Project Title:

Developing an Online Invasive Species Risk-Mapping Tool: Climate Change Adaptation through Strategic Management of a Top Ecological Stressor

Proposal by:

Doug Johnson, Executive Director
California Invasive Plant Council
1442-A Walnut St. #462
Berkeley, CA 94709

510-843-3902
dwjohnson@cal-ipc.org

Scope & Budget:

Location: Across LCCs
Duration in months: 12
Requested Funding: $96,523.00
Leveraged Funding: $113,648.00

Briefly summarize the goals of the project, what products will result, and how the products support decision-making and conservation delivery for natural resource management within the CA LCC.

As a top ecological stressor, invasive plants must be a primary consideration in climate adaptation strategies. Setting priorities for invasive plant management requires mapping where a particular species is found, where it is likely to spread, and what conservation values it impacts. To date, natural resource managers controlling invasive plants have had to rely solely on the limited amount of mapping data collected in the field. Managers need a more comprehensive view of each species' landscape-level distribution. To address this need, Cal-IPC developed a "risk mapping" approach that combines comprehensive distribution maps with maps of current and future suitable range to show where each species is likely to spread. The distribution maps are based on a new dataset created through a major campaign to collect expert opinion data from local resource managers across the state. From this dataset, Cal-IPC recently completed risk maps and management recommendations for 43 invasive plant species in the Sierra Nevada. The proposed project will build an online tool for these data. The tool will allow natural resource managers to generate risk maps and summary statistics for areas they select, and to determine management priorities. It will also allow local experts to update data each year, helping to monitor trends over time. Restoration ecologists at National Park units will guide development of the tool. Cal-IPC will work with the Cal. Dept. of Fish & Game's Biogeographic Data Branch to integrate conservation data layers into the tool. Dr. Nicole Heller of Climate Central will coordinate expert input to strengthen Cal-IPC's suitability modeling and address the challenge of modeling suitable range in California using distribution data from other areas of the globe. Cal-IPC is a 20-year-old NGO with a membership of 1,000 natural resource managers, researchers and volunteer stewards, and a range of widely recognized programs serving the conservation community.

For continuing 2010 CA LCC projects, describe the accomplishments and outcomes to date, why additional funds are needed, and what this proposal will add to the project.

NEW PROJECT

Identify which National LCC Performance Measure(s), if any, your project addresses.

1. A risk and vulnerability assessment developed or refined for priority species and habitats. 3. A population and habitat assessment developed or refined to predict changes in species populations and habitats.

List Partners

Project team: - California Invasive Plant Council - National Park Service, Pacific West Region - Cal. Dept. of Fish & Game, Biogeographic Data Branch - Climate Central Technical advisors: - Dr. David Ackerly, UC Berkeley - Dr. Healy Hamilton, Cal. Academy of Sciences - Dennis Jongsomjit, PRBO Science - Scott Loarie, Carnegie Institution Online tool design team: - GreenInfo Network - Terra GIS Online tool reviewers: - NPS restoration ecologists from CA national parks - Weed Management Area (WMA) participants

Briefly describe how the project team (main PIs) provides the range of experience, expertise, and organizational capacity needed to accomplish the project. List recent and current projects (names, time-periods, PI time commitments, and total budgets). Also attach 1 page CVs for the principle investigator and/or project leaders per below under additional information.

Cal-IPC is a twenty-year-old nonprofit organization serving the state's community of natural resource managers. The organization has 1,000 dues-paying members and an active board of directors comprising representatives of national, state and local agencies, universities, and conservation NGOs. The Cal-IPC Inventory serves as the de facto state list, with some 200 plant species ranked as invasive in the state using a transparent criteria system. Cal-IPC's extensive network of partners and strong programs in science, education and policy make the organization uniquely qualified to build an online risk mapping tool and to coordinate extension of the approach to national invasive plant mapping systems. Doug Johnson has been Executive Director of Cal-IPC since 2002. He leads development of Cal-IPC's risk mapping approach, and will oversee the proposed project. He serves as chair of the state-appointed California Invasive Species Advisory Committee, as vice-chair for the National Association of Exotic Pest Plant Councils, and as a representative on the National Environmental Coalition on Invasive Species. He holds a Master's degree in Geography from San Francisco State University, and has over twenty years experience in project management. Dr. Elizabeth Brusati is Science Program Managers for Cal-IPC. She led implementation of the criteria system for rating invasive plants in California, and currently leads development of Cal-IPC's suitability modeling. Dr. Brusati earned her Ph.D. in Ecology from UC Davis, studying benthic invertebrate diversity in mudflats invaded by Spartina alterniflora hybrids. She will lead efforts to strengthen climatic suitability modeling for invasive plants in California. Jay Goldsmith is a natural resource management specialist for the National Park Service (NPS), Pacific West Region, overseeing management in park units in California, Washington, Oregon, Idaho, Nevada, Hawaii, Guam, Samoa, and Saipan. He recently led development of a Region-wide strategic plan for management of invasive plant species in these parks. He serves on a Service-wide workgroup to evaluate NPS's Exotic Plant Management Team Program, and he chaired a workgroup that reviewed NPS's Integrated Pest Management Program. He currently serves on the state-appointed California Invasive Species Advisory Committee. For this project, he will coordinate NPS restoration ecologists in the CA LCC region to guide development of the online tool. Tom Lupo is Chief of the California Department of Fish & Game's Biogeographic Data Branch. His group oversees the California Natural Diversity Database and other spatial datasets pertaining to habitat conservation and ecological vulnerability assessment for the state. He and his staff will guide the integration of conservation layers into our online tool. Dr. Nicole Heller is Ecosystems and Adaptation Scientist at Climate Central, an NGO headquartered in Palo Alto and Princeton, NJ. Dr. Heller is actively involved in the community of scientists performing climate modeling for conservation, and will serve as a liaison to this network to help strengthen our suitability modeling. She will coordinate with Dr. David Ackerly of UC Berkeley, currently on sabbatical in South Africa, to undertake modeling of invasive plant species found in both that country and in California.

Developing an Online Invasive Species Risk-Mapping Tool:
Climate Change Adaptation through Strategic Management of a Top Ecological Stressor

Project Description

Invasive species are a significant ecological threat, and controlling these species is an important climate change adaptation measure as made clear in California's Wildlife Action Plan. Given limited funding, natural resource managers must make tough decisions about which on-the-ground efforts will be most effective at achieving conservation goals. To better inform this decision making, Cal-IPC's network of natural resource managers has expressed a clear need for landscape-level maps showing where meta-populations of each invasive plant are spreading. The proposed project creates an online "risk mapping" tool to provide this information and to help natural resource managers establish regional priorities for invasive plant management. The online tool will combine three types of datasets: current distribution of invasive plant species by USGS 7.5-minute quadrangle (including abundance, spread trend and management status); potential range for these species based on current and future suitability modeling; and existing GIS layers identifying important conservation values.

The project builds on Cal-IPC's current work mapping distribution of invasive plants statewide and modeling suitability for these species. Cal-IPC has compiled an extensive new dataset built on "expert opinion" that provides for the first time a comprehensive statewide baseline for where each species is (and is not) found, and has combined this with projections of current and future climatic suitability to show where each species is likely to spread. Cal-IPC works closely with local stakeholders through county-based Weed Management Areas (local collaborations that Cal-IPC has played a significant role in supporting over the years) to collect distribution data and rank potential management opportunities. Cal-IPC recently used this approach to create risk maps and prioritize regional management strategies for 43 species in 14 Sierra Nevada Weed Management Areas (report found at www.cal-ipc.org/ip/mapping/sierra).

The proposed project includes several objectives. First, Cal-IPC will work with GreenInfo Network and Terra GIS to create a dynamic online interface for generating maps that integrate data on invasive plant distribution, projected suitability, and conservation values. The tool will also allow updates to distribution data by local experts. Cal-IPC will encourage annual updates to keep the distribution data current and to track trends over time. An advisory group of National Park Service restoration ecologists working in parks within the CA LCC region will help develop and test the online tool. Park ecologists will generate maps and management recommendations for their parks as part of refining the system.

A second objective is incorporating conservation values into the online tool's analytic framework. The current approach of combining maps of distribution and suitability shows vulnerability to spread of invasive plant species. Adding GIS layers of spatially-variable conservation values, such as the state's Areas of Conservation Emphasis (ACE-II) and areas of Essential Habitat Connectivity, is a key next step in determining where invasive species may most impact habitat quality, a fundamental capability needed for implementing conservation strategies such as the Wildlife Action Plan. The California Dept. of Fish &

Game's Biogeographic Data Branch will guide integration of conservation layers such as ACE-II into a combined prioritization tool. Other organizations compiling GIS layers of conservation values, such as Audubon California's Important Bird Areas and the Bay Area Upland Habitat Goals Project's prioritized conservation lands, will be included.

A final objective is strengthening the suitability modeling approach. Coordination of these efforts will be assisted by Dr. Nicole Heller of Climate Central, who is active in the community of scientists modeling climate change impacts on conservation. We will solicit input from Dr. David Ackerly of UC Berkeley, Dr. Healy Hamilton of the California Academy of Sciences, Dennis Jongsomjit of PRBO Science, and Dr. Scott Loarie of the Carnegie Institution, all of whom have expressed interest in guiding this work. These experts will ensure that Cal-IPC's modeling is using the most widely-supported techniques, and will help to address challenges like modeling suitability for species using data from outside California.

Cal-IPC coordinates with partner organizations in some thirty states across the country (see www.naeppc.org) and with several national invasive plant mapping systems under development. The risk mapping approach can be used nationwide to provide landscape-level ecological information that crosses political boundaries, and Cal-IPC plans to transfer the tool to national partners in order to achieve the greatest conservation benefit.

CA LCC Priorities Addressed

This project directly supports regional decision-making by natural resource managers planning on-the-ground conservation projects. Managing invasive plants is a specific and high-priority resource manager need, and information on likely spread for each species—including the impact of climate change—is critical to setting effective landscape-scale strategy. Addressing uncertainty regarding accuracy and completeness of current distribution maps is a major aspect of Cal-IPC's current work with both field-mapped occurrence data and expert knowledge data. The implications of uncertainty with climate change scenarios will be explored by including both wet and dry scenarios in predictive modeling for potential species spread. By facilitating regular updates, the online database will provide an important baseline for tracking change in invasive plant distribution over time and will help monitor regional implementation measures in support of adaptive management.

The online risk-mapping tool, including downscaled suitability models for invasive plant range, will help natural resource managers set strategic priorities for effective invasive plant control measures on the ground. The tool fills an important need by providing an analytic framework where an extensive amount of information can be processed into meaningful management decisions. Which of the 200 plant species considered invasive in California (or the many others on Cal-IPC's watch list) are in—or near to—a particular area? How does the suitability of the area for each species shift with climate change, and how divergent are the projections based on different climate change scenarios? How do spreading infestations overlap with conservation hotspots, key connectivity corridors, or areas with heightened vulnerability to vegetation community transition? Do particular invasive plant infestations lend themselves most effectively to a strategy of eradication, containment, or surveillance? The online tool

will allow resource managers to integrate these factors to make informed decisions about which plant species in which areas are the highest priorities and what management approach makes the most sense.

Cal-IPC will conduct regular campaigns encouraging natural resource managers to update quad values for abundance, spread trend, and management status through the online tool. This will keep the data current and produce a time series for tracking trends, another factor that can be incorporated into the decision-making analysis in the future. Trend data will help monitor the success of management efforts, and may also provide useful data for improving the accuracy of downscaled suitability models. Such data may also help assess dispersal mechanisms for each invasive plant species via particular pathways.

CA LCC Criteria Addressed

State, regional and local decision-makers have requested strategic guidance on setting invasive plant management priorities, and addressing this is one of Cal-IPC's key roles. The proposed online tool will be designed specifically for use by natural resource managers working to control invasive plants, and the advisory group of National Park restoration ecologists will ensure the usefulness of the tool. This project builds on Cal-IPC's long-standing role in bridging between researchers and on-the-ground practitioners.

Controlling invasive plants is a critical and urgent conservation measure, and should be a priority for climate change adaptation. Managing invasive plants effectively with limited resources requires setting priorities based on the best information available. Integrating the new statewide datasets on invasive plant distribution and suitability with existing datasets of conservation values represents an important step forward in providing strategic guidance to natural resource managers. The sooner this information can be made available, the more effective management actions will be.

Invasive plant populations are almost always, by definition, spreading. Suitability modeling is especially important for these species, since it increases understanding of which areas are most vulnerable to future spread, and how that may shift with climate change. By strengthening Cal-IPC's approach to suitability modeling for invasive plants, this current project will better quantify the uncertainty in projections for each species' potential range. This effort integrates information from multiple trophic levels by combining data on invasive plant impacts with data on wildlife habitat values, and also by considering invasive plant dispersal by wildlife as a possible factor to include in the online tool.

The tool is designed to be transferrable and would benefit other LCCs. USGS quads were selected as the mapping unit because they form a consistent and familiar grid across the U.S. Cal-IPC has initiated a partnership with collaborators in Nevada, Arizona, and Oregon to extend the quad mapping approach to their states. Two national invasive plant mapping systems—iMapInvasives, developed by The Nature Conservancy (www.imapinvasives.org) and EDDMapS, developed by the University of Georgia's Center for Invasive Species and Ecosystem Health (www.eddmaps.org)—have expressed interest in building the quad-based risk mapping approach into their systems once a user interface has been developed.

To date, Cal-IPC's risk-mapping work has been funded by the University of California, the US Forest Service, the National Fish & Wildlife Foundation, the Resource Legacy Fund, and an ARRA stimulus grant through the Cal. Dept. of Food & Agriculture. The statewide campaign to collect "expert opinion" data is

leveraging a tremendous amount of local resource manager knowledge; eighty mapping meetings have been organized in the last year, with participants in Weed Management Areas from across the state.

Approach and Scope of Work

Distribution is mapped using USGS 7.5-minute quadrangles as the basic mapping unit (quads form a consistent well-known grid across the entire country, and will facilitate transfer to other states and seamless maps across political boundaries). Cal-IPC conduct sin-person meetings with local natural resource managers to collect "expert opinion" data by quad on relative abundance and spread trend based on a typical invasion curve. Current management status is also noted. Eighty such meetings have been conducted so far, and statewide maps have been completed for the first set of fifty species.

The resolution of these data is necessarily coarser than that of field-mapped occurrence data of invasive plant species, but detailed field data are limited given the number of invasive plant species and the area they cover. Planning strategic management requires knowing not only where a species is found, but also where it is not found, since isolated populations are of particular importance. The risk mapping approach is providing some of the first landscape-level distribution maps of their kind, and the approach lends itself to regular updating for tracking trends over time. Expert opinion data and field-mapped occurrence data, like those reported in Calflora, will be linked so that they inform each other. One of the important strategic functions of the risk maps will be to identify priority areas for field mapping particular populations. Roughly 80% of the quads where expert opinion says a plant species is present do not yet have any field-mapped occurrence data. Cal-IPC will coordinate with Dan Gluesenkamp of Audubon Canyon Ranch, who is developing early detection protocol and tools based on occurrence data as part of the CaliforniaEDN project, to take advantage of synergy between our efforts.

Restoration ecologists in NPS units such as Sequoia-Kings Canyon NP, Yosemite NP, Lassen Volcanic NP, Pinnacles NM, Point Reyes NS, Santa Monica Mountains NRA and Whiskeytown NRA will test the online risk mapping tool and use it to generate recommendations for their long-term vegetation management planning needs. Cal-IPC will explore possible design variations, such as increasing the mapping resolution to USGS 3.75-minute quarter-quads. The NPS is interested in exploring how pathways of invasive plant spread such as roads, trails, wildlife, and wind can be included in the tool's analytic tframework, so approaches to dispersal modeling will be considered for potential inclusion.

The risk mapping approach combines distribution data with climatic suitability data. To generate suitability range maps, Cal-IPC currently uses Maxent with a set of 19 Bioclim layers, modeled on a 30 arc second grid. The model is trainged using occurence data aggregated in the Calflora and California Consortium of Herbaria online databases as well as GIS datasets Cal-IPC collected from partners statewide, which more than doubled the number of points used for modeling. Cal-IPC's suitability modeling under future climate conditions has used 2050 projections from the IPCC's A2 emissions scenario, downscaled by the Canadian Centre for Climate Modeling and Analysis, which tends toward wetter projections for California. Cal-IPC received guidance and support in using this model from the Geospatial Innovation Facility at UC Berkeley.

The proposed project will strengthen this modeling approach by working with expert advisors under the guidance of Dr. Heller. One improvement will be to employ an ensemble of global climate models that better bracket the range of future scenarios and chart uncertainty in projections of shifting climatic suitability, especially as pertains to future precipitation. The utility of incorporating high-resolution downscaling of climate water deficit (by Drs. Lorrie and Alan Flint with the US Geological Survey) can be considered. Also, the potential benefits of an approach where multiple invasive plant species are bundled by the type of habitat they invade can be explored.

One particular factor complicates modeling the full potential range for non-native invasive species. Few of these species have expanded to fill their ecological niche in California, and some species have only recently invaded, providing little evidence of their eventual potential for expansion. Successfully modeling their full potential range requires inclusion of data from other parts of the globe where the species has invaded more extensively. Using a small pilot set of plant species, Cal-IPC will compile occurrence data from outside California and undertake modeling using this additional range. Dr. Ackerly, currently on sabbatical in South Africa, may serve as a liaison with the South African National Biodiversity Institute to help model plants invasive both there and in California.

GreenInfo Network and Terra GIS are experienced in open source coding for online mapping interfaces for conservation applications. They will design a database structure and interface that provides a robust foundation for GIS functionality, and supports integration of conservation layers from diverse sources. The design will also facilitate sharing data with users and with other online mapping systems.

Products/Data Sharing

Dec. 31, 2011: Post test version of online tool for NPS ecologist advisory group to test, with statewide distribution data mapped for 100 invasive plant species and suitability mapped for 50. Convene modeling advisory group to guide improved modeling approach.

Mar. 31, 2012: Complete adding the first conservation layers to the tool with support from Cal DFG.

Jun. 30, 2012: Increase the number of suitability maps to cover 100 invasive plant species, and add data addressing the level of uncertainty.

Sep. 30, 2012: Complete online tool and promote it to the state's community of natural resource managers. Complete invasive plant management recommendations using the tool for a set of National Park units in the CA LCC region.

Measuring Results

Results will include: (1) a public online tool that natural resource managers can use to generate risk maps combining conservation layers with invasive plant distribution and suitability information and showing areas most vulnerable to spread; (2) a dataset accessible through the tool with statewide data for at least 100 invasive plant species; (3) invasive plant management recommendations based on the tool for a set of National Parks within the CA LCC region.

California Landscape Conservation Cooperative 2011 Proposal Budgets

Budget Categories	CA LCC Request	Partner(s) Contribution(s) (monetary)	Partner(s) Contribution(s) (non-monetary value/in-kind)	**Total**
Salaries	$ 61,248.00	$ 61,248.00	$ -	$ 122,496.00
Supplies	$ -	$ -	$ -	$ -
Overhead	$ 20,275.00	$ -	$ -	$ 20,275.00
Equipment	$ -	$ -	$ -	$ -
Other (specify)	$ 15,000.00	$ 30,000.00	$ 22,400.00	$ 67,400.00
Total	$ 96,523.00	$ 91,248.00	$ 22,400.00	$ 210,171.00

Salaries include fringe benefits and payroll taxes at 16% for Mapping & Modeling Specialist at 50% FTE,
Science Program Manager at 25% FTE, Executive Director at 10% FTE.

Overhead includes shared and indirect costs at 21% of total project cost.

Other includes contractors: $10,000 for GreenInfo Network and TerraGIS to develop online user interface,
and $5,000 for Climate Central to lead an advisory group to strengthen suitability modeling.

Partner contribution for salaries is secured, from a state grant, for Mapping & Modeling Specialist at 50% FTE
Science Program Manager at 25% FTE, Executive Director at 10% FTE.

Partner contribution for Other is consulting funds secured from a state grant and a USFS grant for online tool development.

In-kind contributions for Other represent time contributed by natural resource managers contributing
"expert opinion" data (100 experts x 4 hrs x $40/hr) plus our NPS advisors (8 x 8 hrs x $60/hr)
plus our suitability modeling experts (4 x 8 hrs x $80/hr).

United States Department of the Interior

NATIONAL PARK SERVICE
Sequoia and Kings Canyon National Parks
47050 Generals Highway
Three Rivers, California 93271-9651
(559) 565-3341

IN REPLY REFER TO:

March 25, 2011

Doug Johnson
California Invasive Plant Council
1442-A Walnut St., #462
Berkeley, CA 94709

Dear Doug:

I am writing in support of your proposal to the California Landscape Conservation Cooperative titled "Developing an Online Invasive Species Risk-Mapping Tool: Climate Change Adaptation through Strategic Management of a Top Ecological Stressor." I strongly support this project, and will participate in designing the online risk-mapping tool as a representative of the natural resource manager community that will use it.

Sequoia and Kings Canyon National Parks are committed to effective resource management and are eager to implement strategies that account for the potential impacts of climate change. We have just begun a three-year effort to develop an Invasive Plant Management Plan with explicit consideration of climate change, and the Cal-IPC maps that include climate suitability data have been identified as major source of information for our planning efforts. To make the Cal-IPC product the most effective tool for helping us prioritize our invasive plant work, we need landscape-scale distribution maps of invasive plants with information on how their range may shift in response to climate change. The addition of GIS layers representing conservation values will make the tool's analysis even stronger.

It has been exciting working with other local resource managers over the last year to help Cal-IPC map abundance, spread, and management for invasive plant species in our area. I have already begun using Cal-IPC's mapping tool in beta form to provide information for a systematic species prioritization effort for these parks. In the next year, we will work with you to further develop the online tool for using and updating these maps. We look forward to moving forward on this effort with Cal-IPC.

Sincerely,

Athena Demetry
Restoration Ecologist

Northern San Joaquin Valley Weed Management Area
San Joaquin, Stanislaus & Merced County
2101 E. Earhart Ave., Suite 100
Stockton, CA 95206

12 April 2011

Dear Doug:

The Northern San Joaquin Valley Weed Management Area (NSJVWMA), covering San Joaquin, Stanislaus & Merced counties, strongly supports your proposal to the California Landscape Conservation Cooperative titled "Developing an Online Invasive Species Risk-Mapping Tool: Climate Change Adaptation through Strategic Management of a Top Ecological Stressor."

Like other WMAs statewide, we take strategic local action to reduce the environmental and agricultural impacts of invasive plants, including the spread of species such as perennial pepperweed, salt cedar, and Arundo. With our limited resources, we need to focus on the most important plants in the most important places, and assessing this is not easy. We have participated heavily in your quad mapping project and the resulting work is beginning to show us what's happening at a landscape level. This allows us to coordinate our weed management efforts more effectively utilizing our scare resources wisely and assisting us and our community in a comprehensive view of our weed pressures.

Putting this into an online system where we can map invasive plants over time will help make our management work as effective as possible at stopping invasive plants over the long term and will assist us in organizing our efforts in pursuit of grant funding. We are committed to working with Cal-IPC to help test an online mapping system to make sure it best serves our needs on the ground.

Sincerely,

Diana Waller

Diana Waller
NSJVWMA Co-Chair

Note: Diana Waller is District Conservationist with the USDA-Natural Resources Conservation Service in Modesto.

CLIMATE CENTRAL

April 11, 2011

Doug Johnson
California Invasive Plant Council
1442-A Walnut St, #462
Berkeley, CA 94709

Dear Doug:

On behalf of the Climate Central, I am writing to express my support for Cal-IPC's proposal to the California Landscape Conservation Cooperative titled "Developing an Online Invasive Species Risk-Mapping Tool: Climate Change Adaptation through Strategic Management of a Top Ecological Stressor." I believe this project is a very valuable and a much needed contribution to natural resource management.

At Climate Central, I serve as our specialist on climate change adaptation and conservation applications, and I have a background in invasive species management. I am very involved in the scientific community working on these issues in California, through such networks as the Bay Area Ecosystem Climate Change Consortium. I work closely with my colleagues at Climate Central, Dr. Phil Duffy, an expert in downscaling global climate models, and Dr. Claudia Tebaldi, an expert at characterizing uncertainty, to advise natural resource practitioners on the best ways to work with climate model output. I will be happy to serve as a liaison to regional experts for your project. The application of modeling techniques to determine a suitable range for invasive plants is an important and timely challenge. As we have discussed, there are several key ways that we can bring the best available techniques and newly available datasets to bear on the system you are developing, so that the results produced are robust to uncertainty. Finally, I am excited to work with you to integrate Cal-IPC's invasive species risk maps with risk maps for other leading ecological stressors, such as wildfire and development.

Please let me know if you have any questions, and keep me apprised of your progress.

Sincerely,

Nicole Heller

Douglas W. Johnson

Education

M.A., Geography and Human Environmental Studies, San Francisco State University. 2002.

M.S., Mechanical Engineering, Stanford University. 1988.

B.S., Mechanical Engineering, UC Davis. 1985.

Experience

Executive Director, California Invasive Plant Council, Berkeley, CA. 2002-present.

Environmental Aide, California State Parks, Bay Area District, San Francisco, CA. 2001.

Invasive Plant Mapping and Management contractor, Berkeley, CA. 2000.

Program Manager, City & County of San Francisco, Hetch Hetchy Water & Power, Bureau of Energy Conservation, San Franciso, CA. 1990-1999.

The New Curiosity Shop, Mountain View, CA. 1988-1990.

Beam Engineering, Sunnyvale, CA. 1986.

Selected Publications

California Invasive Plant Council. 2011. Prioritizing regional response to invasive plants in the Sierra Nevada.

California Invasive Plant Council. 2006. *California Invasive Plant Inventory.*

California Department of Food and Agriculture and California Invasive Weeds Awareness Coalition. 2005. *California Noxious & Invasive Weed Action Plan.*

DiTomaso, J.M., and D.W. Johnson, eds. 2004. *The Use of Fire as a Tool for Controlling Invasive Plants*. California Invasive Plant Council.

The Watershed Project and California Invasive Plant Council. 2004. *The Weed Workers Handbook: A guide to techniques for removing Bay Area invasive plants.*

Committees

Chair, California Invasive Species Advisory Committee

Vice-Chair, National Association of Exotic Pest Plant Councils

Member, National Environmental Coalition on Invasive Species

Awards, Fellowships, and Grants

Switzer Environmental Fellowship (2000) and Leadership Grants (2002, 2010)

Steven Pease Award for Outstanding Graduate Student in Geography (2001)

ELIZABETH D. BRUSATI

Education

Ph. D., Ecology (Area of Emphasis: Marine Ecology) University of California-Davis, Davis, CA. Dissertation: "Effects of native and hybrid cordgrass on benthic invertebrate communities." 2004.

M.S., Wildlife and Fisheries Sciences, Texas A&M University, College Station, TX. Thesis: "Comparing functions of natural and created marshes for shorebirds and wading birds." 1999.

B.S. (Honors), Wildlife and Fisheries Biology, UC-Davis. 1995.

Experience

Science Program Manager, California Invasive Plant Council, Berkeley, CA. 2004-present.

Research Assistant, NSF Spartina Biocomplexity Project, Environmental Science and Policy, UC-Davis. 2001.

Teaching Assistant, Environmental Science and Policy, and Evolution and Ecology, UC-Davis. 2000-01. Classes: Introduction to Environmental Studies, Introductory Zoology, Field Research Methods.

Senior Intern, Point Reyes Bird Observatory, Tidal Marsh Birds Project, Stinson Beach, CA. 2000.

Scientific Aid, California Dept. of Fish and Game, Office of Spill Prevention and Response, Davis, CA. 1995-96.

Post-Graduate Researcher, Wildlife, Fish, and Conservation Biology, UC-Davis, 1995.

Selected Publications

Brusati, E. D. In press. Invertebrates: Past and Current Invasions *chapter in* Palaima, A. (ed.) *Ecology, conservation and restoration of tidal marshes: the San Francisco Estuary.* University of California Press.

Brusati, E.D., and E. D. Grosholz. 2009. Does invasion of hybrid cordgrass change estuarine food webs? Biological Invasions. 11: 917-926

Brusati, E.D., and E. D. Grosholz. 2007. Effect of native and invasive cordgrass on *Macoma petalum* density, growth, and isotopic signatures. Estuarine, Coastal, and Shelf Science. 71: 517-522

Brusati, E.D., and E. D. Grosholz. 2006. Native and introduced ecosystem engineers produce contrasting effects on estuarine infaunal communities. Biological Invasions. 8: 683-695.

Brusati, E. 2005. Stolen shores. UC Davis Magazine, Spring 2005. 22(3): 22-24.

Brusati, E.D., P.J. DuBowy, and T.E. Lacher, Jr. 2001. Comparing ecological functions of natural and created wetlands for shorebirds in Texas. Waterbirds. 24(3): 371-380.

Awards, Fellowships, and Grants

Canon National Parks Science Scholarship 2001-04
Challenges to California's Natural Resources grant 2002-03
UC-Davis Jastro Shields research grant 2002
University of California Coastal Environmental Quality Initiative grant 2001-02
Welder Wildlife Foundation Fellowship 1997-99
Texas Regents Fellowship 1996-97

Biographical Sketch

Nicole E Heller
Research Scientist, Ecosystems and Adaptation
Climate Central
895 Emerson Street
nheller@climatecentral.org/ www. climatecentral.org

A. PROFESSIONAL PREPARATION

College/University	Major	Degree &Year
Princeton University	Ecology and Evolution	BA, 1995
Stanford University	Biology	PhD, 2005
UC Santa Cruz	Environmental Studies	2006 - 2007

B. SELECTED ACADEMIC/PROFESSIONAL APPOINTMENTS

Research Scientist, Climate Central, Inc., Palo Alto, CA 2008 -
Visiting Scholar, Woods Institute for the Environment, Stanford 2009 -
Visiting Assistant Professor, Franklin and Marshall College, PA 2007 - 2008
Lecturer, University of California, Santa Cruz 2007

C. SELECTED PUBLICATIONS

Safford, H, Hayward, G, Heller N, J. Wiens, Historical Ecology, Climate Change, and Resource Management: Can the past still inform the future, in Historical Ecology, Wiley-Blackwell (forthcoming)

Mastrandrea MD, NE Heller, TL Root, SH Schneider (2010) Bridging the gap: linking climate-impacts research with adaptation planning and management, Climatic Change (2010) 100:87–101

Zavaleta ES & NE Heller (2009) Responses of Communities and Ecosystems to Global Changes in The Princeton Guide to Ecology. Eds Simon Levin et al., Princeton University Press.

Heller NE & ES Zavaleta (2009) Biodiversity management in the face of climate change: a review of 22 years of recommendations. Biological Conservation 142: 14 – 32

Heller NE (2009) Pitfalls and promises of species distribution modeling for predicting future invasions. California Invasive Plant Council Symposium Proceedings, Vol 13, 2009

Heller NE, Shors JW, Sanders NJ, Gordon DM. (2008) Rainfall facilitates the spread, and time alters the impact, of the invasive Argentine ant. Oecologia 155: 385 – 395

Chan KAM, Pringle RM, Ranganathan J, Boggs C, Chan I, Ehrlich P, Heller NE, MacMynowski D, Al-Khafaji K (2007). When agendas collide: human welfare and conservation goals. Conservation Biology 21:59 - 68

Heller NE, Sanders NJ, Gordon DM (2006). Linking spatial and temporal scales in a study of an Argentine ant invasion. Biological Invasions 8: 501- 507.

Sanders NJ, Gotelli NJ, Heller NE, Gordon DM (2003) Community disassembly by an invasive ant species. Proceedings of the National Academy of Sciences 100: 2474 – 2477.

D. SELECTED SYNERGISTIC ACTIVITIES

- Lead organizer for Ecological Society of America symposium (2010) and Issues in Ecology contribution about “Urban Ecosystems as Socio-Ecological Centers of Climate Change Adaptation and Mitigation”
- Current participant and contributor to 2-year stakeholder working group funded by the Moore Foundation and lead by David Ackerly to create a climate change informed conservation plan for the San Francisco Bay Area; Bay Area Ecosystems Climate Change Consortium.
- Served as lead science advisor for three 10-minute segments for the PBS NewsHour that aired in 2008. Segments dealing with the impacts of climate change on local economies and ecologies.
- Awarded a Switzer Environmental Leadership Fellowship in 2004 and have actively participated in extensive NGO, academic network of associations, including media and leadership training sessions.