LCC FY2010 PROPOSAL

Project Leader/Agency/Contact Information:
Josh Ackerman, PhD
US Geological Survey, Western Ecological Research Center, Davis Field Station
One Shields Avenue, University of California, Davis, CA 95616
Phone: (530) 752-0485; *Fax:* (530) 752-9680; *Email:* jackerman@usgs.gov

Title: Avian demographic response to climate change: a multi-species and multi-landscape approach to synthesizing risk factors

Project Goals: Provide natural resource managers with a web-based tool to easily access information on the expected variation in avian demographic responses to environmental change across a gradient of species and landscapes from the San Francisco Bay to the Central Valley of California. Specifically, we will:

1) Assess and synthesize demographic responses to climate change variables (i.e., precipitation and temperature) for several breeding bird species with long-term demographic datasets.

2) Develop the framework for a web-based application (within the California Avian Data Center [CADC]; http://data.prbo.org/cadc2/) that will support the visualization and summation of avian demographic data. By October 2010, the web application will incorporate the main long-term datasets listed below. Ultimately, the application will visualize many different avian datasets throughout the California Landscape Conservation Cooperative.

Partners: US Geological Survey (Josh Ackerman and Mark Herzog), PRBO Conservation Science (Grant Ballard and Tom Gardali), California Waterfowl Association (Dan Loughman and Greg Yarris)

How project will advance LCC goals: This research achieves a number of current LCC goals. Specifically, this research will (1) provide information related to climate change, (2) incorporate data sharing, (3) provide a web-based tool to allow natural resource managers to interface directly with data and results, and (4) provide specific information on the demographic impact that projected environmental changes will have on several species of birds. Our research is collaborative, as USGS, PRBO Conservation Science, and California Waterfowl Association will be working jointly, as well as a many natural resource management agencies (see *Matching Funds* section) that have funded our long-term datasets. We will provide immediate results with a web-based application tool launched by October 2010 within a proven dissemination and visualization tool: the California Avian Data Center. This website will then continue to be improved and expanded based on feedback until the completion of this project in December 2010. Finally, this research allows the LCC to achieve one of its desired 2010 accomplishments, by assessing avian demographic response to climate change. This work will improve our understanding about how birds respond to climate variables that are expected to change dramatically over the next 100 years. Understanding how birds respond to variations in environmental factors will provide insight to natural resource managers on how birds may respond to changing climate variables in the future.

Methods:
Datasets:
Avian Data. This research will take advantage of several of the longest-term datasets on avian breeding demography in California. These datasets represent millions of dollars already invested by conservation agencies into California's natural resources and are listed below in the table:

	Region	Site Name	Habitat	Species	Years	Response Variables	Partner
Central Valley ↑	Central Valley	Conaway Ranch	Agricultural	Mallard, Gadwall	13 years (1991, 1995-2006)	Nest Success, Nest Initiation Date	CWA
	Delta	Grizzly Island	Managed Wetlands	Mallard, Gadwall, Northern Pintail, Cinnamon Teal	23 years (1985-2004, 2008-2010)	Nest Success, Nest Initiation Date	CWA & USGS
	Delta	Rush Ranch	Ancient Tidal Marsh	Song Sparrow	1996 – 2005	Nest Success	PRBO
	San Pablo Bay	China Camp	Ancient Tidal Marsh	Song Sparrow	1996 – 2007	Nest Success	PRBO
	San Francisco Bay	South Bay	Salt Ponds & Marshes	Forster's Tern, American Avocet, Black-necked Stilt	6 years (2005-2010)	Nest Success, Nest Initiation Date	USGS
Coast ↓	Coast	Palomarin	Coastal Scrub	Warbling Vireo, Song Sparrow, Orange Crowned Warbler, Wilson's Warbler, and other landbirds	30 Years (1979-2009)	Arrival Date, Nest Success	PRBO

Climate Variables. Weather data, including precipitation, temperature, and El Nino (Southern Oscillation) Index, will be obtained from the National Center for Atmospheric Research climate center and NOAA weather stations located adjacent to study sites. These variables will be added to the permanent covariate registry of CADC and can be retrieved on-line.

Quantitative Methods:
Nest Survival. We will use the logistic exposure method to estimate daily nest survival for each species at each location. This generalized linear modeling approach will allow us to incorporate local and regional covariates associated with climate change at small and large temporal scales.

Timing of Nest Initiation. Date of nest initiation will be estimated for each individual nest and is defined as the day that the first egg is laid in the nest. In order to model the effects of climate variables on the timing of nest initiation, we will employ linear mixed effects models with initiation date as the response variable, and climate variables, individual nest as the repeated effect (random effect), and site as factors.

Timing of Spring/Fall Arrival. For species where constant effort banding data are available, we will estimate the date of first arrival both in the spring and in the fall. To increase the probability that birds captured are recent arrivals, we will subset the data and only use the first 25% of captures each year for each species. Within this subset of data, the mean date of capture will be used to estimate arrival date. We will then use standard linear modeling to understand the variation in timing of arrival that is explained by climatic variables.

Projection Modeling Methodology. We will extend our modeling efforts and project results into the future (50-100 years) using available climate scenario projections. We will select specific climate scenario projections that provide a range of possible climate trajectories and thus a total measure of uncertainty that incorporates both model and scenario uncertainty.

Web-Based Tool and Incorporation within the California Avian Data Center. We will provide an interface in California Avian Data Center for users to select one of the datasets listed above and a set of covariates to

choose from to fit to the data. The user can then perform a fit to the parameters listed above and review graphical and numeric results showing the effect of predictors at each location within California. An example of a tool following this similar concept can be found at: http://data.prbo.org/partners/usfs/snmis/

Products: The final product will be a web-based tool incorporating our results into the California Avian Data Center, so that natural resource managers can easily access and visualize the results and climate change projections. Additionally, the final report will contain:

a)   Analysis of avian breeding data for several species on how specific demographic variables (depending on species) vary with respect to climate variables expected to change over the next 50-100 years. See table of avian data for information on species, sites, response variables, and length of long-term datasets.

b)   Projection of analyzed demographic variables 50-100 years into the future based on available regional climate change projections.

c)   Directions and use of the visualization tool incorporated into the California Avian Data Center.

Is the Project on-going? If so, describe: 1. what has been completed to date, 2. who has supported it, both fiscally and in-kind, 3. what will this proposal add to the project. A report of the accomplishments and outcomes to date is encouraged. This proposal takes advantage of a number of ongoing long-term research projects within California. In several studies, preliminary analyses have been performed. In all cases, these data have yet to be analyzed in relation to climate variables expected to change due to human induced environmental change. Below are a few examples of the types of data we have available. **Example 1** illustrates our long-term nest survival data. In this case, it is from 25 years of waterfowl research in the Delta and Central Valley. These data show long-term trends in nest success already, and will be modeled within this proposal to determine the relationship between nest survival and rainfall at each site. **Example 2** shows the long-term trend in arrival date for songbirds along the Coast. Whether this can be related to local, regional, or larger scale environmental patterns will be investigated. All of the datasets we will be using for this project have contributed to numerous publications and reports, which can be found at the project PI's websites.

Example 1. Twenty-five year dataset on mallard nest success (and 95% CI) and other demographic variables within the Delta at Grizzly Island Wildlife Area.
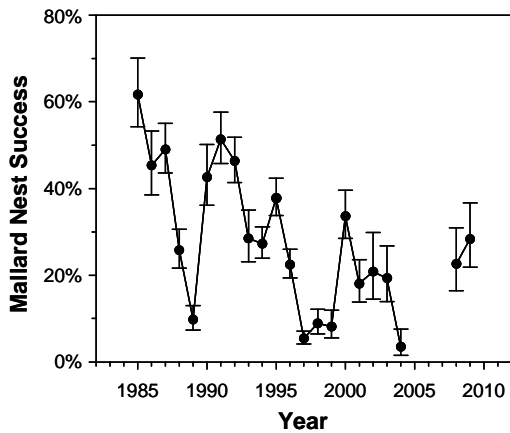
Example 2. Thirty-six year dataset on spring arrival dates for Wilson's Warbler along the coast at Palomarin Field Station.
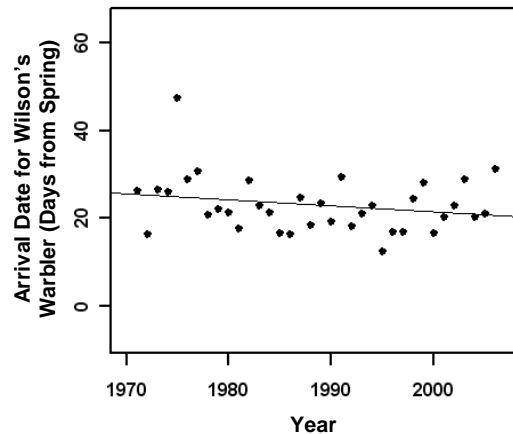
Timetable for Completion: We will develop and launch the web-based data visualization tool within the California Avian Data Center [CADC] by October 2010, as well as complete analyses of several species' responses to climate variables. Analysis of the remaining datasets will occur in Fall 2010 for launch onto

the CADC web application by winter 2011. The initial launch will allow us to evaluate and revise our procedures and methodology to improve the product as we analyze the remaining datasets. Thus, we provide a timeline for three main products below.

Product 1 – Development and launch of CADC web application and analysis of main datasets.

August 31, 2010	– Data analysis and modeling results completed and delivered for testing within CADC application.
	– "Alpha" version of web-based application developed and ready to accept initial datasets for testing.
September 15, 2010	– Analyses finalized based on feedback and review.
	– Second iteration of "Alpha" version of web-based application.
September 30, 2010	– Final version of web-based application launched.

Product 2 – CADC web application updated.

December 31, 2010	– CADC web application updated with additional datasets.

Product 3 – Final report for project.

November 30, 2010	– Analyses of all species and response variables completed and results provided to CADC web application team.
December 31, 2010	– Report submitted to LCC panel for review.

Performance Metrics with Timeline for each: The final version of the web-based application within CADC will be launched by September 30, 2010 and an updated version will be completed by December 31, 2010. We will also present our results and how to use the web-based tool to natural resource managers. For example, we will present our results related to Central Valley and Delta breeding waterfowl to the Central Valley Joint Venture and California Department of Fish and Game. This information will also help future enhancement projects, including the ongoing Grizzly Island Wildlife Area Habitat Restoration Project. We will also present our results related to San Francisco Bay waterbirds to USFWS Refuge managers and the South Bay Salt Pond Restoration Project. Tidal Marsh results will be delivered at Refuges, San Francisco Bay Joint Venture, Coastal Conservancy, and other interested partners.

Conservation Outcomes:
- Based on our breeding demography results, a basic risk assessment will provide information to managers on which species will be impacted most significantly and will allow managers to prioritize actions accordingly.
- Wetland enhancement and restoration projects within the San Francisco Bay will be given additional information on the impacts that environmental changes will have on species inhabiting these habitats.

Budget (by outcomes):

Product	Salary	Hours	Amount
Analysis of Avian Demography Data			
	Ackerman (USGS)	160	$10,616
	Herzog (USGS)	400	$19,883
	Salas (PRBO)	200	$7,524
	Gardali (PRBO)	100	$4,685

CADC Web Application			
	Ballard (PRBO)	43	$2,656
	Fitzgibbon (PRBO)	130	$7,746
	Salas (PRBO)	60	$2,264
	Herzog (USGS)	30	$1,491
Final Report			
	Ackerman (USGS)	160	$10,616
	Herzog (USGS)	160	$7,953
	Gardali (PRBO)	80	$3,781
Budget Summary			
USGS			
	Salary		$50,559
	USGS Overhead (21.9741%)		$11,110
	USGS Subtotal		$61,669
PRBO			
	Salary		$28,656
	PRBO Overhead (33.5%)		$9,600
	PRBO Subtotal		$38,256
GRAND TOTAL			**$99,925**

Matching Funds: We have significant matching funds. USGS will provide matching cost share of $6,262 towards salary. In addition, each long-term breeding bird dataset represents millions of dollars invested by natural resource managers and ecologists. Funders for these datasets include: (waterfowl) California Department of Fish and Game, Wildlife Conservation Board, California Waterfowl Association, USGS, UC Davis, Delta Waterfowl Foundation; (waterbirds) CALFED, US Fish and Wildlife Service, Resource Legacy Fund, State Coastal Conservancy, San Francisco Bay Regional Monitoring Program, South Bay Salt Pond Restoration Project, USGS; (landbirds) PRBO. PRBO has received additional funding from the National Science Foundation and other sources to construct the California Avian Data Center which facilitates sharing of these data resources.

Letters of Support:
1. Central Valley Joint Venture; Robert Shaffer, Coordinator; email: Robert_Shaffer@fws.gov
2. San Francisco Bay National Wildlife Refuge Complex; Mendel Stewart, Manager; email: Mendel_Stewart@fws.gov
3. San Pablo Bay National Wildlife Refuge; Christy Smith, Manager; email: Christy_Smith@fws.gov

CENTRAL VALLEY JOINT VENTURE

Conserving Migratory Bird Habitat

May 24, 2010

To: California Landscape Conservation Cooperative
From: Bob Shaffer, Joint Venture Coordinator
Subject: Support for LCC Science Proposal: *"Avian demographic response to climate change: a multi-species and multi-landscape approach to synthesizing risk factors."*

Dear Madam or Sir:

This letter is in support of the Landscape Conservation Cooperative proposal submitted by Dr. Josh Ackerman entitled: *"Avian demographic response to climate change: a multi-species and multi-landscape approach to synthesizing risk factors."*

The CVJV is a self-directed coalition which includes nine conservation organizations, 11 state and federal agencies and one corporation. This partnership directs its efforts toward the common goal of providing for the habitat needs of migrating and resident birds in the Central Valley of California.

While substantial effort has been dedicated towards modeling the potential spatial response of avian communities to environmental change, little effort has yet to be put forth towards the underlying mechanisms that would be driving these geographic shifts.
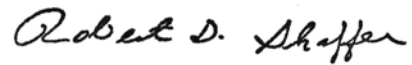
This proposal provides the key first step in evaluating the more specific impacts that climate change will have on avian populations, by providing natural resource managers with a summary of avian demographic responses across multiple species and geographic landscapes. This synthesis of avian demography will be extremely helpful to natural resource managers to plan for expected changes due to altered climatic weather patterns. We appreciate this collaborative team's efforts to include multiple long-term avian demographic databases available among several habitat types within the California Landscape Conservation Cooperative. Their results should provide natural resource managers a broad perspective on the impacts of climate change to avian breeding demography.

Importantly, the team's efforts to incorporate these data within the California Avian Data Center (CADC) will support natural resource managers' requirements for easy access to results using a tool that many managers are already familiar with. Incorporating these

results into CADC will also represent the first set of breeding data made available on this viewable avian database.

The Central Valley Joint Venture has prioritized the need for understanding and addressing climate change impacts to breeding birds. We believe this collaborative study on the variation in demographic response of birds to climate and environmental variables will assist natural resource managers immensely.

Sincerely,

Robert D. Shaffer, Coordinator

United States Department of the Interior

FISH AND WILDLIFE SERVICE
San Francisco Bay National Wildlife Refuge Complex
9500 Thornton Avenue
Newark, California 94560

May 26, 2010

To Whom it May Concern:

Please accept my letter of support for a grant request that Dr. Josh Ackerman of the U.S. Geological Survey (USGS) has submitted to the Service for the California Landscape Conservation Cooperative (LCC). Dr. Ackerman's project proposal is titled: *Avian demographic response to climate change: a multi-species and multi-landscape approach to synthesizing risk factors.* Funding through the LCC would assist USGS in their cooperative research efforts on the refuges within the San Francisco Bay National Wildlife Refuge Complex (Refuge Complex), by providing some insights into how climate change may influence waterbird populations both on refuges and throughout the Bay.

The Refuge Complex includes seven refuges that represent a high diversity of species and habitats from the Salinas River in the South to San Pablo Bay in the North. Given our long-term commitment to restoration within the San Francisco Bay and in particular the South Bay Salt Pond Project, we are very interested in understanding the demographic changes in response to climate variables that are predicted for the waterbirds we manage. This research would provide an excellent supplement to the ongoing collaboration of USGS and PRBO Conservation Science. These climate change results and web application will be able to provide an important addition to the Integrated Avian South Bay Database that USGS and PRBO Conservation Science are already developing. Linking climate change variables with avian demographic rates into the California Avian Data Center will provide the Service with a useful tool in managing our biological resources. Having the current information as well as future predictions incorporated into an online tool will help guide our restoration planning for the South Bay Salt Pond Restoration Project and other restoration efforts we are currently undertaking.

Selection of the USGS project proposal will support the Service's effort to anticipate the potential impacts of climate change and may provide guidance Refuge Managers will need to adapt to impacts of climate change. We recommend approval of their funding request. Please feel free to contact me at (510) 792-0222 ext.123 should you have questions.

Sincerely,

G. Mendel Stewart
Manager, San Francisco Bay National Wildlife
Refuge Complex

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INAMERICA