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Title: Vulnerability Analysis and Monitoring Program for Detecting Changes in San Francisco Bay Tidal Marsh Bird Populations Resulting from Climate Change

Project Summary: To improve conservation and management of the San Francisco Bay Estuary's tidal wetland ecosystem, PRBO will: (1) assess the vulnerability of tidal marsh birds to climate change and sea-level rise, (2) identify locations most suitable for detecting the effects of climate change on tidal marsh bird abundance and distribution, and (3) propose a monitoring program and protocol to detect the effects of climate change on tidal marsh bird populations. Our findings and recommendations will provide information to guide planning for SF Bay wetlands.

Project Goals: The over-arching project goal is to improve resource management decisions by USFWS and other LCC partners to ensure the conservation and long-term sustainability of tidal marsh bird species in the San Francisco Bay Estuary in the face of accelerating climate change and other stressors. PRBO will design a monitoring program and protocol to detect the effects of climate change on tidal marsh bird population abundance and distribution. This monitoring program will provide critical input for the adaptive management of the SF Bay tidal marsh ecosystem, and will facilitate evaluation of management actions and the fine-tuning of specific management goals. This project is a companion to our "Tidal Marsh Bird Population and Habitat Assessment for San Francisco Bay under Future Climate Change Conditions" project and will build on its products, enabling us to evaluate the long-term viability of four tidal-marsh bird species threatened by impacts of climate change: Clapper Rail, Black Rail, Common Yellowthroat, and Song Sparrow (three endemic subspecies: San Pablo, Suisun, and Alameda).

Partners: San Francisco Bay Joint Venture, USFWS (San Francisco Bay National Wildlife Refuge Complex), SF Bay Bird Observatory, San Francisco Estuary Institute, Invasive Spartina Project, California DFG.

How project will advance LCC goals: This project will specifically provide a design for a monitoring program and analyses that will support biological planning, conservation design, prioritizing and coordinating research. Our products will inform resource management decisions that address landscape-scale stressors, including habitat fragmentation, which will interact with anticipated climate change. The monitoring program will identify specific locations to serve as the nexus for monitoring and thus will help the LCC "target the right science in the right places for efficient and effective conservation." By focusing on the ability of SF Bay tidal marsh bird populations to respond to environmental changes, the LCC will better be able to sustain "abundant, diverse and healthy populations of fish, wildlife and plants." The products we develop will contribute to a decision-support system that can compare and contrast the implications of management alternatives. The project provides at least two of the LCC desired products for 2010: 1) a risk and vulnerability assessment for priority species and habitats and 2) an inventory and monitoring protocol to capture data on fish and wildlife populations and their habitats to detect changes resulting from climate change.

Methods: We will use results from our companion project ("Tidal Marsh Bird Population and Habitat Assessment for SF Bay under Future Climate Change Conditions") to assess anticipated impacts of climate change on tidal marsh bird population viability. By analyzing population viability for four species, we will provide management agencies with a powerful means to assess vulnerability of populations to environmental stressors, including climate change, and consider the efficacy of management alternatives (e.g., Beissinger & McCullough 2002, Nur et al. 2007). Long-term population

viability is dependent on successful breeding at levels sufficient to balance mortality, but also sufficient to repopulate marshes that may be subject to local extirpation of marsh bird species. In a tidal marsh, successful reproduction must simultaneously overcome two important causes of mortality: predation and flooding (Greenberg et al. 2006). Climate change may affect flooding rates directly, but it may also cause a loss of habitat connectivity and may reduce the availability of refugia from predation, especially during high tides.

Population modeling can integrate these diverse impacts as well as evaluate anticipated effects of management actions (Nur & Sydeman 1999). The modeling we propose will evaluate each of four marsh bird species of concern: Clapper Rail, Black Rail, Song Sparrow, and Common Yellowthroat. For each we will develop population-dynamic models that will determine long-term viability and population dynamics of marsh bird populations, incorporating risk due to three factors: 1) reduction of habitat and increased isolation of remnant marsh habitat due to sea level rise, 2) change in habitat quality (especially changes in vegetation composition) due to changes in salinity and increased inundation, which itself results from increased likelihood of storm events, as well as anticipated changes in tide levels, and 3) reduction in nest success due to increased flooding of nests. Our approach will extend that of Foin et al. (1994) and Weiss (2005), who examined population viability for Clapper Rails in the San Francisco Estuary, by incorporating edge effects on predation risk, migration, and stochastic effects of occasional flooding, following the approach of Elder & Nott (2008).

We will incorporate estimates of vital rates for each species to determine viability (Nur and Sydeman 1999), and will model the landscape of marshes distributed across the San Francisco Estuary. Marshes will be “connected” by dispersing individuals, with dispersal rates dependent on proximity of marshes to each other as well as the degree to which they are separated by water. The information on configuration of remnant marshes will come from the companion project, “Tidal Marsh Bird Population and Habitat Assessment for SF Bay under Future Climate Change Conditions.”

We will identify the environmental conditions needed to sustain tidal marsh bird populations under different scenarios, incorporating anticipated climate change impacts as well as other stressors. It is beyond the scope of this project to consider specific management actions, but the modeling can evaluate, for example, the change in long-term viability due to X% change in reproductive success, as compared to Y% change in over-winter survival (e.g., if refugia from predators are provided).

An important component of the modeling is the incorporation of sensitivity analysis to identify the most important sources of uncertainty in species’ response to climate change. We will determine how confidence of our overall predictions reflects uncertainty associated with individual components. This will allow us to prioritize future research and monitoring efforts.

We will use data on marsh bird monitoring, compiled by PRBO and collaborators, to develop the proposed monitoring program. This component of the project will extend a monitoring power analysis to detect population change in Clapper Rails conducted by PRBO (Liu et al. 2009). It will also draw on results from the companion project on climate change and the viability analysis, as they become available. The proposed monitoring program will encompass all four tidal marsh bird species and will draw on monitoring data collected since the 1990’s housed at the California Avian Data Center (CADC; www.prbo.org/cadc). Statistical power will be determined using methods as outlined in Nur et al. (1999), focusing in particular on the program MONITOR, which uses simulations to determine a sampling regime needed to detect population change. The statistical power analysis will incorporate the likely magnitude of sea level rise or vegetational change on avian population size and other demographic parameters, as determined by the companion project, “Tidal Marsh Bird Population and Habitat Assessment for SF Bay under Future Climate Change Conditions.”

We will identify a core set of representative locations to measure changes and establish the monitoring program. The number of survey locations and frequency of surveys will be determined as part of the power analysis. We will finalize specific protocols for data collection based on the numerous survey programs conducted by PRBO and colleagues, including protocols developed by the San Francisco Estuary Wetlands Regional Monitoring Program (Nur & Spautz 2002).

The approach described here is feasible given PRBO's experience and expertise in the study of wetland birds in the San Francisco Estuary (Evens et al. 1991, Nur et al. 1997, Liu et al. 2009, Wood et al. 2009, Stralberg et al. 2010), the design of monitoring programs and their analysis (Nur et al. 1999), and population viability analyses using both deterministic and stochastic population models (Beissinger & Nur 1997; Ainley et al. 2001; Nur et al. 2007).

Products: We will produce two reports for the LCC and distribution to its partners:

1. Identification of locations most suitable for detecting effects of climate change on tidal marsh bird population abundance and distribution and the proposed monitoring program and protocol to detect such effects of climate change (Sep. 30, 2010)
2. Assessment of vulnerability and viability for each of the four tidal marsh bird species. (Dec. 31, 2010)

In addition to these two reports, we will summarize and share via the California Avian Data Center website analytical and graphical results, as well as the proposed monitoring program. The reports will include a detailed accounting of the methodology used to fulfill each objective (assessment, identification, and proposed monitoring program) so that partners and other agencies and NGOs can provide input on improvement of the product. Our findings will contribute to the USFWS Draft Tidal Marsh Recovery Plan, and updates of the San Francisco Bay Joint Venture Implementation Plan, Bayland Ecosystem Habitat Goals Report, and the Bay Conservation and Development Commission's SF Bay Adaptation Plan.

Is the Project on-going?

This project is not on-going, but instead builds on multiple projects that are on-going or recently completed. Most immediately, this project will directly link with the companion project, "Tidal Marsh Bird Population and Habitat Assessment for SF Bay under Future Climate Change Conditions" (see that proposal for more details). This project also builds on extensive previous monitoring conducted by PRBO and collaborators. This includes Clapper Rail population monitoring and assessment (1992-1993 and 2005-2009; Liu et al. 2009), supported by several agencies and organizations, notably CDFG, USFWS, and State Coastal Conservancy. The other three tidal marsh species have been surveyed in every year since 1996 (Nur et al. 1997, Wood et al. 2009). In addition, we will seek to collaborate with USGS San Francisco Bay Estuary Field Station (led by John Takekawa), to incorporate their data in this project. This project will synthesize these data sources together with information on demographic parameters to evaluate viability and vulnerability. The data synthesis will also provide a strong scientific basis for a long-term monitoring program to assess impacts of climate change.

Conservation Outcomes:

This project will enhance the ability of resource managers to adaptively manage SF Bay tidal marsh ecosystems adaptively and thus bird conservation outcomes will be improved. The monitoring program will provide critical input to evaluating the conservation needs of the tidal marsh species of concern. Data from the monitoring program will facilitate the implementation of adaptive management of tidal marsh habitat, and in particular will enable the evaluation of a suite of management actions as well as the fine-tuning of specific management goals, as part of the adaptive management process. The vulnerability and viability analyses will guide research prioritization and management policy, and set appropriate conservation and management targets.

Performance Metrics and timeline:

Performance Metric	Jul	Aug	Sep	Oct	Nov	Dec
Meeting with partners, solicit feedback on approach and data availability	XXXX					
Compilation of data, preliminary analyses	XXXX	XXXX				
Monitoring program report, site identification, post on CADC			XXXX			
Provide recommendations for USFWS Tidal Marsh Recovery Plan			XXXX			
Analysis of vulnerability and viability, final models and report			XXXX	XXXX	XXXX	
Final report, communicate results to partners, post on CADC						XXXX

Budget- (by outcomes):

PRODUCT #1: Monitoring program, protocol, and site identification

EXPENSES	Amount
Salaries and Benefits	
Grant Ballard (project coordination, CADC lead) [\$9,949/mo. x 0.5 mos.]	\$4,975
Nadav Nur (analysis, monitoring study design) [\$9,520/mo. x 1 mos.]	\$9,520
Julian Wood (site identification, field protocol) [\$5,844/mo. x 0.50 mos.]	\$2,922
Leo Salas (programming, models, simulations) [\$6,542/mo. x 0.50 mos.]	\$3,271
Sam Veloz (spatial ecologist) [\$7,730/mo. x 0.25 mos.]	\$1,933
Total Direct Costs	\$22,620
Indirect Costs (33.5%)	\$7,578
Total Outcome Expenses	\$30,198
FUNDING	
Requested from CA LCC (pending)	\$20,198
J.M. Long Foundation (pending)	\$10,000
Total Outcome Funding	\$30,198

PRODUCT #2: Vulnerability analysis

EXPENSES	Amount
Salaries and Benefits	
Nadav Nur (analysis, report author) [\$9,520/mo. x 1.5 mos.]	\$14,280
Leo Salas (analysis, report author) [\$6,542/mo. x 1.0 mos.]	\$6,542
Total Direct Costs	\$20,822
Indirect Costs (33.5%)	\$6,975
Total Outcome Expenses	\$27,797
FUNDING	
Requested from CA LCC (pending)	\$20,797
J.M. Long Foundation (pending)	\$7,000
Total Outcome Funding	\$27,797

Total Funds Requested from CA LCC: \$40,995

Matching Funds: \$17,000 (see Budget above for details).

Letters of Support: (1) Will Travis, Bay Conservation and Development Commission, (2) Nadine Hitchcock, Coastal Conservancy, and (3) Ralph Benson, Sonoma Land Trust.

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Making San Francisco Bay Better

May 28, 2010

Debra L. Schlafmann
California Landscape Conservation Cooperative
Pacific Southwest Region (Region 8)
U.S. Fish and Wildlife Service
2800 Cottage Way, Suite W-2606
Sacramento, CA 95825

SUBJECT: PRBO Conservation Science Funding Requests for Assessing Climate Change Impacts on SF Bay Tidal Marsh Bird Populations and Habitats

Dear Ms. Schlafmann:

I am writing to support the requests for funding from PRBO Conservation Science for two projects entitled: *Tidal Marsh Bird Population and Habitat Assessment for SF Bay Under Future Climate Change Conditions* and *Monitoring Protocol for Detecting Changes in SF Bay Tidal Marsh Bird Populations Resulting from Climate Change*.

Our Commission is very concerned regarding the impact of climate change on the San Francisco Bay Region. The Commission's report "*Living with a Rising Bay, Vulnerability and Adaptation in the San Francisco Bay and on the Shoreline*," assessed the vulnerabilities of the Bay's natural and built environment to the impacts of sea level rise. It concludes that the Bay's wetlands, both tidal and diked, face serious threats from sea level rise.

PRBO's analysis will help identify opportunities to secure remaining habitat areas that will provide future value for tidal marsh plant and bird communities. In addition, they will design an associated monitoring protocol for detecting changes in SF Bay tidal marsh bird populations resulting from climate change.

We believe that the work proposed by PRBO is highly relevant to the Commission's efforts to plan for sea level rise and I urge you to fund the studies. Please feel free to call me (415.352.3653, travis@bcdc.ca.gov) or my Deputy Director for Climate Change Steve Goldbeck (415.352.3611, steveg@bcdc.ca.gov) with any questions.

Sincerely,

A handwritten signature in blue ink, appearing to read 'WILL TRAVIS', with a stylized flourish at the end.

WILL TRAVIS
Executive Director

WT/SG/rca



Debra L. Schlafmann
California Landscape Conservation Cooperative
Pacific Southwest Region (Region 8)
U.S. Fish and Wildlife Service
2800 Cottage Way, Suite W-2606
Sacramento, CA 95825

May 26, 2010

RE: PRBO Conservation Science Funding Requests for Assessing Climate Change Impacts on SF Bay Tidal Marsh Bird Populations and Habitats

Dear Ms. Schlafmann:

I am writing to strongly recommend that the California Landscape Conservation Cooperative approve the requests for funding from PRBO Conservation Science for two projects entitled, "Tidal Marsh Bird Population and Habitat Assessment for SF Bay Under Future Climate Change Conditions" and "Monitoring Protocol for Detecting Changes in SF Bay Tidal Marsh Bird Populations Resulting from Climate Change."

Climate change will affect wetlands in the San Francisco Bay through sea level rise and seasonal salinity increases. These changes will transform tidal, freshwater and brackish wetlands into more saline systems and result in greater tidal inundation, thereby changing the plant species composition and habitat structure for birds and other wildlife. Bayland areas already filled, diked, and developed will severely restrict upslope migration of wetlands, resulting in smaller, more fragmented tidal marsh systems. PRBO's analysis will help identify opportunities to secure remaining viable habitat areas that will provide future value for tidal marsh plant and bird communities. In addition, their proposed associated monitoring protocol for detecting changes in SF Bay tidal marsh bird populations resulting from climate change can be applied to monitoring and to adaptive management decisions at many sites where public funding has or will be expended for marsh restoration projects.

This information will also be helpful to our efforts as we work to craft a regional strategy for adapting to the impacts of climate change in the Bay Area. Therefore, I fully support PRBO's proposal to predict the effects of sea level rise and salinity changes on San Francisco Bay wetlands and I urge the California Landscape Conservation Cooperative to fund it in full.

Sincerely,

A handwritten signature in blue ink that reads "Nadine P. Hitchcock".

Nadine P. Hitchcock
Deputy Executive Officer, CA Coastal Conservancy

1330 Broadway, 13th Floor

Oakland, California 94612-2530

510-286-1015 Fax: 510-286-0470





SONOMA LAND TRUST

May 27th, 2010

Debra L. Schlafmann
California Landscape Conservation Cooperative
Pacific Southwest Region (Region 8)
U.S. Fish and Wildlife Service
2800 Cottage Way, Suite W-2606
Sacramento, CA 95825

966 Sonoma Avenue
Santa Rosa, CA 95404
Tel: 707-526-6930
Fax: 707-526-3001

www.sonomalandtrust.org

RE: PRBO Conservation Science Funding Requests for Assessing Climate Change Impacts on SF Bay Tidal Marsh Bird Populations and Habitat

Dear Ms. Schlafmann:

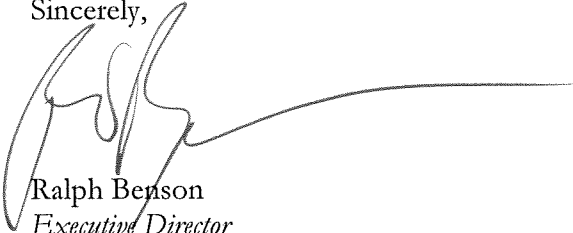
I am writing to urge your support for the proposals from PRBO Conservation Science entitled, "Tidal Marsh Bird Population and Habitat Assessment for SF Bay Under Future Climate Change Conditions" and "Monitoring Protocol for Detecting Changes in SF Bay Tidal Marsh Bird Populations Resulting from Climate Change." PRBO's analysis will help identify opportunities to secure remaining habitat areas that will provide future value for tidal marsh plant and bird communities. In addition, they will design an associated monitoring protocol for detecting changes in SF Bay tidal marsh bird populations resulting from climate change. As a frequent collaborator with and partner in the mission of PRBO Conservation Science, Sonoma Land Trust strongly recommends that the California Landscape Conservation Cooperative approve their requests for funding for two projects.

Sonoma Land Trust, a non-profit organization dedicated to protecting the varied scenic, natural, agricultural and open landscapes of Sonoma County, has played an active role in acquiring property and restoring wildlife habitat along San Francisco Bay. We are currently implementing a 1,000 acre tidal marsh restoration project on San Pablo Bay as well as exploring additional opportunities to implement the recommendations of the 1999 Baylands Ecosystem Habitat Goals Report which calls for a continuous band of tidal marsh along San Pablo Bay. Restoration of tidal marsh in this region provides habitat for recovery of many endangered plants and animals.

We are, however, facing new and unprecedented challenges, including the effect of climate change which will affect wetlands in San Francisco Bay through sea level rise and seasonal salinity increases. These changes will transform tidal, freshwater and brackish wetlands into more saline systems and result in greater tidal inundation, thereby changing the plant species composition and habitat structure for birds and other wildlife. Bayland areas already filled, diked, and developed will severely restrict upslope migration of wetlands, resulting in smaller, more fragmented tidal marsh systems.

PRBO has emerged as a leader in providing critical data and analysis to land trusts and other conservation practitioners that is helping us craft a regional conservation strategy for adapting to the impacts of climate change in the Bay Area. We look forward to a continued collaboration with PRBO and encourage you to fully fund PRBO's proposal to predict the effects of sea level rise and salinity changes on San Francisco Bay wetlands.

Sincerely,

A handwritten signature in black ink, appearing to read 'R. Benson', with a long horizontal flourish extending to the right.

Ralph Benson
Executive Director