Project Title:

An Improved Decision Support Tool for Adaptive Tidal Wetland Restoration and Management

Project Leader:

Julian Wood, San Francisco Bay Program Leader
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Scope & Budget:

Location: San Francisco Bay\Delta
Duration in months: 12
Requested Funding: $99,466.85
Leveraged Funding: $950,000.00

Partners:

Some of the partners to provide input on and use of the decision support tool: Leo Winternitz TNC, Matt Gerhart, Nadine Hitchcock, Amy Hutzel, CA State Coastal Conservancy; Christina Sloop, SFBJV; Wendy Goodfriend, BCDC; Laura Valoppi, John Bourgeois, SBSPRP; Don Brubaker, Mendel Stewart, Cheryl Strong, FWS SFBNWR Complex; Giselle Block, USFWS I&M Program; Julian Meisler, Wendy Eliot, Sonoma Land Trust; Karen Taylor, John Krause CDFG; Kelley Higgason, Gulf of the Farallones National Marine Sanctuary; Patrick Barnard, USGS; East Bay Regional Park District, North Bay Watershed Association, and others.

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.

To be successful, natural resource managers need to synthesize diverse information on the effects of management actions, climate change and other stressors on wildlife populations at appropriate scales. We propose a Decision Support Tool (DST) that integrates the results of multi-disciplinary, multi-taxa modeling allowing users to project outcomes of conservation actions, accounting for effects of climate change and other stressors, to support restoration and management decisions resulting in self-sustaining wildlife populations. Our approach, using tidal wetland habitat in the San Francisco Estuary as an example, can serve as concept model for other habitats and regions. We propose to: 1) make demographic modeling results developed in a previously supported LCC project, "Vulnerability Analysis of San Francisco Bay Tidal Marsh Bird Populations Resulting from Climate Change" spatially-explicit, and 2) produce summaries of habitat and bird modeling results including projections of future population trends and risk of extinctions for partner-defined sites or project areas. Results will be incorporated in a new version of the LCC-funded PRBO Sea-level Rise Tool (www.prbo.org/sfbayslr). Incorporating demographics is critical because even if habitat availability becomes more favorable from one time period to another, a population may not be able to realize a positive change in population abundance if the underlying demographic rates (over-winter survival, reproductive success, etc.) are not sufficient to sustain population growth. The DST will provide information on how restoration can increase population resilience and long-term persistence at multiple scales for multiple species throughout the Estuary. By working closely with or helping lead other efforts focused on preparing for climate change such as Our Coast-Our Future, the Baylands Goals Climate Change Technical Update, and Adapting to Rising Tides, we will maximize the synergistic value of our DST as it evolves. Our tool will benefit the people and wildlife of the San Francisco Bay Area while providing an exportable DST framework for others.

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.

The proposed project builds directly on two previous CA LCC Projects, which modeled climate change impacts on tidal marsh birds. Phases I and II of this project were carried out with 2010 and 2011 LCC funding and accomplished the following: Phase I: •Modeling and spatial layers for current and future tidal marsh elevations, predicted vegetation and bird distribution and abundance •Spatial layers of conservation prioritization for the tidal marsh bird species, accounting for uncertainty •Decision Support Tool that incorporates the above habitat suitability modeling for tidal marsh bird species Phase II: •Completion of interactive population dynamic models for four target species of concern that can identify changes in demographic parameters needed to meet population trend targets •Statistical analysis of 12-year data set on tidal marsh bird reproduction, quantifying impacts of climate change drivers on reproductive success •Stochastic

population model developed and completed for tidal marsh Song Sparrrows that incorporates impacts of projected changes in temperature, precipitation and high-water events •Application of the tidal marsh Song Sparrow model to demonstrate the efficacy of potential management actions to counter-act climate change impacts Specific products and output that have resulted from the two previous LCC projects include: •One peer-reviewed scientific paper (Stralberg et al 2011) •Manuscript being prepared for Ecological Applications (Veloz et al. in prep) •Two Technical Reports (Veloz et al. 2011, Nur et al. 2012). Presentation of results at numerous conferences: State of the Estuary Conference, National LCC Symposium (at US-IALE), Sediment Management Workshop, PIER California Vulnerability and Adaptation Study, and Climate Variability of the eastern north Pacific and western North America (PACLIM), H20 San Diego, and presentations to partner agencies and NGOs, including: BCDC, SPBNWR, Sonoma Land Trust, and many others. Phases I and II, comprising development of spatially-explicit projections and demographic analysis and modeling, respectively, have been completed. We are now ready for additional funds that will integrate the two Phases. This is an especially appropriate time to develop the new product because it will benefit from extensive user feedback received for the current SLR Tool, which has helped identify significant barriers and limitations to maximizing the tool's value.

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

Julian Wood, Senior Scientist and SF Bay Program Leader, has worked on tidal wetlands since 2000. Projects: 1) Tidal Marsh Bird Population and Habitat Assessment for SF Bay Under Future Climate Change Conditions, Funded by CA LCC, 8/2010-3/2011. 2 mos, $100 k, 2) Our Coast-Our Future: San Francisco Bay Area. Funded by National Estuarine Research Reserve Science Collaborative, 4 mos, $900 k, and 3) Sustaining healthy ecosystems in the face of sea level rise: Ensuring the Baylands Goals Report continues to inform. CA LCC, 8/2011-Sept 8/2012. 1 mo, $60 k. Dr. Nadav Nur, Quantitative Program Leader, has 30 years of experience in demographic analysis of birds and served as co-PI on large-scale multi-disciplinary tidal wetland projects. Projects: 1. CA LCC Project: Demographic Impacts of Climate Change on Tidal Marsh Birds, 4/2011 to 4/2012, 4 mos, $80 k. 2. Population Viability Analysis of Cassin's Auklets in Relation to Environmental Variability and Management Actions, 10/2010 -7/2012, 2 mos, $80 k. 3. Conservation of the Ross Sea Ecosystem (Lenfest), 9/2010-8/2015, 2 mos/yr, $550 k. 4. Modeling Impacts of House Mouse Eradication on Ashy Storm Petrels ($200 k), 4 mos, 10/2011-9/2012. Dr. Sam Veloz, Spatial Ecologist, has led numerous multi-disciplinary modeling projects focused on climate change. Relevant Projects: 1. Tidal Marsh Bird Population and Habitat Assessment for SF Bay Under Future Climate Change Conditions, 9/2010-3/2011. 5 mos, $100 k, 2. Modeling impacts of climate change on birds and vegetation on military lands, Funded by the US DOD, 2.5 mos $148 k. 3. Confronting uncertainty in species distribution projections: Co-PI funded by CA LCC, 2.5 mos, $100 k, 4. Our Coast-Our Future: Planning for Sea Level Rise and Storm Hazards in the San Francisco Bay Area. Funded by NERSS Collaborative, 3 mos $900 k, 5. Current and Future Distribution and Abundance of North Pacific Landbirds in the Context of Climate Change. North Pacific LCC, 2 mos, $95 k.

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

A risk and vulnerability assessment
A population and habitat assessment
A biological planning and conservation

An Improved Decision Support Tool for Adaptive Tidal Wetland Restoration and Management

Project Description:

We propose to integrate two LCC products into a Decision Support Tool (DST) that will allow users to make informed restoration and management decisions that ultimately best provide for self-sustaining wildlife populations. We explain the specific need for this innovative DST, how it will be developed and how it will be used. The structure of this DST, which targets tidal wetland ecosystems in the San Francisco Estuary, can serve as a model for other habitats and for other areas in the CA LCC region (e.g., San Diego) and other LCC regions.

Unprecedented efforts to restore tidal marsh habitat in San Francisco Bay, by government agencies and NGO's, are now underway or will be implemented in the near future. However, the anticipated impacts of climate change and other stressors need to be better understood in order to prioritize the investment of resources in restoration and other management activities. Land managers and decision-makers need to synthesize diverse information at appropriate scales to evaluate the potential effectiveness of their conservation actions in terms of maximizing long-term population viability within the context of accelerating climate change.

Towards the goal of developing a DST that can inform tidal wetland management and restoration activities, PRBO has developed two important products. The first is the PRBO/CA LCC Sea-level Rise tool for SF Bay ("SLR Tool"; www.prbo.org/sfbayslr). The SLR Tool is the result of an innovative hybrid approach involving a mechanistic marsh accretion model and incorporating spatial variation at scales relevant to conservation and restoration decision-making (Stralberg et al. 2011). With LCC funding, we built upon our physical modeling results and added current and projected bird and plant distributions as well as maps of conservation prioritization (Veloz et al. 2011). To make our results readily available to managers we created a user-friendly web-based DST that allows users to examine scenarios of future marsh geomorphology in relation to anticipated sea-level rise and marsh accretion, so that future marsh bird populations can be projected with respect to future biophysical conditions at a very fine scale (50 m). We have promoted the use of the SLR Tool by conducting numerous training workshops, demonstrations and presentations and by working one-on-one with users throughout SF Bay.

Because habitat by itself does not ensure long-term viability of robust wildlife populations, a second LCC-funded product developed demographic models of birds and produced an interactive population modeling tool that considers climate change impacts on future population trends for tidal marsh bird species of concern (hereafter, "Vulnerability Analysis" project; Nur et al. 2012; http://data.prbo.org/apps/sfbslr/demography). For example, the effects of changes in temperature, precipitation, and future high water events on population trends and population viability are modeled.

We now propose to integrate these two LCC products into a single DST, including detailed projections of tidal marsh bird abundance, available at a fine spatial scale, while at the same time incorporating information on expected population trends and population persistence and how these will be affected by climate change stressors. The products proposed herein are the result of synthesizing extensive feedback from land managers and decision-makers who have identified critical limitations of the current SLR Tool, including: 1) inability to quantify the impacts of climate change (e.g., acres of habitat lost or gained, changes in bird population size) for a defined area or site and, 2) lack of confidence in bird-habitat models that fail to account for requirements of breeding and over-winter survival as well as population trends.

We propose to: 1) provide information at scales relevant to managers by adding partner-defined site boundaries to the DST, 2) produce site-based summaries of projected habitat change, bird population change, and conservation prioritization, and 3) make the demographic modeling results spatially explicit, allowing users to view site- or region-specific effects of sea-level rise scenarios on population viability and persistence.

With these improvements, the DST will provide important information on how restoration can increase population resilience and long-term persistence at multiple scales for multiple species throughout the Estuary. Developing vulnerability assessments and adaptation plans will be made easier by allowing users to explore the relative impacts of climate change on competing restoration or management plans. For example, a user may select a region or site(s) and generate summaries of tidal marsh habitat or bird population vulnerability, resilience and conservation priority. The DST can be used to evaluate and compare potential restoration sites or to help develop adaptive management strategies. For example, if nest flooding is found to limit a population, the population-level impacts of raising initial elevations at restoration sites can be explored, and contrasted with other alternatives, such as acquisition or restoration of other sites.

CA LCC Priorities addressed:

Priority 1- Our proposed project will provide managers with an improved scenario-based Decision Support Tool that will help allocate limited resources to specific areas where they can have the biggest impact in improving the resilience of tidal marsh habitat and bird species to climate change. The DST will serve as a framework for synthesizing multi-disciplinary, multi-species modeling for other areas where managers need to assess the potential outcomes of conservation actions under climate change scenarios. A primary product will be a scenario-based DST that includes site-specific conservation prioritization and summary metrics of population viability and resilience of tidal marsh ecosystem components. This effort integrates and adds value to two completed LCC-funded products, the PRBO SLR Tool and the Vulnerability Analysis. The project team is closely involved with other Bay Area climate change-related projects and will work to ensure efforts are synergistic and mutually beneficial.

To ensure the DST is used widely to advance climate-smart adaptation strategies, we will conduct workshops and hold training sessions focused on managers' stated needs or planning processes relying primarily on funds from other sources. Workshops will include individual follow-up and technical assistance to improve the effectiveness of use of the DST. Users will be able to demonstrate the consequences of past, current, and future conservation actions (levee breaches to restore tidal flow; land acquisition) by viewing and downloading site-specific conservation rankings and other metrics of conservation outcome.

Priority 2- Another product will be the integration of species-specific demographic modeling results onto spatially-explicit surfaces. This represents a new method for mapping species habitat change and will provide more realistic estimates of population response to climate change and will include insights into drivers of population response. We will increase our understanding of bird response to climate change in a way that directly addresses adaptive management strategies at scales relevant to managers. Direct feedback from partners has and will continue to shape the DST. By making the improvements and adding the functionality requested by partners, the DST will improve the decision-making process for land managers and decision-makers resulting in adaptation plans and conservation actions that increase tidal marsh habitat sustainability and target bird population resilience and persistence.

CA LCC Criteria addressed:

1 - The proposed improvements to the SLR Tool are based on over two years of extensive manager, policy-maker and scientist feedback. This project will be coordinated with and will co-benefit several Bay Area climate adaptation and informatics projects (Our Coast-Our Future, Adapting to Rising Tides, SF Bay Climate/Energy Resilience, SF Bay Commons, and Baylands Goals Climate Change Technical Update).

2 - The spatial integration of the Vulnerability Analysis will greatly improve our understanding of bird population viability and persistence for specific locations and the effect of different climate change and restoration scenarios. Our proposed work responds directly to users calling for scenario testing and summarized vulnerability/resilience metrics for their defined areas of interest from regional to site-level.

3 - This ongoing project builds upon modeling that is integrative (combining physical marsh accretion modeling, habitat suitability modeling and demographic modeling), applies to multiple taxa (diverse species of birds and potentially plants), and considers several major climate system components (projected changes in sea-level rise, salinity temperature, and rainfall).

4 - Our major product, a web-based DST for managers, will also have data download capability for technical users. We received extensive feedback on the current SLR Tool from our target audience and will implement changes to improve the DST's functions and usability including user-identified area-based summaries, spatially explicit metrics of population viability, downloadable pdf maps, and improved metadata for model inputs.

5 - PRBO will work closely with other climate change adaptation projects involving the major SF Bay Area agencies and NGOs listed previously. PRBO will continue to meet often with key partners to ensure that the design and implementation of the DST is focused on the target audience.

6 - The modular construction of our DST allows transferability to other estuaries that have the necessary datasets (So. California, Humboldt Bay, Middle Atlantic marshes). For example, investigators working at Atlantic and Gulf Coast Marshes, with whom we have collaborated (e.g., R. Greenberg, Smithsonian) have the necessary data on tidal marsh ecosystem attributes such as elevation, sediment availability, bird abundance, distribution, and demography, and models of bird-habitat relationships to make use of the structure of the DST.

7 - PRBO has demonstrated the capacity needed to build and promote successful web-based products.

Criteria for Continuing Projects

1) Agencies and NGOs continue to struggle with developing specific adaptation plans in part due to the lack of information available for their area of interest and because of high uncertainty in future conditions that often leaves managers wondering what exactly to prepare for. PRBO's current SLR Tool, while a big step forward in that it provides a spatially explicit, scenario-based tool, still has limitations with regard to its use in adaptation planning. We propose to overcome significant barriers by providing site-specific summaries that incorporate uncertainty and provide custom output (summary reports) of viability, population trends, resilience and conservation metrics.
2) The habitat suitability and demographic modeling for the proposed project has been completed and relevant technical reports have been prepared and posted online (Veloz et al. 2011, Nur et al. 2012). In addition, one publication describing and documenting the modeling approach used in the SLR Tool has appeared in PLoS ONE (Stralberg et al. 2011) and another demonstrating applications of the bird habitat modeling for developing future conservation priorities is in prep (Veloz et al. in prep.).
3) The need for tool improvements has been made clear by numerous partners and the project is currently ready to receive additional funds to implement the necessary changes.

Scope of Work – Approach and Integration with Related Projects:

The current SLR Tool provides side-by-side maps of predicted current and future tidal marsh habitat, bird and plant distributions and conservation rankings at 50 m resolution. The user can only qualitatively estimate the amount of change between current and future by looking at side-by-side maps. To provide users with area-defined summaries of change, we will acquire site and project boundaries from the key partners listed above. Our DST will allow users to select multiple sites and view or download the summary tables and graphs of habitat changes and the demographic effects of these changes and new environmental conditions on the number and likelihood of persistence of birds of a selected species. This work will build on the results of related projects such as BCDC's Adapting to Rising Tides Project that is currently being developed and will inform the DST summaries. We will gather additional user feedback from other efforts (Our Coast-Our Future and North Bay Watershed Association) to develop

summary metrics needed by managers. The summaries will include measures of uncertainty, allowing users to better understand and visualize how different scenarios may affect conservation outcomes.

The current SLR Tool provides projections of future distribution and abundance for four tidal marsh species of high conservation concern (Song Sparrow, Clapper Rail, Black Rail, and Common Yellowthroat) in relation to projected future physical conditions (e.g., marsh elevation, salinity) and landscape features (e.g., proximity to bayland edge). These projections are developed at 20 year intervals, i.e., a "snap shot" is produced for current conditions as well as for 2030, 2050, 2070, 2090, and 2110. Further, they are based on the assumption that abundance is linearly proportional to the abundance of good quality habitat for the species. We propose to add important demographic dynamics to produce realistic population trends that are needed for effective conservation and management. Our population projections will incorporate current conditions as well as climate change impacts to habitat suitability and demography. For each marsh location, and considering each species separately, we will start with the predicted abundance for that species for a given point in time (e.g., 2010) and incorporate the expected population change over the next 20 years (in this case from 2010 to 2030), where expected population change reflects impact of current and future conditions on population trajectory, including landscape effects as well as climate impacts. "Expected population change" as a function of current and future conditions will be provided by the PRBO Vulnerability Analysis already completed. Moreover, there will be multiple scenarios considered with regard to future conditions, for example with regard to sea-level rise and high-water events or changes in predation pressure, scenarios already considered in PRBO's Vulnerability Analysis. Identification of which specific scenarios to consider will be completed with input from key partners in small-group meetings and a workshop.

Not only will environmental conditions influence population trajectory from one time period to another, but future environmental conditions will also influence future habitat suitability. The proposed DST will integrate both expected population change (from the Vulnerability Analysis) and expected habitat suitability (from the SLR model) which can set upper limits to future abundance. For example, a population with an expected positive growth rate as suggested by the Vulnerability Analysis, due to favorable environmental conditions such as low flooding risk or low predation pressure, may not in fact be able to grow if habitat availability and suitability has declined. Similarly, even if habitat availability becomes more favorable from one time period to another, a population may not be able to realize a positive change in population abundance if the underlying demographic rates (over-winter survival, reproductive success, etc.) are not sufficient to sustain population growth.

One of the important applications of the DST will be to consider how population viability and abundance will change due to restoration of tidal marsh habitat. Colonization of newly restored habitat will depend on the suitability of the new habitat, which evolves over time, and the proximity of "source"populations that can provide new recruits for the restored habitat. The accessibility of future restored habitat by tidal marsh birds in extant marsh sites will be incorporated into the modeling.

Timetable for Completion: Primary Tasks	Q1 2012	Q2 2012	Q3 2013	Q4 2013
Summary output framework	**X**	**X**		
Partner-identified site layers	**X**	**X**		
Spatial demographics analysis	**X**	**X**	**X**	
Decision Support Tool Interface		**X**	**X**	**X**
Workshops and trainings				**X**
Final Report				**X**

Products/Data Sharing:

- Partner-identified site boundaries for the entire SF Bay based on input from key partners.
- Area-based summaries will be available including:

    - Acres (hectares) of specific habitat types gained or lost,
    - Estimated change in number of birds and percent change from current to future
    - Acres (hectares) of high conservation priority, current, future, and change
    - Acres (hectares) of uplands available for marsh migration
    - Additional summaries to be identified by key partners
- Primary product will be a user-friendly, web-based DST accessible to the public.
- GIS layers of model output and metadata will be available for advanced users to download from the site and at the emerging SF Bay Commons and California Climate Commons (http://climate.calcommons.org)
- Day-long workshops and presentations will be conducted to increase the understanding of the DST by potential users and optimize the use of the DST. We will publicize the DST and present the underlying spatially explicit demographic and habitat modeling at important regional and international conferences, such as the State of the Estuary Conference (fall 2013).
- Population viability and resilience based on results of the demographic and habitat climate-change modeling will be available in state-of-the-art maps and graphics that depict change in important outcome measures and included in the summary output available for users.

Measuring results*:*
The SF Bay DST project will be successful when the following actions have taken place:

- The DST includes a user-identified boundary layer that key partners endorse.
- Summaries of data projections (area of habitat, number of birds, conservation priority) are available for current, future, and comparison of future to current.
- Maps of the highest conservation priority locations are available at the site level.
- The demographic Vulnerability Analysis is made spatially-explicit and incorporated into the DST scenarios.
- USFWS, CDFG and other agencies use the site-specific summaries for their vulnerability assessments
- Technical report documenting the modeling is completed and available online.
- Site layers for key partners uploaded to the DST and available for generating summaries.
- Ultimately, partner agency and NGO adaptation plans and land management actions are informed as a result of findings and recommendations derived from the improved SLR Tool.

Literature Cited

Nur, N., L. Salas, S. Veloz, J. Wood, L. Liu, and G. Ballard. 2012. Assessing vulnerability of tidal marsh birds to climate change through the analysis of population dynamics and viability. Technical Report to California Landscape Conservation Cooperative http://data.prbo.org/apps/sfbslr/demography

Stralberg, D., M. Brennan, J. C. Callaway, J. K. Wood, L. M. Schile, D. Jongsomjit, M. Kelly, V. T. Parker, and S. Crooks. 2011. Evaluating tidal marsh sustainability in the face of sea-level rise: A Hybrid modeling approach applied to San Francisco Bay. PLoS ONE 6(11): e27388. doi:10.1371/journal.pone.0027388

Veloz, S., N. Nur, L. Salas, D. Stralberg, D. Jongsomjit, J. Wood, L. Liu, and G. Ballard. 2011. Tidal Marsh Bird Population and Habitat Assessment for the San Francisco Estuary under Future Climate Change Conditions. Technical Report Version 1.0. Report to the California Landscape Conservation Cooperative. Available from www.prbo.org/sfbayslr.

California Landscape Conservation Cooperative 2012 Proposal Budgets

Budget Categories	CA LCC Request	Partner(s) Contribution(s) (monetary)	Partner(s) Contribution(s) (PRBO in-kind)	**Total**
Task 1- Spatial Demographic Analysis				
Salaries	$ 41,150.00	$ -	$ -	$ 41,150.00
Supplies	$ -	$ -	$ -	$ -
Overhead	$ 13,785.25	$ -	$ -	$ 13,785.25
Equipment	$ -	$ -	$ -	$ -
Other- Travel	$ -	$ -	$ -	$ -
Total	$ 54,935.25	$ -	$ -	$ 54,935.25
Task 2- DST User Interface				
Salaries	$ 23,492.00	$ -	$ 7,762.00	$ 31,254.00
Supplies	$ -	$ -	$ -	$ -
Overhead	$ 8,204.82	$ -	$ 2,600.27	$ 10,805.09
Equipment	$ 1,000.00	$ -	$ -	$ 1,000.00
Other- Travel	$ -	$ -	$ -	$ -
Total	$ 32,696.82	$ -	$ 10,362.27	$ 43,059.09
Task 3- Workshops Trainings				
Salaries	$ -	$ 7,550.00	$ -	$ 7,550.00
Supplies	$ -	$ 500.00	$ -	$ 500.00
Overhead	$ 251.25	$ 2,696.75	$ -	$ 2,948.00
Equipment	$ -	$ -	$ -	$ -
Other- Travel	$ 750.00	$ -	$ -	$ 750.00
Total	$ 1,001.25	$ 10,746.75	$ -	$ 11,748.00
Task 4- Report				
Salaries	$ 8,115.00	$ -	$ 5,000.00	$ 13,115.00
Supplies	$ -	$ -	$ -	$ -
Overhead	$ 2,718.53	$ -	$ 1,675.00	$ 4,393.53
Equipment		$ 50,000.00	$ -	$ 50,000.00
Other- Travel	$ -	$ -	$ -	$ -
Total	$ 10,833.53	$ 50,000.00	$ 6,675.00	$ 67,508.53
			$ 6,675.00	
Grand Total	$ 99,466.85	$ 60,746.75	$ 17,037.27	$ 177,250.87

Other:

Other Contributions: $25,000 from Grand Foundation-in hand; $17,000 from Rintels Charitable Trust-in hand; $2,500 from Libra Foundation-in hand; $50,000 for data servers and hosting- in hand. In-kind PRBO contributions from National Estuarine Research Reserve System Science Collaboborative project, Our Coast-Our Future, $899,530, Funding in-hand.

SAN FRANCISCO BAY JOINT VENTURE

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Rebecca Fris
Science Coordinator
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13 May 2012

Dear Ms. Fris:

I am pleased to send this letter of support by the San Francisco Bay Joint Venture (SFBJV) for the project entitled: "An Improved Decision Support Tool for Adaptive Tidal Wetland Restoration and Management," submitted by **Julian Wood** (PRBO Conservation Science) for consideration of funding through the California Landscape Conservation Cooperative. The proposal addresses the development of a decision support tool to integrate the results of two prior LCC-funded multi-disciplinary, multi-taxa modeling projects, allowing users to project outcomes of conservation actions, accounting for effects of climate change and other stressors, to support restoration and management decisions that provide for self-sustaining wildlife populations.

The SFBJV is one of 17 wetland habitat Joint Ventures operating under the certification of the North American Waterfowl Management Plan, a Congressional agreement between the United States, Canada, and Mexico. It is a partnership of non-governmental organizations, utilities, landowners, and non-voting agencies. The goal of the SFBJV is to protect, restore, increase and enhance all types of wetlands, riparian habitat and associated uplands throughout the San Francisco Bay region to benefit birds, fish and other wildlife. The Management Board consists of 27 agencies and private organizations whose members agree to support and promote the goal of the Joint Venture and who represent the diversity of wetlands interests found in the San Francisco Bay region.

In the context of conservation delivery effectiveness evaluation, planning and decision-making, the SFBJV regional partnership needs tools to synthesize diverse information on the effects of management actions, climate change and other stressors on wildlife populations at a project scale. This CA LCC project will allow SFBJV partners to assess the impacts of climate change for their specific restoration projects and will provide them with the tools needed to prepare adaptation plans and implement climate-smart restoration and management at their sites. As a result of the project, the SFBJV will receive timely projections on the effectiveness of restoration and management strategies including levee breaches, protection of uplands for marsh migration, and flood protection in the context of climate change induced threats.

From our past collaborations with the project team we are confident that they possess both the skills and abilities to develop and deliver an effective decision support tool that will benefit conservation efforts in the San Francisco Bay Area. The SFBJV Management Board therefore fully supports this proposal to develop the proposed decision support tool, and urges the California Landscape Conservation Cooperative to fund it in full.

Sincerely,

Diane Ross-Leech
Chair, SFBJV Management Board

The Nature Conservancy
Protecting nature. Preserving life.™

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May 11, 2012

Ms. Debra Schlafmann
Coordinator, California Landscape Conservation Cooperative
3020 State University Dr. East #2007
Sacramento, CA 95819

SUBJECT: PRBO proposal: An Improved Decision Support Tool for Adaptive Tidal Wetland Restoration and Management

Dear Ms. Schlafmann:

I am pleased to recommend California LCC funding for the PRBO proposed project, "An Improved Decision Support Tool for Adaptive Tidal Wetland Restoration and Management." The work if funded would be greatly aid our efforts to plan, implement, and evaluate tidal marsh restoration projects throughout the San Francisco Estuary.

The Nature Conservancy has a strong interest in restoring tidal marsh habitat in the San Francisco Bay - Delta Estuary as has been called for by the San Francisco Baylands Goals Project, Suisun Marsh Management Plan, Bay Delta Conservation Plan and other conservation planning efforts. We are working towards identifying suitable sites for future restoration, especially in Suisun Marsh. We look forward to making full use of the PRBO Decision Support Tool (DST) when it is developed.

The Suisun Marsh represents a challenge for restoration because conversion of diked managed wetland to tidal wetland will convert one habitat type of great value to waterfowl and shorebirds, into another habitat type of high importance to marsh birds and water birds. To determine the optimal configuration of habitat, a mosaic of restored and unrestored habitat, requires accurate information on how conservation targets will benefit from proposed restoration activities in the future, while considering impacts of climate change.

PRBO's DST will be useful in identifying current areas of high conservation priority as well as identifying areas that in the future, when restored, will be of high conservation priority, with regard to benefit to tidal marsh bird species. The DST will allow us to compare different restoration scenarios, with respect to configuration of proposed restoration sites, while also considering the impact of climate change under a range of climate-change scenarios (including effects of sea-level rise, changes in salinity, precipitation, temperature, and storms). The DST will be able to provide insight into whether target populations may be able to successfully colonize and thrive in newly restored habitat.

We look forward to working with PRBO on this project and endorse full funding of the proposed Tidal Wetland Restoration and Management Decision Support Tool.

Sincerely,

Leo Winternitz
Senior Policy Advisor

Making San Francisco Bay Better

May 14, 2012

Ms. Debra Schlafmann
Coordinator, California Landscape Conservation Cooperative
3020 State University Dr. East #2007
Sacramento, CA 95819

SUBJECT: PRBO Proposal: An Improved Decision Support Tool for Adaptive Tidal Wetland Restoration and Management

Dear Debra:

I *highly recommend* the California LCC support the PRBO project "An Improved Decision Support Tool for Adaptive Tidal Wetland Restoration and Management."

As the lead team member on the natural areas assessment for the Commission's Adapting to Rising Tides project (http://risingtides.csc.noaa.gov/) I can speak first hand to the necessity of the proposed project. PRBO's Sea Level Rise web tool allows users to visualize a vast array of spatially explicit data and information that greatly informs an understanding of tidal wetland vulnerability to climate change. It is challenging however to download or obtain summarized quantitative information from the web tool for specific areas of interest.

PRBO's proposed project will resolve this issue. It will make it easier to access and summarize the data in the tool that can help end-users evaluate the impacts of climate change at specific sites. This means that the wealth of information in the web tool will be readily available to decision makers of all technological skill levels throughout the region.

The Adapting to Rising Tides project will continue to collaborate with PRBO on how best to conduct rapid natural areas vulnerability assessments using the information in the web tool. Additionally, the ART project in collaboration with PRBO will share the approach and lessons learned with others in the region.

Lastly, we will continue to work with PRBO on improving their web tool by providing critical feedback on future modifications to simplify the use of the tool. We will also assist with promoting the use of the tool and methodology we developed jointly for natural area vulnerability assessments.

BCDC and the ART project partners look forward to continuing the already fruitful collaboration with PRBO. We fully support their proposal to improve the Sea-level Rise Web Tool by adding site-based summaries of climate change impacts on San Francisco baylands, habitats and ecosystems.

Sincerely,

Wendy Goodfriend

WENDY GOODFRIEND
Senior Planner

Julian K. Wood

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EDUCATION

B.A. Biology, 1995, Earlham College, Richmond, IN

RELEVANT EXPERIENCE

Julian Wood is a Senior Scientist and San Francisco Bay Program Leader at PRBO Conservation Science. He is responsible for the development and supervision of numerous bird monitoring projects in the San Francisco Bay Area with an emphasis on bird response to habitat restoration and climate change. He took a leadership role in the development and release of the current SF Bay Sea-level Rise Tool. He is closely involved in major Bay Area climate change planning initiatives: Partner Liason for Our Coast-Our Future; Steering Committee Member for the Baylands Ecosystem Habitat Goals Climate Change Technical Update; Adapting to Rising Tides; Bay Area Climate/Energy Adaptation and Resilience, and SF Bay Commons. He also serves on the California Coastal Conservancy's Invasive Spartina Project Technical Advisory Committee, the South Bay Salt Pond Restoration Project Technical Advisory Committee, and the Petaluma Wetlands Alliance Board.

PUBLICATIONS

Wood, J.K., L. Liu, N. Nur, M. Herzog, and N. Warnock. *In press.* Abundance, species richness, and reproductive success of tidal marsh birds at China Camp State Park, Marin County, California. San Francisco Estuary and Watershed Science.

Stralberg, D., M. Brennan, J. C. Callaway, J. K. Wood, L. M. Schile, D. Jongsomjit, M. Kelly, V. T. Parker, and S. Crooks. 2011. Evaluating tidal marsh sustainability in the face of sea-level rise: a hybrid modeling approach applied to San Francisco Bay. PLoS One 6(11): e27388. doi:10.1371/journal.pone.0027388.

Veloz, S., M. Fitzgibbon, D. Stralberg, S. Michaile, D. Jongsomjit, D. Moody, N. Nur, L. Salas, J. Wood, and G. Ballard. 2011. San Francisco Bay sea level rise: Climate change scenarios for tidal marsh habitats. [web application]. Petaluma, California. www.prbo.org/sfbayslr.

Howell, C.A., J.K. Wood, M.D. Dettling, K. Griggs, C.C.Otte, L. Lina, and T. Gardali. 2010. Least Bell's Vireo breeding records in the Central Valley following decades of extirpation. Western North American Naturalist 70:105-113.

Seavy, N. E., J. H. Viers, J. K. Wood. 2009. Riparian bird response to vegetation structure: a multiscale analysis using LiDAR measurements of canopy height. Ecological Applications 19:1848-1857.

Kreitinger K. and J. K. Wood. 2005. Least Bell's Vireo nests in Stanislaus County: are they coming back? Central Valley Bird Club Bulletin 8: 45-48

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PROFESSIONAL PREPARATION

- B.A. 1974. Cornell University; major in Psychology (concentration in Animal Behavior).
- Ph.D. 1981. Duke University. Zoology *(Ecology);* minor in Mathematics.
- M.S. 1991. University of Washington. Biostatistics.

APPOINTMENTS

- 1981 - 1982, George S. Wise Postdoctoral Fellow, Dept. of Zoology, Tel Aviv Univ., Israel.
- Fall 1984, Asst. Professor in Biology, Biology Dept., Univ. of Rochester, Roch., NY.
- 1985 - 1986, NATO Postdoctoral Fellow in Science, Biol. Sci. Dept., Univ. of Stirling, UK.
- 1986 - 1987, Alexander von Humboldt Research Fellow, Univ. Tübingen, Germany.
- 1989 - present, Quantitative and Population Ecologist, PRBO Conservation Science, Petaluma, CA; current title: Principal Scientist, Climate Change and Informatics Group.

RELEVANT EXPERIENCE

Nadav Nur came to PRBO Conservation Science in 1989 as its first Quantitative Ecologist, having been trained as an ecologist (PhD, 1981) and as a statistician (MS, 1991). Since 1992, he has studied response of birds to tidal marsh and riparian habitat restoration, and has led the avian component of several multi-disciplinary projects focusing on tidal wetlands, including the Coastal Intensive Site Network project (EPA/NOAA), the Integrated Regional Wetlands Monitoring Project (www.irwm.org) and the BREACH II and III Studies of Tidal Marsh Restoration. Dr. Nur has developed population-dynamic models and conducted population viability analyses for numerous species; his PVA for the Western Snowy Plover is a key component of the USFWS 2007 Recovery Plan. Dr. Nur developed metapopulation viability models for Ashy's Storm Petrel and Xantus's Murrelets. He developed a decision support tool for the Gulf of the Farallones National Marine Sanctuary, to guide management of seabird populations.

PUBLICATIONS MOST RELEVANT TO THIS PROPOSAL

(I have published an additional 75 peer-reviewed articles and book chapters as author or co-author.)

Nur, N., Jones, S.L., and Geupel, G.R. 1999. *Statistical Guide to Data Analysis of Avian Monitoring Programs.* Pub. BTP R6001. US Fish & Wildlife Service, Wash., D.C.

Nur, N. and Sydeman, W.J. 1999. Demographic processes and population dynamic models of seabirds: Implications for conservation and restoration. Current Ornithology **15**, 149-188.

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Nur, N., Jahncke, J., Herzog, M., Howar, J., Hyrenbach, D., Ainley, D., Morgan, K., Zamon, J., Ballance, L., Wiens, J., and Stralberg, D. 2011. Where the wild things are: Predicting hotspots of seabird aggregations in the California Current System. Ecological Applications **21**, 2241-2257.

Takekawa, J.Y., Woo, I. Gardiner, R. M. Casazza, J. Ackerman, N. Nur, L. Liu, and H. Spautz. 2011. Avian communities in tidal salt marshes of San Francisco Bay: A Review of functional groups by foraging guild and habitat association. San Francisco Estuary and Watershed Science 9 (3): pp. 1-12.

Wood, J., Liu, L., Nur, N., Herzog, M., and Warnock, N. In press. Abundance, Species Richness, and Reproductive Success of Tidal Marsh Birds at China Camp State Park, Marin County, California. San Francisco Estuary and Watershed Science, in press.

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EDUCATION

Ph.D. Ecology, University of California Davis, September 2002-July 2008
B.A. Environmental Studies, Minor in Latin American Studies, University of California, Santa Cruz, June 1997.

RESEARCH EXPERIENCE

PRBO Conservation Science, Spatial Ecologist current
Bryson Interdisciplinary Climate People and the Environment postdoctoral fellow, Department of Geography, Center of Climatic Research, University of Wisconsin Madison. 8/2009-7/2010. Advisor: Jack Williams
Postdoctoral Researcher, Department of Environmental Science and Policy, UC Davis,7/08-8/09
Advisors: Susan Harrison/ Hugh Safford.
Doctoral Research, UC Davis, 9/02- 9/08
Environmental Services Intern, Calif. State Parks, Monterey District. (10/98 – 8/02)

PEER REVIEWED PUBLICATIONS

Ballard, G., Jongsomjit, D., **Veloz**, **S.D**., and Ainley, D. G. 2011. Coexistence of mesopredators in an intact polar ocean ecosystem: The basis for defining a Ross Sea marine protected area. Biological Conservation, doi:10.1016/j.biocon.2011.11.017.

Williams, J. Kharouba, H., **Veloz, S.D**. McLachlan,J., Vellend, M., Liu, Z., Otto-Bliesner, B., He, F. 2012. The Ice Age Ecologist: Testing Methods for Reserve Prioritization and Biodiversity Conservation During the Last Global Warming. *Global Ecology and Biogeography*, In Press.

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