

Project Title:

Integrated Scenarios and Outreach for Habitat Threat Assessments on California Rangelands: Metrics and Economic Analysis for Decision Support

Project Leader:

Kristin Byrd, Physical Scientist
USGS Western Geographic Science Center
345 Middlefield Road MS-531
Menlo Park, CA 94025

650-329-4279
kbyrd@usgs.gov

Scope & Budget:

Location: CA LCC Wide
Duration in months: 12
Requested Funding: \$99,990.82
Leveraged Funding: \$263,374

Partners:

USGS Western Geographic Science Center (WGSC) USGS Science and Decisions Center (SDC) USGS California Water Science Center (CAWSC) Defenders of Wildlife

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.

In year one, through a multi-stakeholder partnership we developed six integrated scenarios organized around our management question – how to maintain viable rangeland and their ecosystem services in light of future integrated threats. The scenarios represent alternative futures of land use/climate/hydrological change for the California Rangeland Conservation Coalition (CRCC) focus area (the foothills around the Central Valley and most of the southern Inner Coast Range) that are consistent with IPCC emission scenarios – A2, B1, and A1B – and two downscaled general circulation models – PCM (warm, wet future) and GFDL (hot, dry future). The USGS FORE-SCE land use change model, which runs dynamically with downscaled climate model outputs, was used to generate maps of yearly landscape change for each scenario. Based on workshop feedback we developed a list of metrics to be derived from FORE-SCE model outputs that translate our scenarios into information that is relevant to decision-makers’ needs. In year two we propose to calculate metrics at the landscape and watershed scale for the CRCC focus area, and will quantify fragmentation of grazing land, change in bioclimatic distribution of oaks, grassland and shrubland, change in wildlife habitat, change in runoff, recharge and stream discharge, and change in carbon stocks and flux. Our on-line tool will include maps of “water and wildlife hotspot” areas where changes in water availability and wildlife habitat coincide. Economic analysis of scenarios to quantify costs and benefits will be applied to the CRCC landscape. Results will be published in a scholarly manuscript. Comparison of analyses across scenarios will allow resource managers to identify potential risks and opportunities – both biological and economical – for rangeland across alternative futures. Specifically results from model outputs will enable land trusts to target regions for land acquisition that are suitable for ranching and critical for biodiversity. Water districts will be able to assess future impacts to water supply and plan land acquisition and outreach to landowners in order to maximize watershed function. County planners will be able to identify areas important to water supply and areas that are vulnerable to fragmentation and climate and hydrological stressors. Results will be translated to land owners and land managers through an expanded outreach campaign including a presentation at the CRCC Annual Summit and at least three workshops.

For continuing 2011 CA LCC projects, describe the accomplishments and outcomes to date, why additional funds are needed, and what this proposal will add to the project.

Since the project start date on October 1, 2011, we have had great success in outreach to the local ranching and conservation community, which has led to the development of scenarios organized around the focal issue of how to maintain viable rangeland and their ecosystem services in light of future threats. The scenarios represent alternative futures of land use/climate/hydrological change for the California Rangeland Conservation Coalition (CRCC) focus area that are consistent with three emission scenarios and two downscaled GCMs. The USGS FORE-SCE land use change model was updated to run dynamically with downscaled climate model outputs, and generates maps of yearly landscape change for each scenario. We completed model runs for four scenarios - A2 GFDL, A2 PCM, B1 GFDL and B1 PCM. The A1B scenarios will be modeled later this spring. Analysis of model results will take place over spring and summer.

To test the outcome of conservation decisions on rangeland ecosystem services, we incorporated future conservation scenarios into our land use change modeling. By means of “conservation masks” in the B1 and A1B scenarios, we can decouple climate effects from land use impacts. These future modeled protected areas will serve as targeted locations where we can closely evaluate alternative future outcomes of ecosystem services on rangelands. Year one goals were to analyze change to two ecosystem services, water and carbon, and related economic impacts, within a subset of conservation areas in the CRCC focus area. Based on workshop feedback we developed a list of metrics to be derived from FORE-SCE model outputs that translate scenarios into information relevant to decision-makers’ needs. With year two funds we will expand our technical and economic analysis to the entire CRCC focus area. New metrics will be calculated at the landscape and watershed scale. Our on-line tool will include maps of “water and wildlife hotspot” areas where changes in water availability and wildlife habitat coincide. Comparison of analyses across scenarios will allow resource managers to identify potential risks and opportunities – both biological and economical – for rangeland across alternative futures. Results will be translated to land owners and land managers through an expanded outreach campaign including a presentation at the CRCC Annual Summit and at least three workshops. A scholarly manuscript will be published in a peer-reviewed journal.

Briefly describe how the project team (main PIs) provides the range of experience, expertise, and organizational capacity needed to accomplish the project.

Kristin Byrd (WGSC) has expertise in spatial analysis, remote sensing, and modeling urban and exurban growth. Kristin completed a PhD and post-doctoral research at U.C. Berkeley in the Department of Environmental Science, Policy and Management. Current Projects: Title: Advanced Remote Sensing to Quantify Temperate Peatland Capacity for Belowground Carbon Capture, NASA ROSES New Investigator Program in Earth Science, Award Period: 2011-2013, Person-months: 3, Total Award: \$346,333; Title: LandCarbon: Wetlands Project Plan, Award Period: 2011-2012, Person-months: 3, Total Award: \$55,613. Frank Casey (SDC) is the Ecosystem Services Theme Lead at the USGS Science and Decisions Center. Dr. Casey has experience in the market and non-market valuation of ecosystem services, including those services associated with California rangelands. He has a PhD in Food and Resource Economics from the University of Florida and an MS in Agricultural Economics from Cornell University. Current Projects: Title: Economic Valuation of the USDA Sage Grouse Initiative, Award Period: 2012-2013, Person-months: 2, Total Award: \$100K; Title: The Role of Economic Valuation in the Principles and Guidelines for Water Resource Projects, Award Period: 2012-2013, Person-months: 1, Total Award: \$5K. Lorraine Flint and Alan Flint (CAWSC) have expertise in downscaling climate data for application to regional water balance models to calculate the hydrologic response of watersheds and landscapes to current and future climates at very fine spatial scales. Current Projects: Title: Sierra Snowmelt, California Department of Water Resources, Award Period: 2008-2012, Person-months: 2, Total Award: \$360K; Title: Russian River Climate Change, Sonoma County Water Agency, Award Period: 2009-2012, Person-months: 2, Total Award: \$420K; Title: Influence of Climate Change on Sediment Transport in the Sacramento Valley Watershed, Calfed, Award Period: 2011-2013, Person-months: 2, Total Award: \$366K.

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

A risk and vulnerability assessment

Project Description: In Year One with input from land owners and resource managers, we developed six integrated land use/climate/hydrological change scenarios for the California Rangeland Conservation Coalition (CRCC) focus area (the foothills around the Central Valley and most of the southern Inner Coast Range) that are consistent with IPCC emission scenarios – A2, B1, and A1B – and two downscaled general circulation models (GCM) – PCM (warm, wet future) and GFDL (hot, dry future) (Figure 1). The USGS FORE-SCE land use change model, which runs dynamically with downscaled climate model outputs, was used to generate maps of yearly landscape change for each scenario. We are refining methods to evaluate potential threats to rangeland ecosystem services (wildlife, water and carbon) by analyzing a selection of watersheds in the CRCC area. We are also conducting preliminary economic analyses associated with changes in land use and selected ecosystem services. Based on workshop feedback we developed an expanded list of metrics to be derived from FORE-SCE model outputs that translate our scenarios into information that is meaningful and relevant to decision-makers’ needs.

In Year Two we propose to calculate metrics at the landscape and watershed scale for the CRCC focus area, and will quantify fragmentation of grazing land, change in bioclimatic distribution of oaks, grassland and shrubland, change in wildlife habitat, change in runoff, recharge and stream discharge, and change in carbon stocks and flux. We will expand our technical and economic analysis to the entire study area and develop an on-line tool for identifying “water and wildlife hotspot” areas where changes in water availability and wildlife habitat coincide. The relative impacts of land use, climate and hydrologic stressors will be identified across the landscape, and we will conduct more detailed economic analyses of these impacts. Model results and the economic analyses will be translated to land owners and land managers through an expanded outreach campaign including a presentation at the California Rangeland Conservation Coalition Annual Summit and at least three workshops. A scholarly manuscript will be published in a peer-reviewed journal.

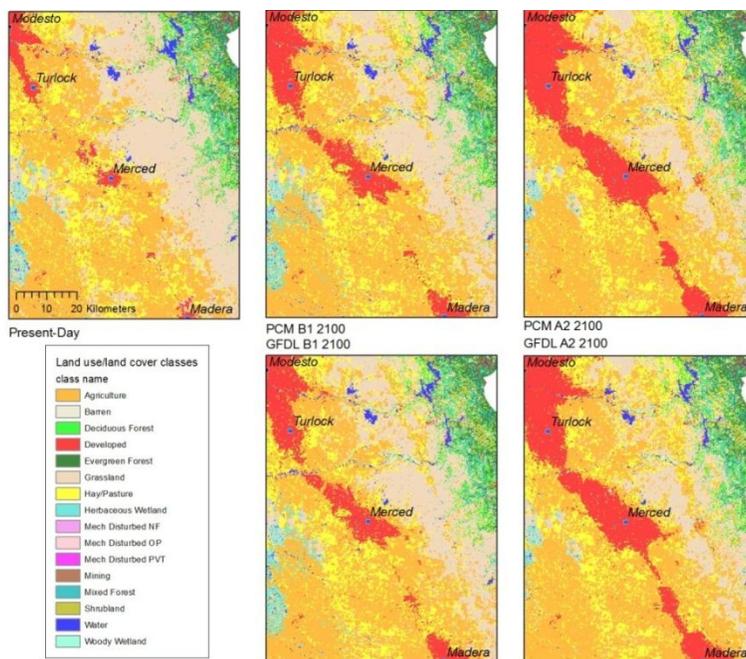


Figure 1. USGS FORE-SCE land use change model results at 250-meter resolution for four scenarios consistent with IPCC emission scenarios A2 and B1 and downscaled general circulation models PCM (warm, wet future) and GFDL (hot, dry future). Model results show change in development and agriculture from present-day to 2100 across all scenarios for a Central Valley region. While all scenarios show an increase in growth, less agricultural expansion and development occur in the B1 scenarios than the A2 scenarios. In Year Two we propose to derive metrics from these model outputs that translate scenarios into information relevant to manager needs. Metrics and economic impacts will be quantified for the California Rangeland Conservation Coalition focus area and translated to resource managers and land owners via workshops and an on-line tool.

CA LCC Priorities Addressed: Under Priority 1, Decision Support for Managers, we will a) Provide mechanisms for translation of new data to natural resources managers – we will offer workshops and outreach materials for managers and land owners; b) Develop tools that help managers allocate limited resources based on scenario evaluation – our website will allow managers to compare alternative land use /climate/hydrological change scenarios in order to identify “water and wildlife hotspot” areas where changes in water availability and wildlife habitat coincide; c) Add value to existing conservation planning efforts – our scenarios will help agencies, conservation organizations and land trusts identify threatened areas suitable for ranching and critical to biodiversity; d) Develop models at scales relevant to managers – we will characterize broad rangeland habitat response to projected change under alternative scenarios based on downscaled output from GCMs that will address specific needs for planners to preserve intact areas of grazing land to maintain viable ranches, for water districts protect water supply and maximize watershed function, and for agencies, conservation organizations and

land trusts to identify threatened but critical areas for conservation. Under Priority 2, Ecosystem Impact and Response, we will a) Find ways to assess relative contributions of land-use change compared with climate change – our scenarios have been structured to decouple and analyze separately climate change and land use change effects in key conservation priority areas; and b) Better understand potential plant response to climate change – we will identify the bioclimatic distribution of key rangeland vegetation communities and oak species as a result of changing climatic water deficit.

CA LCC Criteria Addressed:

1) Address Natural Resource Management Need. Partners within the CRCC are seeking guidance on how future threats of climate change and land use change may impact the viability of a ranching landscape and associated ecosystem services within the Central Valley and surrounding foothills. In addition resource management agencies need scientific data and tools to prepare for and mitigate the impacts of climate change. Land trusts can use project information to target regions for land acquisition that are suitable for ranching and critical for biodiversity. Water districts will be able to assess future impacts to water supply and plan actions such as land acquisition and outreach to landowners in order to maximize watershed function. County planners will be able to identify intact areas of grazing land critical for viable ranching that are vulnerable to fragmentation and climate and hydrological stressors. Over time, as project results are used to support planning decisions, measurable biological outcomes will include area of protected, un-fragmented grazing land, watershed runoff and recharge rates, and area of protected oak woodland habitat located within future suitable bioclimatic zones. Overall results from this project will help guide decisions to mitigate the impact of climate and land use change and ensure the protection of rangeland habitats.

2) Ecological or ecosystem responses to climate change. Results will show the magnitude and location of climate, hydrological, and development-driven threats to habitats within rangelands under alternative scenarios. By integrating projections of land use change with climatic water deficit, we will model potential shifts in major vegetation types and water availability on rangelands, both key components of wildlife habitat.

3) Integrative in nature. This project integrates socioeconomic, climate and hydrologic data to assess impacts of climate and land use change to changes to wildlife habitat, water availability, and carbon sequestration on rangeland.

4) Accessibility. We will develop a web-based visualization tool and an outreach campaign to provide managers access to data and results. Our data will also be hosted on the Climate Adaptation Commons website.

5) Partnership/leveraging. This is a multi-partner project that includes geographers, biologists, hydrologists, and economists. The USGS will continue collaboration with Defenders of Wildlife. We have secured in-kind support in the amount of \$263,374.

6) Transferability. Rangelands threatened by future development, climate and hydrological change dominate the western U.S and so issues addressed in this project are applicable elsewhere. The national LandCarbon scenario methodology can be applied to other LCCs. In other LCCs downscaled climate data produced by the National Climate Change and Wildlife Science Center will be available to integrate with LandCarbon land use change scenario data.

7) Capacity. The team includes hydrologists, economists, geographers and ecologists with the capacity to accomplish this multi-disciplinary project. **Dr. Kristin Byrd** has expertise in spatial analysis, remote sensing, and modeling urban and exurban growth. **Dr. Frank Casey** has experience in the market and non-market valuation of ecosystem services, including those services associated with rangelands located in the California LCC. **Drs. Lorraine Flint and Alan Flint** have expertise in downscaling climate data for application to regional water balance models to calculate the hydrologic response of watersheds and landscapes to current and future climates at very fine spatial scales. **Dr. Pelayo Alvarez** oversees research and outreach activities for the CRCC. He coordinates stakeholder meetings, field trips, conferences on topics including conservation and ecosystem services, and he manages the Coalition's website. This project is leveraging land use change modeling capabilities provided by the USGS Earth Resources and Observation Science (EROS) Data Center team in Sioux Falls, SD.

8) Continued relevance. This project directly addresses CA LCC priorities by developing models that characterize habitat response to projected change under alternative scenarios. We will assess relative contributions of land use change compared with climate and hydrological changes. The project will also translate results to managers by providing access to new information via a website and workshops.

9) Project Performance. The project is on track with its timeline. We have completed model runs for four scenarios - A2 GFDL, A2 PCM, B1 GFDL and B1 PCM. The A1B scenarios will be modeled later this spring. Analysis of model results will take place over spring and summer.

10) Readiness. By September 30 (end of Year One) we will have refined methods to evaluate potential threats to rangeland ecosystem services. Starting in October 2012 we will be ready to expand our analysis to the entire study area, calculate additional metrics, and develop an on-line tool for identifying “water and wildlife hotspot” areas where changes in water availability and wildlife habitat coincide.

Approach and Scope of Work – Approach and Integration with Related Projects:

Background and project objectives: Stakeholder feedback has guided our translation of FORE-SCE land use change model outputs into information that is useful for resource managers. Analyses of model outputs will produce metrics of change in land use, climate and hydrology and their interactions that will allow resource managers to compare scenarios in meaningful ways that are relevant to management needs. Metrics will be provided at two scales – landscape and watershed – and are described in detail below.

Landscape level analysis: A portion of scenario metrics will be produced at the landscape scale. The CRCC focus area will be divided into three regions – the Sacramento Valley and surrounding foothills, the Delta, and the San Joaquin Valley and surrounding foothills. Landscape level results will be provided for each region. We will identify and determine the ecosystem services and their associated values with the six areas of inquiry listed below.

1. Change in extent of key rangeland land cover types: The FORE-SCE land use change model produces maps of change to broad vegetation classes defined in the National Land Cover Dataset (Figure 1). We will identify those classes most commonly characteristic of rangeland – grassland, shrubland, deciduous forest, and mixed forest, and quantify the change in extent and distribution of each class for each scenario from 2010 – 2100.

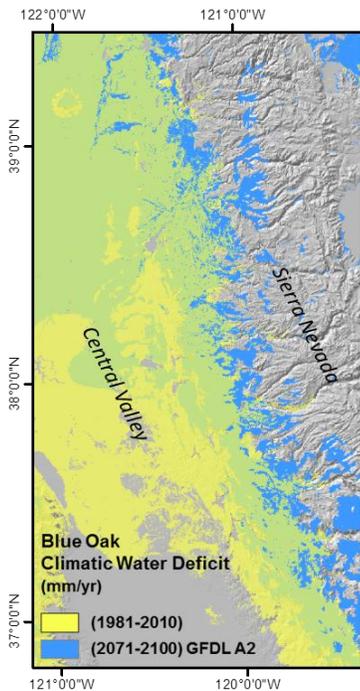


Figure 2. Climatic water deficit for Blue Oak for modern and future climate. Blue (future) is seen underneath transparent yellow (modern).

2. Fragmentation of grazing land: Through our rancher’s focus group, we identified two key ranching concerns: limited availability of grazing land for lease and the fragmentation of grazing land from development. We will calculate standard landscape metrics such as patch area and edge, patch subdivision and isolation and how these metrics change with time for each scenario using Fragstats, a computer software program designed to compute a wide variety of landscape metrics (<http://www.umass.edu/landeco/research/fragstats/fragstats.html>).

3. Change in bioclimatic distribution of oaks and grassland and shrubland: We will use climatic water deficit (CWD) to model a bioclimatic distribution for three key oak species: blue oak (*Quercus douglasii*), valley oak (*Quercus lobata*) and interior live oak (*Quercus wislizenii*), plus grassland and shrubland. CWD is calculated in the basin characterization model (BCM) as potential evapotranspiration minus actual evapotranspiration, which is a function of change in soil moisture storage, and represents an annual stress index that correlates with the distribution of vegetation across the landscape. This variable will be used to define distinct bioclimatic distributions for major vegetation types within the CRCC study area on the basis of current climatic conditions and will be calculated for future climatic conditions to project potential changes in vegetation types. Present-day and historical distributions of these species and communities will be based on a dataset of known locations derived from museum records and the Wieslander Vegetation Type Map (VTM)

collection. An example of modern and future distribution for blue oak is shown in Figure 2.

4. Change in runoff and recharge: For the entire CRCC focus area, change in runoff and recharge based on downscaled GCMs and emissions scenarios will be provided for three 30-year intervals: 2011 – 2040, 2041 – 2070, and 2071 – 2100, and departure from historical means and variation will be calculated. The BCM calculates runoff and recharge for all grid cells and the upstream area upstream of any location can be cumulated and processed to determine discharge.

5. Change in wildlife habitat: The integrated land use/climate/hydrological change model results will be overlaid with the CRCC map of high priority conservation areas to determine which high priority regions are at greater risk from land conversion and climate change within each scenario. This future threat information can be used for long-term planning of wildlife corridors and to identify shifting conservation priorities with time.

6. Water and wildlife hotspots: In rangelands water availability is a critical component of wildlife habitat. By integrating results from 4) change in runoff and recharge, and 5) change in wildlife habitat, we will identify “water and wildlife hotspot” areas where change in water availability and wildlife habitat coincide. In locations with measured streamflow, available site specific calibrations will be possible to estimate changes in local streamflow as well.

Watershed level analysis: A broad selection of key watersheds in high priority conservation areas will be selected for additional analysis of change. We will identify and determine the ecosystem services and their associated values with the four areas of inquiry listed below.

1. Change in wildlife habitat: Similar to landscape-scale analysis, with results presented at the watershed scale.

2. Change in carbon stocks and carbon flux: Through the USGS LandCarbon project, biogeochemical modeling will be conducted using the General Ensemble Modeling System (GEMS), which was developed by the USGS to provide spatially explicit biogeochemical simulations over large areas (http://www.usgs.gov/climate_landuse/land_carbon/BGM.asp).

3. Change in runoff/recharge: For a given scenario and time period, modeled development patterns in a watershed will be used to modify runoff and recharge calculations to establish changes in water availability on the basis of changes in land use. Conversion of grazing land to agriculture is expected to occur over large areas also; however modeling change in water availability due to agricultural conversion is far more complex than modeling change due to urbanization, and will be beyond the scope of this one-year project. Currently the CRCC identifies priority conservation areas based on high biodiversity and threat from development. Therefore we will limit our modeling of water availability to watersheds where urbanization is the primary land use change.

4. Change in stream discharge: Stream discharge will be modeled in key watersheds and calibrated with measured stream flow data. Changes in projected streamflow will be estimated on the basis of all GCMs and emissions scenarios for three 30-year intervals, as well as the changes in variability representing extremes, such as high peak flows or droughts.

Analysis of potential economic impacts on California rangelands: An economic impact analysis, consisting of three stages described in the Year One proposal will be applied across the landscape of the CRCC focus area. These stages include 1) identification of the types of ecosystem services that will be impacted by land use/climate/hydrological change, and their overall economic importance, 2) reporting, *based on secondary published materials*, what the provisional magnitudes of the economic costs and benefits of each scenario will entail, and 3) discussion of the economic incentive mechanisms and policies that could be adopted and applied to maintain the viability and increase the effectiveness of rangelands within the CA LCC to conserve and enhance at risk habitats and species.

Development of a web-based visualization tool: As part of Year One funding we are developing a Google-maps web application based on the format of the USGS Puget Sound Ecosystem Portfolio Model website (<http://geography.wr.usgs.gov/pugetSound/index.html>). This website will allow users to compare and contrast results at the data point scale or the regional scale across three scenarios simultaneously. Model results described above will be available on the website in the form of maps. Identification of “wildlife and water hotspot” areas will be a key feature of the website. In addition our data and supporting materials will be hosted via the Climate Adaptation Commons.

Outreach campaign: The outreach campaign will include a presentation at the CRCC Annual Summit and at least three workshops targeting potential end users of the on-line tool and other interested stakeholders. Workshops will reach out to managers of public and private lands and decision makers in the Rangeland Coalition focus area. In addition to workshops, printed materials such as factsheets will be created and links to the on-line tool will be posted on the Rangeland Coalition website and other Coalition signatories’ websites.

We have identified five groups of stakeholders by topic. **Wildlife Habitat and Restoration:** Organizations such as Wildlife Conservation Board, FWS, NRCS, CDFG, Central Valley Joint Venture, Riparian

Habitat Joint Venture, Audubon, Sustainable Conservation; **Land Conservation:** Department of Conservation, land trusts (through the California Council of Land Trusts); **Water:** Department of Water Resources, State and Regional Water Boards, water districts, public utilities such as San Francisco Public Utilities Commission; **Agricultural Associations:** California Cattlemen’s Association, California Woolgrowers Association. California Farm Bureau, Resource Conservation Districts; **Climate change/Carbon sequestration:** Climate Action Registry, Environmental Defense Fund, Sun One Solutions.

Targeted outreach events including only organizations within an area of interest mentioned above will be conducted in combination with interdisciplinary workshops with a blend of organizations with diverse interests. Through outreach efforts we aim to inform potential end users (i.e. ranchers and land managers) of how the information and tools generated by this project can help them make decisions in the face of climate change. The information generated and outreach materials will be made available to the LCC and the CRCC to be used in their outreach efforts when appropriate. To measure the impact of our outreach efforts we will keep track of the number of participants in our workshops and follow up with participants to assess the usefulness of the on-line tool. We will also record the monthly average number of visits to the on-line tool.

Integration with Related Projects: The proposal will add additional information on climate change and ecosystem services such as water and carbon sequestration to the ongoing efforts of the CRCC to protect rangeland habitats in the Central Valley. In addition it will help prioritize conservation efforts at the landscape level such as the Central Valley Joint Venture recent strategy to expand its boundaries to include rangeland/grassland habitats in higher elevations. It can also help NRCS direct funds and resources to private lands from programs such as the Bay–Delta initiative. The project will help water management programs at the regional scale like the Integrated Water Resources Management Programs (IRWMPs), the Northern Foothills Partnership or the Blue Ridge Berryessa Conservation Partnership. At the local level results from our project can help watershed groups, land trusts and resource conservation districts establish priorities for conservation. Data on carbon sequestration can help guide the development of carbon offset protocols from rangelands providing additional incentives for rangeland conservation while reducing greenhouse gas emissions.

Products/Data Sharing: This project will result in the following products and deliverables. These products will be distributed to the CRCC network of more than 100 partner organizations via an outreach campaign organized by the Defenders of Wildlife. Data will also be available via a USGS WebGIS website and the Climate Adaptation Commons website. Products and timeline are: **Sept 2012:** Year One project report including an economic analysis report, development of WebGIS tool, and USGS SDC seminar; **Oct 2012 - Mar 2013:** Spatial analysis of model outputs: calculation of landscape metrics, change in bioclimatic distribution of rangeland vegetation communities, change in runoff/recharge and stream discharge with urbanization, change in wildlife habitat and carbon stocks, identification of “water and wildlife hotspots.” **Mar - May 2013:** Analysis of economic impacts of integrated land use/climate/hydrologic changes; **May - Sept 2013:** Refinement of on-line tool, preparation of scholarly manuscript; **Ongoing:** Outreach campaign involving workshops, meetings, etc., with California Rangeland Conservation Coalition members, public and private resource managers, and land owners to disseminate project results and provide assistance in integrating results into land management.

Measuring Results: This project will produce two types of data: Metrics of land use/climate/hydrological changes for six scenarios and related economic impact data. Metrics derived from model outputs will be accessible via an on-line tool and the Climate Adaptations Commons website. Economic impact data will be used to inform policy makers and natural resource management agencies of the types of incentives mechanisms that may be the most effective. The Defenders of Wildlife will distribute this information through an outreach campaign directed at the CRCC network of more than 100 partner organizations that include land owners, land managers from state, federal and local agencies, researchers and conservation organizations. Outreach programs will help stakeholders integrate results into land planning and management decisions. With model results on water availability, ranchers will be able to prepare for shifts in plant community composition that may affect forage availability and quality so they can adjust their herd size to the available forage. Results will help direct restoration efforts to areas where water availability will allow species to survive. Water districts will be able to concentrate land acquisition (fee title and easements) on areas that are important for recharge. Data on carbon storage changes will inform entities responsible for the implementation of AB32 and carbon markets. Overall this information will help raise awareness of the ecological importance of rangelands in the Central Valley, help curb the trend of land conversion, and increase the protection of rangeland habitats and associated ecosystem services.

Project Title: Integrated Scenarios and Outreach for Habitat Threat Assessments on California Rangelands: Metrics and Economic Analysis for Decision Support

Contact: Kristin Byrd, USGS Western Geographic Science Center, kbyrd@usgs.gov, 650-329-4279

California Landscape Conservation Cooperative 2012 Proposal Budgets

**Product: Analysis and publication of integrated scenario model results, development of on-line tool
USGS Western Geographic Science Center**

Budget Categories	CA LCC Request	Partner(s) Contribution(s) (monetary)	Partner(s) Contribution(s) (non-monetary value/in-kind)	Total
Salaries	\$ 44,414.40	\$ -	\$ 51,360.00	\$ 95,774.40
Supplies	\$ -	\$ -	\$ -	\$ -
Overhead	\$ 6,662.16		\$ -	\$ 6,662.16
Equipment	\$ -	\$ -	\$ -	\$ -
Other (specify)	\$ -	\$ -	\$ -	\$ -
Sub-Total	\$ 51,076.56	\$ -	\$ 51,360.00	\$ 102,436.56

**Product: Modeling of hydrological and ecological changes across integrated scenarios
USGS California Water Science Center**

Budget Categories	CA LCC Request	Partner(s) Contribution(s) (monetary)	Partner(s) Contribution(s) (non-monetary value/in-kind)	Total
Salaries	\$ 9,995.00	\$ -	\$ 160,000.00	\$ 169,995.00
Supplies	\$ -	\$ -	\$ -	\$ -
Overhead	\$ 1,499.25		\$ -	\$ 1,499.25
Equipment	\$ -	\$ -	\$ -	\$ -
Other (specify)	\$ -	\$ -	\$ -	\$ -
Sub-Total	\$ 12,393.80	\$ -	\$ 160,000.00	\$ 172,393.80

**Product: Economic impacts analysis of integrated scenarios
USGS Center for Science and Decisions**

Budget Categories	CA LCC Request	Partner(s) Contribution(s) (monetary)	Partner(s) Contribution(s) (non-monetary value/in-kind)	Total
Salaries	\$ 9,995.00	\$ -	\$ 25,678.00	\$ 35,673.00
Supplies	\$ -	\$ -	\$ 3,000.00	\$ 3,000.00
Overhead	\$ 1,499.25		\$ -	\$ 1,499.25
Equipment	\$ -	\$ -	\$ -	\$ -
Other (specify)	\$ -	\$ -	\$ 1,336.00	\$ 1,336.00
Sub-Total	\$ 11,494.25	\$ -	\$ 30,014.00	\$ 41,508.25

**Product: Outreach Campaign
Defenders of Wildlife**

Budget Categories	CA LCC Request	Partner(s) Contribution(s) (monetary)	Partner(s) Contribution(s) (non-monetary value/in-kind)	Total
Salaries	\$ 20,898.00	\$ -	\$ 25,000.00	\$ 45,898.00
Supplies	\$ 1,250.00	\$ -	\$ -	\$ 1,250.00
Overhead	\$ 2,777.76	\$ -	\$ -	\$ 2,777.76
Equipment	\$ -	\$ -	\$ -	\$ -
Other (specify)	\$ 1,000.00	\$ -	\$ -	\$ 1,000.00
Sub-Total	\$ 25,925.76	\$ -	\$ 25,000.00	\$ 50,925.76

Total Budget for FY 2013

Budget Categories	CA LCC Request	Partner(s) Contribution(s) (monetary)	Partner(s) Contribution(s) (non-monetary value/in-kind)	Total
Salaries	\$ 85,302.40	\$ -	\$ 262,038.00	\$ 347,340.40
Supplies	\$ 1,250.00	\$ -	\$ -	\$ 1,250.00
Overhead	\$ 12,438.42	\$ -	\$ -	\$ 12,438.42
Equipment	\$ -	\$ -	\$ -	\$ -
Other (specify)	\$ 1,000.00	\$ -	\$ 1,336.00	\$ 2,336.00
Total	\$ 99,990.82	\$ -	\$ 263,374.00	\$ 363,364.82

Other:

Defenders of Wildlife: \$1000 for meeting expenses and travel

Description of in-kind services:

USGS Western Geographic Science Center:

\$51,360: Calculation of land use demands for each scenario

USGS California Water Science Center

\$25,000: Downscaling climate projections and model development

\$60,000: Historical climate and hydrologic analyses

\$75,000: Future ensemble projections of climate and hydrology

USGS Center for Science and Decisions

\$25,678: Salary

\$1,336: Travel

\$3,000: Supplies

Defenders of Wildlife

\$25,000: NRCS-Cooperative Agreement California Rangeland Coalition

May 10, 2012

Rebecca Fris, Research Coordinator
California Landscape Conservation Cooperative
Suite 2007, Modoc Hall
3020 State University Drive East
Sacramento, CA 95819

RE: Support for funding USGS and Defenders of Wildlife grant proposal

Dear Ms. Fris:

The Nature Conservancy applauds the proposal put forth by the U.S. Geological Survey Western Geographic Science Center and Defenders of Wildlife, "Integrating Science into Decisions: Climate Change/Land Use Scenarios and Outreach for Habitat Threat Assessments on California Rangelands" (proposal), and supports funding for the project.

The Conservancy is a global, non-profit organization dedicated to the conservation of biodiversity. We seek to achieve our mission through science-based planning and implementation of conservation strategies that provide for the needs of people and nature. We believe the proposal will be an important step in increasing our knowledge base and will complement existing work that has been done to help preserve ecologically valuable rangelands in California's Central Valley.

Please do not hesitate to contact me should you have any questions regarding our support for the proposal. I can be reached at (916) 596-6677.

Sincerely,



Jaymee Marty
Associate Director, Conservation Science
The Nature Conservancy

cc: Pelayo Alvarez, Defenders of Wildlife



DEPARTMENT OF CONSERVATION

Managing California's Working Lands

DIRECTOR'S OFFICE

801 K STREET • MS 24-01 • SACRAMENTO, CALIFORNIA 95814

PHONE 916 / 322-1080 • FAX 916 / 445-0732 • TDD 916 / 324-2555 • WEB SITE conservation.ca.gov

May 10, 2012

Ms. Rebecca Fris, Research Coordinator
California Landscape Conservation Cooperative
Suite 2007, Modoc Hall
3020 State University Drive East
Sacramento, CA 95819

Dear Ms. Fris:

On behalf of the Department of Conservation, I would like to provide our strong support to a full proposal your organization is currently considering for grant funding through the California Landscape Conservation Cooperative. The title of the project is: "Integrating science into decisions: climate change/land use change scenarios and outreach for habitat threat assessments on California rangelands." The applicant is the U.S. Geological Survey in partnership with a number of organizations, including the Defenders of Wildlife.

The Department believes that this research work is vital to both the protection of the State's invaluable rangeland resources, as well as gaining a critical understanding of the potential threats of a changing climate on the values produced from California's rangelands, and the management strategies needed to ensure the production of these critical values into the future.

The knowledge gained from the implementation of this project will also be of direct value to the Department of Conservation as we consider the future natural resource conservation needs of California's working landscapes.

We therefore give this proposal our full support and recommendation.

Sincerely,



Mark Nechodom
Director

CALIFORNIA
RANGELAND
Trust

May 14, 2012

Ms. Rebecca Fris, Research Coordinator
California Landscape Conservation Cooperative
Suite 2007, Modoc Hall
3020 State University Drive East
Sacramento, CA 95819

Dear Ms. Fris:

We write in support of the proposal entitled, 'Integrating Science into Decisions: Land Use Scenarios and Outreach for Habitat Threat Assessments on Central Valley Ranch Land' submitted by Dr. Kristyn Byrd from the United States Geological Survey to the California Landscape Conservation Cooperative. This proposal is in response to the CLLC's 2012 Request for Applications.

The California Rangeland Trust works to conserve the open space, natural habitat and stewardship of California's ranches. We currently have forever protected over 240,000 acres of California's working rangelands. Rangelands in the Central Valley of California provide a multitude of ecosystem services including watershed health, wildlife habitat and climate change mitigation. Measuring the impacts of climate and land use changes on ecosystem services in the Central Valley is essential in the development of cost-effective programs that protect lands from conversion and help management decisions in the face of climate change.

In addition, science-based data will help us prioritize our investments in conservation to ensure an efficient use of resources. We are confident that this team has the expertise to carry out the research described in the proposal and the outreach needed to share the results of this project with a broad group of stakeholders.

Thank you for your strong consideration of the Byrd proposal. Should you have any questions or if we can provide any further information, please feel free to contact me.

Sincerely,



Michael M. Delbar
Chief Operating Officer

KRISTIN B. BYRD

U.S. Geological Survey, 345 Middlefield Road, MS-531, Menlo Park, CA 94025
Email: kbyrd@usgs.gov; Phone: 650-329-4279

EDUCATION

PhD **University of California, Berkeley**, 2005, Environmental Science, Policy, and Management (ESPM)
Maggi Kelly (chair), Adina Merenlender, Alex Horne, dissertation committee
MA **San Francisco State University**, 1998, Ecology and Systematics
BS **Cornell University, College of Agriculture and Life Sciences**, 1993, Environmental Science

PROFESSIONAL EXPERIENCE

Physical Scientist, U.S. Geological Survey *Feb. 2009 – Present*
Western Geographic Science Center, Menlo Park, CA
GIS Coordinator, California Academy of Sciences, San Francisco, CA *Jan. 2007 – Dec. 2008*
Post–Doctoral Researcher, ESPM Department, U.C. Berkeley, Berkeley, CA *Jan. 2006 – Dec. 2006*
P.I. Adina Merenlender, in partnership with The Nature Conservancy
Wetlands Bio-Technician, Point Reyes National Seashore, CA (summer position) *May 2001 – Sept. 2001*
Senior Staff Biologist, URS Corporation, Oakland, CA *April 1998 – March 2001*
Fellow, United Nations Economic Commission for Africa (UNECA) *Oct. 1994 – July 1995*
Natural Resources Division, Addis Ababa, Ethiopia
Natural Resources Interpreter, Yosemite National Park, CA (internship) *June 1994 – Sept. 1994*
Environmental Analyst, Energetics, Inc., Columbia, MD *June 1993 – June 1994*

PUBLICATIONS

Byrd, K. B., A. R. Rissman, and A. M. Merenlender. 2009. Impacts of conservation easements for threat abatement and fire management in a rural oak woodland landscape. *Landscape and Urban Planning* 92:106-116.
Byrd, K. B. 2009. Remote sensing and spatial analysis of watershed and estuarine processes for conservation planning in Elkhorn Slough, Monterey County, California, pp. 495-520 *In* X. Yang (ed.). *Remote Sensing and Geospatial Technologies for Coastal Ecosystem Assessment and Management*. Springer-Verlag Berlin Heidelberg.
Byrd, K. B., N. M. Kelly and A. M. Merenlender. 2007. Temporal and spatial relationships between watershed land use and salt marsh disturbance in a Pacific estuary. *Environmental Management* 39(1):98-112.
Byrd, K. B. and N. M. Kelly. 2006. Salt marsh vegetation response to edaphic and topographical changes from upland sedimentation in a Pacific estuary. *Wetlands* 26(3):813-829.
Byrd, K. B., N. M. Kelly, and E. Van Dyke. 2004. Decadal changes in a Pacific estuary: a multi-source remote sensing approach for historical ecology. *GIScience and Remote Sensing* 41(4):347-370.
Byrd, K. B., V. T. Parker, D. R. Vogler, and K. W. Cullings. 2000. The influence of clear-cutting on ectomycorrhizal fungus diversity in a lodgepole pine (*Pinus contorta*) stand, Yellowstone National Park, Wyoming, and Gallatin National Forest, Montana. *Canadian Journal of Botany* 78(2):149-156.

AWARDS, GRANTS AND FELLOWSHIPS

- NASA New Investigator Award in Earth Sciences; \$265,788 2010
Advanced Remote Sensing to Quantify Temperate Peatland Capacity for Belowground Carbon Capture
- Estuarine Conservation Research Award 2004
Elkhorn Slough National Estuarine Research Reserve and the Elkhorn Slough Foundation
- U.C. Center for Water Resources Grant, with P.I. N. Maggi Kelly 2002 – 2004
Linking upland landcover change with wetland structure in Elkhorn Slough, CA; \$56,000
- U.C. Marine Council Coastal Environmental Quality Graduate Fellowship 2002
Agriculture in the watershed and its impact on the structure of salt marshes in Elkhorn Slough – use of remote sensing for historical change detection; \$25,000
- U.C. Marine Council Coastal Environmental Quality Graduate Research Support 2002 – 2003
Agriculture in the watershed and its impact on the structure of salt marshes in Elkhorn Slough – use of remote sensing for historical change detection; \$17,500
- ESPM Departmental Fellowship, U.C. Berkeley 2000 – 2001
- U.S. Dept. of Education Graduate Assistance in Areas of National Need Fellowship 1995 – 1997
Support for M.A. at San Francisco State University

LORRAINE E. FLINT

U.S. Geological Survey, California Water Science Center, Sacramento, CA 95819-6129; Phone (916) 278-3223, email: lflint@usgs.gov

Education: PhD 2002, Oregon State University (Soil Physics), MS 1985, Oregon State University (Forest Soils), BS 1979, Humboldt State University (Wildlife Biology)

Positions: 2001-present: Research Hydrologist, U.S. Geological Survey, California Water Science Center, Sacramento, CA.; 1986-2001: Hydrologist, Project Chief, Yucca Mountain Project, Matrix-Hydrologic Properties; 1982-1985: Research Assistant, Dept. of Soil Science, Oregon State University

Scientific Presentations: Authored/coauthored over 100 national and international presentations, including about 15 in the last 2 years on downscaling climate change scenarios to fine-scale spatial resolution and using them in regional hydrologic models for analyses on historical and future environmental and ecological conditions.

Publications: Published over 65 peer-reviewed journal articles, book chapters, and USGS reports.

Research Direction: Current research involves downscaling future climate projections to ecologically relevant scales (1-km to 30-m) and using that as input to a regional scale hydrologic model with the same scale output. The research provides precipitation, min and max air temperature, soil moisture, potential and actual evapotranspiration, solar radiation, climatic water deficit, snow accumulation, snow melt, sublimation, recharge, and runoff. Projects are being conducted throughout the western US for analyses of water availability, flow and transport, snowmelt processes, and ecosystem change, with particular attention to the California, the Sierra Nevada, and the SF Bay Area.

Relevant Publications:

- Flint, L.E. and Flint, A.L., Downscaling climate change scenarios for ecologic applications: USGS approved, in journal review.
- Flint, A.L., Flint, L.E., Curtis, J.A., and Buesch, D.C., 2010, A Preliminary Water Balance Model for the Tigris and Euphrates River System: USGS Open-File Report.
- Flint, L.E., and Flint, A.L., 2008, Regional analysis of ground-water recharge, in Stonestrom, D.A., Constantz, J., Ferré, T.P.A., and Leake, S.A., eds., Ground-water recharge in the arid and semiarid southwestern United States: US Geological Survey Professional Paper 1703, p. 29-59.
- Flint, L.E. and Flint, A.L., 2008, A basin-scale approach to estimating stream temperatures of tributaries to the Lower Klamath River, California, *J. of Environmental Quality* 37:57-68.
- Flint, A.L. and Flint, L.E., 2008, Modeling soil moisture processes and recharge under a melting snowpack: 7:350-357 *Vadose Zone J.*
- Flint, A.L., and Flint, L.E., 2007, Application of the basin characterization model to estimate in-place recharge and runoff potential in the Basin and Range carbonate-rock aquifer system, White Pine County, Nevada, and adjacent areas in Nevada and Utah: USGS SIR 2007-5099, 20 p.
- Flint, A.L., Flint, L.E., Hevesi, J.A., and Blainey, J.M., 2004, Fundamental concepts of recharge in the Desert Southwest: a regional modeling perspective, in *Groundwater Recharge in a Desert Environment: The Southwestern United States*, edited by J.F. Hogan, F.M. Phillips, and B.R. Scanlon, Water Science and Applications Series, vol. 9, AGU, Washington, D.C., 159-184.

Curriculum Vitae
Frank Casey, Ph.D.

2010-Present: United States Geological Survey, Ecosystem Services Theme Lead, Science and Decisions Center. Responsibilities include incorporation of ecosystem services and their valuation (including market mechanisms) in adaptive management research and planning for resource conservation on both public and private lands using a structured decision making approach. Dr. Casey has initiated a bi-monthly seminar series on economic valuation of ecosystem services, participates in several in-house and external steering committees, and is active in developing a role for the SDC in applying ecosystem services concepts and valuation in the context of the Landscape Conservation Cooperatives.

1999- 2010: Senior Director, Conservation Economics and Finance Program, Defenders of Wildlife. Responsibilities included (1) development and implementation a comprehensive system of public and private land owner economic incentives at the federal and state level for wildlife habitat and biodiversity conservation. This included developing a sub-program in the estimation of ecosystem service benefits and the application of ecosystem service markets to wildlife habitat and other resources; (2) policy assistance to the wildlife community, Congress, and relevant government agencies in selecting and implementing economic incentives for the conservation and protection of wildlife habitat and biodiversity; (3) leading an internal Defenders of Wildlife working group to review, analyze, develop and promote specific changes to the conservation title of Farm Bill legislation for biodiversity conservation; (4) economic conceptualization and program implementation for (a) a national performance-based resource conservation incentive program, and (b) full cost-benefit valuation of natural lands and habitat for at risk species, including ecosystem services. Dr. Casey was the founding director of the Conservation Economics and Finance Program.

Dr. Casey is an agricultural and natural resources economist whose areas of expertise include financial and institutional incentive mechanisms for resource conservation, developing economic policy alternatives for habitat conservation by private landowners, including ecosystem service payments and markets, the economics of wildlife habitat and biodiversity conservation, soil fertility, and water allocation, the economics of regulation and technology adoption, and natural resource conflict resolution. He is lead editor for a book entitled, *Flexible Incentives for the Adoption of Environmental Technologies and Agriculture* and authored a recent a report entitled *Incentives for Biodiversity Conservation: An Ecological and Economic Assessment*. One of Dr. Casey's most recent publications in the area of ecosystem services as co-author is an article "An assessment of market-based approaches to providing ecosystem services on agricultural lands", published in *Ecological Economics* (December 15, 2007). He has a PhD in Food and Resource Economics from the University of Florida and an MS in Agricultural Economics from Cornell University.

PELAYO ALVAREZ
Conservation Program Director
California Rangeland Conservation Coalition
Defender of Wildlife
1303 J St. Suite 270
Sacramento CA 95814.
Phone: 916-313-5800
E-mail: palvarez@defenders.org

Education

Ph.D. Ecology, (Agroecology) UC Davis, June 2008.
M.S. Animal Science, Oklahoma State University, Stillwater, OK, August 1997.
B.S. Veterinary Medicine, with minor in Animal Production and Economics, Universidad de Leon (Spain), March 1993.

Work Experience

Conservation Program Director, Defenders of Wildlife, Sacramento, California. Co-director of the California Rangeland Conservation Coalition. Responsible for the coordination of the research, outreach and steering committees.

Analyst/Industry Liaison, Center for Animal Disease Modeling and Surveillance, UC Davis, Davis, California. Liaison with livestock associations, government agencies and other academic institutions to collect data for animal disease models. Outreach and media and industry relations.

Community Liaison, John Muir Institute of the Environment, Davis, California, March 2005-June 2006. Liaison between a community and an NGO in a community-based riparian restoration project. Community development. Indoor and outdoor experiential education. Field trips.

Consultant, The World Bank, Washington DC, August 1997-July 1999.
Media relations. Design and implementation of outreach campaigns in agriculture and environmental issues. Budget management. International travel.

Projects Assistant, The Nature Conservancy, Arlington, VA, September 1999-December 1999.
Database management. IT helpdesk.

Areas of Interest

Rangeland conservation, rangeland ecology, ecosystem services, wildlife conservation on private land, sustainable agriculture.