



FPL

FUTURE PARK LEADERS
of EMERGING CHANGE

2020 Program Accomplishments Report





Future Park Leaders of Emerging Change Internship Program
Program Accomplishments Report
Fiscal Year 2020

Ecological Society of America
National Park Service

Front Cover Photos

Top left: Fernando Casal at Katahdin Woods and Waters National Monument, ME.
Middle: Sophia Chau at Devils Postpile National Monument, CA
Right: Minh Phan at Fire Island National Seashore, NY.

Above Photo Taryn Black at Mt. Rainier National Park, WA.

FUTURE PARK LEADERS OF EMERGING CHANGE INTERNSHIP PROGRAM ACCOMPLISHMENT REPORT 2020

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National Park Service (NPS)

Melanie Wood

Program Manager

melanie_wood@nps.gov | 970-267-2198

Larry Perez

Communications Coordinator

larry_perez@nps.gov | 970-267-2136

ECOLOGICAL SOCIETY OF AMERICA

esa

Ecological Society of America (ESA)

Jessica Johnston

Education Programs Coordinator

fpl@esa.org | 202-833-8773 ext. 222

Teresa Mourad

Director of Education and Diversity Programs

teresa@esa.org | 202-833-8773 ext. 234

EXECUTIVE SUMMARY

In 2020, the Future Park Leaders of Emerging Change (FPL) Internship Program successfully completed its 6th year and placed 10 interns in 10 national parks and program offices of the National Park System in cooperation with the Ecological Society of America (ESA). These talented college students and recent graduates supported the NPS mission by completing important highly rigorous natural and cultural resource projects that address emerging resource management issues driven by global drivers of change and related effects.

The 2020 FPL interns contributed a total of 4,457 service hours or the equivalent of over 2 years of full-time work completing critical science and resource management projects for the NPS.

In 2020 the Future Park Leaders of Emerging Change Internship Program accomplished the following:

- Received over 400 applications for the program
- Supported 10 internships, 7 of which were fully or partially remote due to the COVID-19 pandemic
- Organized a series of professional development workshops
- Hosted 3 virtual seminars to present the interns' project results to ESA and Department of the Interior staff.



Colin Lock, War in the Pacific National Historic Park, Guam

STATEMENT OF PURPOSE

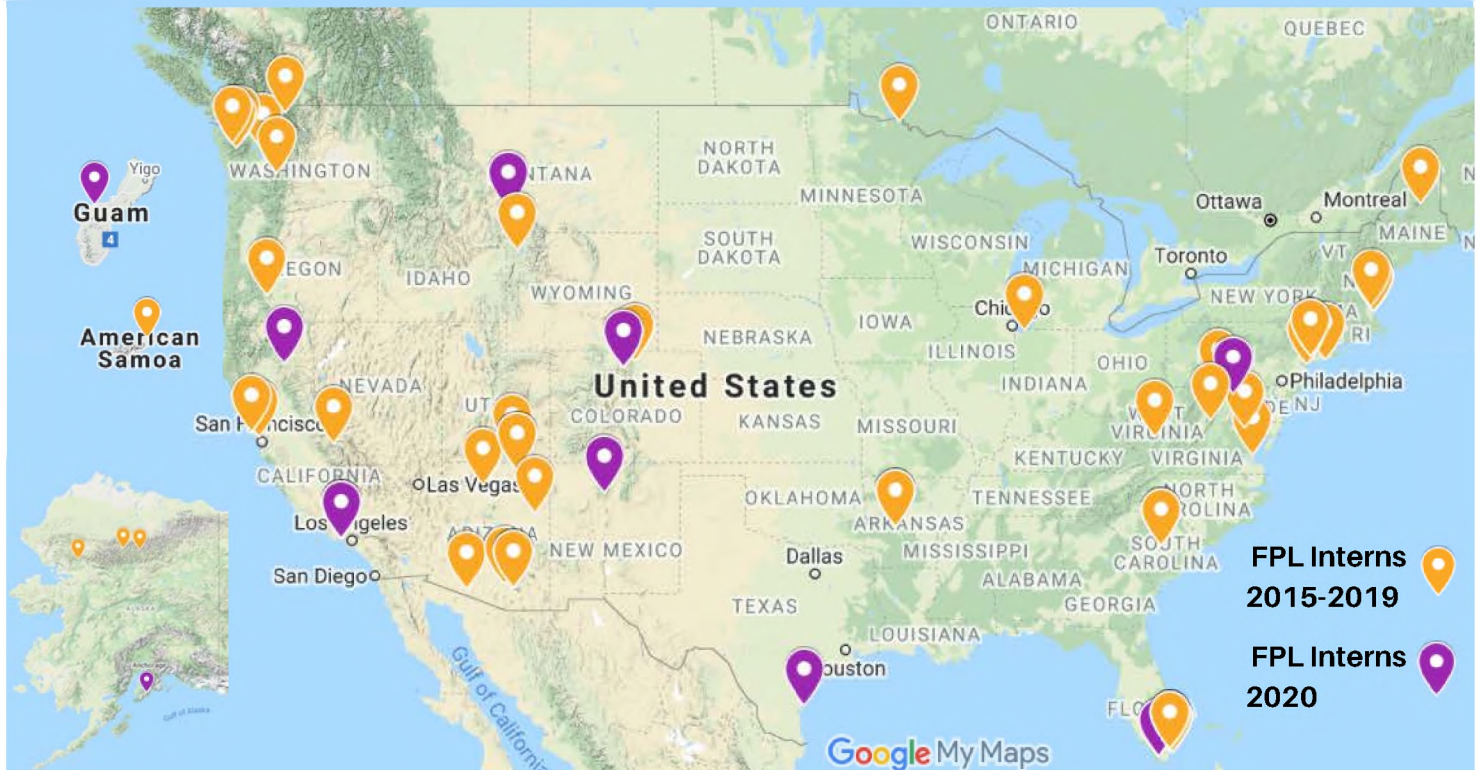
FPL is a competitive internship program for high-achieving undergraduate and graduate students to conduct rigorous and innovative projects that address management needs related to natural and cultural resources, park infrastructure, visitor use, and interpretation and education in NPS park and program offices. FPL is an approved Direct Hire Authority program: interns who successfully complete the internship and the requirements of their academic degree program are eligible to be hired without competition into permanent positions in select bureaus of the U.S. Department of Interior (DOI).

Program Objectives

The objectives of the FPL are three-fold:

1. Students gain valuable work experience, develop leadership skills, and explore career paths in the Department of the Interior.
2. NPS parks and programs utilize innovative, cutting edge science to address management challenges in national parks.
3. NPS builds the next generation of leaders and a more diverse professional workforce through participation in the Direct Hire Authority for Resource Assistant Internship Programs.

Location of FPL projects organized by DOI Region. The FPL hosted 69 interns in 49 NPS units between 2015 and 2020.



Future Park Leaders - Working with Partners

The Future Park Leaders of Emerging Change is supported by a dedicated team at the National Park Service (NPS) and the Ecological Society of America (ESA). Over the course of 14 months, the NPS and ESA selected host sites, promoted the program, recruited and hired interns, managed impacts from the COVID-19 pandemic, and organized professional development workshops and student presentations. The success of this program is due to tremendous support for all aspects of Future Park Leaders. ESA appreciates the opportunity to be involved in such a valuable program that promotes student engagement and opportunities to gain important career-building skills at some of the most beautiful places in the United States.

About the Partner Organizations

National Park Service, Climate Change Response Program

www.nps.gov/orgs/ccrp



Established in 2010, the National Park Service Climate Change Response Program (CCRP) advances efforts to address the effects of climate change across the breadth of the National Park System. The Program works across directorates and program areas to support parks through technical expertise and research, guidance and training, project and planning support, and provision of communication products. The Program works with other agencies, organizations, and stakeholder groups—nationally and internationally—to maximize information sharing, support, learning, and project effectiveness.

Ecological Society of America

www.esa.org



The Ecological Society of America (ESA) is a nonpartisan, nonprofit organization of scientists founded in 1915. Our mission is to advance the science and practice of ecology and support ecologists throughout their careers. We envision a future where people embrace science to understand and foster a thriving planet.

NPS TEAM



Larry Perez
Communications Coordinator
Climate Change Response Program



Cat Hawkins Hoffman
Division Chief
Climate Change Response Program



Melanie Wood
Program Manager
Climate Change Response Program

ESA TEAM



Teresa Mourad
Director of Education and
Diversity Programs



Jessica Johnston
Education Programs
Coordinator

PROGRAM RECRUITMENT

ESA recruited students for the 2020 FPL program, housed the website and application system, hired the interns as ESA employees so that they were covered by liability insurance, and ensured their compensation.

Recruitment: ESA announced the program widely using email listservs to reach faculty advisors and students, posting it on job boards, sending materials to conferences, using social media platforms, and networking with educational institutions. ESA launched the call for student applications on the FPL website <https://futureparkleaders.org/>.

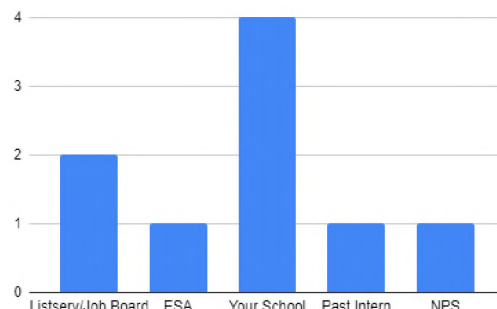
Announcements were sent to:

- ESA's 24,000-strong network, education contacts, Strategies for Ecology Education, Diversity and Sustainability (SEEDS) Newsletter, and ESA sections such as Education, Early Career, Communication and Engagement, and Student sections.
- Organizations and academic institutions across the United States who serve under-represented minorities (i.e., Historically Black Colleges and Universities, Hispanic serving institutions, tribal academic institutions).
- Directors of programs awarded through the Broadening Participation portfolio of the National Science Foundation in Life Science, Biology, Ecology, Computer Science, Climate Science, Environmental Science, and Social Sciences
- Students that used the signup form when visiting futureparkleaders.org
- Followers on our Twitter, Facebook, and Instagram
- Members of the Professional Societies Alliance for Life Science Education.

In addition, the program announcement was posted on the Pathways to Science and Society for Advancement of Chicanos/Hispanics and Native Americans in Science (SACNAS).

ESA staff distributed program flyers at the ESA Annual Meeting, the Entomological Society of America annual meeting, and the annual SACNAS conference via help from staff at the Plant Science Research Network (PRNS) to interested students and advisors.

HOW DID YOU HEAR ABOUT US?



PROGRAM SUMMARY

We received 476 applications from graduate students, upper-level undergraduate students (juniors and seniors), and recent graduates. The CCRP from NPS convened 12 separate panels consisting of (at minimum) the park/program supervisor and a representative from the CCRP to review anywhere from 20-50 student applications for each project. They conducted interviews by phone or in-person with the top two to four candidates and then made the awards to the selected interns by mid-March, 2020. The interns were selected from universities all across the United States and represented a diversity of age (21-35 years) and gender (70% female). Thirty percent of the cohort was identified as minority or multi-racial.

During their summer internship, students were hourly employees of ESA. The ESA program administrators managed the hiring process, ensuring that the interns smoothly navigated the process and completed their onboarding tasks and training as required. They also updated the FPL Internship Handbook to reflect ESA policies and procedures regarding timesheets, benefits, safety requirements and training, best practices in conducting field work, and more.

The FPL Program awarded 12 projects for the summer 2020 season. Of the original 12 projects, 2 were cancelled or postponed to the next season. The remaining 10 projects are listed below.

NPS Unit	Project Title
Everglades National Park*	Impacts of Everglades Restoration on Tree Island Archeological Sites
National Center for Preservation Technology and Training*	Vulnerability of Coastal Cultural Resources in Jean Lafitte NHP
Padre Island National Seashore	The Threat of Marine Debris on Sea Turtles
Rocky Mountain National Park	Impacts of Visitation on Atmospheric Nitrogen Deposition
Greater Yellowstone Network and Yellowstone National Park*	Climate Smart Conservation for Aquatic Resources
Valles Caldera National Preserve*	Cultural Heritage Vulnerability After Catastrophic Wildfire
Santa Monica Mountains National Recreation Area*	Monitoring Drought Induced Dieback in Oak Woodlands
Lassen Volcanic National Park	Impacts of Climate Change on Zoonotic Disease
Kenai Fjords National Park*	Communicating the Rapid Loss of Glaciers through Mapping
War in the Pacific National Historic Park*	Assessing Conditions for Coral Reef Restoration

* Indicates remote projects where interns worked from home due to NPS precautions in response to the COVID-19 pandemic.

PROGRAM CHANGES: SUMMER 2020

COVID-19 pandemic abruptly impacted the ability for FPL interns to travel to NPS units prior to the start of the 2020 FPL Summer season. FPL program administrators worked closely with each of the 12 original NPS project leads to complete as many projects as possible. One project was cancelled, and a second was postponed to summer 2021. Of the remaining 10 projects, 3 continued as planned following social distance guidelines, while the remaining 7 internships were completed remotely with some project-related travel. In addition to project changes, the in-person professional development workshop normally held in August of each year was cancelled. In lieu of the in-person workshop, FPL program administrators organized a professional development webinar series.

Challenges: FPL program administrators ran into the following noteworthy challenges:

- Seven internships shifted to remote work from the interns' home with some project-related travel
- One project had a major delay in start date to September 2nd, 2020
- Two interns had limited or no access to PIV cards and networks given that several offices were closed or severely backed up with background checks
- One project ended 2 weeks early – the FPL intern had a personal emergency that prevented completion of the project.



NPS Team Rocky Mountain NPS, CO

INTERN TRAINING

Before beginning their internships, participants attended an orientation session that provided basic information about Future Park Leaders, introduced them to the ESA and NPS, and helped them to understand their responsibilities and the expectations of the program. Each intern received an Intern Handbook to serve as a guide to program logistics.

Webinars

During the internships, FPL organized regular check-ins with interns and a webinar-based Professional Development Workshop Series. The regular check-ins were provided to give interns a place to meet informally and discuss amongst each other their internship progress. The webinar series was provided in lieu of the week-long, in-person workshop offered in past years, which was cancelled due to the coronavirus pandemic.

Webinar topics included:

Date	Time Eastern	Title
5/22/20	5:00 PM	FPL New Hire Orientation
6/3/30	6:00 PM	Check-In: Meeting mentor and LDMP
6/4/20	2:00 PM	Collaborating with Interpreters to Communicate Science in National Parks*
6/9/20	2:00 PM	Welcome to the National Park Service: An Introduction for NPS Interns*
6/17/20	6:00 PM	Check-In: How is everyone holding up?
6/18/20	2:00 PM	Diversity, Equity, and Inclusion*
6/24/20	6:00 PM	Science Communication Workshop
7/1/20		No Meeting this week
7/8/20	6:00 PM	Check-In: Are you achieving your personal goals?
7/15/20	6:00 PM	Federal Careers Workshop Part I
7/22/20	6:00 PM	Federal Careers Workshop Part II
7/29/20	6:00 PM	Check-In: Presentation Flyers and closeout requirements
8/3/20	10:30 AM	Thank you for your Service from Ray Sauvjot*
8/6/20	11:00 AM	National Park Service Director (acting)*
8/12/20	6:00 PM	Check-In: Practice Presentation and exchange contacts.
8/19/20	3:00 PM	Presentations Round I – Presentations of final projects
9/2/20	12:00 PM	Check-In: Practice presentations and give each other feedback
9/9/20	3:00 PM	Presentations Round II – Presentation of final projects
11/17/20	3:00 PM	Presentations Round III – Presentation of final projects

*Indicate webinars hosted by Mosaics in Science Internship Program.

PROGRAM COSTS

The table shown below summarizes the costs for the Future Park Leaders of Emerging Change program beginning in FY2018. Program expenses included staff and intern salaries, cost of travel, housing, and the application platform.

Table 1. FPL Program cost breakdown in FY2020.

Summary of Expenditures: 9/12/2018 - 12/30/2021	
Staff Salaries	\$51,215.30
Intern Salaries	\$77,080.00
Fringe	\$21,783.09
Total Salary and Fringe	\$150,078.39
Staff Travel	\$2,700.45
Internship costs (Mileage, Travel, and Housing)	\$13,543.59
Direct Expenses (Application Platform)	\$6,727.50
Total Direct	\$173,049.93
Indirect costs - 25.85%	\$44,733.41
TOTAL	\$217,783.34



STUDENT PROJECT REPORTS

The following pages provide brief project reports, figures, and images for each of the 2020 FPL internships. These summaries were written by the FPL interns and then collated by FPL administrative staff. Detailed reports and additional materials are available upon request to Climate_Change@nps.gov.

Project Summary

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Note: The project at the National Center for Preservation, Technology and Training Project is incomplete and not listed.



FPL 2018 Annual Workshop, Estes Park, CO

War in the Pacific National Historical Park

Assessing Conditions for Coral Reef Restoration

Mentors: Ashton Williams & Mike Gawel

Colin Lock

Project Overview The objective of this internship was to create an RShiny application to manage, visualize, summarize, and map a variety of water quality parameters from various data sources for the island of Guam.

Problem statement Coral reefs are in decline worldwide due to environmental changes, and many reef managers have begun actively restoring coral reef by culturing corals in ocean nurseries and outplanting nursery-grown corals to denuded reef sites. Water quality data, including temperature and light intensity, is an important factor in identifying sites where coral outplants will survive and thrive. On Guam, several agencies collect in-situ and satellite-based water quality data, but there is no centralized database where agencies can share this data with each other or the general public. A need was identified for an easy-to-use, publicly-accessible application where data could not only be stored, but also visualized and summarized for wider use. The application will soon be hosted by a local partner, the University of Guam, and should be publicly available within a year.

Objectives Coral reefs are in decline worldwide due to environmental changes. Over half of War in the Pacific (WAPA) NHP's lands are underwater, and most of this submerged land is home to coral reef communities. Guam's attractive reefs serve to support its tourism economy and protect shorelines from storm erosion. Although containing the highest diversity of coral species among all US National parks, WAPA's coral reefs have been badly damaged and continue to be threatened by warming waters, ENSO-related low tides, acidification, pollution, and over-fishing. Without intervention, Guam's coral reefs may decline to the point of no longer fulfilling human needs for fisheries, tourism, and recreation. To this end, WAPA natural resources staff have collaborated with other local agencies, such as the University of Guam, to begin reef restoration efforts.

In May 2019, nearly 500 coral fragments were taken from the NPS-funded, University of Guam-operated coral nursery and outplanted into WAPA's Asan Beach unit. Roughly 1.1 hectares of reef flat was restored, making this the largest outplanting project to date undertaken on Guam.

However, more reef restoration effort will be needed to ensure the survival of Guam's coral reefs into the future. Site selection is one of the most critical factors for outplanting success; outplanted corals may thrive at a healthy site, or experience total mortality at a poor site.

For several years, WAPA staff has used underwater data loggers to track temperature and light intensity on the park's shallow reef flats. These loggers have been deployed and regularly offloaded for several years, and this data allowed park staff and partners to identify the Asan Beach unit area as suitable for coral transplantation to support reef restoration. However, much of the data generated by loggers has gone unused due to the staff time required to enter the data into a database, analyze the data, and generate reports. As WAPA's coral reef restoration program grows, this water quality data will be critical to choosing new sites where coral outplants can thrive. A need was identified for an application where users could manage data, upload new data, summarize and select data, visualize data, and download products easily, quickly, and without writing complicated code. Integrating data from multiple sources (such as other in-situ logger, NOAA satellite data, and tidal buoys) was also desired.

Methods Water quality data collected between from in-situ loggers was organized, quality controlled, collated into a single file. The data were collected between 2017-2020 and varied in sampling rate; to standardize and shrink the database, data were summarized into hourly averages. Each individual data output ranged from several weeks to several months of data, and each output was plotted and visually checked for one-off anomalies, impossible readings, and obvious signs of malfunction. Once the data were collated into a single quality-controlled database, an RShiny app was designed to meet the needs of users who needed to generate products (such as plots and table summaries) without any coding knowledge. Once designed, the intern created and beta-tested the app to ensure functionality of all components.

Results The current version of the app was presented as a "proof of concept" to partners at the University of Guam, who are able and willing to host the app (as NPS cannot). The intern and mentor are currently working with the University of Guam to improve and host the app, and they hope to launch the app publicly within a year. Once running, partner agencies (such as the University of Guam Marine Laboratory and Guam EPA) will be able to add their data to the database and produce summaries and plots efficiently.

Members of the public will be able to download plots and summarized data tables with a few clicks, rather than a few thousand lines of code. App functions are described in the Deliverables section below.

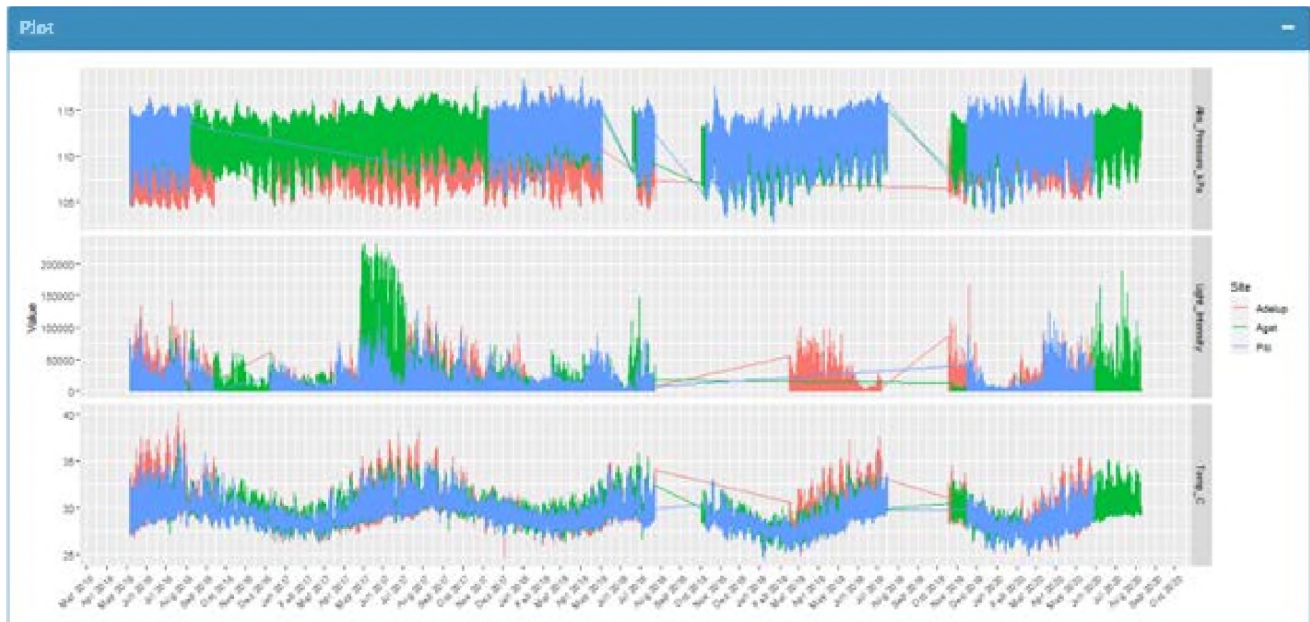
Recommendations The app still has a long way to go before it is ready for public access. Current recommendations for improvement and continuation include:

- Inclusion of more in-situ data sources, particularly underwater logger data from partner agencies, such as University of Guam.
- Inclusion of more external data, including NOAA tidal data, rain gauge data, NPS I&M quarterly water sampling, etc.
- Inclusion of more logger types, including oxygen loggers and conductivity/salinity loggers.
- Addition of customizable plot options (such as color, theme, line thickness, axis titles, font sizes, etc.)
- Addition of basic descriptive statistics functionality for data summaries (e.g. mean, standard deviation, etc.)
- Addition of a logged user function, to allow only verified users to upload new data to the database.
- Addition of an automatic quality control check function for new data.

Deliverables The RShiny app can be found in a GitHub repository:
<https://github.com/clockdive/Guam-Marine-Water-Quality-Database>

Outputs from the app are demonstrated below. The app allows users to create plots to visualize the data, and offers a variety of options to customize plots as needed. Users can subset data by date range, data type, and logger location. Multiple plots can be generated at once, and external data (such as NOAA bleaching alert status level) can be overlaid on plots. The app also allows users to upload new data, download custom subsets and summaries of data, and update external data sets.





Guam Marine Water Quality

- Dashboard
- Visualize/Export data
- Upload
- Update external databases
- Contact

External Datasets

NOAA Coral Reef Watch SST Data

This data is pulled from the NOAA Coral Reef Watch data set and has a 5-km resolution. Available data includes daily average SST, high SST, low SST, anomaly (difference from monthly average), degree heating weeks, and bleaching alert level.

For more information, see www.coralreefwatch.noaa.gov/satellite/index.html

Update NOAA Coral Reef Watch SST Dataset Now

NOAA Aqua MODIS SST Data

This data is pulled from the NOAA Aqua MODIS 1-Day Composite data set.

For more information, see <https://coastwatch.pfeg.noaa.gov/info/MSR/>

Update NOAA Aqua MODIS SST Dataset Now

Oceanic Nino Index

The Oceanic Nino Index is based on centered 30-year base periods updated every five years.

For more information, see: https://origin.cpc.ncep.noaa.gov/products/analysis_monitoring/eqw/oni.shtml

Update NOAA ONI Dataset Now

Pacific Decadal Oscillation

The Pacific Decadal Oscillation

Update NOAA PDO Dataset Now

Santa Monica Mountains National Recreation Area

Monitoring Drought Induced Dieback in Oak Woodlands

Mentor: Martha Witter
Anne-Marie Parkinson

Abstract The 2011-2018 California mega drought provided a unique opportunity to assess how oaks responded to a severe drought. Remote sensing using the enhanced vegetation index with 30-m Landsat imagery was used to retroactively monitor oak dieback across the park. There is 75% probability 3,000-acres of oak woodlands experienced high dieback.

Management Issue Oaks are considered extremely fire and drought tolerant, but severe dieback was noticed in some areas of the park during a 7-year mega drought. These trees are under threat from increasing fire severity and longer more, severe droughts as it can take several decades for dead oaks to be replaced by recruiting saplings. Additionally, oak dieback can increase invasive species which reduces ecosystem resilience and alters the fire regime. Current research suggests both these extreme events are likely to increase in the future. Understanding where dieback has occurred and what contributes to dieback will contribute to more informed management planning.

Project Objectives The goal of this project was to explore the best method to monitor oak dieback across the park. Unfortunately, there was not enough time to answer any big questions about oak dieback patterns. Instead I worked on setting up a framework for long-term landscape scale monitoring since the first step in assessing trends in oak dieback is simply determining where dieback has occurred. My research this summer answered the following questions:

- What is the best method to identify drought-induced oak dieback?
- Can the method distinguish between different severities of oak dieback?

Approach The first step of the project was to assess the best satellite imagery and approach to monitor drought. I conducted a review of available satellites during the study period (mid 200s to 2020) and conducted a literature review of current methods and consulted with a fellow colleague also monitoring drought in southern California.

Approach The first step of the project was to assess the best satellite imagery and approach to monitor drought. I conducted a review of available satellites during the study period (mid 2000s to 2020) and conducted a literature review of current methods and consulted with a fellow colleague also monitoring drought in southern California.

After the approach was determined, I analyzed drought in trends in the park. The first step required finding a threshold to remove non-oak dominated pixels. The second step required finding a threshold to classify if a pixel has high dieback or no dieback. These steps required the making of test data. Google Earth was used to find a small sample of pixels to get a classification accuracy of the two thresholds to ensure the thresholds had appropriate accuracy. The final step was applying step 1 and 2 to all pixels across the park to estimate landscape scale dieback.

Results I determined that using the enhanced vegetation index Z scores with 30m Landsat imagery was the best method to monitor drought dieback. Landsat was the highest resolution imagery that was free, readily available, and available both before and throughout the drought. EVI is an index that essentially quantifies vegetation greenness. EVI is easy to calculate and robust compared to similar indices. EVI Z scores compare average summer EVI during the drought to a pre-drought baseline.

The approach to remove non-oak dominated pixels required a two-step threshold. The first step removed pixels with EVI less than 0.18 in September 2004 and the second step removed pixels that had an increase in EVI between October and December > 0.115 . The oak classification accuracy was 86% and the misclassification of other vegetation as oaks was 39%. A binomial logistic regression using 2016 Z scores was used to determine a threshold for classifying dieback. Pixels with 2016 Z scores less than negative 0.35 have a 75% probability of high dieback. After removing oaks that burned from 2005-2016 and applying the pixel removal thresholds, about 3,000 acres of oak woodlands were classified as having high dieback.

Recommendations: Future research should explore trends in dieback across the park using variables like slope, aspect, and precipitation using the approach described above. This will aid in management planning, such as future oak restoration sites. This simple method should be compared with more advanced remote sensing techniques such as spectral mixture analysis.

This answer will determine if more advanced methods are worth the time, effort, and money to hire an expert to analyze future drought at a landscape scale or if my simple approach is good enough. Lastly, since I only looked at unburned oaks, future research should also assess the interaction of burn severity, drought, and dieback using higher resolution imagery. Understanding how these landscape altering events affect oak mortality and regrowth is an important step as current literature suggests these events will increase by the end of the century.

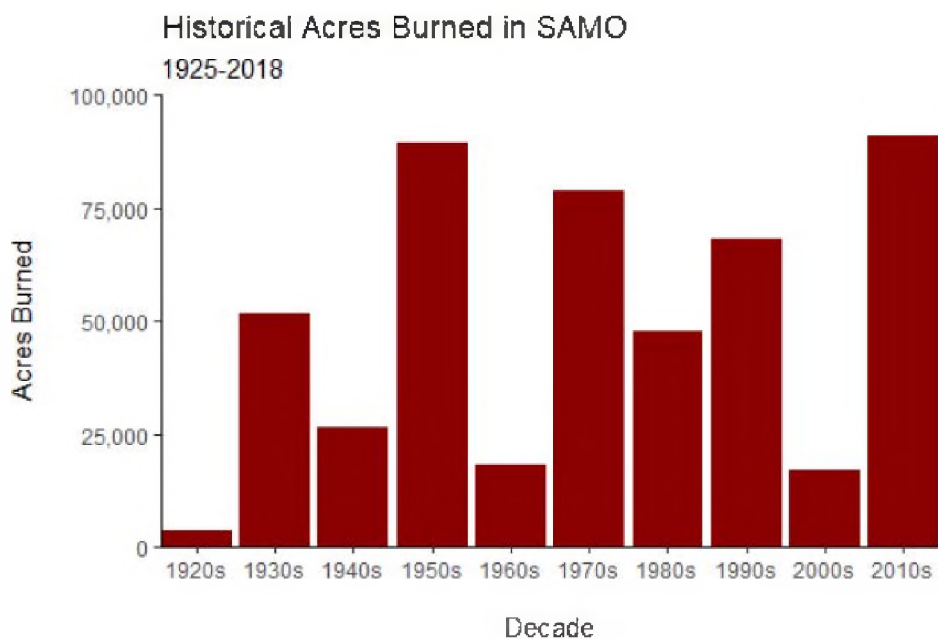


Figure 3: Number of acres burned per decade in SAMO from 1925 - 2018.

Deliverables: There were no hard deliverables for this project, but organized documents and an in-depth write up were required to enable the next person who picks up the project to be able to easily continue the project. The following will be delivered on an external drive:

- Tidy R code
- Data sheet and ArcGIS layer metadata
- Future project recommendations
- More in depth fine write up

Padre Island National Seashore

Quantifying the Emerging Threat of Marine Debris on Sea Turtles

Mentor: Cynthia Rubio
Daniel Choi

Overview: Little is known about trash ingestion by sea turtles in the Gulf of Mexico. Necropsies of 507 green turtles revealed that trash ingestion has not changed substantially since the 1990s. Small turtles ingested the most trash. Successful regional turtle conservation requires additional research to quantify trash ingestion in other species.

Problem statement: Prevalence of trash in the marine environment has grown exponentially in recent decades and sea turtles are among the taxa most affected (Avio et al. 2017, Nelms et al. 2016). However, little effort has gone toward documenting trash ingestion in the Gulf of Mexico since the 1990s, and green sea turtles (*Chelonia mydas*) have received relatively less focus. Further, existing studies have primarily reported only the percent of turtles ingested at least one trash item, which is uninformative, especially with small sample sizes (Casale et al. 2016). The impact of trash ingestion in the Gulf of Mexico is poorly understood.

Objectives: To date, no study in the Gulf of Mexico has included the sample size or standardized procedure necessary for reliable assessment of the threat of trash pollution on sea turtles. Therefore, I examined trash ingestion by a large number of green sea turtles in the Gulf of Mexico. My objectives were to 1) establish thorough and standardized baseline information of trash ingestion to which future studies can be compared; 2) investigate how trash ingestion has changed over a three-decade period; and 3) determine what factors predict trash ingestion by green sea turtles in the Gulf of Mexico.

Methods: Here, I examined trash ingestion by green sea turtles using a standardized protocol and reported data according to recommendations from other studies. I examined the full gastrointestinal tracts (GITs) of 313 green turtles recovered from the lower Texas coast between 2007 and 2019 and individually categorized and measured each trash item. I also categorized and measured items from the persevered GIT contents of 194 turtles from 1987 to 2002. In total, this study presents findings from 507 green turtles collected between 1987 and 2019, which is among the largest sample sizes and collection periods ever used.

I classified items as industrial plastic pellets, plastic sheets, plastic threads (e.g., fishing line), hard plastic fragments, foamed plastic, other plastic, or non-plastic. To aid in comparison to other studies and to establish a thorough baseline understanding of trash ingestion, I calculated a variety of metrics, including number, mass, and surface area of items per turtle, mass ingested per cm of turtle length, conditional frequency of occurrence, and relative ingestion rates of various trash categories and colors.

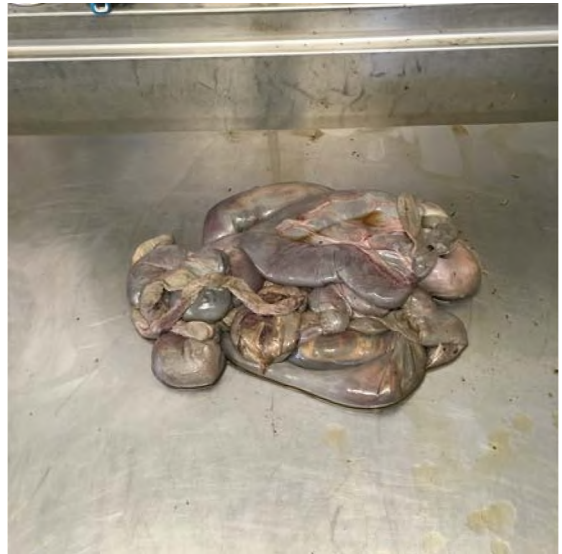
Results: Trash ingestion was recorded for 260 out of 507 turtles (51.3%) and the greatest amount found in any individual turtle was 11.11 g. No turtles showed evidence of obstruction or penetration of the GIT or death otherwise related to trash ingestion. Ninety-nine percent of trash items were plastic, and plastic sheets (e.g., trash bags) and hard plastic fragments were most common. Additionally, clear and white trash items were most frequent. Most trash items were found in the intestines, suggesting studies that only examine the esophagus and stomach can highly underestimate trash ingestion.

Percent frequency of occurrence increased over time, primarily because more turtles ingested minimal amounts, suggesting the overall severity of trash ingestion has not changed substantially over time. Smaller turtles ingested much more trash and tended to ingest hard plastic fragments while larger turtles ingested more sheets and threads (e.g., fishing line). Because Texas green turtles undergo size-based habitat shifts, trash ingestion may be strongly related to foraging ecology. Trash ingestion was also higher in spring and at higher latitudes. Compared to other geographic regions, the severity of trash ingestion in this study was minimal.

Recommendations: This study examined only green turtles, so an updated understanding of trash ingestion by other species in the Gulf of Mexico is needed. As was done here, I highly suggest future studies adhere to standardized data collection and reporting. Specifically, reporting both mass and number of items is necessary in assessing the biological impact of trash ingestion. As Padre Island National Seashore monitors strandings, GITs should be collected when possible for other turtle species. For carcasses that are traditionally buried or otherwise left on the beach, park staff should consider collecting just the GIT. As future necropsies are completed, staff should not use anecdotal evidence (e.g., whether they saw trash during the necropsy) to make assessments of trash ingestion.

Most trash items in the Gulf of Mexico turtles I examined were not detectable without close and meticulous examination of the GIT. To better understand this issue, park staff should encourage government, commercial, or academic partners to preserve GIT contents, as this allows for simple later analysis of trash ingestion.

Deliverables: Choi, Daniel Y. 2020. Three decades of monitoring trash ingestion by green sea turtles (*Chelonia mydas*) in the Gulf of Mexico. Technical report submitted to Padre Island National Seashore, Division of Sea Turtle Science and Recovery. pp. 1-41.



Greater Yellowstone Ecosystem (GYE)

Developing a Climate Smart conservation framework for aquatic resources

Mentor: Dave Thoma
Janelle Christensen

Overview: Resource managers don't often incorporate climate change into their management plans. In order to help them do so, this project aimed to facilitate the incorporation of climate exposure in planning and create easy to access resources using a water balance data set created by Mike Tereck, David Thoma and John Gross.

Problem Statement: The Greater Yellowstone Ecosystem (GYE) consists of five National Forests, two National Parks, two Wildlife Refuges and Bureau of Land Management lands from three states. Because of the various entities that exist within the GYE, planning and aligning management of aquatic resources can be challenging. Adding on to that, busy resource managers often don't have the time to add new information in their resource management plans for healthy ecosystems. The task becomes even more challenging for one impacted by climate change. Unfortunately, managers don't usually take time to make their management plans climate aligned, which could result in unintended consequences if management actions are not capable of achieving management goals.

Objectives: This project aimed to address this issue by helping managers think about and prepare for the impacts of climate change using Climate Smart Conservation. Managers are busy and compiling useful climate data is complicated. Because of that, this project's goal was to provide condensed information about climate drivers that could be used to inform climate exposure, vulnerability and ultimately project level management decisions. As a group, the Greater Yellowstone Coordinating Committee's (GYCC) subcommittee on climate adaptation uses water balance variables to provide integrative climate driver metrics that will exert chronic and acute pressures that transform habitats. This provides a look into the future at the project level. The goal was to make this information as visually appealing, dynamic, and digestible as possible, all compiled into a single document.

Method: In this project, I interviewed resource managers from various backgrounds in and around the GYE to better understand how they managed their resources.

Those interviews are being used to understand how people take climate change into account in their planning, if they are planning, how vulnerable their resources are, and what concerns them about the future for their resources. That information will then be used to inform a Climate Smart Conservation workshop to be held next spring. Knowing what concerns managers and where they are in the process of incorporating climate change into their plans allows for the GYCC subcommittee to better understand what needs to be the focus and work of the workshop. In addition to these interviews, I worked with data in R to summarize water balance variables in a concise report that can be used at a 1 km² level anywhere in the US. This data will help the subcommittee better answer questions and show managers what the future of their resources may be in a timely manner at the project level.

Results: I created a tool that can be used by resource managers to understand how climate has changed in the past and will likely change in the future. The water balance data provides a useful set of individual graphs for 8 water balance variables, including soil water, rain, runoff, actual evapotranspiration, potential evapotranspiration, accumulated growing degree days, accumulated snow water equivalent, and deficit. It lays out these variables in an easy to understand format and provides some basic interpretation of the variables for people who aren't familiar with hydrology to understand how they apply to their projects. Additionally, the interviews will be beneficial in informing the GYCC subcommittee on what to focus on in the workshop in the spring.

Recommendations: I believe the subcommittee has a really good idea of what the next steps are and are actively working to prepare for the workshop. I think it would be useful to prepare for a workshop that may end up being remote due to COVID and also work to contact people to beta test the R code with. Presenting this example at the workshop would show attendees the strength of this data and how it can be used to inform management decisions. It would similarly be beneficial for the team to work through the cycle entirely with one person/manager for a specific project to show the power of this work. Deliverables: The main product I created is the R code for graphically summarizing the water balance variables. This code can be found on my github at: https://github.com/Janelle88/water_balance. Links to the interview summaries, interview recordings, and all other work associated with the interviews can be found on the GYCC subcommittee's Teams site. These interviews are intended to be confidential and for the subcommittee only, but for access to a summary of this information, contact David Thoma at Dave_thoma@nps.gov or Ann Rodman at Ann_rodman@nps.gov.

Annual values through time

These graphs, are shown in more detail later in this report. The variables of runoff, rain, potential evapotranspiration (PET), actual evapotranspiration (AET), and deficit are summed in the graphs that show annual values through time. Accumulated snow water equivalent (SWE) and accumulated growing degree days (AGDD) show the max value in the year, and soil water shows the mean of the values.

The reason for the different mathematical evaluations is due to how hydrologist look at these variables. Hydrologists accumulate water variables that don't have an upper limit like rain runoff, and evapotranspiration, whereas they average values that have an upper limit like soil moisture. With soil moisture there is a limit to the amount of water soil can hold based on soil water holding capacity that is related to soil texture, rock fragments (that don't store water) and soil depth. Temperature variables are averaged by convention and growing degree days are summed to account for the seasonal accumulation of heat that controls biological metabolism and thus growth rates and phenology when water is available. For the variables that are accumulated, we take the max of the variable because it is already a summation of the total through the year.

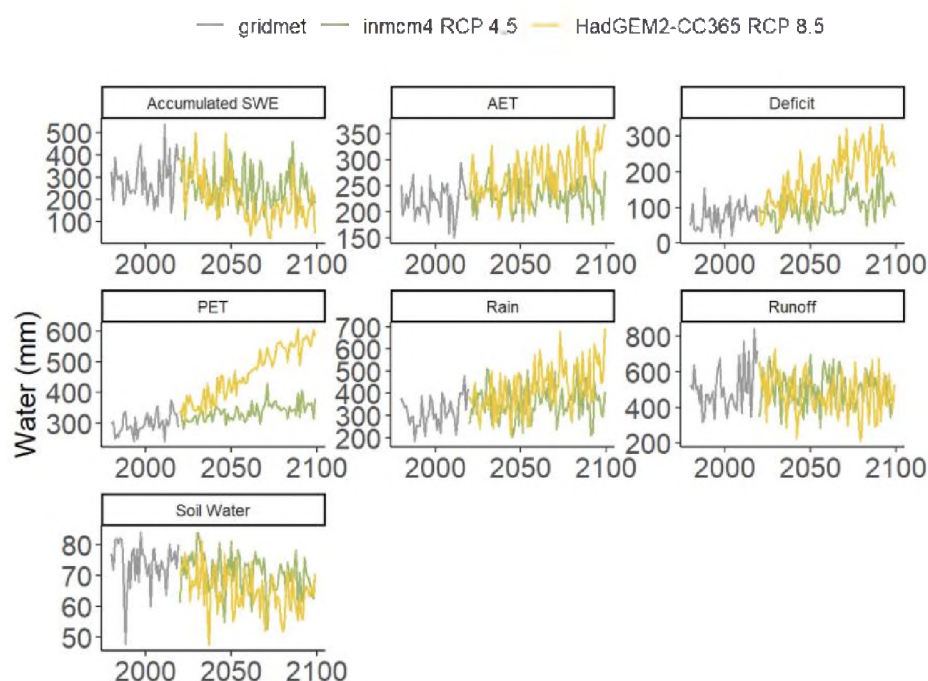
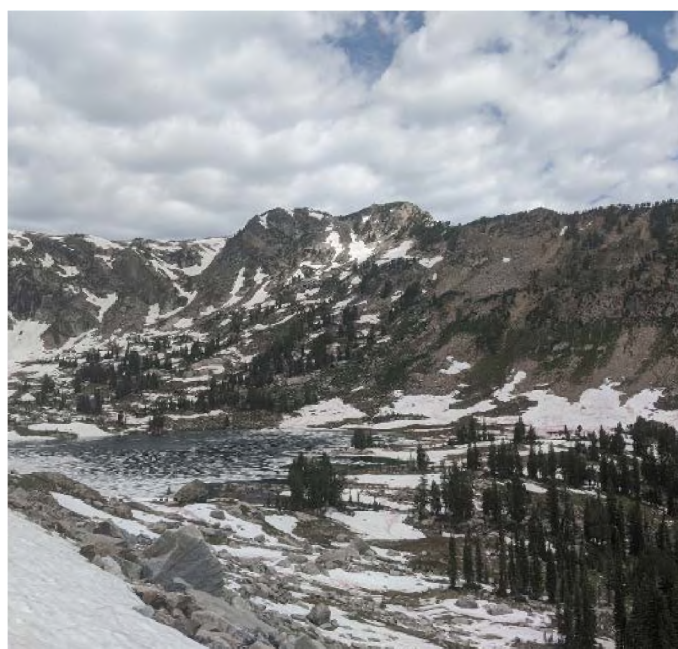
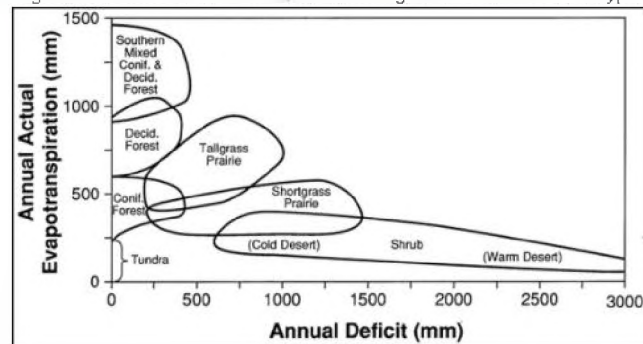


Figure 1. Annual averages over time. The gray line represents historical data modeled from gridmet climate data, the turquoise line represents and the yellow line represents paste(model_bc)



Deficit v. Actual Evapotranspiration (AET)

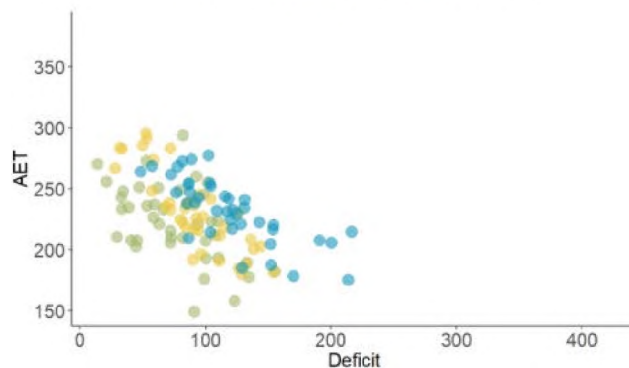
Deficit and Actual Evapotranspiration (AET) are the two best predictors of vegetation type, and are useful variables in understanding what an area may look like in the future. To understand why these variables are such good predictors of vegetation, deficit can be understood as unmet water need by plants and AET as the water used by vegetation. According to Nathan Stevenson, AET and deficit are climatic controls of vegetation distribution. If the clustering of AET and deficit change in climate space, vegetation assemblages will respond and change to assemblages adapted to the new climate space (1998). The figure below shows how AET v. deficit changes for different habitat types.



Stephenson (1998)

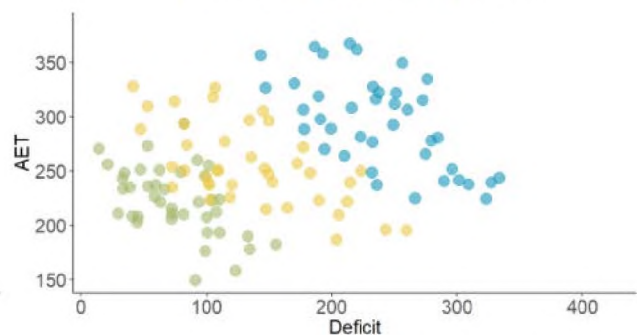
Deficit v. AET in mcm4 RCP 4.5

● 1980-2019 ● 2020-2059 ● 2060-2099



Deficit v. AET HadGEM2-CC365 RCP 8.5

● 1980-2019 ● 2020-2059 ● 2060-2099



Mapping Recreational Impacts in Rocky Mountain National Park Community Science in the Loch Vale Watershed

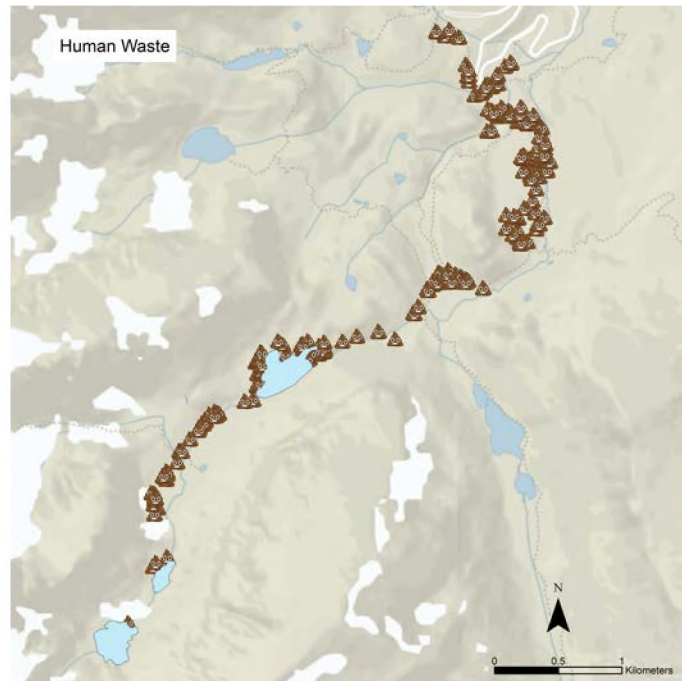
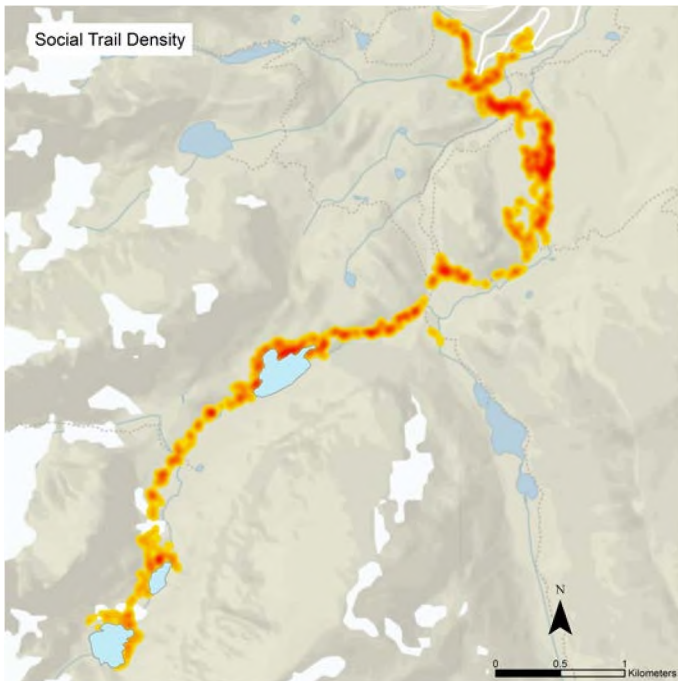
Mentors: Koren Nydick and Scott Esser
Kirk Acharya

Rocky Mountain National Park has been grappling with the management challenge of increasing visitor ship, especially in day use trail systems. The increasing number of trail users result in resource impacts of informal trails, human waste, and soil loss which present aesthetic, ecological, and sanitary issues for park managers. To understand this management issue our study's objectives were to design a community led impact monitoring program (CLIM) that engaged park volunteers in an efficient, teachable, and transferrable data collection scheme and to map the extent of these three recreational impacts in the popular Loch Vale Watershed (LVWS). To do so we worked with a team of four community scientists using the ESRI Collector application to collect spatial data on lines of informal trails, points of human waste, and polygon areas of soil loss along the official trail from the Glacier Gorge and Bear Lake parking lots to the end of the LVWS at Sky Pond (13.52 km). Additionally, we quantified the volume of trail users along the trail by installing a network of six automatic infrared trail counters on the official trail. All data analysis was performed in R and ESRI ArcMap. Our results found almost 40 km of informal trails, over 300 points of human waste, and over 5000 m² of soil loss in the LVWS. We found significant clustering of waste and informal trails near the trailhead, at points of visitor interest, and trail junctions. Soil loss had a smaller extent of impact when compared to informal trails and waste, but future iterations of the program may be able to describe greater impact extent with higher accuracy of two-dimensional mapping efforts.

Our recommendations for park management is to implement "the three E" solutions: engineering, ecology, and education. For informal trails and soil loss areas a focus should be placed on constructed or natural barriers and overlooks along with ecological restoration of impacted areas. Significant clustering of human waste present multiple areas to construct latrines for visitor use. All three of these impacts should be mitigated with education programs that encourage Leave No Trace principles at the first point of contact with trail users, especially in the front country and single day use. These solutions would leverage the knowledge, resources, and personnel of many park working groups for a collaborative and effective management strategy to minimize recreational impacts.

Deliverables:

- ArcGIS Online Database and Collector application for visualizing and monitoring visitor impacts
- Framework for engaging volunteers in the Community Led Impact Monitoring program
- Database, Microsoft Form, and Analysis Workflow in R for the long term storage, calibration and, use of trail counter data



Kenai Fjords National Park

Understanding and Communicating the Rapid Loss of Coastal Glaciers through Terminus Mapping and Repeat Photography

Mentor: Deborah Kurtz

Taryn Black

ABSTRACT Glaciers are critical resources at Kenai Fjords National Park. Glacier monitoring helps park managers plan for current and future conditions. We created a glacier outline geodatabase from satellite images. Individual changes depend on local conditions, but most glaciers have retreated. We recommend monitoring glaciers more frequently to capture accelerating changes.

PROBLEM STATEMENT While climate change is beyond park managers' control, park scientists are striving to maintain a current understanding of the park's climate-sensitive glaciers by documenting and measuring the current extent of glaciers and calculating the rates of change to glacial area and/or extent. Recent increases in glacial melt have prompted park scientists to increase the frequency of documentation and measurements to ensure that these changes are recorded at a meaningful scale. This enables park managers to plan for future resource conditions related to habitat change, geohazard scenario planning, visitor use scenario planning, and to communicate current glacier conditions to park visitors.

OBJECTIVES This project contributes to ongoing glacier monitoring efforts at Kenai Fjords National Park (KEFJ). The primary objectives were to (1) develop a glacier terminus position database based on satellite images for a subset of coastal glaciers within KEFJ; (2) calculate the individual glacier rates of retreat based on those data; and (3) disseminate that information via a journal article, presentation, and Story Map. The glacier terminus position database complements previously collected data regarding glacier extent and is designed to be easily updated with future data. The journal article and presentation will communicate recent changes and the current state of the park's glaciers to park management, interpreters, and other researchers. The Story Map will present the results in a format that is engaging to the public.

METHOD The bulk of the effort for this project went into creating the glacier terminus position database. I reviewed available satellite images and developed a set of criteria to identify suitable images.

I wrote a Python script to identify and download images meeting those criteria and pre-process them (re-project, color-composite, and pan-sharpen) to a suitable quality for analysis. In tandem with the image acquisition process, I developed a metadata structure for the database, emphasizing 2 attributes critical for data analysis (e.g. image year and season) and reproducibility (e.g. satellite and coordinates for the image). Once the images and database structure were prepared, I used ArcGIS to review spring and autumn images each year and trace the ice margin of each visible glacier. Finally, I wrote Python scripts to analyze these data, calculate rates of retreat for each glacier, and produce plots summarizing their changes over time. I delivered a brief presentation of the project findings to a diverse audience of park staff at the end of the internship. We are drafting a manuscript for submission to a peer-reviewed journal, to further communicate the findings to park staff and other researchers.

RESULTS I created a geodatabase containing 547 individual glacier outlines, across 19 coastal glaciers between 1984 and 2020. Most of these glaciers either retreated or stayed relatively stable at the terminus throughout the study period. I was also able to distinguish between ice loss at the glacier terminus and ice loss along the glacier margins (due to overall thinning of the glacier), which in some cases revealed glaciers that were losing area despite not showing significant changes at the terminus.

There were two interesting exceptions to the overall trend of ice loss. Satellite images showed that Holgate Glacier, which was thought to have recently retreated, has actually advanced in the past few years, and appears to have had a cyclical pattern of advance and retreat over the past several decades. This pattern, known as the “tidewater glacier cycle”, has been observed in other coastal glaciers. The other interesting exception was Paguna Glacier, which has advanced throughout the study period. Paguna Glacier was covered in rock debris from a landslide related to the 1964 Alaska earthquake. We suspect that this debris cover is acting as an insulator for the glacier, effectively protecting it from solar radiation and allowing it to grow.

RECOMMENDATIONS The NPS Inventory and Monitoring program currently monitors KEFJ’s glaciers by mapping glacial margins on a decadal basis. The results of this project identified changes that are occurring on a finer timescale which allows us to better understand and interpret the observations that our staff, visitors, and local tour companies make on a seasonal and annual basis. We recommend repeating this annual mapping every five to ten years as time allows to better understand rates of change and to interpret the dynamic fjord environment.

DELIVERABLES

Terminus Position Geodatabase

A geodatabase of coastal glacier terminus positions and associated satellite imagery with metadata will be published to the Integrated Resource Management Applications (IRMA) Portal (irma.nps.gov)

Journal Article

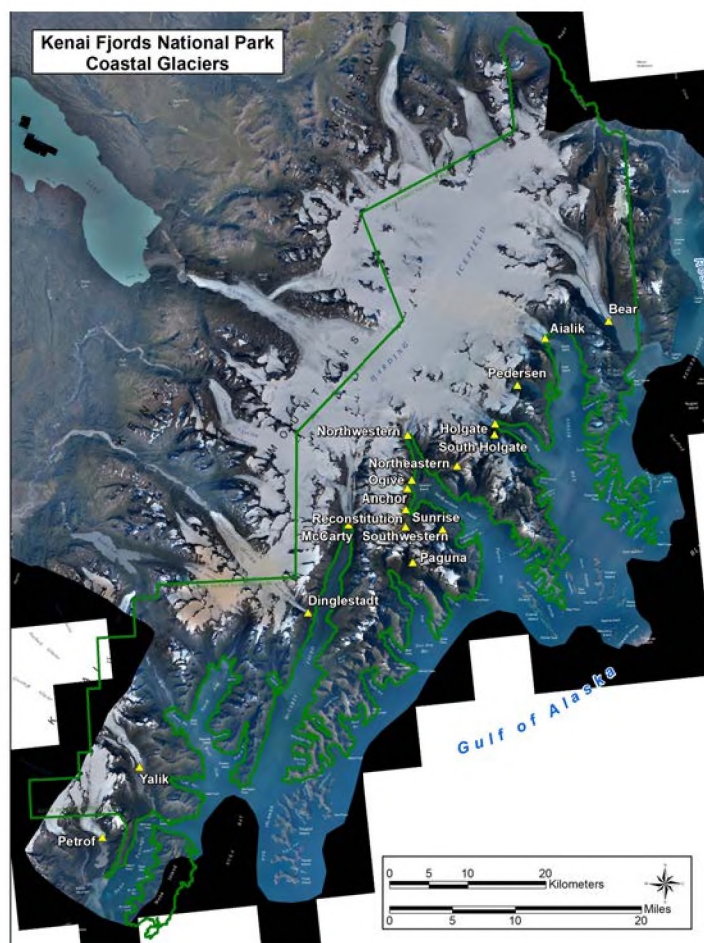
We are writing a manuscript on the observed coastal glacier change and will submit it to the Journal of Glaciology (www.cambridge.org/core/journals/journal-of-glaciology) this autumn.

Maps Illustrating Glacier Retreat

Maps of historic terminus positions for individual glaciers, illustrating glacial retreat, will be included with the journal article.

StoryMap

Unfortunately, due to unanticipated impacts and time constraints associated with teleworking during the pandemic, we were unable to create a StoryMap about coastal glacier retreat in KEFJ.



Lassen Volcanic National Park

Climate Change Impacts on a Zoonotic Disease in Alpine Ecosystems: A Pilot Study

Mentor: Mike Magnuson
Sarah Barsch

Abstract: This pilot study explored the methods, materials, and effort required to effectively conduct an manipulative experiment exploring the hypothesis that American Pika occurring sympatrically with primary plague host species are also affected by plague. We were able to develop repeatable methods that act as the framework for a promising long-term study.

Problem Statement: Plague is a non-native disease caused by a flea-borne bacterium (*Yersinia pestis*) introduced to North America from Asia in 1900. Because they did not evolve with the pathogen, North American mammals are particularly sensitive to plague (Biggins and Kosoy 2001). Climate change is hypothesized to further increase plague risk in some locations due to host species' range shift and recent fluctuations in the occupancy of American pika habitats suggest direct or indirect effects of climate on pikas and raise suspicion that plague may be impacting their populations (Foley et al. 2017). This pilot study developed methods for experimentally manipulating plague to clarify its impact on pika.

Objectives: The purpose of this pilot study is to determine if we are able to reduce flea load on pika and sympatric small mammal communities. Plague is known to be found in rodents (chipmunks, squirrels, marmots, etc.) but its effect on pika is unknown. Pika are known to associate with these species within Lassen Volcanic National Park, which may present plague transmission risk. Recent projections for pikas suggest dramatic losses during this century, and research has already uncovered instances of American pika extirpation from historically occupied sites, as well as high pika turnover across many parks. Climate change has been implicated in these events, but the mechanism(s) of extirpation and turnover are not known (Stewart et al. 2015; Rodhouse et al. 2018). Plague, which also occurs in these park units, varies with climate and could affect pika dynamics (Nelson 1980). Pika are central to circulation of plague in Asia, where pika die-offs coincide with increased plague occurrence in associated rodents that share fleas with pikas (Biggins and Kosoy 2001).

The goal of this project was to determine and test methods for experimentally manipulating plague in Lassen Volcanic National Park to better understand the impact of plague on pika and better develop flea mitigation as a potential management technique in the complex talus environment.

Methods: In order to evaluate the impact of plague on American pikas and associated small mammals, areas of suitable habitat were observed during periods of increased activity (morning and evening) and searched for signs of pika activity to confirm occupancy and estimate the number of individuals present. Cameras were placed at locations with pika sign to test camera settings and placement, and to remotely gather data on the predictable behaviors that would better inform the subsequent trapping effort. Half of the occupied areas were designated control sites, while the other half would be test sites. Randomly generated points were created within mapped polygons representing individual pika territories. Each station at the test sites was baited and enclosed by a circle of approximately 5 grams of deltamethrin dust. Cameras were placed at each bait station to confirm animals were stepping in the dust while retrieving bait. After dusting, sherman traps were placed at the same locations overnight and during the day targeting both nocturnal and diurnal species. Tomahawk traps were used to target pika and placed opportunistically at hay piles, latrines, and areas where cameras had confirmed regular activity. Each captured animal was anesthetized, combed for fleas, sexed, weighed, and measured. All fleas were collected to be identified and tested for *Yersinia pestis*.

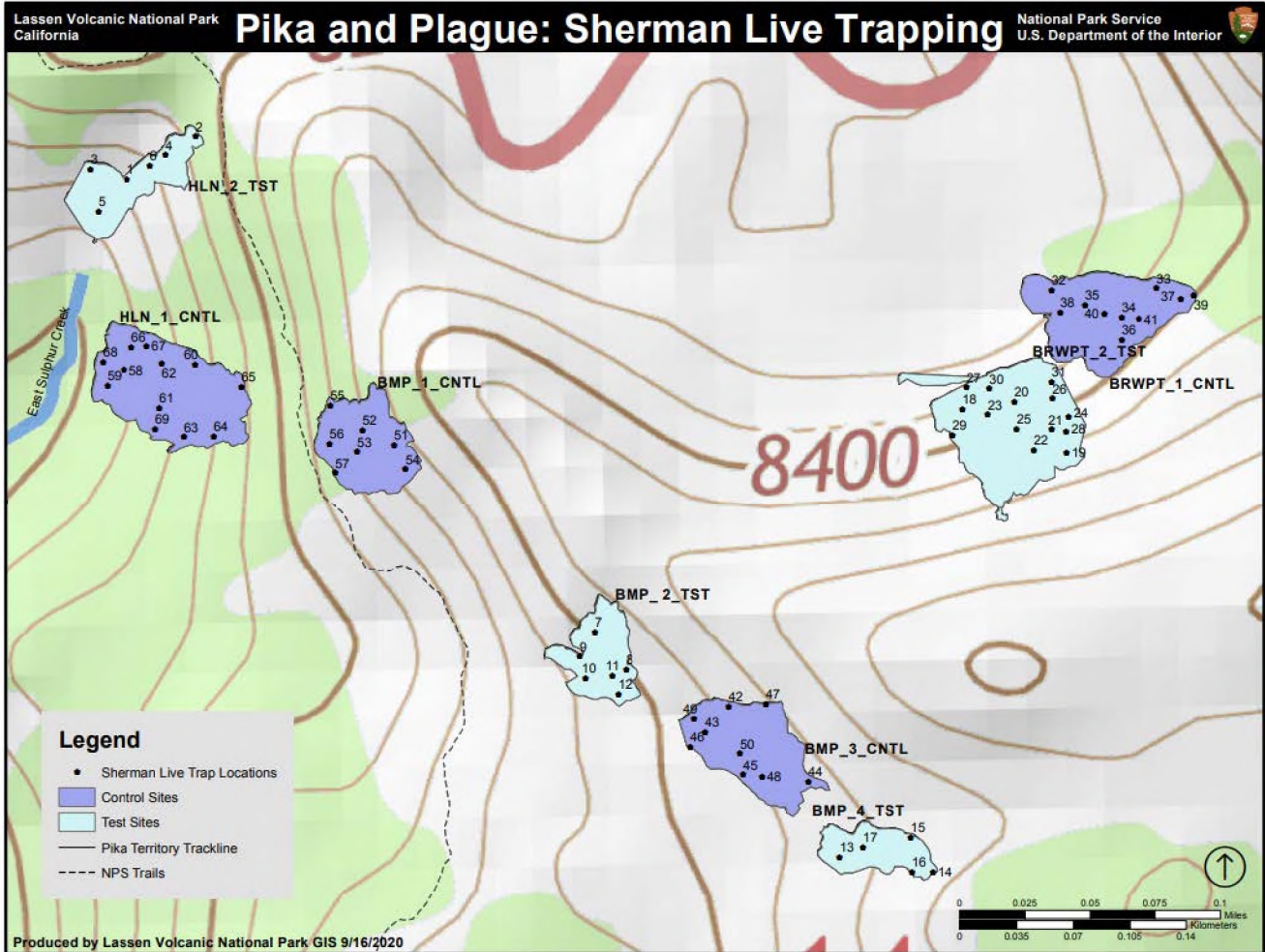
Results: We successfully trapped three control/test pairs for two nights each. The fourth control/ test pair was omitted due to time and resource constraints. Species captured were *Peromyscus maniculatus* (N=29), *Tamias* spp (N=7), *Callospermophilus lateralis* (N=3), *Microtus* spp (N=1), and *Ochotona princeps* (N=1). Of the animals captured (N= 41; not including recaptures), 45% had at least one flea (N=19). 55% of the fleas collected were from control individuals, while the remaining 45% were collected from test individuals, suggesting a decrease in flea prevalence between test and control sites, but a larger sample size is needed to determine if this is statistically significant. It is important to note that only one individual of the species in question, *Ochotona princeps*, was captured, leaving us unable to determine the efficacy of deltamethrin dust for this species with the current data. However, the most valuable results from this pilot study were less quantifiable. From a management perspective, this pilot study succeeded at developing effective methods for manipulating plague in the complex talus environment and determined the time and effort necessary executing a long-term study focusing on data collection.

Recommendations: This project laid the groundwork for a promising novel approach to conserving the American pika, associated small mammals, and the predators that depend on them. By continuing efforts to control plague using deltamethrin dust, population densities of these species could develop. My recommendation is to continue applying the methods developed during this pilot study, with a few changes. I suggest a crew of at least four members (one crew lead, three interns or volunteers) should be hired from Mid-summer to early fall to carry on the process of identifying occupied pika habitat throughout Lassen Volcanic National Park focusing on representing the park's unique elevational gradient with the goal of better understanding the intersection of climate change and plague. Instead of focusing on individual pika territories, I recommend that this crew focus on patches of suitable, occupied habitat. In addition to randomly dispersed locations, these habitat patches should be trapped using a targeted approach, which would involve placing dusting bait stations and traps nearby observed scat or burrows to improve the likelihood of treating individuals with dust and improving trap success. Finally each habitat patch should be trapped repeatedly (at least 3 times) with each pika trap being moved slightly to maintain the novelty of the trap and therefore, the likelihood that a pika will be curious enough to enter.

Deliverables

- 1) Scientific Research and Collection Permit (separate document)
- 2) Study site maps (separate document)
- 3) Camera trapping data spreadsheet (separate document)
- 4) LAVO Pika and Plague Field Protocol (separate document)
- 5) U.S. Department of Interior Institutional Animal Care and Use Committee (IACUC) documentation and approval (separate document)
- 6) Flea samples (located at LAVO Resource Management)
- 7) Trapping data spreadsheet and preliminary figures (separate document)





Valles Caldera National Preserve

A Comprehensive Model for Wildfire and Cultural Resource Management

Mentor: Stephanie Bergman
Kelsey M. Reese

Abstract: The project explained in the following paper was completed under the Future Park Leaders of Emerging Change internship. It is a three-part project that assessed previously-recorded archaeological features, currently-available hyper-localized weather data, and predictions of site locations to be recorded in the future to inform cultural resource management decisions for wildland fire management. Problem statement: Since the year 2000, 63% of VCNP and 50% of recorded archaeological sites have been exposed to some type of unplanned fire event. This project was designed in response to the changing climatic regimes over the past two decades that have resulted in more frequent and catastrophic wildland fire events. The stated purpose of the internship was to develop “a geospatial model that assesses cultural resource vulnerability on the landscape-scale to inform management decisions during wildland fire” (Ecological Society of America 2020).

Objectives: The project was developed to provide a comprehensive assessment and modeling tool to aid in cultural resource management decisions before and during wildfire events, and is split into three main sections:

1. Quantifying vulnerability of previously-recorded archaeological sites based on the features recorded within corresponding site boundaries;
2. Utilizing real-time weather data to assess areas within VCNP that are most susceptible to wildland fire events; and
3. Predicting areas within VCNP and the immediately surrounding region that are likely to contain un-recorded archaeological resources.

Methods: The methods are briefly summarized for each of the three sections of the project:

1. Quantifying cultural resource vulnerability was a multi-step process to combine several independent metrics to create a singular, standardized score across all recorded sites within VCNP. The Vulnerability Score calculated here is an extension of that developed by Rockman et al. (2016) and uses the definitions for “Sensitivity” and “Exposure” by Yu et al. (2019).
id green, yellow, and red for a readily-interpretable “no, slow, or go” while in the field.

2. The second part of this model uses real-time, hyper-localized weather data to incorporate “fuels, weather and/or topography (the three sides of the wildland fire behavior triangle)” (Ziegler 2019) in conjunction with recorded features at archaeological sites across VCNP. This part of the model utilizes hourly data collected on and around VCNP, and reported by the Western Regional Climate Center (<https://wrcc.dri.edu/vallescaldera/>), to calculate several drought indices using recent temperature, precipitation, humidity, wind speed, and mean annual precipitation (available: <https://www.nps.gov/vall/planyourvisit/conditions.htm>).
3. In addition to assessing cultural resource vulnerability for known archaeological sites, a predictive analysis was created to provide a landscape-scale assessment of vulnerability that includes potentially un-recorded cultural resources. A machine learning algorithm, Random Forest (Phillips et al.), is used to combine multiple input raster layers with known archaeological sites to determine areas in and around VCNP most likely to contain some type of archaeological feature.

Results: The results are briefly summarized for each of the three sections of the project:

1. The results are shown on a green (low-vulnerability)/yellow/red (high-vulnerability) continuous color-scale. Vulnerability Scores can be separated into any bin size to display the information differently—for example, the scores can be split into the lowest, middle, and highest thirds and displayed as solid green, yellow, and red for a readily-interpretable “no, slow, or go” while in the field.
2. Combining real-time drought indices with known archaeological site vulnerability provides a more comprehensive insight into the cultural resources most at risk for a wildland fire event on any given day.
3. The results of the predictive model can be used to inform future survey projects by revealing areas most likely to contain some type of cultural resource. The predictive model can also be used to understand the extent of land-use through time, and provide some insight into archaeological resources that may have previously been lost in previous wildland fire events.

Recommendations: The recommendations made to Valles Caldera National Preserve in relation to this model include more detailed reporting on the types of archaeological features present at each site. Most site reports provide a range of numbers of artifacts present (a common practice), and are sufficient for producing the model presented here, but the representative power of the Vulnerability Scores will become more powerful as the data for each individual site becomes more accurate.

Other recommendations include fire abatement strategies and archaeological survey in areas that are most likely to contain vulnerable site types.

Deliverables: Deliverables for this project include (*still in development):

1. A standardized Vulnerability Score for all cultural resource sites within Valles Caldera National Preserve.
2. Script for calculating hyper-localized drought indices in real-time.
3. A spatialized model showing areas across Valles Caldera National Preserve most-likely to contain un-recorded cultural resources.
4. A white paper explaining the project in detail, along with the decisions made in the development of the model.
5. *A user-friendly web interface for ease-of-use.

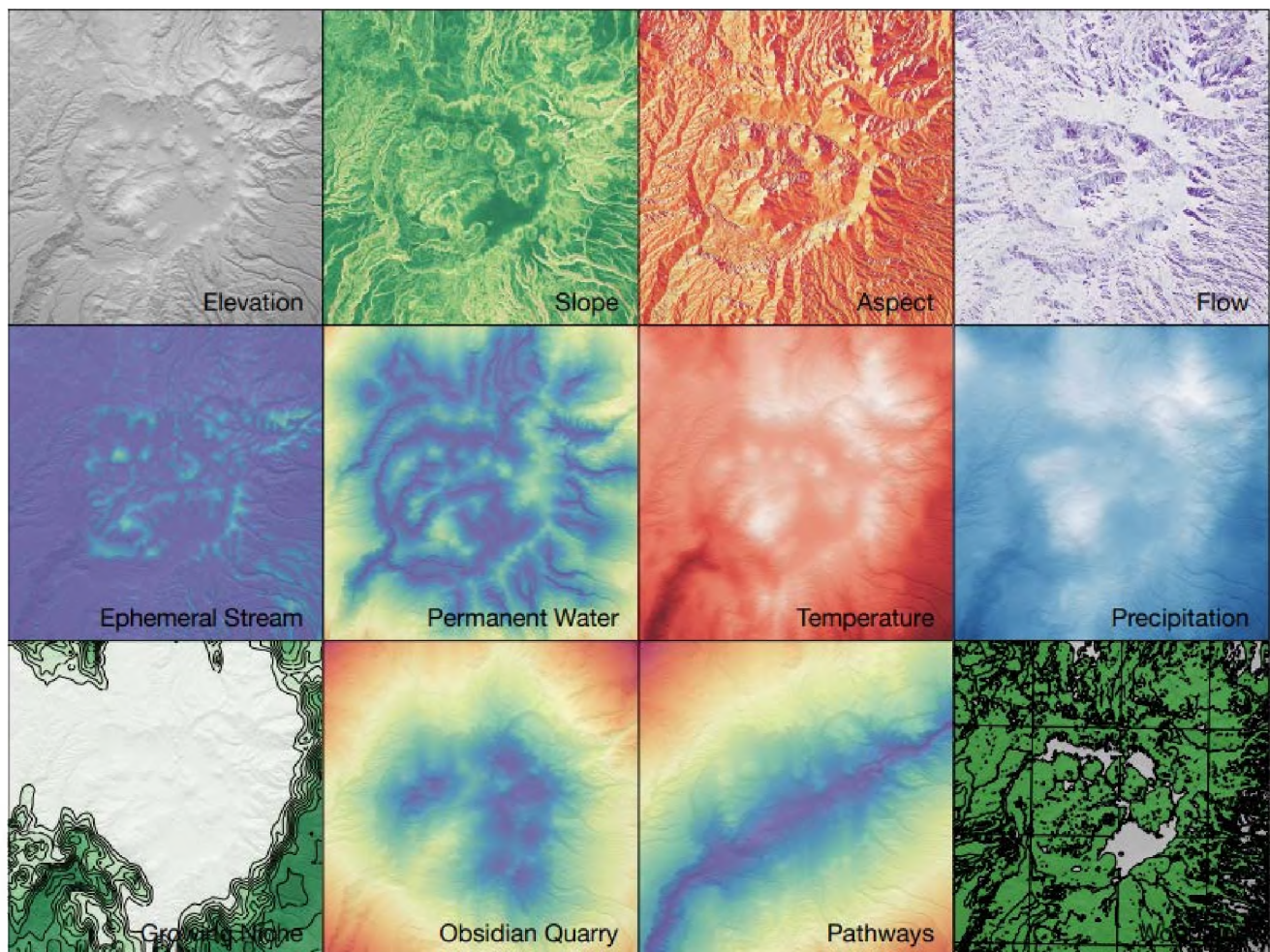
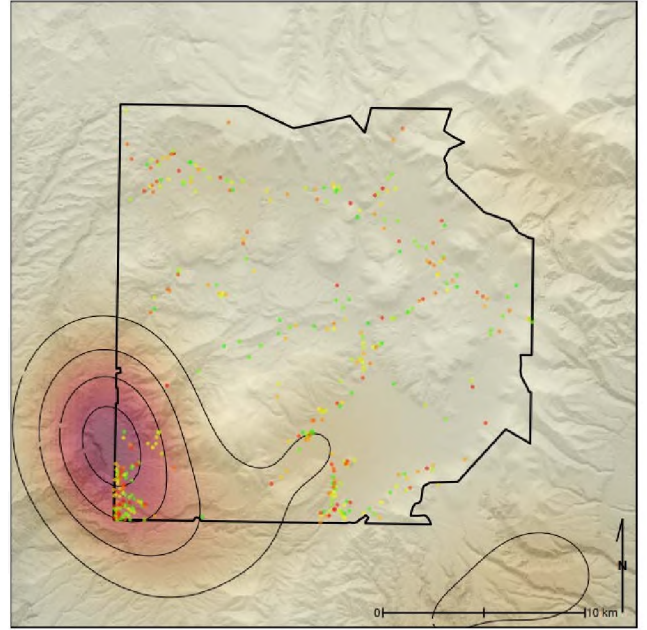
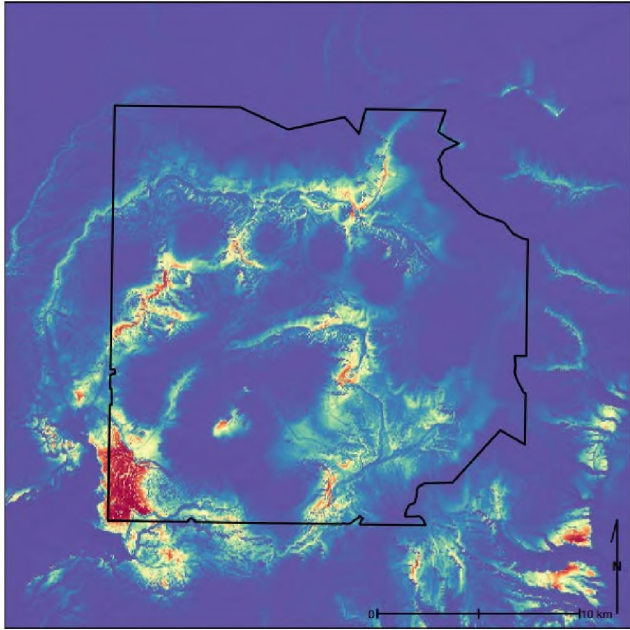


Figure 8: Layers used in the site location predictive model: elevation, slope, aspect flow direction, cost to ephemeral streams, cost to permanent water sources, mean temperature, mean precipitation, maize growing niche, cost to obsidian quarries, cost to least-cost pathways, and extent of contemporary woodlands.



Everglades National Park

Monitoring the Impacts of Everglades Restoration on Tree Island Archeological Sites

Mentor: Gregory Luna Golya & Mark Vadas

Guadalupe Andrade Maldonado

Abstract: This project focused on improving a predictive model for determining archeological sites on tree islands specifically in Shark river slough. I began with a literature review to explore the complexities of tree islands in the everglades, archaic sites of the everglades, the importance of the carbonate layer for archaeological artifacts, the hydrological history, and the vegetation composition of the Everglades. This project based off an existing GIS model that predicted the locations where archeological sites might occur. This existing model focused on elevation, hydrology, and vegetation data. There were some discrepancies between 10-50 meters regarding the vegetation data. The vegetation information we have from this existing model focuses on hardwood hammocks where sites tend to occur most (62% of sites here) since its on higher ground. The main variables that drove this updated model were vegetation data from various sources and elevation data from LIDAR as well as previous knowledge of existing archeological sites. I also explored some datasets through USGS, although they were not significant in the new model, the Sentinel data I analyzed was helpful to highlight tree islands from surrounding vegetation. What I worked on during my time with the Everglades national park is a part of a bigger whole that will be used to determine where archaeological sites are and if they are widespread along tree islands or not. Archaeological site localization is the first step to forming an analysis of cost and benefits to restoration.

Problem Statement: Archeological sites on tree islands at Everglades National Park may be impacted by the long-term water level restoration project (Comprehensive Everglades Restoration Plan-CERP). To determine the level of influence that the restoration project could have on archeological sites it is crucial to determine the probability of archeological sites on tree islands.

Objectives:

1. Learn from the existing model to take its benefits
2. Focus on a feasible area with a large amount of existing tree islands (shark river slough)
3. Create a new model using Maxent and a series of environmental GIS layers
4. Test the model in field locations to determine the accuracy in predicting archaeological sites

Approach/method: The methods used to accomplish our objectives were heavily based on GIS techniques and modeling. The bulk of this project rested on figuring out which layers would be the most helpful in predicting archaeological sites, via running layers through a model. A great amount of time was spent sifting through datasets to narrow on layers with 10-meter accuracy that covered shark river slough.

Aside from the layers the Everglades National Park had, I looked through Sentinel data. This data correlated with the existing layers in terms of accuracy (10 meters). Once I got imagery with no clouds, I used the image classification wizard in ArcPro. ESRI's Classification Wizard, which is like a remote sensing technique in ENVI (remote sensing software), was used to analyze imagery in the Shark River Slough. For our image analysis work, we clipped a USGS sentinel tiff to our slough boundary layer. We then ran it through the supervised pixel classification to quantify and highlight the tree islands compared to other vegetation. Since we want to highlight the tree islands from everything else, a supervised classification is the best approach that allows us to define which types of pixels make up tree islands. This would provide the model with classified data to work with.

We then highlighted overall vegetation using the NDVI tool to determine the NDVI values for each area. The NDVI values allow us to modify values to sperate streets and pavement values from vegetation. After extracting an NDVI gradient raster layer, we ran it through the unsupervised cell classification into lowest/no, low, medium, and high vegetation for it to be properly processed into our model. The reason we used an unsupervised pixel classification for this file was because we were working with a gradient of low vegetation to high vegetation. The unsupervised classification works better to organize pixels from the gradient into similar categories.

Once our layers were collected and clipped to the shark river slough boundary, we ran models to determine the best layers for the predictive model. After our remote work was at a stopping point, we hoped to do an accuracy assessment in the field.

However, due to the impacts of Hurricane Eta and a prolonged rainy period in the Everglades, we were not able to test our model in the field. The roads leading up to the area in Shark River slough were completely flooded.

Results: In terms of our GIS layers elevation and existing vegetation layers were significant to the predictive model. The USGS Sentinel data was found to not contribute significantly to the model but was instrumental in distinguishing the tree islands and surrounding vegetation. Although there still needs to be field work done to test the model, we can see in the visuals from our model that not all tree islands will have archaeological sites.

Recommendations: Considering the many changes that occurred for this project to persist during COVID-19 restrictions and barriers, FPL and the Everglades National Park did a great job in retaining the educational and professional growth aspects of this project. Although my personal obstacles with COVID limited my time in the field, I believe that an extended field work component to this internship is crucial to further this project and provides necessary background to fully grasp the significance of this GIS remote work. Since we were unable to fully begin the field work component of the model, the next steps would be to perform an accuracy assessment of the new predictive model and adjust and changes in GIS layers. I think that the changing length and occurrence of dry and wet seasons in the Everglades might also be a crucial factor to consider when updating layers for the future.

Deliverables: Project deliverables are in the form of GIS layers in geodatabases in the Everglades National Park secure folders.

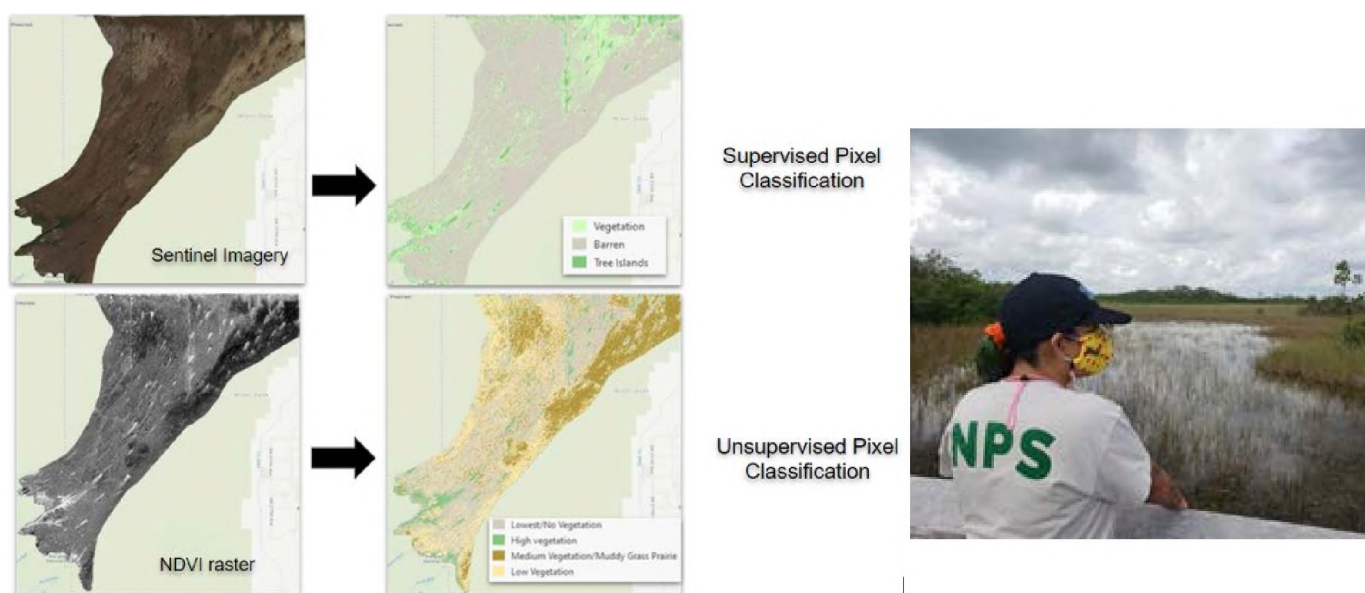
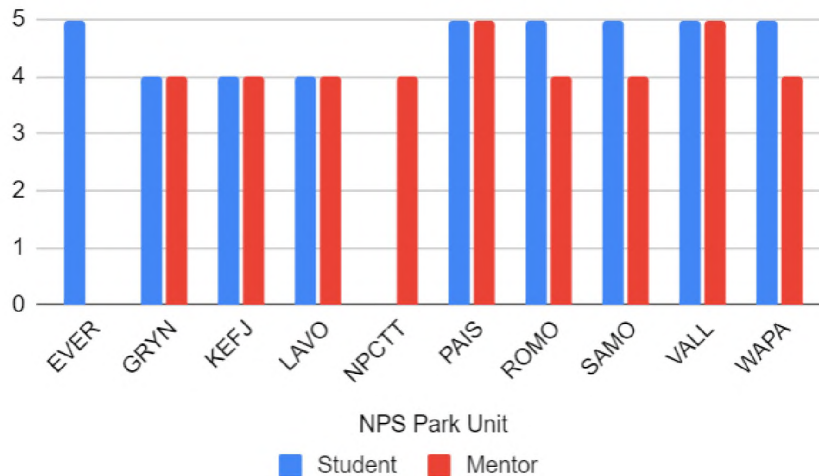


Figure 1 Sentinel image (top left), classified sentinel image (top right), NDVI raster (bottom left), classified NDVI low to high vegetation (bottom right)

SURVEY RESPONSES

FPL mentors and interns were asked to complete a post internship survey; responses are highlighted below.

Q3. Success at Meeting Internship Goals (5 = Very Successful; 1 = Very Unsuccessful)



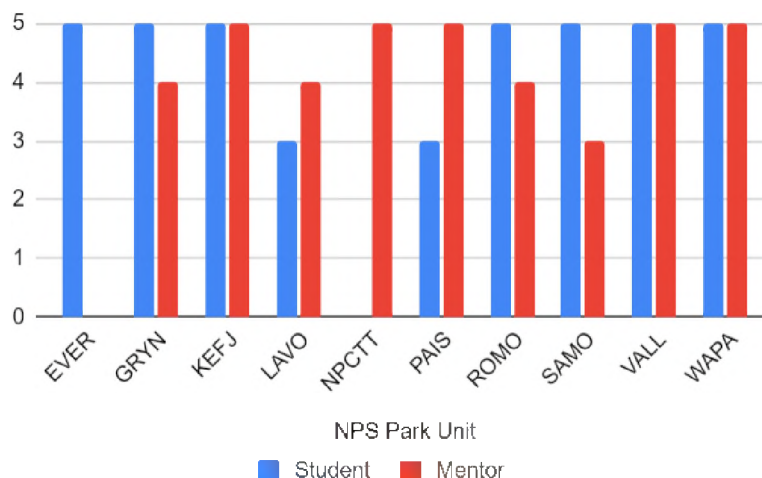
Student Comments:

- I met my goals by learning more about remote sensing and even during an internship turning to a remote position, I still got to meet new people and expand my network.
- I definitely met my first two goals of learning more about federal science careers and how to ensure long-term data maintenance and usability. However, my last goal regarding interacting with different stakeholders was more difficult to achieve while working remotely.
- I learned a great deal about of my professional goals I had originally proposed in the beginning of the internship.
- The level of autonomy I had throughout this process exceeded my expectations. Though I know I put all of my effort into this project and internship, I do think there is room for growth in terms of communicating a need for more support and direction from my supervisors, especially at the beginning of the project.

Mentor Comments:

- Due to Covid-19, the intern worked remotely (out of state). This greatly impacted our ability to fully bring her into the park, both the team and the environment.
- Truly impressed with the creative and knowledgeable competency my intern possesses. She exceeded my expectations and produced a usable GIS model that proved very successful already.

Q5. Your project was designed in advance and likely modified along the way. How do you rate the quality of your project design? (1 = Poor, 5 = Excellent).



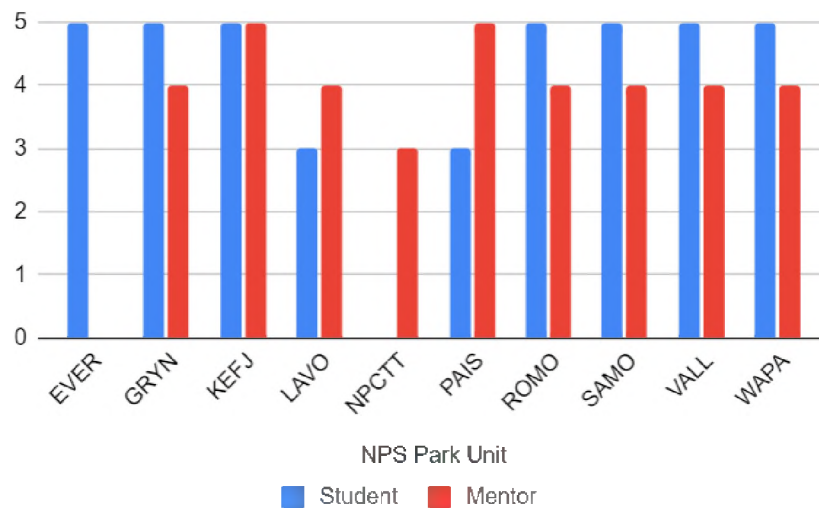
Student Comments:

- I am very happy with the project and project outcomes. I only wish I could continue working longer.
- I worked very hard to design a project that was feasible in execution, intentional, and effectively communicated through permitting paperwork and protocols. The initial trial and error humbled me and motivated me to work even harder throughout the rest of the summer.
- I think that my mentors had a really great idea for this project and gave me a lot of wiggle room to be able to take the project where I wanted, but with good guidance from them of what they felt like they needed.
- Although I didn't meet all of the goals initially laid out in the project, I think it would have been feasible if COVID hadn't thrown a wrench in things!

Mentor Comments:

- The intern was able to implement the project as we had envisioned it. We described the "what" and "why". They figured out the "how". It was a very challenging project to finish in the time allotted but we selected a great intern.
- Quality of project was excellent. Intern used time wisely and maintained a high quality of work during unexpected challenges.
- The project was designed to fill a need in the park and local scientific community, and we met that need. This was very much dependent on the intern--I think we did a good job in being specific with the position description, which allowed us to select an intern who could meet the project needs.

Q7. Mentoring is about guiding and facilitating an intern's professional growth. At the beginning of summer, you outlined different ways in which you would build a mentoring relationship. How successful were you at meeting these goals?



Student Comments:

- My mentor was an absolutely wonderful mentor. I felt our relationship was very collaborative when brainstorming the different directions my project could take, she was an unparalleled resource for information and history of the Preserve. I always felt like I could approach her with any questions/comments/issues/thoughts. I could not have asked for a better match.
- My mentor connected me with a lot of people and helped me network, he was very encouraging of my interests, he was incredibly supportive, and he always found ways to get me to interact with the ecosystem. I don't think I've ever had a better supervisor to be honest, and I can't think of anything that he could improve upon.
- My mentor is a fantastic person, but she is far too busy to serve as an effective mentor. If this park was involved with the FPL program again, I think the mentor should be clearly defined as someone else, who can be more invested in the project and the intern. That being said, she was fantastic to work with.

Mentor Comments:

- This part of the internship ended up being very-time consuming for me due to the intern working remotely, but I think it was very successful and she seemed very pleased with the effort and attention she received.
- We were successful though I wish she could have had more direct experience with certain professionals, especially in ecology and fire management. This was difficult due to living off site and the pandemic.

Table 1: FPL intern responses (n=7) to questions from a post-internship survey.

Survey Questions	Response Type (n = 9)				
	Excellent	Good	Neutral	Fair	Poor
Online application process	44% (4)	56% (5)	0	0	0
Interview and selection process	89% (8)	11% (1)	0	0	0
Orientation webinar and employee onboarding	33% (3)	44% (4)	22% (2)	0	0
The FPL Handbook	33% (3)	33% (3)	33% (3)	0	0
Support from FPL administrators during your internship	78% (7)	22% (2)	0	0	0
Close-out of your project (so far)	44% (4)	44% (4)	12% (1)	0	0
Information about next steps in career development and use of direct hire authority	44% (4)	44% (4)	12% (1)	0	0
As a whole, how do you rate your experience participating in the Future Park Leaders of Emerging Change Program?	89% (8)	11% (1)	0	0	0

What were some of the highlights of this experience? Were any of your expectations not met? What suggestions do you have for improvement?

Student Comments:

- I really, really appreciated the focus on career development outside of this internship. I would have loved even more resume, interview, or networking development opportunities because the ones provided were so useful!
- Highlights: interactions with program staff. With experience from similar programs, I know that the level of investment and support from all program staff in FPL is not the norm. You guys were fantastic and made this entire project incredible. Improvement: though certainly cohort dependent, and disrupted this year by lack of in-person activities, establishing a GroupMe or similar chat function for each cohort could go along way.
- I did not find the bi-weekly check ins too helpful. I think it would've been better if the interns were able to hang out without a administrator present.
- Honestly, the only thing that I feel I missed out on was the D.C trip. There is no level of Zoom interaction that can replace talking to someone face-to-face.

Mentor Comments:

- The direct hire authority stuff was confusing at the outset.
- The FPL program is very well organized but, in some ways, it makes the entire process from applying to hiring to mentoring a bit more time-consuming for the supervisor than it needs to be.
- Our park was very happy with the FPL program! It was our first time hosting an intern through FPL, and the process was very easy, streamlined, and efficient.

INTERN BIOS



Sarah Barsch

I am undergraduate at California Polytechnic State University, San Luis Obispo studying ecology and wildlife biology, where I spend much of my time researching kangaroo rats and rock climbing in California's diverse national parks. I am passionate about using science to promote the health and connection of wildlife, people, and their environment.



Colin Lock

I am pursuing my master's degree at the University of Guam Marine Laboratory. My thesis work uses gene expression to quantify the stress response as corals undergo micro-fragmentation — i.e. a restoration technique used to stimulate the growth of corals.



Kelsey Reese

I am currently a Ph.D. Candidate at the University of Notre Dame and a University Presidential Fellow in Humanities and Social Sciences. My dissertation work focuses on understanding occupation, community development, and resiliency of populations in ecologically marginal spaces.



Guadalupe Maldonado Andrade

I am a Ph.D. student at UC Riverside with the Plant Biology department. I love GIS, remote sensing, and above all fieldwork. I have implemented my fieldwork and GIS skills when working with plants in Riverside County, Lake Pátzcuaro (Mexico), Catalina Island, and Baja California.



Daniel Choi

I am a master's student at NC State University studying Fisheries, Wildlife, and Conservation Biology. Growing up with my siblings, I always enjoyed being outside, building with scraps of wood, or making up riddles. Since then, I've loved cross disciplinary learning, such as ethnobiology.



Taryn Black

I am a PhD student in Earth and Space Sciences at University of Washington. I use satellite imagery to study the retreat of outlet glaciers in Greenland, and I compare those records to climate datasets to better understand which factors dominate the observed widespread retreat.



Kirk Acharya

I recently completed my master's degree in Conservation Ecology at the University of Michigan describing the effects of climate and species interactions on the growth of temperate forests. I am passionate about connecting people with their natural areas and engaging community scientists in robust research.



Janelle Christensen

After living abroad in Senegal, West Africa for Peace Corps, and China, I became deeply aware of how rare and special the National Parks and wild spaces in America are, and decided to dedicate my life to preserving their beauty for future generations. Currently I am pursuing a Master's degree at UC Santa Barbara Bren School for Environmental Science & Management



Anne-Marie Parkinson

I am a first-year master's student at the Bren School of Environmental Science & Management at University of California, Santa Barbara. I am pursuing a specialization in Conservation Planning with a focus in Environmental Data Science. Previously, I have studied post-fire regeneration of conifers and oaks.



Macy Linton - Incomplete

I received my bachelors in geography with a concentration in GIS from Louisiana State University in May 2020. While at LSU, I conducted research for the Mississippi River Delta Archaeological Mitigation (MRDAM) project.

CONCLUSION

The Ecological Society of America is pleased to have successfully completed the 2020 year of the prestigious FPL internship program in partnership with the NPS Climate Change Response Program despite the disruptions brought about by the coronavirus pandemic.

Imagining how to navigate NPS unit response to the pandemic took much innovation on the part of site mentors and supervisors, and NPS and ESA program administrators. Instead of canceling the program this year, we were able to keep the bulk of the original projects intact in close communication with mentors and students. The ability to adapt to a tense and uncertain situation demonstrates the high degree of commitment of all involved to the success of the program.

We are especially proud of our recruitment efforts in the first year which tripled the number of applicants from underrepresented minority groups. With key processes in place, we are grateful for the opportunity to work with the highly professional NPS team as we transition to the Scientists in the Parks program in the coming year.

FPL Intern 2019, Rachel Fricke, Mount Rainer, WA



ACKNOWLEDGMENTS

The NPS Climate Change Response Program would like to express their sincere gratitude to the Ecological Society of America for their invaluable work and guidance to the interns throughout the course of the FPL program. We would especially like to thank the interns for the critical science and management support they contributed to parks and the education and outreach they provided for the public.

We would also like to thank our project leads in NPS units across the Service for mentoring and motivating the interns throughout their experiences and in their project and the colleges and universities that support these outstanding participants.



Sarah Barsch, Lassen Volcanic National Park, CA