

Incorporating Climate-Smart Adaptive Strategies into Wetlands Recovery in Coastal Southern California

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Southern California Wetlands Recovery Project, Bruce Posthumus, Chair of the Wetland Managers Group, San Diego Regional Water Quality Control Board, 2375 Northside Drive, Suite 100, San Diego, CA 92108; Phone: (619) 521-3379, bruce.posthumus@waterboards.ca.gov

Project Start Date: July 1st, 2014

Project End Date: July 1st, 2017

Total Requested Funding: \$157,622

Geographic Scope: South Coast

Partner Contributions: California State Coastal Conservancy - \$80,000

PROJECT SUMMARY AND MANAGEMENT RELEVANCE

Climate change science has evolved rapidly over the past decade. Most coastal areas of the United States have been modeled and assessed for potential sea-level rise effects on infrastructure, and in some cases threats to natural resources along the coast. Coastal wetland managers universally acknowledge the need to account for sea-level rise and other climate change effects in decisions about restoration, management, and monitoring.

Southern California has received substantial study due to the concentrated development in the coastal zone, density of distinct coastal wetlands, and desire to protect and restore those wetlands for both ecological and social functions. Southern California has a unique advantage of having existing structured agreements through the Southern California Wetlands Recovery Project (WRP) between Federal, State, and local wetland managers on cooperative assessment and restoration prioritization. These agreements allow for a collaborative approach to assessing climate change effects on coastal wetlands.

Despite the existence of high quality scientific information, there are significant barriers to the application of available tools to real-world decisions regarding how to best restore and manage coastal wetlands in consideration of climate change effects. These barriers derive from the difficulty in determining the most appropriate restoration or management prescription in light of site-specific habitat conditions, constraints, and expected future conditions. Wetlands along the southern California coast vary widely in terms of their size, habitat composition, and forcing functions. For example, the balance between fluvial and littoral processes can affect the size, extent, and frequency of tidal inlet closures. This in turn affects habitat composition and influences appropriate management actions. This heterogeneity along the coast combined with the variety of infrastructure constraints and other anthropogenic stressors makes it difficult for managers to know which tools to use and how to best apply them to inform restoration and management for their specific circumstance.

The goal of this project is to develop a method for managers to assess climate change-associated vulnerabilities at specific wetland locations by using the most appropriate tools to develop restoration and management priorities. This will be done by defining major coastal archetypes based on wetland setting, form, and composition. Existing models and tools will be coupled with specific archetypes in consideration of major anthropogenic constraints to help inform the decision making process. We will focus on the tools and models related to changes in hydrology related to climate change, such as sea-level rise, fluvial inputs, and associated impacts on sediment movement and other factors, as these are the most influential drivers affecting coastal wetlands. With an understanding of the vulnerabilities of wetland ecosystems, we will then develop climate-smart adaptation strategies and a decision-support tool to guide restoration project prioritization and design.

This project will capitalize on the long-standing scientific and management partnership between the WRP and the Southern California Coastal Water Research Project (SCCWRP). The WRP is an exemplary regional partnership of resource managers and scientists with a 15-year track record of success in conserving, restoring and enhancing wetlands and watersheds, and developing guidance for monitoring and assessment. The WRP consists of 18 state and federal agencies working collaboratively with local partners. The geographic scope of the WRP includes coastal wetlands and watersheds in the Southern California Bight from Point Conception (in Santa Barbara County) south to the international border with Mexico. SCCWRP is a joint powers agency founded in 1969 to focus on collaborative science to support management of coastal aquatic resources in the southern

California Bight. SCCWRP staff has been integral in the development of many of the wetland assessment and monitoring tools commonly used in California. SCCWRP's 14 member agencies include the major regulatory and discharger agencies in southern California who are empowered to make decisions regarding coastal resource management.

Alignment with Existing Plans

The WRP guides wetland recovery in Southern California by listing priority acquisition, restoration, and enhancement projects on the *Work Plan*, a living document that is revised annually. Projects on the *Work Plan* must be consistent with the priorities and strategies in the WRP's regional restoration strategy. By incorporating climate change science into our restoration strategy, the opportunities listed within the *Work Plan* will increasingly reflect projects that are resilient to the effects climate change on a landscape scale. The WRP partner agencies use the *Work Plan* to identify potential projects for available grant funds, thus implementing the suggested climate-smart strategies.

The proposed project meets every criterion listed in the LCC's Strategic Plan for a place-based project: 1) the project team consists of willing science and management partners who are already engaged via their involvement in the WRP and who have the authority to take action on the ground; 2) the project's results will demonstrate and inform climate-smart conservation at the regional scale; 3) the project will focus on an important issue for that ecoregion as identified by other regional and state plans (i.e. the State's Wetlands Conservation Program Development and State Wildlife Action Plan); 4) the project will leverage ongoing efforts by analyzing existing tools and models; and 5) the LCC's unique capacities will add value towards the project's climate-smart conservation efforts (see "Value-added" section below).

In terms of the LCC's "Science-Management Framework", the proposed project addresses each need listed in the "Science-Management Needs and Delivery" section. The project will gather and analyze current climate change science in a manner that will make information accessible and relevant to other resource managers. The results of this analysis will allow the project team to develop methods and decision-support tools for managers hoping to apply climate-smart adaptation strategies to their conservation efforts. Last, the project will develop "on-the-ground" tools for achieving self-sustaining coastal ecosystems into the future by providing guidance on site-specific prioritization and design that will lead to implementation.

The proposed project also draws upon existing conservation planning documents. The State Coastal Conservancy (on behalf of the WRP) is a signatory to the State of California's Five Year Coordinated Workplan for Wetland Conservation Program Development (also known as the "WPP"). The WPP establishes development of a regional restoration strategy that incorporates climate-smart adaptation measures as one of the key priorities for both California EPA and the State Natural Resources Agency. The proposed project also aligns with the California State Wildlife Action Plan (SWAP). For the South Coast Region (Chapter 9), the SWAP recognizes coastal wetlands as important and productive habitat that is facing a range of stressors. The WRP is identified as a program that other wildlife agencies and conservation organizations should coordinate with in order to protect and restore the region's wetlands (section E).

CAPACITY

Science Team:

Southern California Coastal Water Research Project (SCCWRP) – science lead, Eric Stein. Dr. Stein will work with the WRP’s Science Advisory Panel to define wetland archetypes based on their form and function and to evaluate the applicability of existing technical tools to use in each of these archetypes. The objective is to “translate” technical output into preferred management actions. Dr. Stein and the rest of the science team have worked over the past 20 years on developing assessment tools and transitioning those tools to management action. Dr. Stein is also the former chair of the WRP Science Panel and SCCWRP scientists have provided staff support to the Science Panel in their past efforts.

Tijuana River National Estuarine Research Reserve (TRNERR) – Jeff Crooks. Dr. Crooks runs the Research and Monitoring program at TRNERR, and will work with the WRP’s Science Advisory Panel in translating lessons learned from a climate change vulnerability assessment and adaptation strategy currently being conducted in the Tijuana River Valley (funded by NOAA’s Climate Program Office). Dr. Crooks has been working on the ecology and management of California’s estuarine ecosystems for over 25 years, and currently has a mayoral appointment to serve on the City of San Diego’s Wetlands Advisory Board. He also formerly served on the WRP’s Science Advisory Panel.

UCLA – Rich Ambrose. Dr. Ambrose is a long-time wetland researcher in the South Coast. He chairs the Scientific Advisory Panel of the California Coastal Commission overseeing large mitigation projects, and the Technical Advisory Committee for the Santa Monica Bay Restoration Commission (SMBRC). He also serves on the U.S. Army Corps of Engineers’ Environmental Advisory Board (EAB), the California Ocean Protection Council’s Science Advisory Team, the Southern California Wetland Recovery Project’s Science Advisory Panel, and the SMBRC Marine Resources Advisory Committee. He has provided advice about environmental restoration issues to a wide variety of government, including the National Oceanic and Atmospheric Administration, California State Water Resources Control Board, California Coastal Commission, California State Lands Commission, State Coastal Conservancy, and California Department of Transportation.

USGS – John Y. Takekawa. Dr. Takekawa will provide input into climate change effects to coastal ecosystems with emphasis on wildlife habitats and wildlife responses. He will use experiences from 30 years of studies of wetlands and wildlife in California to help provide management guideline in addressing climate change threats. Dr. Takekawa founded the U. S. Geological Survey San Francisco Bay Estuary Field Station in 1995 and since then has served on several wetland restoration science panels and has experience working at coastal wetlands throughout California.

Resource Management Team:

State Coastal Conservancy (SCC) – Megan Cooper. The SCC will provide oversight and contract administration, while the WRP (see below), will direct all management-related project actions. The SCC has a long-standing record of managing large federal and non-federal grants for the purpose of habitat restoration that involve implementation of projects with multiple parties, deadlines, and the distribution of resources to multiple agencies and organizations. The SCC has also provided staff to the WRP for over the past 14 years and within that time has spent more than \$628 million dollars on the WRP’s 94 completed wetland restoration projects.

Southern California Wetlands Recovery Project (WRP) – includes staff members from 18 state and federal agency partners. The WRP’s structure consists of two management groups, the Board of Governors (BOG), which is the policy-making body and the Wetland Managers Group (WMG), which is made up of representatives from the 18 member agencies. Bruce Posthumus from the San Diego Regional Water Quality Control Board is currently the Chair of the WMG. The Science

Advisory Panel (SAP), which consists of recognized experts in wetland science in the fields of ecology, zoology, chemistry and physical sciences, provides technical support to the BOG and the WMG. Science and management are inextricably linked in the structure of the WRP, and thus it is the ideal partnership for the proposed project.

APPROACH AND SCOPE OF WORK

PARTNERSHIP: see “Capacity” section above.

INFORMATION: The first step of the project will be to *identify the most relevant tools* for answering questions about prioritizing and designing coastal wetland restoration projects, and then clarify the inputs and outputs of each tool. Several on-going efforts are attempting to make sense of the vast number of climate change models and tools that are available to will help coastal resource managers identify vulnerabilities and develop adaptive strategies. These climate change models and tools provide guidance on topics such as sea-level rise (such as CoSMos; Barnard et al. 2014), marsh evolution (such as SLAMM or MEM; Park et al. 1989; Schile et al. 2014), fluvial inputs, sedimentation rates and wildlife impacts from shifts in hydrology (such as John Takekawa’s project “Sea-level rise modeling across the California salt marsh gradient for resource managers: evaluation of methodology”). Examples of efforts to synthesize these data include The Nature Conservancy’s California Coastal Resilience Network, the San Francisco Bay NERR’s *Tools for Climate Change Adaptation Planning*, and the San Francisco Bay NERR and NOAA’s “Lifting the Fog” Workshop. The best tools for application in this project will be identified via these synthesis projects. We will seek tools that do not require additional field data collection, are publicly available, and are appropriate for the wetland types with the WRP region.

DECISION-SUPPORT: Next, we will *apply the most relevant tools* at representative wetland archetypes. A wetland archetype is a set of regional coastal estuarine patterns that have distinct habitat mixes. The most common coastal wetland archetype in Southern California is a broad tidal marsh with adjacent intertidal flats and smaller areas of subtidal water, open water, and salt flat. Several other patterns exist in different physiographic settings. By binning wetlands by archetype, we can apply the tools to groups of wetlands, instead of on a site-specific level. This level of analysis will allow us to take a regional approach and apply these over a large geographic area. The results of tool application will provide us with data on impacts to habitats and species from hydrological shifts related to climate change.

DECISION-SUPPORT: After we have applied the tools, we will *identify vulnerabilities* (exposure and sensitivity) for each wetland archetype. Certain archetypes might have great vulnerabilities to sea-level rise, fluvial inputs, and associated sediment dynamics than others. And the vulnerabilities will vary by archetype. Several individual restoration projects have modeled sea-level rise (mostly using “bathtub” models) affects on tidal marsh habitats in order to better design restoration projects. However, no projects have fully assessed the available tools, then applied those tools and identified vulnerabilities to provide a fuller picture of anticipated impacts prior to developing adaptation strategies. By completing an assessment like this on a regional level, we will provide a novel method for large-scale restoration planning that considers vulnerabilities to wetlands on a regional scale so that adaptive strategies can be coordinated and integrated throughout the region.

STRATEGIES: The identified vulnerabilities will inform our next step, which is to *develop adaptive strategies* for wetland archetypes. These adaptive strategies will provide us with management/restoration actions by archetype throughout the region. In order to better plan and design management actions and restoration projects, resources managers need a better understanding of the archetype-specific strategies that will help wetlands adapt to climate change stressors. There is no “one-size-fits-all” solution to sea level rise and other hydrological impacts. The solution at one wetland might not apply to another. This project will utilize relevant tools and scientific expertise gained through a collaborative structure to produce adaptive strategies that will be tailored toward making decisions on management decisions and restoration design.

DECISION-SUPPORT: Our final task for this project will be to *develop a decision-support tool* that will match up specific adaptive strategies and associated management actions with wetland archetypes, resulting in a guidance document to be shared and promulgated throughout the resource management community.

ACTION: The five tasks described above will be leveraged with work being funded by the SCC to update the WRP’s regional restoration strategy. The products of the LCC project will help us re-evaluate and revise the WRP’s regional restoration goals and strategies, as needed. The restoration strategy is the foundational document used by the WRP and its member agencies to develop a work plan of prioritized projects, which are then implemented via funding from WRP partners.

DELIVERABLES AND ACCESSIBILITY

Deliverables (see attached Deliverables List):

Deliverables throughout the project will be developed by the science team, the Science Advisory Panel (SAP), and the Wetland Managers Group (WMG).

- 1. Outreach Workshops.** Review, input and collaboration on deliverables will be provided through a series of workshops with the SAP and the WMG. The existing framework of the WRP will provide the structure for science team to interact with the resource management team. This will allow the scientists to query the managers regarding the factors that affect their decisions on individual wetland restoration projects. In particular, the WMG and SAP workshops will be essential in prioritizing existing climate change tools, applying tools to certain archetypes, identifying vulnerabilities, summarize existing management tradeoffs, and developing the decision-making framework for managers.
Deliverable: The deliverables from the workshops will be the inputs that are needed to develop the other deliverables listed below. Meeting minutes will be produced for each workshop.
- 2. Identify Coastal Wetland Archetypes.** The first step to *identify the most relevant tools* will be to identify the wetland archetypes in the project area. Wetland archetypes have been previously identified based on analysis of historical wetland conditions as shown on the coast and geodetic survey t-sheets. These archetypes are based on size, habitat composition, and mouth conditions. The science team will consider hydrology and related wetland functions (not considered in the historical analysis) to refine the existing archetypes. The refined archetypes will be keyed to structural features that may affect management/restoration decisions.
Deliverable: List of coastal wetland archetypes with additional information on hydrology and related functions and other issues that may affect management decisions.

3. **Develop Matrix of Most Relevant Tools.** The next step in the task to *identify the most relevant tools* will be to compile the tools into a matrix identifying inputs, outputs, assumptions and applicability for coastal wetlands in Southern California. Existing tools will be evaluated by the science team and attributed in terms of their applicability to each archetype and the confidence in the model/output for each type. Confidence estimates will be based on the approach of the model, strength of underlying data, and model/tool assumptions. The science team will also develop a straightforward description or illustration of each model output that will help managers understand the tool's relevancy to their specific situation.
Deliverable: Matrix of existing climate change tools, the applicability of relevant tools for use in Southern California coastal wetlands, and sample outputs.
4. **Decision-support Tool.** The product of *identifying vulnerabilities* and *developing adaptive strategies* will be a *decision-support tool* that assists resources managers in making project-specific decisions about prioritization and design. The decision-support tool will consist of a set of flow charts, matrices, and tool profiles that will allow users 1) identify the wetland archetype for a particular site, 2) identify vulnerabilities of the archetype, 3) identify key adaptive strategies, and 4) identify potential constraints (such as infrastructure) to implementation. The results of the four considerations above will then be used to select one or more restoration or management actions for a particular site. Development of the tool will include ground-truthing its application at an example project site.
Deliverable: A decision-support tool consisting of flowcharts, matrices, and tool profiles that will provide resource managers with climate-smart guidance for site-specific decisions on wetland management and restoration projects.
5. **Regional Restoration Strategy.** The decision-support tool will guide resource managers to match climate-smart adaptation strategies with climate change vulnerabilities within wetland archetypes. Specifically, it will inform the WRP's key management goals and priorities in the region, identifying constraints for archetypes within the service area, and selecting climate-smart adaptive actions. This regional restoration strategy that will guide restoration efforts that incorporate appropriate climate-smart adaptive strategies, and will lead directly to implementation of projects through the WRP's *Workplan*.

Accessibility:

The target audience for this project is the coastal resource management community in Southern California. The products developed through this project will be immediately available to the representatives of the 18 agencies that are members of the WRP, as these agencies will help create the documents. Potential limitations of the tools will be the ability of partner agencies to incorporate new approaches and methodologies into existing practices. However, overcoming obstacles to region-wide approaches was the impetus for creation of the WRP, and our unique partnership of agencies and scientists was designed to address these limitations. This project will help us continue to move the conversation forward in Southern California with sound science informing management. Through the WRP's existing partnerships, the products and lessons-learned will also be incorporated into statewide conservation plans such as the WPP and the SWAP.

To reach a broader audience, the LCC's Climate Commons will provide a forum for communicating the results of this project. Through the Climate Commons we will reach resource managers

throughout the State who are outside of the WRP's regular area of outreach. Hopefully through the Climate Commons we can begin dialogues with managers and scientists in other regions who would like to apply similar approaches and methods to those we've developed. We can continue to refine our products through these discussions, as well as progress the status of wetlands management throughout the State. We will also share our results on the SCC's and WRP's websites and various social media outlets and EcoAtlas (ecoatlas.org), the State's portal for wetlands data and information.

MEASURING RESULTS

The WRP will track effectiveness and ecological response of its actions a number of ways. First, the Integrated Wetlands Regional Assessment Program (IWRAP), based on the EPA's three-tiered monitoring framework, was developed by the WRP's SAP. This monitoring framework provides a standardized format for project monitoring and assessment. Wetlands restoration and preservation projects that are funded through the WRP partnership will utilize the data generated through IWRAP, such as regional maps generated through the Southern California Wetlands Monitoring Project (socialwetlands.com) and projects-specific monitoring that is completed for permit and grant compliance. Next, project monitoring data will be uploaded to EcoAtlas (see above). EcoAtlas provides the platform to track all permitted actions related to wetlands in California. Statewide monitoring and assessments, project-specific monitoring and baseline maps are all provided on the interactive website.

VALUE-ADDED AND TRANSFERABILITY

The tools and products developed through this project will be shared with a broad audience on the LCC's California Climate Commons, which we hope will provide guidance to many other regions throughout the State on how to address climate change in regional restoration planning. The methods and tools developed through this project will be transferable to other coastal regions throughout California. Many areas throughout the State could apply the methods for analyzing climate change data and incorporating results into project prioritization and design. One potential limitation of exporting the methods developed through this project could be the lack of regional partnerships like the WRP. In addition, Southern California is the only region on the coast that has developed a description of wetland archetypes, which will allow us to develop adaptive strategies on a regional scale without having to assess every individual wetland. Despite these limitations, providing a method for applying climate change data, beyond the "bathtub" modeling for sea-level rise, to restoration and management decisions will be valuable to resource managers throughout the State.

The LCC will make a significant contribution to the WRP's efforts to restore coastal ecosystems throughout southern California by supplying funding necessary to incorporate climate-smart adaptation strategies into regional restoration planning. While the WRP strives to perform restoration efforts on a landscape-scale, stressing connectivity that provides ecological function rather than simple species assemblages, it does not currently have the capacity to prioritize, test, and apply the latest climate change science to management strategies at this regional scale. The LCC will further the WRP's existing partnership between science and managers by expanding communication with other organizations applying climate change science to wetland conservation efforts in coastal California.

Works Cited

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Park, R. A., M. S. Trehan, P. W. Mausel, and R. C. Howe. 1989. The Effects of Sea Level Rise on U.S. Coastal Wetlands. Pages 1-1 to 1-55. in J. B. Smith and D. A. Tirpak, eds. *The Potential Effects of Global Climate Change on the United States, Appendix B - Sea Level Rise*. U.S. Environmental Protection Agency, Washington, D.C.

Schile, L. M., Callaway J. C., Morris J. T., Stralberg D., Parker V. T., and Kelly, M. 2014. Modeling Tidal Marsh Distribution with Sea-Level Rise: Evaluating the Role of Vegetation, Sediment, and Upland Habitat in Marsh Resiliency. *PLoS ONE* 9:e88760.

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PROFESSIONAL PREPARATION:

D.Env. Environmental Science and Engineering, University of California, Los Angeles, 1995
M.Ed. Science Education, University of California, Los Angeles, 1988
B.S. Biology, University of California, Los Angeles, 1987

PROFESSIONAL EXPERIENCE:

2002 – Present	Principal Scientist - Southern California Coastal Water Research Project
1998 – 2002	Adjunct Associate Professor - California State University, Los Angeles, Department of Geography and Urban Analysis
1998 – 2002	Principal Ecologist, Associate Principal - PCR Services Corporation
1993 – 1998	Biologist, Senior Project Manager - U.S Army Corps of Engineers, Los Angeles District

SELECTED RECENT PEER-REVIEWED PUBLICATIONS:

Mazor, R.D., E.D. Stein, P.R. Ode, and K Schiff. 2014. Integrating intermittent streams into watershed assessments: Applicability of an index of biotic integrity. *Freshwater Science*. DOI: 10.1086/675683

Stein, E.D., B.P. White, R.D. Mazor, J.K. Jackson, J.M. Battle, P.E. Miller, E.M. Pilgrim, B.W. Sweeney. 2014. Does DNA Barcoding Improve Performance of Traditional Stream Bioassessment Metrics? *Freshwater Science*. 33(1):302–311. DOI: 10.1086/674782

Jackson, J.K, J.M. Battle, B.P. White, E.M. Pilgrim, E.D. Stein, P.E. Miller, and B.W. Sweeney. 2014. Cryptic biodiversity in streams - a comparison of macroinvertebrate communities based on morphological and DNA barcode identifications. *Freshwater Science*. 33(1):312–324. DOI: 10.1086/675225.

White, B.P., E.M. Pilgrim, L.M. Boykin, E.D. Stein, R.D. Mazor. 2014. Comparison of four species-delimitation methods applied to a DNA barcode data set of insect larvae for use in routine bioassessment. *Freshwater Science*. 33(1):338–348. DOI: 10.1086/674982

Lackey, L.G., and E.D. Stein. 2014. Selecting the optimum plot size for a California design-based stream and wetland mapping program. *Environmental Monitoring and Assessment*. 186:2599–2608. DOI 10.1007/s10661-013-3563-y

Fetscher, A.E., R. Stancheva, J.P. Kociolek, R.G. Sheath, E.D. Stein, R.D. Mazor, P.R. Ode, and L.B. Busse. 2014. Development and comparison of stream indices of biotic integrity using diatoms vs. non-diatom algae vs. a combination. *Journal of Applied Phycology*. 26(1):433-450. DOI 10.1007/s10811-013-0088-2

SYNERGISTIC ACTIVITIES:

- Associate Editor, *Wetlands: Journal of the Society of Wetland Scientists* (2009-Present)
- Southern California Wetlands Recovery Program Science Advisory Panel (1999-Present)
- Santa Monica Bay Restoration Commission Technical Advisory Committee (2013-present)
- USEPA, Environmental Law Institute (ELI), Nature Conservancy (TNC) - watershed approach (2012 – present).
- California Wetland Monitoring Workgroup, Co-chair (2008 – present)
- California Healthy Streams Partnership (2011 – present)

THESIS ADVISORY & POSTGRADUATE-SCHOLAR SPONSOR:

S. Lopez (UCLA), L. Lackey (UCLA), L. Fong (UCLA), M. Schliebe (CSULB), B. White (CSU Fullerton), I. Irvine (UC Irvine), B. Hawley (Colorado State University), B. Haines (Colorado State University), V. Yoon (UCLA), S. Lee (UCLA), D. Cummings (CSULA), L. Morales (CSULA)

Megan R. Cooper

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PROFESSIONAL EXPERIENCE

Project Development Analyst, CALIFORNIA STATE COASTAL CONSERVANCY ***October 2007 – present***

Develop and manage coastal restoration, acquisition, and access projects throughout Southern California and support the Southern California Wetlands Recovery project (see below). Develop project scopes and budgets; seek and coordinate funding; supervise grantees; interview, select and supervise contractors such as engineers, biologists, and architects; ensure on-time invoicing and reporting; coordinate regional goals and methods for coastal wetland restoration.

Project Coordinator, SOUTHERN CALIFORNIA WETLANDS RECOVERY PROJECT ***August 2005 – October 2007***

Support regional collaboration of public agencies, environmental organizations, individual citizens, scientists and elected leaders working together at local, regional, state and federal levels to preserve, enhance and restore coastal wetlands and watersheds from Santa Barbara, California, south to the international border

Senior Biologist, MERKEL AND ASSOCIATES, INC. ***August 2001 – April 2005***

Managed approximately twenty projects in the nearshore marine environment of California involving biological assessments, habitat restoration, and organization of permit application processes; worked with teams of employees and subconsultants on resource management, habitat design, and permitting; conducted field research and analyzed data to assess habitat quality of nearshore marine habitats; prepared project bid proposals for marine habitat survey and restoration work.

California Sea Grant Fellow, CALIFORNIA COASTAL COMMISSION ***October 2000 – July 2001***

Awarded competitive fellowship; compiled literature review on habitat buffers; coordinated five-person team to implement internal website; collected and evaluated information on California marine protected areas for Marine Life Protection Act planning team; and assisted Commission staff with biological aspects of permit applications.

Research Assistant, SAN DIEGO STATE FOUNDATION, ***June 1998 – September 2000***

Assisted in subtidal marine ecology research; developed data gathering methodologies; conducted field research using SCUBA; performed laboratory research; analyzed and managed large data sets; published research paper in peer-reviewed journal; managed teams of biologists; drove and maintained small research boats.

EDUCATION

San Diego State University, San Diego, California

Master of Science. Ecology, August 2000. Thesis: Functional Equivalency between the Seagrasses *Ruppia maritima* and *Zostera marina*. Advisor: Susan Williams

University of California, San Diego, La Jolla, California

Bachelor of Science. Ecology, Behavior, and Evolution, June 1996

California Landscape Conservation Cooperative 2014 Proposal Budgets

Budget Categories	CA LCC Request	Partner(s) Contribution(s) (monetary)	Partner(s) Contribution(s) (non-monetary value/in-kind)	Total
Salaries	\$ 133,397.00	\$ 80,000.00	\$ -	\$ 213,397.00
Supplies	\$ -	\$ -	\$ -	\$ -
Overhead	\$ 14,924.00	\$ -	\$ -	\$ -
Equipment	\$ -	\$ -	\$ -	\$ -
Other (specify)	\$ 11,800.00	\$ -	\$ -	\$ 11,800.00

Total	\$ 160,121.00	\$ 80,000.00	\$ -	\$ 240,121.00
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Other:

The "Other" budget category includes \$9,300 for travel and \$2,500 for printing. The travel budget will cover travel to five science advisory meetings for John Takekawa, Rich Ambrose and Jeff Crooks. The printing budget will cover production of the written tools and documents associated with the deliverables.

Detailed budgets by task will be provided as needed.

Deliverable Name	Deliverable Type (select from pull-down)	Expected Delivery Date	Description	How will access to this product be provided? (See examples)	Target Audience (be as specific as possible)
Quarterly Financial and Progress Reports	Administrative	Quarterly	These are the quarterly reports required of all projects.	Quarterly Financial and Progress Reports should be emailed to CA LCC	Financial: CA LCC; Progress: CA LCC and Partners
Outreach Workshops	Training, Outreach, or Workshop	Approximately 2 workshops per year	The deliverables from the workshops will be the inputs that are needed to develop the other deliverables listed below. Meeting minutes will be produced for each workshop.	Announcement emailed to WRP partners and science team; resulting products available as described below	WRP Partner Agencies and Science Advisory Panel
Identify Coastal Wetland Archetypes	Other, describe in Description field	January 1, 2015	List of coastal wetland archetypes with additional information on hydrology and related functions and other issues that may affect management decisions	Partner websites; LCC Climate Commons	WRP Partner Agencies and stakeholders, and other resource managers throughout Southern California
Develop Matrix of Relevant Tools	Other, describe in Description field	July 1, 2015	Matrix of existing climate change tools, the applicability of relevant tools for use in Southern California coastal wetlands, and sample outputs.	Partner websites; LCC Climate Commons	WRP Partner Agencies and stakeholders, other resource managers throughout Southern California, CA LCC and Partners
Decision-support tool	Application or Tool	July 1, 2016	A decision-support tool consisting of flowcharts, matrices, and tool profiles that will provide resource managers with climate-smart guidance for site-specific decisions on wetland management and restoration projects.	Partner websites; LCC Climate Commons	WRP Partner Agencies and stakeholders, other resource managers throughout Southern California, CA LCC and Partners
WRP regional restoration strategy	Report	July 1, 2017	The products of the LCC project will help us re-evaluate and revise the WRP's regional restoration goals and strategies, as needed. We will develop a report that documents the deliverables and how they can be applied for site-specific decision-making.	Partner websites; LCC Climate Commons	WRP Partner Agencies and stakeholders, other resource managers throughout Southern California, CA LCC and Partners