to regional needs. Four new Federal RFP-funded projects were initiated in 2020 (in addition to five others begun in 2019 prior to October) and

thirteen new research projects with consortium support for graduate students were initiated through the year: three at UOG in the fall of 2019; four at UHM in February 2020; and six selected through the MCC program at UHH to begin in August 2020 (Appendix A). Progress on these most recent projects will be provided in next year's report.

Several projects begun during the previous cooperative agreement were completed in the fall and spring semesters of 2019 and 2020, respectively. In addition to the Mikkelson/Fletcher and Summers/Spirandelli projects described above in Partnerships, UHM graduate student Devon DeBevoise, working with PI Dr. Camilo Mora, helped construct a low-cost, robotic plant growing system designed to control water, temperature, and CO_2 conditions for individual plants (up to a hundred in each machine) with the aim of tackling research questions that require growing numerous plants under diverse controlled conditions, simulating multiple possible climate change scenarios. DeBevoise was able to complete an experiment on strawberry guava plants (a common invasive species in Hawai'i) to test the equipment. While PI-CASC's role has finished in the project, there are plans for a larger experiment this fall to quantify temperature and drought tolerance on another plant species.

Two one-year research projects, built on new and existing manager-researcher partnerships and funded by PI-CASC through the UHH consortium member, were completed in December of 2019. One project, led by Courtney Hurt, a recent UHH graduate, in cooperation with several Hawai'i Island manager groups explored the impacts of climate change on the South Kona 'ōelu (mackeral scad) fishery, illustrating the utility of pooling multiple knowledge bases (e.g. local fishing practices and state management actions) for the benefit of a community. Another project, led by UHH graduate student Kimo Melcher working with PI Dr. Ryan Perroy, focused on using drone technology to compile detailed maps of watershed erosion on Moloka'i, in an effort to create models to inform management strategies for projects such as determining favorable habitats for reestablishment of native vegetation and implementation of anti-erosion measures.

Capacity Building

PI-CASC focuses its capacity building efforts on supporting undergraduate and graduate students to create a future community of researchers and managers equipped with the tools to work with agencies and communities to address adaptation needs for ecosystems and people through actionable science.

In the summer of 2020, we officially launched the PI-CASC Summer Undergraduate Research Fellowship (SURF) program. For this summer experience, promising undergraduates with ties to Hawai'i or Guam (either from the islands or currently attending university there) were selected from a diverse applicant pool to participate in 10 weeks of climate and ecosystem research with a university faculty mentor, with a stipend to cover summer living expenses. Through short written reports and presentations at a final (virtual) symposium, the fellows shared their work on sea-level rise effects on plant ecology, forest restoration and survivability of native plant species, and interactions of climate change and invasive species. The mentors and fellows were able to adjust for the complexities of the coronavirus pandemic by interacting virtually, including for a workshop on co-production and community-based research practices, and, where feasible, through added safety protocols in office, lab, and greenhouse spaces. The quality of the three

selected students was impressive, and all three reported fulfilling summer experiences. At least one of the mentors has requested to continue the student's project work into the fall semester. Two Native Hawaiian undergraduates were also supported by PI-CASC to participate in the Pacific Intership Programs for Exploring Science (PIPES). As a part of the PIPES 2020 cohort of 20 interns, they participated in hybrid internship experiences, involving field and online work, weekly cohort seminars, final written reports, and online speed presentations of their experience. Both undergraduate programs were important in helping our next generation of climate adaptation leaders move their careers forward despite an ongoing pandemic.

This year also marked the first official cohort of the PI-CASC Graduate Scholars program. With new projects already begun at UOG and UHM, and six anticipated at UHH, there will be 13 Graduate Scholars to shared experiences as a cohort through the next year, including orientations, workshops, symposia, and communication opportunities (written and oral).

As described in Partnerships, PI-CASC at UOG is also working to increase capacity in resource management and actionable science in the western USAPI through degree advancement and workforce development with local resource managers.

Products and Tools

PI-CASC delivers actionable science by supporting research that generates knowledge and information that can directly improve the ability of local managers and decision-makers to affect positive changes in ecosystem and community adaptation to climate change. Progress this year toward developing science products and tools has mostly been in selecting and starting projects.

Two important written products were created that bear mentioning. The Summers/Spirandelli project (described above) yielded a detailed report, the "West Kauaʻi Community Vulnerability Assessment," which helped inform the County's West Kauaʻi Community Plan update, including proposed climate change and sea-level rise actions and policies. Their report also describes their novel methodology for conducting community outreach and in-reach that informed the proposed climate adaptation actions and priorities.

Also of note this year was the addition of a case study featuring PI-CASC-supported work in the US Climate Resilience Toolkit in January 2020. This project was completed in 2018 by Rose Hart, a UHH graduate student working with PI Dr. Ryan Perroy, and examined coastal erosion rates in different geologic settings around Hawaiʻi Island with the goal of informing the County of Hawaiʻi Planning Department in determining suitable, scientifically based shoreline construction set-back rules. This collaborative project is a prime example of the benefits of co-production and thus was an excellent addition to the US Climate Resilience Toolkit case studies.

Two projects initiated this year with PI Dr. Phil Thompson at the UH Sea Level Center will create novel products for adapting to sea-level rise. The first project is developing a smart-phone-based application for augmented reality visualization of sea-level rise impacts at Puʻuhonua O Hōnaunau National Park on Hawaiʻi Island. Dr. Thompson's second project will develop an online interactive sea-level rise impacts mapping tool for American Sāmoa, based in part on the success of the Hawaiʻi Sea Level Rise Viewer, which contains sea-level rise impact map data developed with PI-CASC funding support.

OUTREACH and COMMUNICATION

Published articles
Please see Appendix C for a list of peer reviewed journal publications and non-peer reviewed technical publications from this period.

Presentations and workshops
PI-CASC hosted several workshops, including the MCC needs assessment workshop (Nov. 2019) and the Pacific RISCC workshops (May, July 2020). PI-CASC also had a workshop in Guam titled Introduction to Remote Sensing, led by Dr. Romina King and Dr. Edgar Aban (Aug 2020), and education, outreach, and co-production workshops were also held for PI-CASC students, both undergraduate and graduate through the summer of 2020.

In January 2020, PI-CASC staff partnered with researchers in kick-off meetings for the Hawai‘i Drought Knowledge Exchange (PI Abby Frazier), joining partners from the East-West Center to meet with managers and stakeholders at the Hawai‘i Volcanoes National Park and Pu‘u Wa‘awa‘a Forest Reserve. Stakeholders heard about the available science, and managers voiced their priorities and research questions. In-person meetings gave researchers and PI-CASC an opportunity to see the landscapes, hear the stories, and intimately learn about the ecosystems and human communities they would be supporting

Scott Laursen and Darcy Yogi provided individual, invited presentations as part of a global, continuous 31-hour webinar in June 2020, sponsored by the International Small Islands Studies Association (ISISA). Amongst 70 participants from 30 countries, Laursen discussed the MCC manager-driven research program and outlined the impacts of the program by co-presenting with Bethany Morrison, a manager who used the research products. Yogi talked about her role in a Hawaiian fishpond needs assessment project (described in Partnerships, above) that shared traditional knowledge to help inform decision-making.

As part of her role as Vice-chair for the Government of Guam Climate Resilience Commission, Dr. Romina King prepared a presentation summarizing the results of the DOI funded Climate Change Vulnerability Assessment of coastal built environments for Guam for the 5th Assembly Planners on Guam (Feb 2020). (The presentation was delivered by a PI-CASC partner, Evangeline Lujan, on her behalf while Dr. King was on maternity leave.)

PI-CASC university consortium deputy director, Dr. Brad Romine, has spent eight years as an extension specialist at UHM with Hawai‘i Sea Grant. He leverages his joint position between PI-CASC and Hawai‘i Sea Grant to focus his expertise on providing actionable science in service to community and local government decision-makers around coastal resource management and sea-level rise adaptation. Dr. Romine provided nine presentations and conducted one workshop with various groups on these topics over the reporting period including students, community groups, researchers, and government officials.

Major engagements with stakeholders
As noted in Partnerships and above, PI-CASC consortium staff Scott Laursen and consortium lead Sharon Ziegler-Chong at UHH conducted an MCC workshop on Hawai‘i Island in

November 2019, bringing together established and new partners to assess research and management needs and structure a framework for a consortium request for proposals. Among the stakeholder organizations in attendance were: Ala Kahakai (National Park Service), Conservation International, US Fish and Wildlife Service, Pacific Fire Exchange, MaunaKea Watershed Alliance, Dept. of Hawaiian Home Lands, Aquatic Resources Division, Dept. of Land and Natural Resources (Puʻuwaʻawaʻa), South Kohala Coastal Partnership, Sierra Club of Hawaiʻi, Hawaiʻi County, Kailapa Community Association, and The Nature Conservancy.

Unfortunately, due to coronavirus pandemic travel restrictions, PI-CASC was forced to postpone our annual major engagement with west Pacific stakeholders, resource managers, and researchers at the Center for Island Sustainability Conference in Guam, which was scheduled for April 1-3, 2020, and was to include a joint PI-CASC/AK CASC research pre-symposium on March 31. We are planning to enageg in this endeavor in person or virtually in March/April 2021

Websites and social media

The current PI-CASC websites have been maintained and kept updated while work has been ongoing (despite slowing from the pandemic) to combine all three consortium sites developed early in the previous cooperative agreement into a single, comprehensive PI-CASC website. Detailed planning of site navigation and functionality combined with streamlining of old content with addition of new content will provide a user-friendly, content-rich experience to help rebrand PI-CASC as the go-to organization for climate adaptation science in Hawaiʻi and the USAPI.

This year also marked PI-CASC's first foray as a center into an active social media presence. The fledgling Facebook account has 58 posts since October 2019 and is building a following. We anticipate that the new website and Facebook accounts, with a planned refreshing of our monthly Pacific Pandanus newsletter will create a positive feedback loop and encourage more activity on all fronts.

Other products

Several new communications products were generated during this period for briefings with governmental representatives and other stakeholders, including two new informational one-pagers (one for the Center in general and one oriented towards work in the Pacific Basin beyond Hawaiʻi), and a 2019-2020 Research Portfolio. In addition, we continue to provide our monthly Pacific Pandanus newsletter featuring news stories and links to research and resource management efforts and other related information and opportunities throughout our region.

Under the auspices of our UOG consortium lead, researcher Dr. Mark Lander created a climate data archive, the Historical Guam Anderson Air Force Base Rain Database, as part of an ongoing effort to populate the independent supplemental climate data from METAR observational data reports as a cross-reference to the official records. With Brandon Bukunt (NOAA NWS), Dr. Lander also developed a Drought Information Statement for Guam and USAPI, based on their Pacific ENSO Applications Climate Center (PEAC) work.

NEXT STEPS

We are planning modifications for conducting the work proposed for year 2 due to the uncertainty associated with the ongoing pandemic, university prohibition on travel to the continent and varying restrictions on inter-island travel (presently requiring 14-day quarantine upon arrival), and the inability to conduct in-person meetings and other engagements on our own islands. However, while we may not be able to engage in the ways that we proposed, we will continue to work diligently to reconfigure those activities in the current environment toward the goals and deliverables outlined. The challenges of the last several months have pushed us to adapt and seek opportunities to learn how to meet the challenges ahead.

As the timing of our funding year falls between the start of the academic semesters the reporting of our grad student research endeavors will continue to be offset from the report year and many of the research projects initiated during this year will not be completed by the end of next year's annual report, but will make progress towards their end dates in FY22 for which we will report. Of course, it must be recognized that the ongoing potential impact of the COVID-19 pandemic on researchers' abilities to engage in field and laboratory work remains unknown. We will continue to engage graduate and undergraduate students working on these projects through virtual workshops and give them opportunities for professional development through presentations and public outreach. With regard to the latter, we seek to expand the number of SURF students next summer through leveraging opportunities with other programs and investigators. Interactions with stakeholders will continue, either virtual or in person to continue the growth of our network connections and partnerships in development including ongoing co-production workshops across the islands.

We will continue the planning and execution of our first Pacific Islands Climate Adaptation Science Summit scheduled for November 17/18, 2020, which will be a virtual experience engaging researchers, partners, and stakeholders from across the Pacific Basin to determine local needs and highlight PI-CASC as an important facilitator of climate adaptation science in the region. PI-CASC will also participate in the annual 2021 Center for Island Sustainability Conference in Guam, with a student research symposium before the conference and active participation in sessions throughout the main conference. Whether this will be virtual, or in-person remains to be seen. Similarly, we will continue to build our collaboration with AK CASC, in the hopes that we may soon resume in-person research, cultural exchange, and co-production workshops between the CASCs and affiliated researchers in both Alaska and Hawai‘i.

The new website will launch, and the monthly Pacific Pandanus newsletter will be updated and redesigned prior to the close of year 1. We are also embarking on a new annual product like the research portfolio (described earlier) to present an update each year on our endeavors, which will be shared with stakeholders and government representatives.

APPENDICES

Appendix A: Research Projects

Table 1: Projects begun during the reporting period

Start/End dates	Title	PI/Co-I	Student	Funding amount	Funding source
8/20 - 7/23	Using cutting-edge NASA technology to assess coral reef bleaching events and measure recovery rates of dominant coral taxa at priority reef areas in Guam and the Commonwealth of the Northern Mariana Islands (CNMI)	Romina King			USGS RFP
6/20 - 5/21	Visualizing Sea-level Rise at Pu'uhonua O Honaunau National Historic Park with Interactive, Virtual Technology	Phil Thompson			USGS RFP
5/20 - 4/22	Climate change, variability, and drought in the US-Affiliated Pacific Islands: Working with managers to mitigate the impacts of drought and wildfires	Abby Frazier			USGS RFP
5/20 - 4/22	Predicting the effects of climate change on the spread of fire-promoting plants in Hawai‘i: assessing emerging threats to rare native plants and ecosystems	Curt Daehler			USGS RFP
2/20 - 1/22	Microbial biogeochemical cycling across a chronosequence of mangrove introductions across Hawai‘i	Rosie Alegado	Becca Lensing		UHM*
2/20 - 1/22	Vulnerability of Coastal Ecosystems to Increased Salinity from Climate Change	Kasey Barton	Anna McCormick		UHM*
2/20 - 1/22	Enhancing social-ecological resilience and ecosystem services through restoration of coastal agroforestry systems	Leah Bremer	Gina McGuire		UHM*
2/20 - 1/22	Fostering a SOEST culture of place-based and community-based pedagogy in support of coastal sustainability in Hawai‘i	Barbara Bruno	Tineill Dudoit		UHM*
9/19 - 8/21	Biochar as a Mitigation Tool for Soil Rehabilitation in Guam’s Badlands and Savannah Grasslands	Mohammad Galobi	Patrick Keeler		UOG
9/19 - 8/21	Comparing arbuscular mycorrhizal diversity among different life stages of Intsia bijuga (Colebr.) Kuntze in Guam’s Limestone Forests	Andrea Blas	Charles Paulino		UOG
9/19 - 8/21	Working with managers to mitigate the impacts of drought and wildfire	Abby Frazier	Farron Taijeron		UOG
8/20 - 7/22	A comprehensive shoreline inventory for Hawai‘i Island to increase resilience in the face of rising sea levels	Ryan Perroy	Aloha Kapono		UHH
8/20 - 7/22	The Path Near the Sea; Adapting to Climate Inflictions Upon Intertidal Shoreline	John Burns	Lauren Kapono		UHH

8/20 - 7/22	Development of an early warning system for climate-change related invasion by mosquitoes into Hakalau Forest NWR	Patrick Hart	Stephanie Mladinich	UHH
8/20 - 7/22	Optimizing forest restoration techniques to increase endangered species habitat and mitigate future drought: Kanakaleonui Bird Corridor	Jon Price	Amberly Pigeo	UHH
8/20 - 7/22	How will changing reefscapes affect the prevalence of ciguatera on Hawaiian reefs?	Tim Grabowski	Nikola Rodriguez	UHH
8/20 - 7/22	Understanding Plants of the Past to Inform Community Reforestation Efforts in the Future: A Place-Based Approach for Promoting Resilience in the Puʻuwaʻawaʻa Community-Based Subsistence Forest Area, North Kona, Hawaiʻi	Jon Price	David Russell	UHH

* PI-CASC is funding the graduate student on these projects, leveraging the research activities funded by Hawaiʻi Sea Grant.

Table 2: Projects ongoing or finished during the reporting period

Start/End dates	Title	PI/Co-I	Student	Funding amount	Funding source
10/19 - 6/22	Assessing mosquito populations in Kauaʻi to help limit the spread of avian disease and inform the conservation of Hawaiian forest birds	Dennis LaPointe			USGS RFP
7/19 - 7/21	The future resiliency of mangrove forests to sea-level rise in the western Pacific: Initiating a national assessment approach	Karen Thorne			USGS RFP
6/19 - 6/21	The impact of climate change and sea-level rise on the future flooding of coastal parks and refuges in Hawaiʻi and the US Affiliated Pacific Islands	Curt Storlazzi			USGS RFP
3/19 - 7/20	Science needs assessment to support management of loko iʻa (Hawaiian fishpond) resources and practices critical to Native Hawaiian communities	Rosie Alegado			USGS RFP
2/19 - 2/21	Working with natural resource managers to co-produce drought analyses in Hawaiʻi	Christian Giardina/ Abby Frazier			USGS RFP
1/19 - 12/20	Managing non-native game mammals to reduce future conflicts with native plant conservation in Hawaiʻi	Steve Hess/Lucas Fortini			USGS RFP
10/18 - 7/20	Supporting sea-level rise preparedness in Hawaiian National Parks	Phil Thompson			USGS RFP
6/18 - 6/20	Identifying the risk of runoff and erosion in Hawaiʻi's National Parks	Lucas Fortini			USGS RFP
9/16 - 12/21	Effects of Drought on Soil Moisture and Water resources in Hawai'i	Alan Mair			USGS RFP

2/18 - 1/20	Integrating Climate Science with Local Knowledge through Community Vulnerability Assessment on Kaua`i	Daniele Spirandelli	Alisha Summers	UHM*
2/18 - 1/20	A Next-Generation Beach Observing System for Hawaii	Charles Fletcher	Anna Mikkelson	UHM*
2/18 - 1/20	Impacts on climatic changes on a native and an invasive Hawaiian plant using a newly developed Intelligent Plant Growing System (ISP)	Camilo Mora	Devon DeBevoise	UHM*
2/18 - 2/19	Coral Reef CO2 variations at the Coastal Ocean Hawaii Acidification Network (COHAMN): Impact of Basin Scale Oceanographic Forcing	Eric DeCarlo	Lucie Knor	UHM*
11/18 - 12/19	E Hui Pū: A collaborative approach to understand climate change impacts on traditional Hawaiian ʻŌpelu (mackerel scad) aggregation sites in South Kona, Hawaiʻi	John Burns/Tim Grabowski	Courtney Hurt	UHH
11/18 - 9/19	Determining effectiveness of high-elevation habitat restoration efforts for Palila, an endangered honeycreeper: increasing resiliency to climate change impacts	Patrick Hart	Kahua Julian	UHH
11/18 - 12/19	Developing geospatial models in Hawaiian watersheds to mitigate erosion & climate change	Ryan Perroy/Rebecca Ostertag	Kimo Melcher	UHH
7/18 - 7/20	Water quality in the face of climate change: Establishing a baseline in Pohnpei, Federated States of Micronesia	Tracy Wiegner	Bryan Tonga	UHH

* PI-CASC is funding the graduate student on these projects, leveraging the research activities funded by Hawaiʻi Sea Grant.

Appendix B: PI-CASC Leadership Communications Charter

Charter for Maintaining Effective Communications and Right Relations

Purpose: This document serves to formalize the processes by which the members of the Pacific Islands Climate Adaptation Science Center (PI-CASC) leadership team communicate with one another to maintain effective functioning of the center and right relations with one another.

Regular meetings: Regular communication is essential to ensure the PI-CASC functions effectively and as a single unified center. To that end:

- The Federal and University Directors will, to the extent possible, have a weekly check-in meeting.
- The leadership team will have monthly video conference calls to discuss progress on meeting the goals of the center, address any issues that might prevent such progress, and share ideas to meet those goals.
- In lieu of a monthly video call, the leadership team will have quarterly in-person meetings, with the location to rotate around to the different university consortium sites.
- The leadership team and associated staff of the PI-CASC will have an annual retreat to look back and celebrate the past year's achievements and set goals for the following year.

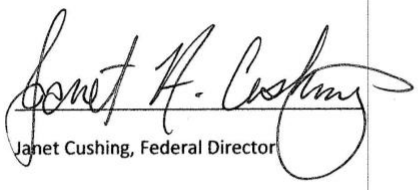
These regular meetings do not prevent ad hoc calls or other meetings that might come up throughout the year. We acknowledge and encourage free-flowing communication among all members of the PI-CASC.

Collaboration approach: Our different perspectives make us strong and bring diversity to our center, however, it is inevitable that there will be disagreements on how to approach an activity or other matters concerning the PI-CASC. In order to focus on collaboration and resolve disagreements in a respectful manner and focusing on the primary goal of maintaining right relations with one another, we will endeavor to take the following steps:

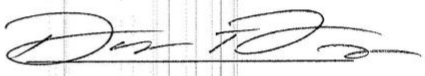
1. Actively listen to try to understand each other's perspectives
2. Explain the motivation behind our individual perspectives with the idea of sharing a perspective to grow the center as a whole versus winning an argument
3. Ask questions to gain clarity of the other's perspective
4. Seek consensus
5. Maintain a sense of a cohesive team/ family

Accountability: We will hold each other accountable to maintain the tenets of this charter. If any one of us feels that a member is not adhering to this charter, it is our responsibility to respectfully request that person to be mindful in upholding his/her commitment.

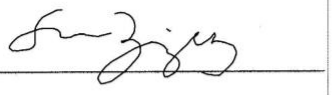
We, the members of the PI-CASC leadership team, commit to following the processes outlined above:



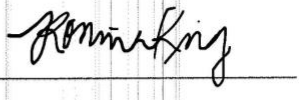
Janet Cushing, Federal Director



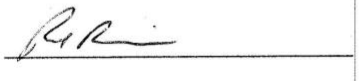
Darren Lerner, University Director



Sharon Ziegler-Chong, University Consortium
University of Hawai'i-Hilo Lead



Romina King, University Consortium
University of Guam Lead



Brad Romine, University Deputy Director

Appendix C: Publications

Barton, K.E., Jones C., Edwards K.F., Shiels, A.B., & Knight, T. (2020). Local adaptation constrains drought tolerance in a tropical foundation tree. *J. of Ecology*, doi: 10.1111/1365-2745.13354

Economy, L. M., T. N. Wiegner, A. M. Strauch, J. D. Awaya, & Gerken, T. (2019). Rainfall and Streamflow Effects on Estuarine Staphylococcus aureus and Fecal Indicator Bacteria Concentrations. *J. Environ. Qual., 48*,1711-1721. doi:10.2134/jeq2019.05.0196

Frazier, A.G., Deenik, J.L., Fujii, N.D., Funderburk, G.R., Giambelluca, T.W., Giardina, C.P., et al. (2019). Managing effects of drought in Hawai'i and US-Affiliated Pacific Islands. In J.M. Vose, D.L. Peterson, C.H. Luce, T. Patel-Weynand (Eds.), *Effects of Drought on Forests and Rangelands in the United States: Translating Science into Management Responses* (Gen. Tech. Rep. WO-98). Washington, DC: U.S. Department of Agriculture, Forest Service, Washington Office. 95-121. doi:10.2737/WO-GTR-98

Gesch, D., Palaseanu-Lovejoy, M., Danielson, J., Fletcher, C., Kottermair, M., Barbee, M., & Jalandoni, A. (2020). Inundation exposure assessment for Majuro Atoll, Republic of the Marshall Islands using a high-accuracy digital elevation model. *Remote Sens.*, *12*(1), 154. doi: 10.3390/rs12010154

King, R., Bautista, K., Higgs, M., & Leon Guerrero, E., (2019). *Vulnerability Assessment of Built Infrastructure near Coastal Bays using three Sea Level Rise Scenarios - Guam* (Technical Report). Guam: University of Guam. Available at: https://bsp.guam.gov/guamccva/

Krushelnycky, P.D., Felts, J.M., Robichaux, R.H., Barton, K.E., Litton, C.M., & Brown, M.D. (2019). Clinal variation in drought resistance shapes past population declines and future management of a threatened plant. *Ecological Monographs*, doi: 10.1002/ecm.1398

Samuel, M.D., Liao, W., Atkinson, C.T., & LaPointe, D.A. (2020). Facilitated adaptation for conservation--Can gene editing save Hawai'i's endangered birds from climate driven avian malaria? *Bio Conserv., 241*, 108390. doi: 10.1016/j.biocon.2019.108390