2011 NPS George Melendez Wright Climate Change Fellowship Program







FELLOWS' RESEARCH STATUS REPORTS

SEPTEMBER 30, 2011

COLLEGE OF THE ENVIRONMENT
UNIVERSITY of WASHINGTON

National Park Service
U.S. Department of the Interior

2011 NPS George Melendez Wright Climate Change Fellowship Program

FELLOWS' RESEARCH STATUS REPORTS

SEPTEMBER 30, 2011

Submitted by the University of Washington
Principal Investigator: Lisa J. Graumlich

2011 NPS George M. Wright Climate Change Fellowship Program
Fellowship Research Status Reports
September 16, 2011

Table of Contents

Fellow Name: Lukas Bell-Dereske
Affiliation: Rice University
Project Name: *How do microbial symbioses affect plant community and ecosystem responses to climate change? A test in the dunes of Sleeping Bear Dunes National Lakeshore*
National Park(s): Sleeping Bear Dunes National Lakeshore
Start date: May 30, 2011
Projected end date: September 30, 2012
Award amount: $19,965

Brief overall project description:

My project utilizes the plant communities in Sleeping Bear Dunes National Lakeshore to quantify the effects of predicted changes in precipitation regimes on the fragile dune community. I am focusing on how the dominant ecosystem engineering grass species *Ammophila breviligulata* and the endophyte *Epichloë spp.* alters the response of the dune plant community. During the first year I surveyed dune plant communities to measure correlation between *A. breviligulata* density and endophytes frequency with plant diversity. During the second year I will establish an experiment that will manipulate the precipitation regime, endophyte presence, and the inter- versus intra-specific interactions in the community.

Location(s) of Research:
Sleeping Bear Dunes National Lakeshore

Timeline of:

1. **Accomplishments to-date:**

- Completed preliminary surveys of the natural density and diversity of plant species in the foredunes throughout the Sleeping Bear Dunes National Lakeshore.
- Established a pilot experiment examining the effects of *A. breviligulata* density on the growth of four common dune plant species.
- Gave a guide tour of my pilot study to undergraduates from Grandvalley State University.

2. **Anticipated completion date for each task of the project: (insert rows as needed)**

Research Project Tasks:	**Anticipated Completion Date:**
Analyze data from surveys and pilot experiment	October 2011
Seed collection for Climate Change experiment	October 14, 2011
Propagation of plants	May 1, 2012
Plant experiment	May 2012
Build Rainout Shelters	May 2012
Survey more sites in Sleeping Bear Dunes	Summer 2012
Analyze data from pilot study and additional surveys	September 2012
Analyze data from Climate Change experiment	October 2012

3. **Expected Deliverables/Research Products: (insert rows as needed)**

Research Product:	**Delivery/completion date:**
Survey of dune plant community publication	**October 2012**
Pilot study publication	**October 2012**
Climate Change experiment publication	**November 2012**

Fellow Name: Sarah Bisbing
Affiliation: Colorado State University
Project Name: *Discrete populations? Examining the role of genetic variation and landscape heterogeneity in the phenotypic divergence of Pinus contorta*
National Park(s): Glacier Bay, Yosemite, and Yellowstone
Start date: May 2011
Projected end date: September 2012
Award amount: $19,200

Brief overall project description:

An understanding of the role of phenotypic plasticity and genetic variation in overall success and relative distribution is still poorly documented for many widespread organisms. As changes in climate impact habitat, species will be forced to adapt or migrate to accommodate their environmental requirements. Nowhere has the response of plant species to heterogeneous environments been more apparent than in the *Pinus spp.* of western North America, particularly in the ecological amplitude of *Pinus contorta*. This research will use genetic and ecological information to examine the nature of adaptation and the drivers of variation among the subspecies of *Pinus contorta*, the most widespread pine of western North America. I am addressing the following questions: 1) Does the phenotypic variation across subspecies of *Pinus contorta* correspond to high genetic differentiation between subspecies? 2) Could population structure be responsible for local adaptation to the range of conditions, or is species plasticity driving persistence across this extensive ecological amplitude (isolation by adaptation)? 3) How may each subspecies respond to future local and regional changes in climatic conditions? Molecular genetic analysis, greenhouse experiments, and species distribution modeling will be used to assess current population structure and the response of the species to variable conditions. By using genetic and ecological information to assess variation and model potential distribution under future climate change scenarios, we aim to provide managers with the resources required to prepare them for the impacts of climate change. Such information will be crucial for land managers working to maintain species and communities in the face of a rapidly changing climate, providing them with a better understanding of the adaptive abilities of *Pinus contorta* and aiding in predictions of species' performance in novel environments. Moreover, information on population structure will enable managers to preserve unique populations across the landscape, providing species with the opportunity to persist through the maintenance of high levels of variation.

Location(s) of Research:

Sampling occurred across the entire range of *Pinus contorta*, from the Yukon to southern California and east to South Dakota. Genetic samples were collected from all four subspecies and from each distinct ecological region. Sampling on National Park Service land occurred within the following parks: Glacier Bay, Yosemite, and Yellowstone.

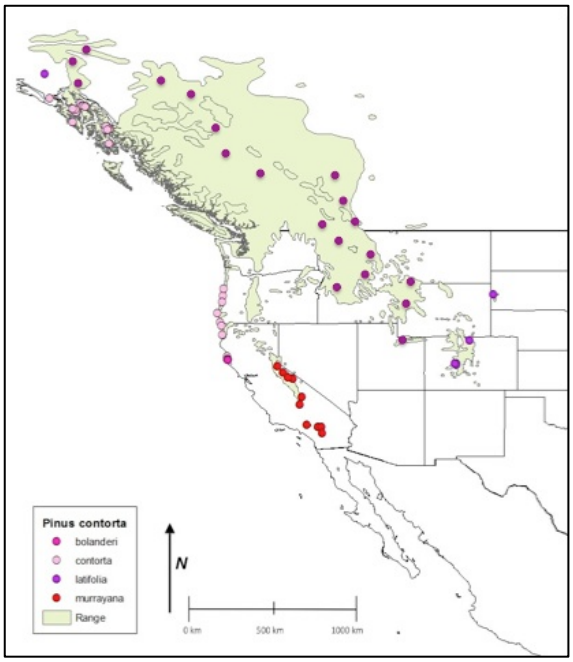


Figure 1: *Pinus contorta* natural range of occurrence and genetic sampling locations for this study.

Timeline of:

1. **Accomplishments to-date:**

- Collection of all genetic samples from across the range of *Pinus contorta* (summer 2010 - summer 2011)
- Extraction of DNA from a subset of samples (350 individuals representing 35 populations) (summer 2011)
- Testing of microsatellite primers for use in genetic analysis (spring 2011)
- Planting of seeds and care of seedlings for greenhouse study (spring 2011)

2. **Anticipated completion date for each task of the project: (insert rows as needed)**

Research Project Tasks:	**Anticipated Completion Date:**
PCR and sequencing of DNA	Summer 2012
Analysis of genetic data	Fall 2012
Greenhouse study of *PICO* plasticity	Fall 2012
Generation of Range Shift Maps	Fall 2012
Initiation of long-term reciprocal transplant	Fall 2012

3. **Expected Deliverables/Research Products: (insert rows as needed)**

Research Product:	**Delivery/completion date:**
Future Range Maps of *Pinus contorta*	**Fall 2012**
Range-wide Population Structure Data	**Fall 2012**
Established long-term, agency-collaborated reciprocal transplant study (on USFS NF land)	**Initiation – Summer 2012** **Study Timeline – 5-8 years**

Fellow Name: Kirsten Feifel
Affiliation: University of Washington
Project Name: *Harmful algal blooms and climate in Olympic National Park*
National Park(s): Olympic National Park and Olympic National Marine Sanctuary
Start date: August, 2011
Projected end date: September, 2012
Award amount: $18,908

Brief overall project description:

The impacts of climate change can have cascading consequences in coastal ecosystems, altering important natural resources for large predators like the sea otter and marine birds and for tribal subsistence. It has been suggested that climate may be a contributor to an increase in harmful algal bloom (HAB) outbreaks but there are few long-term records able to statistically assess relationships between environmental variability and HABs. Exposure to HABs can negatively affect food webs, wildlife, tribal subsistence, and recreational shellfish harvest. Over the past decade, Olympic National Park has had multiple HAB outbreaks that forced managers to close tribal and recreational shellfish harvests. If HABs along the Olympic coast become an annual event which persist in the environment, large coastal predators may alter their feeding behavior or relocate to sites that do not experience HABs. However, a lack of data has precluded the ability of managers to assess if HABs are truly increasing in Olympic National Park, and if so, what the cause is. One way to examine the relationship between historical climate variability and HABs is to develop long-term records using sediment cores. Some HAB forming species in the Pacific Northwest can form a dormant cyst after a bloom that becomes entrained in the sedimentary record; changes in cyst abundances over time reflect changes in HAB populations. Using sediment records to reconstruct historical HABs will help managers to understand past environmental drivers of blooms and elucidate the potential effects future climate change may pose to natural resources. It is important for resource managers to know how HAB populations will respond to climate change to help them better protect natural resources and proactively refine tribal and recreational shellfish harvest policies.

Location(s) of Research:
Olympic National Park and Olympic National Marine Sanctuary

Timeline of:

1. **Accomplishments to-date:**

- **Completed a three day research cruise aboard the NOAA R/V Tatoosh in August, 2011. Collected a total of 25 sediment samples along five transect lines at depths ranging from 4 – 150 m.**
- **Conducting preliminary analysis of sediment samples in the laboratory.**

2. **Anticipated completion date for each task of the project: (insert rows as needed)**

Research Project Tasks:	**Anticipated Completion Date:**
Analyze sediment samples for cyst stages of HABs	October, 2011
Germinate cysts found in sediment samples	November, 2011
Write up results of research cruise in a scientific journal	January, 2012
Follow-up research cruise	May, 2012

3. **Expected Deliverables/Research Products: (insert rows as needed)**

Research Product:	**Delivery/completion date:**
Cyst bed map of the Olympic coast	**January, 2012**
Report to park managers of cruise results	**Januray, 2012**
Peer-reviewed paper	**March, 2012**

Fellow Name: Christopher P. Jury
Affiliation: Hawai‘i Institute of Marine Biology, University of Hawai‘i at Manoa
Project Name: *Coral resilience and resistance in the National Parks of the Pacific Islands during times of global change*
National Park(s): Kalaupapa, Haleakala, Kaloko-Honokohau, and Hawaii Volcanoes National Parks
Start date: 9/1/2011
Projected end date: 7/31/2012
Award amount: $18,617

Brief overall project description:

Climate change and ocean acidification, both a result of the release of anthropogenic CO_2 to the environment, pose significant threats to the continued persistence of coral reefs. Coral reefs are economically and culturally valuable and conserving them is a major priority of the National Parks Service. Elevated temperature causes stress to corals, and may result in coral bleaching, leading to reduced coral growth rates and death. Ocean acidification often results in reduced coral growth rates as well. Seawater temperatures are normally higher on the leeward sides of the larger Hawaiian Islands as compared to corresponding windward shores. Coral communities on these leeward shores may have higher thermal tolerances than windward corals. If these tolerances are the result of adaptation, leeward corals might serve as source populations for corals resilient or resistant to climate change. Alternatively, if these temperature tolerances are the result of acclimatization one might expect windward corals to acclimatize to higher temperatures over time. Few studies have examined the effects of combined high temperature and low pH on coral physiology, but synergistic negative effects, antagonistic effects, and no interaction have been reported, making it difficult to project how corals will react to coincident temperature and pH stress, and confounding predictions of which coral communities are likely to be the most resilient to global change. This study will examine coral resilience and resistance in the face of global change in or near Kalaupapa, Haleakala, Kaloko-Honokohau, and Hawaii Volcanoes National Parks, and in nearby coral communities. The results of this study will aide resource managers in conservation efforts in these parks, and elsewhere where corals grow.

Location(s) of Research:

Kalaupapa, Haleakala, Kaloko-Honokohau, and Hawaii Volcanoes National Parks, and in nearby coral communities.

Timeline of:

1. **Accomplishments to-date:**

    a. I am currently collecting corals from the sites listed above. Experiments will follow thereafter.

2. **Anticipated completion date for each task of the project: (insert rows as needed)**

Research Project Tasks:	**Anticipated Completion Date:**
Collect corals and transport to HIMB	9/30/2011
Allow corals to heal prior to experimentation	10/31/2011
Perform temp x pH perturbation experiments	2/28/2012
Complete tissue/skeletal analyses	6/30/2012
Complete final report, submit to NPS and to park managers	8/31/2012
Complete manuscript(s) and submit to journals	9/30/2012

3. **Expected Deliverables/Research Products: (insert rows as needed)**

Research Product:	**Delivery/completion date:**
Report to NPS and park managers	8/31/2012
Manuscript(s) submitted to scientific journals	9/30/2012
Presentation(s) at scientific meeting(s)	12/31/2012

Fellow Name: Kristen Kaczynski
Affiliation: Colorado State University
Project Name: *Linking climate drivers to the timing of willow (Salix spp.) decline in Rocky Mountain National Park*
National Park(s): Rocky Mountain National Park
Start date: January 2011
Projected end date: September 2012
Award amount: $19,684

Brief overall project description:

Willows are critical components of Rocky Mountain riparian ecosystems, particularly within Rocky Mountain National Park (RMNP), where they provide the majority of the woody vegetation. However, willow stands have declined in stature, condition, and production over the past two decades. Research on willow decline has focused primarily on the effects of elk browsing and altered hydrologic regimes due to the loss of beaver populations. However, other key stresses related to climate change, such as fungal infection and temperature induced late-season drought may be interacting in novel ways with these known factors. I will perform controlled greenhouse experiments to test the strengths of the interacting stressors, including drought and temperature stresses. In addition, I am interested in investigating connections between the onset of the decline and landscape scale climate drivers, such as drought or increased/decreased maximum or minimum ambient temperatures. I will explore these linkages using the population age structure of live and dead stems to examine short spatial and temporal scale, and GIS and aerial photos to examine longer scales. Results will inform RMNP managers on the timing and causes of this decline and should form the foundation for riparian recovery and restoration efforts within RMNP and possibly throughout the West.

Location(s) of Research:
Rocky Mountain National Park

Timeline of:

1. **Accomplishments to-date:**

- Collected, cut, sanded and mounted stem sections for stem ring chronology – to determine when the willow dieback began.
- Compiled, scanned (when necessary), rectified, and mosaicked aerial photos of the Kawuneeche Valley from 1937, 1969, 1987, 1996, 1999, 2001, 2005 and 2008.
- Analyzed changes (presence/absence) of willows in the valley over the period with which I had aerial photos (see Figure 1)

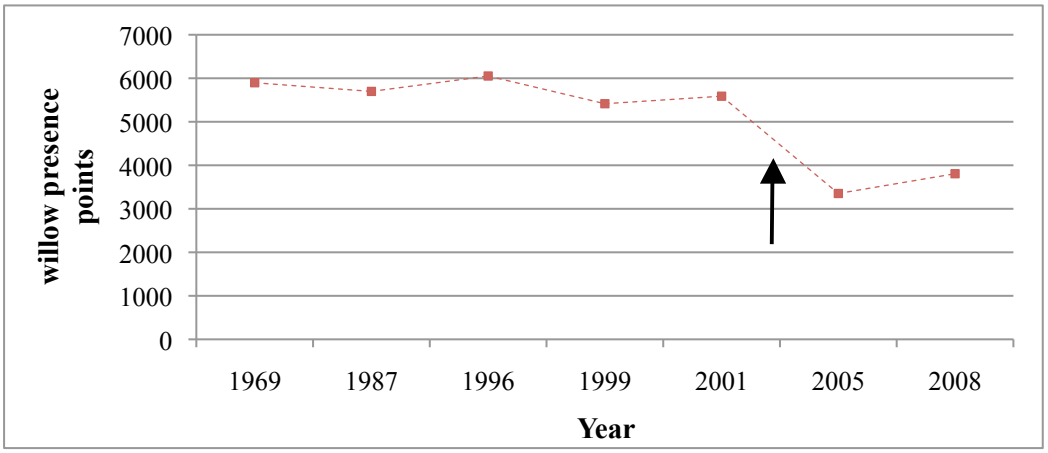


Figure 1: Willow presence points in the Kawuneeche Valley study area determined using aerial photo analysis. Arrow indicates a sharp decline in willows that occurred between 2001 and 2005.

- Ground-truthed 123 willow presence and absence points to determine accuracy of photo interpretation – accuracy was 76%. There were more errors of omission (22%) than commission (2%), due to the presence of very short willows which could not be deciphered in the photos.
- Measured depth to groundwater at existing wells throughout the Kawuneeche Valley at one period in the summer (dangerously high river waters prohibited me from doing this more often)
- Built and maintained experiment manipulating temperature and water levels on willow stems. Completed most data collection of willows where I examined the interacting stressors - heat, drought and fungal infection. I collected data on photosynthetic rates and seasonal growth of the willow stems, as well as soil moisture and temperature of the different treatments.

Figure 2: Climate change and willows experiment, Rocky Mountain National Park, summer 2011.

2. **Anticipated completion date for each task of the project: (insert rows as needed)**

Research Project Tasks:	**Anticipated Completion Date:**
Stem ring chronology to determine timing of stem dieback	December 2011
Compilation of climate variables (ie. min and max temperature, stream flow) to relate to stem dieback	December 2011
Analyze stem ring dieback years with climate variables and write up results	June 2012
Analyze willow presence points with climate variables and write up results	June 2012
Measure and analyze fungal infections on willow stems	November 2011
Analyze treatment effects on willow growth, photosynthetic rate and canker growth	March 2012
Write up results of controlled experiment	June 2012
Draft final report to NPS	September 2012

3. **Expected Deliverables/Research Products: (insert rows as needed)**

Research Product:	**Delivery/completion date:**
Presentation/poster at biennial RMNP research conference	**March 6 and 7, 2012**
Presentation of findings and update on research at 2012 Interpretive Staff training	**June 2012**
Final report to NPS on all findings on willow decline	**December 2012**

Fellow Name: Lydia Kapsenberg
Affiliation: University of California Santa Barbara
Project Name: *Assessment of ocean acidification in the Channel Islands National Park and its impact on local marine species*
National Park(s): Channel Islands National Park
Start date: August 1, 2011
Projected end date: Sept. 15, 2012
Award amount: $19,987

Brief overall project description:

Ocean acidification (OA), the decline in surface seawater pH as a direct result of anthropogenic CO_2 dissolving into surface oceans, is expected to affect many marine species, especially calcifying organisms. The result of these biological impacts will likely alter community structure of key marine ecosystems. The Channel Islands National Park (CINP) spans a temperature gradient associated with the California Current Large Marine Ecosystem seasonal upwelling, however, there are no data regarding the local near-shore carbonate chemistry. The objectives of this project are two-fold: (1) To deploy two autonomous pH SeaFET sensors to characterize near-shore pH in the CINP and to estimate pCO_2 in the field in order to inform laboratory studies, and (2) to conduct laboratory based experiments testing fertilization of two sea urchin species (*Strongylocentrotus purpuratus* and *S. franciscanus)* from two locations spanning an upwelling gradient in the CINP. The environmental and biological data can be used to assess the potential for species' tolerance to the changing marine environment. This project will advance CINP resource management by initiating a pH monitoring program within the Park's waters and by documenting near-shore carbon chemistry for the first time as well as advancing the understanding of the effects of OA on local marine organisms.

Locations of Research:

Channel Islands National Park -Anacapa Island: Landing cove
-Santa Cruz Island: Prisoner's Harbor

Timeline of:

1. **Accomplishments to-date:**

   SeaFET deployment – I have conducted a site inspection on Anacapa Island and Santa Cruz Island and selected locations for SeaFET deployment on the island piers. I have designed and build two PVC mounting plates that will be attached to the pier pilings and provide a mount for the SeaFETs (see Fig. 1). Two SeaFETs have been ordered from Dr. Todd Martz' lab at Scripps Institute of Oceanography. Delivery is expected by September-October. Both SeaFETs will be deployed by SCUBA soon thereafter to capture ocean pH fluctuations throughout the annual upwelling cycle that starts in March.

Fig. 1 PVC SeaFET mounts

Biology - The experimental protocol for the fertilization experiments has been finalized and conducted on *S. purpuratus* individuals from a Santa Barbara population. I am in the process of developing a protocol for a second laboratory based experiment that was not mentioned in the original proposal. This experiment involves rearing sea urchin larvae in different levels of seawater pCO_2 and assessing their performance when exposed to a thermal gradient in order to assess the ability of larvae to deal with an additional environmental stressor.

2. **Anticipated completion date for each task of the project:**

Research Project Tasks:	**Anticipated Completion Date:**
SeaFET deployment at Anacapa and Santa Cruz Island	December 31, 2011
SeaFET data download/service (every few weeks post-deployment)	Sept. 30, 2012.
Sea urchin collections (two species, two sites)	January 2012
Fertilization experiments	April 2012
Thermotolerance experiments	April 2012

3. **Expected Deliverables/Research Products:**

Research Product:	**Delivery/completion date:**
Publicly available data on pH and carbonate chemistry from two CINP sites	Dec. 15, 2012
Presentation to park managers	Sept. 15-Dec. 15, 2012
Informational poster for CINP visitor center on OA	Dec. 15, 2012
Scientific publication in peer-reviewed journal	N/A
Ph.D. thesis chapter	N/A

Fellow Name: Caitlin McDonough
Affiliation: Boston University
Project Name: *Reconstructing past plant phenology in Acadia National Park: tracking climate change through herbarium specimens, written records, and historic photographs.*
National Park(s): Acadia National Park
Start date: May 15, 2011
Projected end date: July 30, 2011
Award amount: $12,004

Brief overall project description:
Climate change threatens natural communities across the globe. National Park managers must be able to monitor the ecological effects of climate change in order to protect the ecological integrity of some of the country's most iconic and biologically significant places. But monitoring for trends in climate change requires an understanding of the baseline conditions. Acadia National Park and its long cultural history, with over a century of botanical observations, may be able to provide a long-term look at the changes occurring in local plant populations. This project explored two types of historical data: phenology observations captured in herbarium specimens and abundance descriptions recorded in an 1894 catalog of Mount Desert Island's flora. These newly explored old datasets will provide Acadia National Park with a context for monitoring changes in its plant communities.

Phenology, the study of the timing of biological events, is a good indicator of species' responses to a changing climate. The phenologies of many plants are tied to temperature; warming may lead to earlier or delayed springs, shifting the timing of leaf-out and flowering. Shifting plant phenology can lead to disruptions in community interactions, losses of species, increases in invasives, and changes in ecosystem functions. For these reasons, the Northeast Temperate Network, which includes Acadia National Park, has recently identified phenology as a Vital Sign for monitoring. Elsewhere in New England, researchers have used historical phenology studies and long-term weather records to document the substantial ecological impacts of climate change over long time periods. Are these phenology shifts happening at Acadia too? Reconstructing past plant phenological trends in Acadia National Park will add depth to the current monitoring program, and provide a model for how species may respond to future climate changes. The herbarium specimens, collected at the height of flowering, capture a phenological datapoint; a wealth of visiting botanists and summering naturalists has left Acadia with a large collection of historic herbarium specimens.

Two of the botanists responsible for early herbarium specimens also compiled a comprehensive flora of Mount Desert Island in the late nineteenth century. Their published accounts of abundance data for each species can now be compared to the present day abundances on the island. Changes in abundance over the last century here can be compared to declines and disappearances in other New England locales. Have plant populations in a protected National Park fared better than populations in urban/suburban New England? Or are factors like climate change, invasive species, and forest succession responsible for region-wide declines and disappearances in native species? Historic datasets provide the lens for looking at our landscape in a new light.

Location(s) of Research: Acadia National Park

Timeline of:

1. **Accomplishments to-date:**

- Photographed herbarium specimens in Acadia National Park's collection housed at the College of the Atlantic in Bar Harbor, ME
- Compiled comparison of 1894 plant species abundances to present days plant species abundances for all wildflowers on Mount Desert Island
- Presented research to the public
- Presented research to the Resource Management and Interpretation staff of Acadia National Park
- Drafted a scientific paper from our research results

2. **Anticipated completion date for each task of the project: (insert rows as needed)**

Research Project Tasks:	**Anticipated Completion Date:**
Polish draft of research paper	September 30, 2011
Add graminoids and conifers to the 1894/present day abundance comparison	October 31, 2011
Compile phenology dataset from Herbarium specimen photographs	November 30, 2011

3. **Expected Deliverables/Research Products: (insert rows as needed)**

Research Product:	**Delivery/completion date:**
Publishable Research Paper	**December 15, 2011**

Fellow Name: Lauren E. Oakes
Affiliation: Stanford University
Project Name: *Understanding human and ecological responses to yellow-cedar decline in southeast Alaska's coastal rainforests: a case study looking at what climate-related changes in forest communities mean for conservation and management planning.*
National Park(s): Glacier Bay National Park; West Chichagof Yakobi Wilderness
Start date: April 1, 2011
Projected end date: December 2012, with completed dissertation June 2014
Award amount: $19,179

Brief overall project description:

Extending north from British Columbia through southeast Alaska's Alexander Archipelago, yellow-cedar (*Callitropsis nootkatensis*), a species of high cultural, economic, and ecologic value, has been dying off since the approximate onset of the industrial revolution. Much research has focused on understanding climatic drivers of this forest transition, as reduced snow-pack makes these vulnerable trees susceptible to sudden freeze-thaw events (Hennon *et al*., 2008, 2010). In the Tongass National Forest, yellow-cedar mortality covers nearly 500,000 acres, with little understanding of succession (vegetation development) in the forest community. Glacier Bay National Park & Preserve (GLBA) sits at the northernmost boundary of this forest ecosystem as Alaska's only National Park protecting intact cedar stands. Work supported by the Wright Fellowship will contribute to doctoral research conducted by Stanford University student Lauren Oakes. This interdisciplinary research plan combines ecological, social, and geographic methods to address the following questions: As species respond within dead stands and decline continues in others, how do the structure and dynamics of the forest change? What do these changes mean for conservation planning in protected areas and managing public lands for multiple uses?

By establishing sites across cedar stands that have died at various time intervals (1900-present) and comparing changes in observed stand dynamics, this project will advance understanding of ecological change in coastal forests extending south from GLBA. In addition to analyzing change through a chronosequence (space for time), this research will draw upon historical data sets of inventories to test measured changes (time for time) and to document the spread of decline by analysis of archival aerial imagery. As a case study for examining social and ecological responses to shifts in forest communities, the dissertation work advanced by this project will improve conservation planning and adaptive strategies for resource managers facing climate-driven changes in and around park boundaries.

Location(s) of Research:

Glacier Bay National Park – Graves Harbor & Dick's Arm
West Chichagof Yakobi Wilderness – Slocum Arm & Klag Bay

Timeline of:

1. **Accomplishments to-date:**

- Acquired archival aerial photographs (1926 – present) and satellite imagery of study area for analysis
- Completed 83 miles of coastal survey by boat to classify time since yellow-cedar mortality across study area; stratified study area by mortality class & randomized plot selection
- Established 40 plots across major mortality classes (old, mid-range, recent) with controls in live forests
- Collected extensive data on overstory dynamics and understory in all 40 plots over 10 week field season (while fending off bears and surviving constant rain and rough terrain!)
- Installed climate sensors across study area from West Chichagof Wilderness to Glacier Bay National Park; sensors currently collecting soil & air temperature data for the next year +
- Verified access, feasibility for sites in GLBA; 10 plots to be established and measured in field season 2012
- Photographed canopy cover for analysis of light and forest structure across study area (West Chichagof & GLBA); images will also be used for educational display an/or book publication in future
- Collected over 300 tree cores from southern extent of study area north to GLBA for analysis
- Established local partnerships for community engagement & education surrounding project (GLBA, Sitka Conservation Society, Sitka Sound Science Center, USDA Forest Service – Sitka District)
- Delivered photographs to GLBA along with report from site visit
- Completed additional data collection for Wilderness Character monitoring (national initiative through National Forest Foundation & US Forest Service Stewardship Challenge)
- Initiated data entry from field season 2011 for subsequent analysis and planning for field season 2012
- Documented field season 2011 extensively with high resolution photographic equipment, maintained a public blog (www.forest-frolic.blogspot.com) and personal journals for future use in communicating science to a broader audience

2. **Anticipated completion date for each task of the project: (insert rows as needed)**

Research Project Tasks:	**Anticipated Completion Date:**
Complete initial analysis of data collected from field season 2011 (plot measurements, canopy cover, tree cores)	February 2012
Status reports to AK regional reports regarding field season 2011	February 2012
Complete study design for social research questions regarding management & conservation	March 2012
Submit progress report to GLBA for renewal of park permit, study approval	March 2012

Pilot focus group, interviews or surveys	April 2012
Design questions and protocols for continued ecological study in follow-up field season 2012	June 2012
Establish & measure 10 plots in GLBA, collect additional tree cores and canopy cover images	June 2012
Collect temperature sensors (GLBA, West-Chich) for data analysis	July 2012
Execute additional field work for follow-up	July – Aug 2012
Give public presentation of research findings to GLBA; submit summary poster for park interpretive binder	TBD in August-October 2012
Complete analysis of 2011-2012 data for academic publication; submit	December 2012
Continue work on educational display for GLBA Visitor Center (currently seeking grant support for photographic materials); proceed with analysis, additional research and writing for dissertation	Anticipated dissertation completion: 2014

3. Expected Deliverables/Research Products: (insert rows as needed)

Research Product:	**Delivery/completion date:**
Academic publication	Submitted by December 2012
Educational experience for undergraduates and community partners through field work and data analysis	Ongoing (Alaska and California)
Public presentation of findings for GLBA and other community partners	TBD in August/September 2012
Project reports & exchange of findings with community partners	Ongoing (Alaska)
Materials for GLBA interpretive guide/binders in Visitor Center	October 2012
Educational display, integrating photography, science and writing	By dissertation completion, if not sooner!
Publication for broader audience… book?	dissertation or beyond…

4. Possible Deliverables/Research Products (pending research results and approval):

Research Product:	**Status:**
Establishment of long-term climate monitoring sites, maintained by Forest Service after study completion	Pending approval & financial support
Contribution of scientific findings from this research to larger, published conservation & management plan for yellow-cedar (lead by Forest Service)	TBD, larger project pending approval
Field course (2-3 weeks for undergraduate students) centered around broader research interests	Currently developing course focus, seeking financial support; program targeted for 2013 (based out of Sitka, Alaska – Sitka Sound Science Center)

Fellow Name: Krista Slemmons
Affiliation: University of Maine
Project Name: *Investigating how climate induced changes in alpine glaciers alter phytoplankton communities and lake habitat.*
National Park(s): Glacier National Park
Start date: 6/2011
Projected end date: 9/2012

Brief overall project description:

Evaluating the response of alpine lakes to changing glacial runoff is an imperative step toward understanding the future of lake biota and water clarity as glaciers disappear. Lakes that are glacially fed (GF) are biologically and physically different to those that are snow fed (SF). The degree of these differences, however, is poorly understood. Predicting the fate of these communities in the future is difficult without understanding the biological fluctuations in structure and function of these lakes in the past.

The goal of this research is to investigate, utilizing paleo and modern approaches, the impacts of glacial recession and cessation on lake ecosystems. Given that algal groups provide fundamental clues regarding lake productivity and water clarity, analysis of these metrics will provide valuable information regarding the influence of glacial melting. The impacts of glacial nutrients on phytoplankton have far reaching consequences for fish and wildlife populations reliant on these essential primary producers. In order to assess impacts of glacial recession temporally, diatoms will be examined from sediment cores of GF and SF lakes within Glacier National Park. An ecological model will be created through analysis of past and modern lake habitat conditions. It is expected that there will be differences in primary producers through time as the result of changing glacial volumes. Changes in the base of the food web will have significant impacts on lake productivity and water clarity and furthermore will have profound effects on the ecosystems services that these lakes provide including alterations in lake aesthetics and habitat for endangered fish. These results will better inform park management of predicted changes influencing water clarity and lake productivity and ultimately influence the success of invasive fish species once glaciers ultimately disappear.

Location(s) of Research: Glacier National Park

Timeline of:

1. **Accomplishments to-date:**

- Analyzed lakes sediment cores from a glacially fed lake (Trout Lake) and a snow fed lake (Two Medicine) for loss on ignition, diatom assemblages, ^{210}Pb dating

2. Anticipated completion date for each task of the project: (insert rows as needed)

Research Project Tasks:	Anticipated Completion Date:
• Analyzed lakes sediment cores from a glacially fed lake (Trout Lake) and a snow fed lake (Two Medicine) for loss on ignition, diatom assemblages, ^{210}Pb dating, baseline limnological data	Completed
• Analyze lakes sediment cores from two glacially fed lake (Avalanche and Kintla Lakes) and two snow fed lake (Three Bears and Upper Two Medicine Lakes) for loss on ignition, diatom assemblages, ^{210}Pb dating, baseline limnological data	August, 2012
• GIS analysis of 6 watersheds to determine change in glacial extent over the last 150 years	January, 2012
• Pigment analysis for Two Medicine and Trout Lakes	April, 2012
• Pigment analysis for Avalanche, Kintla, Upper Two Medicine and Three Bears)	August, 2012
• Data analysis	Spring and Summer, 2012
• Final report	September, 2012

3. Expected Deliverables/Research Products: (insert rows as needed)

Research Product:	Delivery/completion date:
• Final report to NPS	September, 2012
• Peer reviewed publication	Spring, 2013
• Dissertation and presentation	Spring, 2013
• Presentation at a professional meeting	Summer, 2013
• Presentation at GNP Science and History Day	Summer, 2013

Fellow Name: Jackson Webster
Affiliation: University of Colorado, Boulder
Project Name: *The Effects of Fire and Fire Management Practices on Mercury Fate and Transport in Mesa Verde National Park*
National Park(s): Mesa Verde National Park
Start date: 6-01-2011
Projected end date: 9-15-2012
Award amount: $20,000

Brief overall project description:

Forest fires are increasing in frequency and magnitude in the United States, and climate change predictions for much of the western U.S., including southwestern Colorado, suggest hotter and drier conditions, favoring a continuation of this trend. Wild land fire may play a role in mercury mobilization, speciation, methylation, and bioaccumulation in streams, lakes, and reservoirs. Furthermore, fuel management practices critical to preserving forests and minimizing wild fire intensity may indirectly influence the fate of mercury species in forest soils. We hypothesize that forest fire oxidizes the sulfur present in soil organic matter, and that the extent of sulfur oxidation is related to the intensity of the burning. The increase in the oxidation state of the organic sulfur will decrease the abundance of reduced sulfur-containing functional groups capable of strong mercury binding in forest soil. To test these theories, soil samples will be collected from the organic litter layer (O horizon) at locations affected by wild fire and prescribed burns from low to severe intensity throughout Mesa Verde National Park. Oxidation state of sulfur will be measured using x-ray absorption near-edge structure (XANES) spectroscopy and mercury(II) adsorption experiments will be performed by competitive ligand exchange. This research will help elucidate the role of wild fire and fire management in the biogeochemical cycling of mercury species in Mesa Verde National Park.

Location(s) of Research: Mesa Verde National Park

Timeline of:

1. **Accomplishments to-date:**

- We have collected over 100 samples from park. These samples represent soils from unburned, prescribed-fire treatment sites, and historical wildfires
- Samples have been sectioned by depth increment, homogenized, and freeze dried
- We have conducted mercury analysis on each sample
- We have determined organic matter content by loss on ignition for nearly half of the samples
- We have initiated experiments to determine if fire affected soils release more mercury than their unburned counterparts.

2. **Anticipated completion date for each task of the project:**

Research Project Tasks:	**Anticipated Completion Date:**
Field Sampling	Completed
Characterization of samples	October 1st, 2012
Adsorption and desorption experiments	June 1st, 2012
XANES analysis and interpretation	May 1st, 2012

3. **Expected Deliverables/Research Products:**

Research Product:	**Delivery/completion date:**
Manuscript 1 – Fire, sulfur oxidation, and Hg binding	Sept 15st 2012
Manuscript 2 – The impacts of prescribed fire on mercury transport	Sept 15st 2012
Soil-Mercury mapping for park managers	Sept 15st 2012
Final Report	Sept 15th 2012

Fellow Name: Kristie S. Wendelberger
Affiliation: Florida International University
Project Name: *Detecting long-term community shifts in response to sea level rise and Everglades' restoration: Can remote sensing, competitive ability, and life stage be used in guiding conservation actions?*
National Park(s): Everglades National Park
Start date: 1 June 2011
Projected end date: 30 December 2012
Award amount: $20,000

Brief overall project description:

Coastal communities in Florida are threatened by sea level rise (SLR) while simultaneously undergoing restoration to natural freshwater flows. Many species in the low-lying Everglades coastal communities are unique. These communities harbor 74 rare plant species, 56 of which are restricted to areas with brackish or saline groundwater, while 40 are found only in coastal hardwood hammocks; rare species richness tends to be negatively correlated with salinity in coastal habitats.

When the complexities of SLR and Everglades' restoration are added to an environmental matrix driven by elevation, salinity, inundation, and rainfall, it is difficult to know when a community is undergoing long-term shifts in species abundance and composition as a result of changes in salinity regime or is fluctuating normally. To form a realistic conservation action strategy in the face of large-scale change, land managers need to be able to prioritize species

under greatest extinction threat versus those that will continue to persist. With this information, they can decide how to allocate resources and funding to make the best decisions to preserve the greatest amount of biodiversity.

My research addresses these issues in three ways:

1) I will create a baseline map of the coastal rare plant communities in Everglades National Park.

Question: What is the percentage of coastal Buttonwood forest understory dominated by the halophyte (salt-loving) *Batis maritima* as opposed to glycophyte (nonsalt-loving) species?

2) I will look at the abilities of halophyte species to eco-engineer their environment to be more suitable for their own establishment.

Question: Do halophytes out-compete glycophytes in freshwater-limited systems?

3) I will assess which life stages are most vulnerable to increasing salinity levels for 6 coastal plant species found in the Buttonwood forest.

Question: Is seed germination, seedling establishment, or juvenile growth more affected by salinity levels and thus more vulnerable to sea-level rise?

Location(s) of Research: Everglades National Park

Timeline of:

1. **Accomplishments to-date:**

- Collection permits have been obtained from Everglades National Park.
- Seeds have been collected from three of the six study species for seedling germination and establishment salt tolerance studies (*Swietenia mahagoni, Conocarpus erectus* and *Chromolaena frustrata*). ***Swietenia mahagoni* was added to the list of species—now 6 species—because the park felt it was a species of concern for sea level rise and included it in their experiments on juvenile salt tolerance.

Figure 1. Seeds collected as of September 2011.

Swietenia mahagoni

Chromolaena frustrata

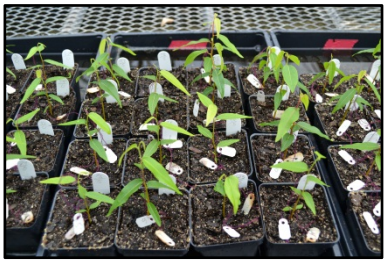
Conocarpus erectus

- Seedling establishment experiments have been initiated on *Swietenia mahagoni* and *Conocarpus erectus.*

Figure 2. GMWCC fellow Kristie Wendelberger monitoring salinity treatment levels in the FIU greenhouse.

Figure 3. *Swietenia mahagoni* seedlings after 5 weeks of salinity treatments. Seedling mortality is high in the 30 ppt and 45 ppt treatments on this date.

0 ppt



5 ppt

15 ppt

30 ppt

45 ppt

- Cuttings of *Batis maritima, Salicornia perennis, Heliotropium angiospermum,* and *Alternanthera flavescens* have been collected and established in the FIU greenhouse in preparation for the halophyte/glycophyte competition study.

Figure 4. Cuttings collected for the halophyte/glycophyte competition experiments and rooting in a perlite/vermiculite mix in the greenhouse.




Batis maritima ***Salicornia perennis*** ***Alternanthera flavescens*** ***Heliotropium angiospermum***

2. Anticipated completion date for each task of the project: (insert rows as needed)

Research Project Tasks:	**Anticipated Completion Date:**
Swietenia mahagoni seedling establishment study	September 2011
Swietenia mahagoni seed germination study	October 2011
Conocarpus erectus seedling establishment study	October 2011
Conocarpus erectus seed germination study	November 2011
Chromolaena frustrata seedling establishment and germination studies	December 2011
Capparis flexuosa germination and seedling establishment studies	January 2012
Piscidia piscipula germination and seedling establishment studies	February 2012
Eugenia foetida germination and seedling establishment studies	June 2012
Halophyte/glycophyte competition study	May 2012
Remote sensing mapping project	December 2012

3. **Expected Deliverables/Research Products: (insert rows as needed)**

Research Product:	**Delivery/completion date:**
PhD dissertation	May 2014
Peer-reviewed publication—seedling germination/establishment studies tentative submission date	January 2013
Peer-reviewed publication—halophyte/glycophyte competition study tentative submission date	January 2013
Peer-reviewed publication—remote sensing/community mapping project tentative submission date	September 2013
Report findings to the park—yearly reports	December 2011; 2012; 2013; 2014
Presenting study results at the 9th INTECOL International Wetlands Conference/Greater Everglades Ecosystem Restoration Conference	June 2012