The George Melendez Wright Climate Change Fellowship Program: Promoting innovative park science for resource management

By Gregg Garfin, Lisa Norby, Lisa Graumlich, and Tim Watkins

A REPORT BY THE U.S. CLIMATE Change Science Program (now the U.S. Global Change Research Program) concluded, with very high confidence, that "terrestrial and marine systems are already being demonstrably affected by climate change" (Janetos et al. 2008). Observable impacts, such as glacier retreat (Watson et al. 2008), changes in growing season length, phenology, and species distributions, have been documented in U.S. ecosystems (e.g., Inouye 2008), including national parks. In order to improve the quality of science-based resource management information available to National Park Service (NPS) resource managers, and to increase the understanding of park resources, the National Park Service established the George Melendez Wright Climate Change Fellowship in 2010. This program supports new and innovative research by graduate students on impacts of climate change on protected areas.

Program overview

Applicants were required to describe their research goals, methods, products, and justify their budget requests; in addition, they were required to describe the relevance of their proposed research to national park resource conservation and to garner sponsorship from the parks in which proposed research was to be conducted. Twenty-two fellowships, totaling $300,245, were awarded, from more than 140 proposals submitted in spring 2010 (table 1, next page). Program-sponsored research is being conducted in 31 national parks in the following NPS regions: Pacific West (11), Intermountain (5), Alaska (3), Northeast (1), Southeast (2); one Pacific West project is in Hawaii. In addition to NPS sponsorship of the program, outside grants, fellowships, and awards garnered by the 2010–2011 fellowship winners added $262,760 to the total resources available for their research. These additional funds added substantially to the value provided by the NPS investment in the fellowship program. The first-year program is administered by the University of Arizona, and project descriptions can be found at http://www.nature.nps.gov/climatechange/internshipsresearch.cfm. The 2011–2012 program, for which 11 finalists were recently selected, is administered by the University of Washington (http://coenv.washington.edu/students/melendez_wright/).

Projects overview

The research projects cover a wide variety of topics, observational methods, and experimental approaches. We categorized the fellowship projects into the following subject areas: glaciers (2), park policy (1), vegetation studies (10), and wildlife (9). The glacier studies focus on glacier mass balance and measurement of physical processes related to fluctuations in glacier mass and extent. The park policy study uses document review and interviews to analyze a process to make multijurisdic-

Abstract

In 2010 the National Park Service Climate Change Response Program created the George Melendez Wright Climate Change Fellowship to foster new and innovative research on climate change impacts in protected areas, and to promote national parks as laboratories for research on climate change. The program aims to increase the use of scientific knowledge to further resource management in parks and deepen the utility of place-based science for society in national parks. In its first year the program funded 22 proposals by graduate students from across the country. Research in progress covers an extensive variety of topics, from examination of how genetic factors mediate climate change effects in vulnerable tree species to ethnographic studies of the effects of environmental change on the practices of subsistence fisheries in coastal preserves and monuments. The geographic and ecosystem extent of projects ranges from Hawaiian cloud forests and Alaskan alpine environments, to forests in the Intermountain West, to coastal wetlands in Louisiana. Most program fellows have made field collections and are in the process of analyzing data. Preliminary results document the sensitivity of vegetation in the cloud forests of Haleakalā National Park to drought, California seashore vulnerabilities, and a variety of climate and ecological impacts on subsistence fisheries in Alaska.

Key words

climate change, climate impacts, fellowship program, resource management, parks for science, science for parks

Table 1. George Melendez Wright Climate Change Fellows and projects for 2010–2011*

Name	Institution	Title
Kate Boersma	Oregon State University	Climate-induced top predator extinctions affect aquatic community structure in arid headwater streams
Helen Bothwell	Northern Arizona University	Long-term vulnerability and risk assessment of a key habitat type throughout the western U.S.: Cottonwood riparian areas
Brian Cheng	University of California–Davis	Community responses to global change
Danielle Christianson	University of California–Berkeley	Linking climate change to forest dynamics from seedling-to-ecosystem scales
Sarah Corman	Brown University	Salt-marsh phenology and productivity in a changing climate
Shelley Crausbay	University of Wisconsin–Madison	Variation in water stress at the upper limit of cloud forest along a secondary climate gradient, Haleakalā National Park
Kristen Dybala	University of California–Davis	Impacts of climate change on avian population dynamics: A bottom-up approach
Ailene Kane Ettinger	University of Washington	Testing the limits: Effects of climate and competition on conifer distributions at Mount Rainier
Kevin Ford	University of Washington	Climate change and range shifts of subalpine and alpine meadows at Mount Rainier National Park
T. J. Fudge	University of Washington	Quantifying shrinking glaciers in Olympic National Park: Impact on summer streamflow
Sarah Olverson Hameed	University of California–Davis	Climate change implications for natural communities: A management question at Point Reyes National Seashore
Yu-Hsin Hsueh	Louisiana State University	Rainfall events in a hummocky terrain may release saltwater stress of bald cypress (*Taxodium distichum* L. Rich) in the Barataria Wetland, Louisiana
Shawn Johnson	University of Michigan	Building knowledge at the landscape scale: Glacier National Park and its neighbors
Allison Kidder	University of California–Berkeley	Water relations of *Baccharis pilularis* D.C. seedling establishment in a changing climate
Tyler Lewis	University of Alaska–Fairbanks	Ecosystem change in boreal wetlands and its relation to wetland birds
Amy Luxbacher	University of Minnesota–Twin Cities	Modeling the past as a window to the future: A study of how climate fluctuations have influenced the distribution and demographic history of the montane salamander, *Plethodon jordani*
Kaitlin Maguire	University of California–Berkeley	Mammalian distribution and niche dynamics in relation to climate change during the Miocene, John Day Fossil Beds
Katie Moerlein	University of Alaska–Fairbanks	Local observations of climate change and impacts on subsistence fisheries in Noatak, Alaska
Adam Springer	University of Arizona	Using historical data to evaluate the effect of climate change on perennial vegetation in Saguaro National Park
Morgan Tingley	University of California–Berkeley	Long-term trends in the avifauna of the Sierra Nevada: Community dynamics in three national parks over a century of climate change
Jennifer Wilkening	University of Colorado–Boulder	Estimating climate-mediated stress in a sentinel species and NPS key vital sign
Joanna Young	University of Alaska–Fairbanks	Effects of changing climate on Denali Park glaciers: A case study on the Kahiltna Glacier

*For brief project descriptions, see http://www.nature.nps.gov/climatechange/internshipsresearch.cfm.


KATIE MOERLEIN

Figure 1. This aerial photo of the community of Noatak, Alaska, located on the west bank of the Noatak River shows Cape Krusenstern National Monument in the background. From Katie Moerlein's GMW CCFP project, "Local observations of climate change and impacts on subsistence fisheries in Noatak, Alaska."


SHELLEY CRAUSBAY

Figure 2. This apparatus measures the sap flux velocity of ʻŌhiʻa (*Metrosideros polymorpha*) in Haleakalā National Park's cloud forest. From Shelley Crausbay's project, "Variation in water stress at the upper limit of cloud forest along a secondary climate gradient, Haleakalā National Park."


MELISSA LACEY

Figure 3. Western hemlock (*Tsuga heterophylla*) seedling, from Ailene Kane Ettinger's project, "Testing the limits: Effects of climate and competition on conifer distributions at Mount Rainier."

tional landscape-scale management decisions in the face of climate change. The vegetation studies examine observed and potential changes in species distribution, genetics, forest composition, productivity, physiology, and phenology in environments ranging from coastal salt marshes to alpine meadows. The wildlife studies examine a wide range of organisms, including amphibians, insects, mollusks, birds, fish, and mammals, in a correspondingly wide range of habitats. The botanical and wildlife research uses such techniques as field surveys, laboratory and field experiments, physiological assays, and modeling.

Preliminary research results

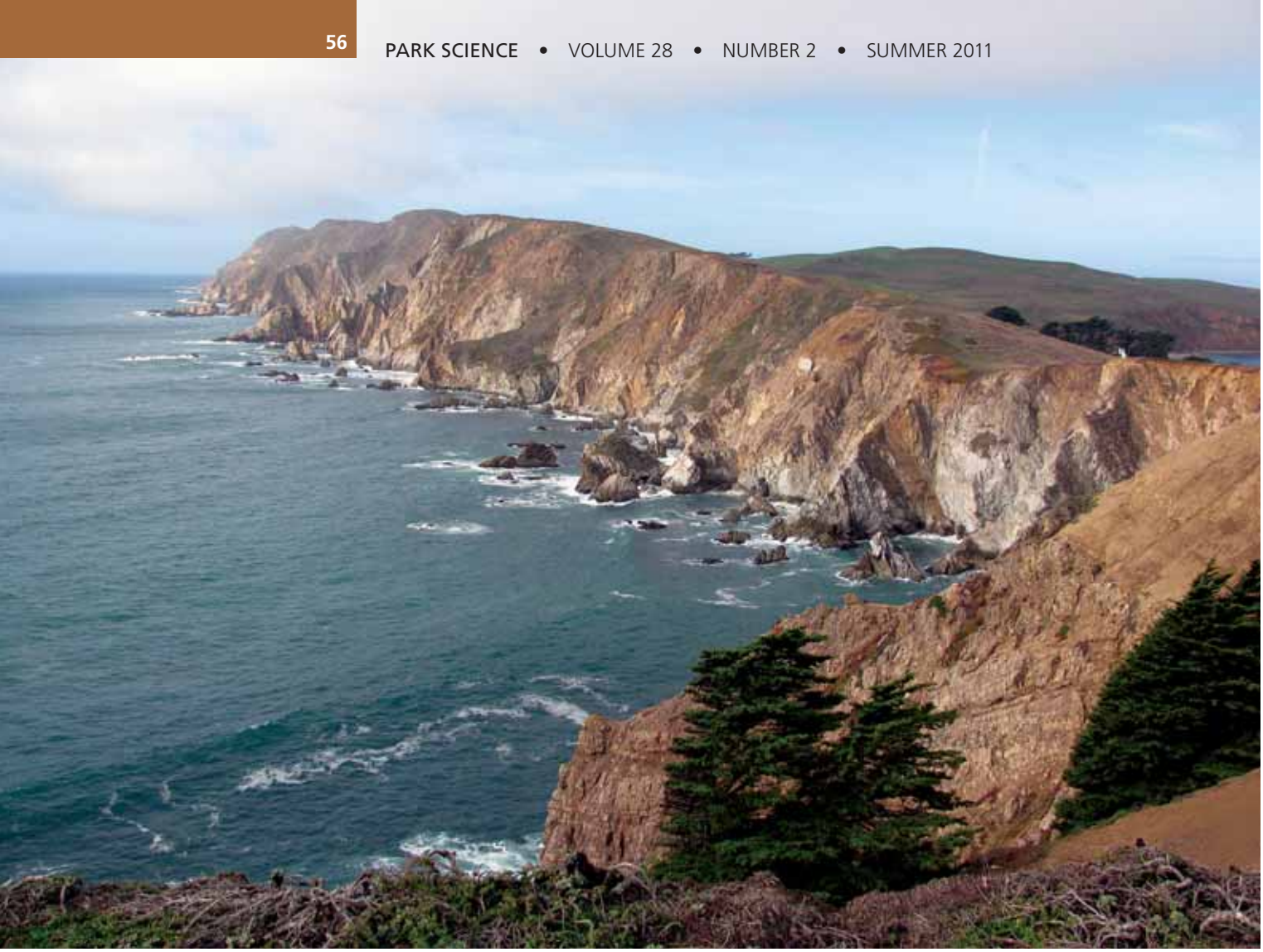
For the 2010–2011 program, funds were disbursed during late spring and early summer. Most program fellows have made initial field collections or observations and are in the process of analyzing data or gearing up for 2011 field seasons. The following examples highlight preliminary research results, submitted in November 2010, from selected projects. (Note: These results have not yet been published or peer-reviewed.)

Preliminary results demonstrate . . . improved understanding of the mechanisms underlying climatic and ecological impacts in national parks.

To answer questions about the effect of climate and ecological changes on the subsistence fisheries used by indigenous peoples in northwestern Alaska parks and preserves, Katie Moerlein observed Inupiaq Eskimo fishers and hunters in Noatak (fig. 1). She documented their concerns and interviewed them to ascertain changes they have witnessed. Her analyses thus far reveal observation of local decreases of Dolly Varden trout (*Salvelinus malma*), decreased predictability of travel conditions, and changes in the timing of fish species' runs.

The cloud forests of Haleakalā National Park (Hawaii) might seem like an unusual place to study the impacts of drought, but portions of the park have become drier in recent decades. Shelley Crausbay collected data on hydroclimatic (e.g., precipitation) and ecophysiological (e.g., sap flow) factors in ʻŌhiʻa (*Metrosideros polymorpha*), the primary canopy tree (fig. 2), along an elevational transect. For trees near the ecotone, initial results show rapid declines in sap flow just days after lengthy rains, indicating frequent water stress, despite high average rainfall—up to 6,000 mm (234 in) per year. These data will show how vulnerability to moisture stress varies spatially and will help park managers prioritize investment of resources for addressing endangered and invasive species issues in vulnerable forest areas.

Changes in geographic ranges of species are a key concern for park managers faced with planning for a changing climate. Ailene Kane Ettinger is analyzing effects of climate and interspecific competition on tree growth in Mount Rainier's (Washington) forests by conducting field experiments in plots at multiple elevations (fig. 3). Initial results suggest that, as temperature increases during the 21st century, tree



KATIE A. HOLZER

Figure 4. Point Reyes National Seashore coastline; the photo illustrates the vulnerability to erosion of the seashore's communities. From Sarah Olverson Hameed's GMW CCFP project, "Climate Change Implications for Natural Communities: A Management Question at Point Reyes National Seashore." Coinvestigators are Jill H. Baty, Katie A. Holzer, and Angela N. Doerr. All are graduate students at the University of California–Davis.

line conifers will grow faster, but lower-elevation conifers will have mixed responses (Ettinger et al. 2011).

Assessing the vulnerability of coastal environments to sea-level rise is a key challenge for managers of national seashores and preserves. Sarah Olverson Hameed and her fellow graduate students are performing a multifaceted assessment of vulnerability at Point Reyes National Seashore in California (fig. 4). They have combined expert judgments on vulnerability of each seashore community type to climate change with climate, dynamic vegetation, and sea-level rise models to develop a vulnerability assessment tool for vegetation communities in the national seashore. The next step in their research is to evaluate the impact of projected changes on species of interest to seashore managers.

Summary

The first year of the George Melendez Wright Climate Change Fellowship has enabled student researchers to conduct advanced scientific studies that help answer climate change questions confronting park managers. Preliminary results demonstrate evidence of a wide range of observed changes, and improved understanding of the mechanisms underlying climatic and ecological impacts in national parks. Moreover, the program has already demonstrated value through the leveraging of funds garnered by motivated young investigators from across the country. The final results from the 2010–2011 class are due in September 2011 just as the initial field seasons of the 2011–2012 class are concluding. The George Melendez Wright Climate Change Fellowship demonstrates one aspect of the National Park Service's tradition of supporting science to inform management challenges in the parks.

Coda

The fellowship is an annual program. Eleven 2011 fellows were selected in April and are beginning their field research during summer 2011. Research topics are diverse and include analyzing sediment cores to reveal biological responses to past climate change in Olympic (Washington) and Glacier (Montana) national parks; assessing how sensitive different populations of marine invertebrates are to ocean acidification in Hawaii and the Channel Islands in California; and analyzing historical writings, photographs, and other records of plant phenology in Acadia

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National Park (Maine) over the past 100 years. Projects are being conducted in 16 units of the National Park System, from Acadia to American Samoa, and in six NPS regions. A full list of projects is available at http://www.nature.nps.gov/climatechange/internshipsresearch.cfm.

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About the authors

Gregg Garfin *is assistant professor in the School of Natural Resources and the Environment at the University of Arizona, Tucson. He can be reached by e-mail (gmgarfin@email.arizona.edu) or phone at (520) 626-4372.* ***Lisa Norby*** *just concluded a detail as the acting George Melendez Wright Climate Change Youth Initiative coordinator, National Park Service, Natural Resource Stewardship and Science–Geologic Resources Division, Lakewood, Colorado. She can be reached by e-mail at lisa_norby@nps.gov or phone at (303) 969-2318.* ***Lisa Graumlich*** *is Virginia and Prentice Bloedel Professor and dean of the College of the Environment at the University of Washington, Seattle. She is lead project investigator for the 2011 George Melendez Wright Climate Change Fellowship Program. The new George Melendez Wright Climate Change Fellowship Program coordinator is* ***Tim Watkins****, National Park Service, Climate Change Response Program, who can be reached by e-mail at tim_watkins@nps.gov or phone at (202) 513-7189.*