Summary Information

Marin Audubon Society

Petaluma Marsh Expansion Project − monitoring and secondary test site for the integrated regional wetland monitoring project

Amount sought: $235,000

Duration: 12 months

Lead investigator: Dr. Stuart Siegel, Wetlands and Water Resources

Short Description

This project will monitor and evaluate the Petaluma Marsh Expansion Project (PMEP),(ERP Project # ERP−98−F13). This project will monitor this marsh as a secondary site within the Integrated Regional Wetland Monitoring Project (IRWM). This project will: 1) evaluate the underlying management question, how are ecosystem restoration efforts throughout the region affecting ecosystem processes at different scales; and (2) through application of adaptive monitoring strategy concepts, prepare for subsequent longer−term monitoring.

Executive Summary

The restoration action we propose to monitor and evaluate is the Petaluma Marsh Expansion Project (PMEP), which is funded by the CALFED Ecological Restoration Program (ERP Project # ERP−98−F13) and CalTrans and owned and operated by the Marin Audubon Society (MAS). We want to monitor this marsh as a secondary site within the Integrated Regional Wetland Monitoring Project (IRWM).

The project site is next to the ancient Petaluma Marsh, on the San Antonio Creek near the Marin/Sonoma County borders. The project involves restoring approximately 110 acres of diked baylands back to tidal marsh by breaching/lowering levees, excavating tidal channels, planting salt marsh vegetation, and more. The goals of the restoration project are (1) to increase tidal marsh habitat in the North Bay, which has lost most of its historic tidal marshes, and (2) to provide habitat for special−status species such as the California clapper rail and salt marsh harvest mouse. After the restoration project is completed, MAS will donate the property to the California Department of Fish and Game for permanent protection as part of the Petaluma Marsh.

The IRWM project seeks to accomplish two goals on behalf of CALFED: (1) to evaluate the underlying management question, how are ecosystem restoration efforts throughout the region affecting ecosystem processes at different scales; and (2) through application of adaptive monitoring strategy concepts, prepare for subsequent longer−term monitoring. The PMEP provides an excellent opportunity to test and evaluate an array of metrics developed during the IRWM Pilot Project to assess physical, biological, and ecological processes in restoring tidal marshes. An integrated team including universities, federal agencies, and private consultants will study the following metrics at PMEP:

Physical Processes

− tidal water supply

− sediment and pore water salinity

− sediment transport and accretion

− geomorphology and topography

Landscape Ecology

− site−scale geomorphological features

− vegetation patches

Plants

− plant community structure, distribution, and diversity

− presence of special−status species

Birds

− general surveys

− specialized (i.e. predation, shorebird, nesting) surveys

− species of special concern

Fish and Invertebrates

− fish assemblage, life history structure, and behavior in tidal channels

− benthic/epibenthic invertebrates, neuston, and emergent insect populations

− food web linkages between fish and invertebrates

Primary Productivity and Nutrients

− low marsh macrovegetation, mudflat, FAV, SAV, and phytoplankton productivity

− nitrate, ammonium, silicate, and phosphate levels in the water column

These metrics will be sampled over a one−year period concurrent with the second year of post−construction monitoring at PMEP. Data from all teams (physical processes, landscape ecology, etc.) will be intergrated and used to refine the existing IRWM conceptual model. Integrating such data together into a single conceptual model should provide answers to questions about how restoration is and in the future would impact ecosystem processes, and further, suggest the important processes that different groups of organisms respond to regardless of spatial and temporal scale. Knowing what physical conditions lead to which biological communities (and vice−versa) can inform the restoration design process and help move CALFED and its associated agencies meet the goals of the Ecological Restoration Program.

Information will be made availible to CALFED, its implementing agencies, and the general public via a web site (www.irwm.org), reports, and conference presentations.

Implementation and subsequent IRWM monitoring of the PMEP achieves a number of ERP goals, including Draft Stage 1 Implementation Plan Strategic Goals 1, 2, and 4; multiple Restoration Priorities for the Bay Region, and multiple Petaluma River Ecological Management Zone Visions for species and tidal perrenial aquatic habitat.

APPLICATION TO CALFED ECOSYSTEM RESTORATION PROGRAM

PETALUMA MARSH EXPANSION PROJECT, MARIN COUNTY
MONITORING AND SECONDARY TEST SITE FOR THE INTEGRATED REGIONAL WETLAND MONITORING PROJECT

A. Project Description: Project Goals and Scope of Work

We have established two purposes of this funding request to the California Bay-Delta Authority for monitoring at the Marin Audubon Society's Petaluma Marsh Expansion Project: (1) to provide sufficient funding for initial implementation of the existing regulatory-based monitoring plan, and (2) to provide funds for additional monitoring activities necessary to include this restoration project as a "secondary test site" for the Integrated Regional Wetland Monitoring Project.

Purpose 1: Supplemental Funding to Implement Existing Monitoring Plan. The Marin Audubon Society (MAS) has an approved 10-year regulatory-based monitoring program that generally consists of monitoring at years 0, 2, 5, and 10 with limited-scope vegetation at one target location occurring every year (PWA and P. Baye, 2003). MAS has obtained $185,000 from the California Department of Transportation to implement this monitoring plan. MAS believes this level of funding is likely to be inadequate to implement this existing monitoring plan effectively and is requesting additional funds from CALFED to ensure this regulatory monitoring can be carried out effectively.

Purpose 2: IRWM Secondary Site. The Integrated Regional Wetland Monitoring Project (IRWM) is a CALFED Science Program-funded endeavor with two goals: to evaluate the effect of tidal marsh restoration projects on ecological processes at multiple scale and to identify monitoring methodologies that effectively inform the first goal. IRWM is mid-way through its initial phase and is currently applying to the Science Program for second-phase funding. This second phase emphasizes "testing" its approaches at marsh restoration sites not included within the initial project; these "secondary" sites would be the focus of a targeted field sampling and data analysis program aimed and determining whether the predictive metrics and methods developed under IRWM are effective.

1. Problem, Goals, and Objectives of Previously-Funded Restoration Action

Restoration Project Description

The restoration action we propose to monitor and evaluate is the Petaluma Marsh Expansion Project (PMEP), which is funded by the CALFED Ecological Restoration Program (ERP Project # ERP-98-F13) and CalTrans and owned and operated by the Marin Audubon Society (MAS). We want to monitor this marsh as a secondary site within the Integrated Regional Wetland Monitoring Project (IRWM).

The project site is located at the northern border of Marin County near its border with Sonoma County, north of Redwood Landfill on San Antonio Creek, a tributary of the Petaluma River (Figure 1). The property is approximately 181 acres in size, of which 110 acres are diked and the subject of the previously-funded restoration action and the remaining 71 acres are tidal marsh acquired for permanent conservation. The entire property was once part of the 3,000-acre Petaluma Marsh, the largest intact tidal marsh in the San Francisco. The property was diked in the mid -1960's by a previous owner who established the landfill. A railroad track now owned by the Sonoma Marin Rail Transit Authority

(SMART) borders the property to the west, the Corda ranch borders the property to the north, the Petaluma Marsh which is largely owned by the California Department of Fish and Game is to the east, and Redwood Landfill owned by Waste Management Inc. is to the south. The property has no public road access. The only access is through Redwood Landfill, a private ranch owned by the Corda Family, or by boat.

Restoration activities including the following field actions:

- Construction of a new levee adjacent to the railroad embankment
- Excavation of on-site borrow trenches
- Installation of soil mounds
- On-site mitigation for the loss of 3 acres of seasonal wetlands
- Excavation of starter channels
- Installation of ditch blocks to close off existing levee borrow ditches
- Import of soil material as available
- Lowering the perimeter levee to MHHW
- Breaching the levee at two locations
- Planting of intertidal, upland and seasonal wetland vegetation

Goals and Objectives of Restoration Activities

The problem addressed by the restoration project is the loss of tidal marsh habitat in the Estuary and North Bay in particular. At the time of its publication in 1993, the *Comprehensive Conservation and Management Plan for the San Francisco Estuary* (CCMP) stated that more than 82% of the historic tidal wetlands in the Bay had been filled or diked. Therefore, the goals of the PMEP are:

- To restore maximum acreage of diked marsh to tidal action to restore saline emergent wetlands
- To benefit endangered and special status-species such as the California clapper rail, salt marsh harvest mouse, black rail, salt-marsh yellowthroat, San Pablo song sparrow, steelhead trout, splittail and other native fish, as well as migratory shorebirds and waterfowl

After the restoration project is completed, MAS will donate the property to the California Department of Fish and Game for permanent protection as part of the Petaluma Marsh.

Specific Tasks of the Restoration Activities

- Prepare design plan - completed November 2002
- Secure permits - October 2003
- Acquire property by MAS - September 2003
- Construct the design plan - commenced January 2004
- Post-construction monitoring - will begin when construction is completed in 2005 or 2006

Current Project Status

Project construction is now underway, but was delayed for several reasons: (1) the Golden Gate Bridge District (GGBD), which owned the railroad at the time, would not approve constructing an extension to their railroad berm for flood protection. They requested that MAS build a berm for them to use for a second rail line; that request was declined. As a result, MAS needed to relocate and redesign a levee to protect the railroad line. (2) Soils tests revealed that the soil type on the project site is not the usual bay mud, but peat. Because of the instability of peat soils, MAS needed to develop a more extensive design for the levee than previously anticipated, and more stable, suitable soils had to be imported.

Construction Status:

- Construction begun - 2004
- Levee keyway completed
- Phase 1 anticipated to be completed by December 31, 2004, weather permitting
- Initial planting in the marsh plain is anticipated to occur in January or February of 2005
- Phase 2, which includes placement of a second lift on the levee after it lies dormant for several months to allow subsidence to occur, is expected to be completed in September 2005. Should the weather be too rainy to allow for settlement, completion of the levee and final breach of the outer levee would have to be delayed until 2006. Final planting will be completed in 2005 or 2006.
- Construction completion: 2005 or 2006 at the latest depending on the amount of rain.

Post Construction Monitoring:
After construction is completed in 2005 or 2006, a 10 year monitoring program is planned and required by our Army Corps of Engineers (USACE) and other permits. Monitoring would commence immediately following the end of construction and planting activities.

2. Justification

At the regional scale, CALFED has established ecosystem restoration as a critical priority based on the conceptual model that by increasing the quantity and quality of many habitats utilized by a wide variety of species targeted for recovery and conservation, the underlying ecosystem processes that support these target species would be supported at levels greater than pre-restoration conditions. The inherent assumption in this conceptual model is that the cumulative effects of numerous restoration actions will have a demonstrable positive effect on the ecosystem and the species that depend on the associated ecosystem processes.

The initial IRWM project seeks to accomplish two goals on behalf of CALFED: (1) to evaluate the underlying management question, *how are ecosystem restoration efforts throughout the region affecting ecosystem processes at different scales*; and (2) through application of adaptive monitoring strategy concepts, prepare for subsequent longer-term monitoring. The current IRWM funding runs into 2005 and IRWM is concurrently applying to the Science Program for ongoing funding. The goal of IRWM-II is to utilize the intensive data gathered at six sites in the San Francisco Estuary (from the Petaluma River to western Delta) to refine our initial conceptual models and to develop quantitative, statistically predictive models. Merging the separate models together represents a first step, but refining the linkages among different ecosystems processes requires understanding reciprocal interactions among regions, the landscapes within regions, as well as site-specific dynamics. Such integration can only be achieved within a single model that permits the influence of processes that differ in the spatial and temporal extent. The overall objective of IRWM-II is to refine our model by developing quantitative metrics that can be used to assess the linkage between ecosystem processes and specific aspects of biological dynamics such as composition, productivity and abundance.

IRWM-II seeks to accomplish five goals:

1. Develop rapid and efficient, but informative restoration/monitoring methodology
2. Develop system metrics that indicate composition of different groups of organisms
3. Develop metrics that are indicative of key ecological processes and therefore of responses such as productivity and abundance
4. Develop frameworks that link this metrics together into predictive models

5. Apply and validate our predictive model (metrics) at sites at which we have not been collecting intensive data

The PMEP provides an excellent opportunity to carry out goal #5. The role of PMEP in IRWM is to serve as a secondary site at which an intensive single year monitoring effort would occur, in conjunction with the mandated USACE monitoring. The existing PMEP MMP outlines the monitoring activities to occur over the course of ten years. The proposed IRWM monitoring efforts would augment the MMP efforts by increasing the scope and extent of parameters monitored for physical processes, plants, fish, birds, invertebrates, primary productivity/nutrients, landscape ecology. The proposed IRWM monitoring activities build upon the regulatory monitoring plan requirements in order to provide a greater understanding of process and function during the early stages of restoration and to test and refine a variety of IRMW evaluation metrics.

A goal of the IRWM project is the application of adaptive monitoring strategy concepts to improve the efficacy of monitoring efforts at restoring tidal marshes. While the existing Mitigation and Monitoring Plan for PMEP (PWA, 2003) is adequate to fulfill regulatory requirements, it does not monitor a variety of valuable metrics of interest to the IRWM team and of clear interest to CALFED. Allowing for monitoring to include the interdisciplinary array of IRWM metrics has the potential to increase the amount of useful knowledge gained about young restoring marshes that is transferable to future restoration sites. More detailed information explaining IRWM monitoring purpose, extent and methodology is in Section 4, “Approach and Scope of Work”.

The PMEP is a unique site to monitor because it is currently the only wetland restoration site in the San Francisco Bay Estuary that is directly adjacent to a very large tract of ancient, undisturbed tidal marsh. The only similar marshes are Rush Ranch in Suisun and Brown’s Island at the boundary between Suisun and the western Delta. None of the restored tidal marshes studied in the first stage of IRWM (Bull Island, Sherman Lake, Pond 2A, and Carl’s Marsh) were located as close to such marsh. This proximity to ancient marsh could have large implications for site colonization by uncommon and rare plants as well as more complex faunal communities. Several tidal marsh restoration projects are located along the Petaluma River, including Carl’s Marsh (45 acres, downstream, 1994), Toy Property (60 acres, downstream, 1985), and Bahia (375 acres, downstream, currently in planning phases). The northwest corner of San Pablo Bay near the mouth of the Petaluma River has several more projects, including Sonoma Baylands (300 acres, 1996), Hamilton/Bel Marin Keys (2500 acres, in planning stage), and Sears Point (2300 acres, in planning stage). Restorations of other marsh types are also located nearby: North Parcel Seasonal Wetlands (280 acres, 2003) and Rush Creek Cemetery Marsh (270 acres, managed tidal). Finally, monitoring at PMEP provides an opportunity to perform a detailed study of site evolution soon following construction. The opportunity to monitor a newly restoring site could allow for further developing and refining metrics across a broader spectrum of site conditions. Additionally, lessons gained from a restoring tidal marsh in the early phases of development may prove quite valuable in their applicability to future restoration sites. For these reasons, the IRWM team is anxious to incorporate PMEP into the second round of IRWM research.

IRWM Conceptual Models

To address the underlying management question “*How do tidal marsh restoration efforts affect ecosystem processes at different scales?”* IRWM has developed and refined conceptual models of system interaction and response integrated across physical, biological and chemical parameters at varying scales. Drawing

upon conceptual model developmental approaches currently being established for the Delta Regional Ecosystem Restoration Implementation Plan (DRERIP) and on preliminary IRWM field results, IRWM has identified the regional and site scale ecosystem drivers and outcomes that appear to best describe and predict ecosystem process effects (see Figure 2).

Metrics arise from different spatial scales
One feature that arises from this conceptual model is that ecosystem processes and forms (geomorphic as well as landscape position) that affect organisms arise from different spatial and temporal scales. Secondly, although the specific linkages have not been illustrated, organisms respond to different sets of these processes.

Regional Processes: For example, plants and aquatic organisms respond strongly to the salinity context of a particular wetland. In San Pablo Bay the salinity levels (which peak in late summer) begin approaching seawater but at Browns Island salinity generally peaks at much lower levels of salinity, while farther into the Delta, only freshwater values can be measured. The presence or absence of salinity, and its seasonal range, influence the pool of potential species that can be a part of the system, either within a marsh, or in the waters associated with a marsh.

Landscape Processes: At the same time, birds and other terrestrial vertebrates do not respond directly to salinity gradients, but rather to other characteristics of the landscape as well as specific wetland features. Landscape level influences might be amount of other marshes nearby, % watershed that is urbanized, or many other features.

Site Processes: Some processes are entirely site-specific, such as channel density, elevation and topographic variability, water and soil salinity, distance from channels, inundation regime, sediment supply, and other variations on the hydrological regime. Many of these features determine, for example, what plant species can survive and dominate particular sites.

Interactions among Processes Arising from Different Spatial Extents: Some wetland site features are strongly influenced by the regional context of salinity. For example, soil salinity at any particular marsh *elevation* will vary depending on location in the overall SF Bay-Delta system and on within-site drainage and evapotranspiration conditions. Landscape processes, such as % urbanization, may themselves influence certain within marsh characteristics, such as mineral composition in the soil pore water. Inundation itself depends on the combination of local hydrology (elevation within a marsh, proximity to channels, extent of within-marsh microtopography affecting drainage), tidal range and winter local watershed and delta outflow regimes.

3. Previously Funded Monitoring
While no prior monitoring has been carried out at PMEP, the adjacent Petaluma Marsh has been the subject of much research. The Petaluma Marsh is the largest ancient tidal marsh remaining in the entire San Francisco Bay Estuary, and as such was studied as part of the BREACH II monitoring project funded by the CALFED Science Program. The first round of IRWM monitoring was also funded by CALFED.

The existing mitigation and monitoring plan (MMP) for PMEP was develop by PWA to fulfill the site's USACE permit. The following table summarizes the plan's parameters and methods:

Monitoring Parameter	Monitoring Method/Activity	Time of Year	Years Required*
Hydrology			
▪ Tidal range**	Tide gauge deployment	Winter	0**, 10
Geomorphology	Aerial photography/plan view analysis	Summer or fall	2, 5, 10
▪ Tidal channel development	Channel cross-section/thalweg surveys	Summer or fall	0, 2, 5, 10
▪ Marshplain accretion	Marshplain transect surveys	Summer or fall	0, 2, 5, 10
	Sedimentation plates	Summer or fall	2, 5, 10
▪ Levee condition	Cross-section surveys	Summer or fall	0, 2, 5, 10
	Cross-section and crest surveys	Summer or fall	0, 2, 5, 10
Biology	Field survey, releve	Summer	2, 5, 10
▪ Plant species composition, frequency	Field survey, releve, cover class	Summer	2, 5, 10
	Field survey, releve, cover class, weed mapping	Spring and summer	1 to 10
▪ Vegetation cover	Aerial photography/GIS analysis (includes ground-truthing)	Summer	2, 5, 10
	Line-intercept field sampling	Summer	1, 2, 3, 5, 10
▪ Vegetation height	Line-intercept field sampling	Summer	1, 2, 3, 5, 10
▪ Cordgrass survivorship	Quadrat (plot) sampling, census	Summer	0, 1, 2, 3, 5, 10
▪ Bird use	Established surveys by volunteers	Per future avian monitoring plan	
Photo Documentation	Site visit and observation photography	Spring or summer	0 to 10
▪ Ground photography	Station re-photography	Summer or fall	0, 2, 5, 10
▪ Aerial photography	High-resolution color infrared, fly-over	Summer	2, 5, 10***
Reporting			
▪ Comprehensive report		December 31	2, 5, 10
▪ Memorandum		December 31	1, 3, 4, 6 to 9

*Year 0 is the calendar year construction is completed.
** If the tidal range performance standard is not met in Year 0, tide gauges will be deployed to monitor tidal range each year, starting with Year 2, until the performance standard is met.
*** Aerial photography may be performed for one optional year for the purpose of adaptive management.
Source: Philip Williams and Associates, Ltd.

CalTrans has committed $185,000 to perform this monitoring as part of its mitigation for impacts of bridge retrofit activities at Sonoma Creek. However, MAS believes this amount is not enough to satisfy the monitoring requirements put forth in the MMP. By making the PMEP a part of IRWM, we not only improve our understanding of restored tidal salt marshes, but ensure that the mitigation and monitoring requirements of the USACE are implemented.

4. Approach and Scope of Work

We have organized the Scope of Work into two broad categories: supplemental monitoring related to the existing monitoring plan and IRWM additional monitoring.

Part 1: Existing Monitoring Supplemental Scope

MAS is requesting additional monitoring funds to address three aspects: (1) provide sufficient funds to implement the existing regulatory-based monitoring plan, (2) add an as-built aerial photograph, and (3) add exterior channel morphologic monitoring and shift existing funds to later stages to allow for ongoing exterior slough morphologic monitoring beyond the CALFED funding cycle.

I. Supplemental Monitoring Funds

As stated above, MAS feels that the existing funding from Caltrans, $185,000, is insufficient to meet the existing monitoring obligations. MAS is asking for an additional **$50,000** to ensure that this monitoring can be completed effectively.

II. As-Built Aerial Photography and GIS

The most common missing element of tidal marsh restoration projects are good data on the as-built condition. We will install ground control and fly new aerial photography within three months of the construction completion. We will orthorectify this image and use GIS to delineate the as-built locations of the many restoration features. We have budgeted **$10,000** for this work.

III. As-Built and Subsequent Exterior Tidal Slough Morphology

This restoration project depends upon natural scouring of San Antonio Creek and Mud Slough to achieve equilibrium geometry that provides unrestricted tidal exchange to the restored site. However, no data are collected to determine if this project expectation is met and thus if the site does not evolve as anticipated, it will difficult to assess the underlying reasons. Therefore, we will add four channel cross sections adjacent to the site and two cross sections bayward of the site plus a channel longitudal profile from the most bayward cross section upstream to the northern breach. We will use professional hydrographic survey methods for all these surveys. We have budgeted these surveys at $20,000 each period. Because MAS would like to add the exterior channel morphologic monitoring at time periods concurrent with all the other monitoring activities (years 0, 2, 5, and 10) and knowing that CALFED funds cannot extend beyond a three-year time frame, we would like to shift the existing Caltrans funds to post-year 2 activities and request CALFED to fund the years 0 and 2 monitoring at the level necessary to cover costs for the additional external channel morphologic monitoring. This budget shift works out to four survey events at $20,000 each, for an additional **$80,000**.

Part 2: IRWM Additional Monitoring

The sampling regime for IRWM efforts at the PMEP will focus on the following categories:

- Physical processes
- Landscape ecology
- Plant communities
- Bird communities
- Fish and invertebrate communities
- Primary productivity and nutrients

An overview of data collection purpose, sampling metrics, methods, analyses, and QA/QC protocols for each category are explained below.

I. Physical Processes

The Physical Processes team will focus on studying the hydrologic and geomorphic features of the site: tidal water supply, sediment and pore water salinity, sediment transport, sediment accretion, and geomorphology and topography.

Tidal Water Supply

The inundation regime is one of the drivers that fundamentally control physical and ecological processes within a tidal marsh and at restoration sites in particular. The existing PMEP monitoring plan only includes tide stage monitoring at year 0; given the expectation of exterior slough scour and thus increased tidal flows, we propose to monitor tide stage again at year 2. We would place datalogging water level sensors in three locations: in San Antonio Creek, in one of the excavated first-order channels, and on the

marsh plain. By monitoring these three locations, we can measure how water levels in the restored marsh respond to the tidal water supply brought in by San Antonio Creek. We will monitor water levels for a full one-year period during Year 2 and from these data calculate the annual inundation regime. Instruments will be housed inside stilling wells attached to posts driven at least 2-3 deep into the local substrate; they will also be surveyed to local benchmarks to convert the data to the North American Vertical Datum (NAVD) of 1988. All data will be collected at 12-minute intervals concurrent with National Ocean Service continuous recording stations in the region; this will allow for easy QA/QC with verified tidal information. Instruments will be downloaded with a field computer and maintained (cleaned, calibrated) approximately every 6 weeks to ensure against malfunction and data loss. At six and twelve-month intervals, we will calculate tidal datums (heights of MHHW, MHW, MTL, MLW and MLLW) for PMEP following NOS protocols (Swanson 1974; Gill and Schultz 2001) and summarized for San Francisco Estuary application (Siegel 2001). We will also calculate tidal inundation and frequency to characterize the site's inundation regime.

Sediment and Pore Water Salinity

Pore water salinity affects plant community composition and reflects sediment deposition processes (settling of suspended sediments, peat accretion, oxidation). To measure pore water salinity, we will install four piezometers at PMEP: two within 5 feet of an excavated first-order tidal channel, and two far (~300 feet) from any of said channels on the marsh plain. Piezometers will be constructed to collect pore water at a depth of 15 cm below the ground surface. Total salinity measurements will be made quarterly at a minimum and coordinated with other field activities at each site. This will help characterize pore water salinity in areas that can be presumed to have different inundation regimes.

In addition, four sediment samples will be collected at random locations within each zone as specified by the Plant Team. Sediment samples will be collected once to establish baseline sediment conditions at PMEP. Each sample will be analyzed for bulk density, grain size, organic content and nitrogen. The median and variance for each sediment zone will be determined. Location and timing of sediment sampling will be coordinated with the Plant Team.

Sediment Transport

One of the key factors determining the accretion rate of the marsh is the amount of suspended sediment that enters the site on each tide and that is deposited on the marsh surface. The suspended sediment concentration the water column will be a major factor in determining the rate at which the marsh surface evolves. Therefore, we will measure inlet suspended sediment concentrations (SSC) at each of the two PMEP levee breaches through the installation of data-logging optical backscatter sensors (OBS). These will measure SSC every 12 minutes and will be downloaded and cleaned every 6 weeks, both intervals concurrent with the water level sensors. All OBS sensors will be calibrated at three times during this project – initiation, mid-term, and completion. Calibrations will utilize field sediment and water with four reference samples (3 concentration ranges and a QA/QC sample) sent to an analytical laboratory for SSC concentration determination. At six and twelve-month intervals, we will develop time series of suspended sediment concentrations and calculate measures of central tendency and range of variability.

Sediment Accretion

Marsh surfaces need to keep up with sea-level rise through the process of accretion (the build-up of live and decaying plant parts and inorganic sediments). However, if accretion rates are low the marsh surface may not be able to keep pace with sea level rise and the inundation regime will change over time. To

measure sediment accretion at PMEP, we will install two sediment elevation tables (SETs) and operate them in tandem with a feldspar marker horizon. As with the piezometers, one SET will be located near a first-order excavated channel, and one will be located far (~300 ft) from said channel. The amount of subsurface marsh change (subsidence, compaction, or marsh swelling) is determined by subtracting marsh accretion (measured using the feldspar marker horizon) from marsh elevation change (measured by the SET). SET and accretion measurements will be taken every 6 months. Analyzing SET data consists of using the initial elevations as the baseline and subtracting those baseline measurements from subsequent measurements divided by the time interval between measurements. We will calculate two measures of accretion rates: interval, or the rate between each measurement, and cumulative, or the rate between baseline and each measurement. Following each 6-month data collection effort, we will update the calculations.

Geomorphology

The geomorphic features of each site include vegetated marsh plain, unvegetated mudflat (early stage restoration evolution), tidal channel networks, ponds and pannes, levees, and adjacent uplands. The tidal channel network in particular plays a dominant role because of its functions as a distributary network for water, sediment, nutrients, and aquatic organisms and for fisheries habitat, nesting birds, and vegetation distribution. To characterize PMEP geomorphic features, we will set ground control for aerial photography to be flown as part of the existing PMEP monitoring program plus the as-built.

II. Landscape Ecology

Using aerial photography, photogrammetry, and geographic information systems (GIS), the Landscape Ecology Team (LET) will provide a variety of site-level (or within-site) mapping and metrics data for use by the other teams. In addition, the LET in conjunction with the Physical Processes Team will assist other teams with interpreting and mapping their data.

Site-scale Approach

Aerial photographs collected as part of the PMEP existing monitoring plan and the as-built proposed above will serve as the basis for our site-scale data extraction. be examined and a new photo will be taken in the late spring/early summer of monitoring Year 2 to capture the peak plant growth period for the landscape-scale approach (see below). We will test the previously-prepared IRWM patch delineations of channels, ponds and pannes, marsh plain (“low” and “high” if appropriate), upland transition (if appropriate), and adjacent uplands (levees, etc,). These features will be extracted from the aerial photograph, combined with field data collected by various teams (PPT, Plant Team), and mapped. Site-scale map products include an all-team sampling locations map, a partial topographic map, an inundation map, and a geomorphic attributes map. The geomorphic and edge/ecotone metrics used to develop these maps will be compiled, reported, and integrated into the refined conceptual model.

Landscape-scale Approach

Using the latest photogrammetric techniques, the LET will define wetland patch delineation criteria and use the PMEP aerial photograph to extract vegetation data. The vegetation patches will be mapped and subsequently ground-truthed by the Plant Team. The PMEP vegetation metrics will be compiled into an existing IRWM database that combines other sites with associated metrics, linked to Modern Baylands (c. 1997) polygons. Reports summarizing patch delineation methods, metrics, and temporal and spatial variation in marsh patches will be produced. Finally, the vegetation data will be combined with data from other teams to refine the conceptual model (see below).

Collaborative Integrative Analysis

One role of the LET is to integrate and synthesize the work performed by other teams, similar to the role of the PPT. This role is appropriate because GIS is, by nature, a tool for overlaying, merging and analyzing data from different sources and representing multiple spatial and temporal scales. The LET will collaborate with the other teams to integrate site-scale monitoring data and create site-level habitat maps for selected indicator taxa. Spatial data will be analyzed and mapped using ArcView and/or ArcInfo software. The LET will also develop descriptive associations between monitoring targets and spatial wetland metrics and, to the extent that sample sizes are adequate, conduct statistical analyses testing each teams' hypotheses about the role of site- and landscape-scale spatial metrics on ecosystem processes. In addition, the LET will investigate the relationships between physical processes, spatial metrics and wetland vegetation. By using the data from other teams' sampling efforts, the LET can build a suite of predictive logistic regression models and/or regression trees that describe these relationships. Because these models will demonstrate the interdisciplinary nature of the project, they cannot be developed without data from other teams.

III. Plant Communities

Plant communities will be monitored through an adaptive management viewpoint and are designed to provide an accurate and quantitative representation of the growth and change of the vegetation community within the various topographic zones in the site. In order to accurately compare data between IRWM sites, it is necessary to collect and process vegetation data that test the metrics developed in the IRWM program on similar scales. Thus, the plant team will work in conjunction with the PMEP Landscape Ecology Team to collect the following data:

Evaluating the variations in plant community structure

To characterize patterns of zonation as a function of tidal elevation and distance from tidal source, and to test for distinctive assemblages, plant community structure will be assessed along transects normal to small channels (first- and second-order), large channels (third- and higher-order), the foreshore (tidal flat or bay to marsh ecotone), and the backshore (marsh to upland ecotone). Although the channel-side and shoreline transects will be randomly located, there will be an effort to subdivide the sampling strata into areas with and without previous field studies of plant communities. We will attempt to develop new data that are comparable to past data, without disrupting existing studies. Measured state indicators will include:

- plant cover by species in 0.25-m^2 quadrats
- canopy height
- canopy layering
- species diversity in quadrats of varying sizes (in order to derive other indicators such as species-area curves, diversity indices, etc.) for each transect.

Describing vegetation as habitat for the other biological Science Teams

The vegetation of the tidal wetlands has a major function as habitat for small mammals, birds, and other wildlife. The Plant Team has therefore been asked by the other biological teams of the Program to help describe the plant community as habitat. This will mostly be accomplished with the selected indicators of plant community structure that will be measured along the transects. In addition to these transects, the Plant Team will work closely with the Landscape Ecology Team to produce a map of the mosaic of major-dominant plant assemblages for each site. These maps will be based on existing aerial photography

of that done as a part of the existing PMEP MMP and the ADAR imaging to be produced by the Landscape Ecology Team. The Plant Team will oversee the definition of patches in the mosaic and the ground-truthing of the maps. Where possible, field sampling along the transects will be completed at the same time when remote sensing data are collected. Selected field sampling sites will be marked to ensure that these sites are easily identifiable in the remotely sensed images. This will enable direct field verification of remote sensing data and will enable us to extend vegetation classification across entire sites.

Establishing a baseline data record for plant species that are of special concern

Populations of rare species at each location will be identified and mapped with GPS receivers, so that population baselines can be established. We will consult with local experts on these species and review existing data on rare species distributions at the study sites and within the subregions of the Estuary (e.g., California Natural Diversity Database and the CNPS inventory or rare species). Based on these preliminary data, we will conduct broad field surveys throughout potential habitats of each rare species at each sampling location, using photo base maps of the sites.

When individuals of a species of interest are found, the location will be identified with a GPS receiver, and data will be collected concerning the approximate number of individuals and the spatial extent of the population. Where possible, actual boundaries of the species patch will be mapped with the GPS receiver and will provide a baseline of rare species distribution for future comparisons.

IV. Bird Communities

We propose to monitor bird communities for the significant metrics developed as part of the IRWM project. Each of the species below are wholly or partly dependent on tidal marsh habitat and thus are important indicators of marsh habitat viability.

The metrics are segregated into two groups: 1) intensively measured metrics, reflecting population processes and 2) extensive metrics requiring less effort and reflecting occurrence, abundance and, potentially, change in abundance.

Intensive metrics include: i) reproductive success, as measured by number of fledglings produced per breeding pair, probability of nest attempt surviving to fledge young, ii) density of breeding pairs, and iii) size of breeding territories.

Extensive Bird metrics include the following as calculated per plot (survey area), as well as averaged over plots for the entire marsh site: i) Abundance per unit area of the following tidal marsh-associated species:

a. Song Sparrow
b. Common Yellowthroat
c. Black Rail
d. Clapper Rail
e. Northern Harrier
f. American Avocet
g. Black-necked Stilts
h. Several waterbird species, still to be identified to be selected from: herons, egrets, gulls and terns, diving ducks, dabbling ducks, small shorebirds (e.g., Western Sandpiper), and large shorebirds.

ii) tidal marsh-associated species diversity, iii) change in abundance (from one breeding season to another, or over longer periods of time) for Song Sparrow, Common Yellowthroat, Black Rail, and Clapper Rail), and iv) change in occurrence/absence of above species, per entire marsh area.

Generalized Surveys

The general marsh surveys will provide information on passerines, waterfowl, large waterbirds, raptors,

and shorebirds. The objectives of the generalized surveys are to determine distribution and abundance of the key bird species and to estimate species richness (or diversity) for each group (e.g., shorebirds).

The sampling strata for the generalized surveys are marsh plain, marsh channel (large and small channels combined), interior pannes (a habitat element of the marsh plain), and adjacent tidal flats. Generalized surveys will be based on "surveys areas," a form of transect sampling, following protocols developed by PRBO and used since 1999 (Nur et al. 1997). Each survey area will be 100-m x 300-m large. Survey areas will be randomly chosen among the possible areas in each stratum of each site. The areas will be replicated if possible. All birds observed within each area will be recorded. The generalized surveys will be conducted on both fall (focusing on Sept – Oct) and spring migrations (March – April).

Specialized Surveys

Specialized surveys will be conducted for taxa that can only be adequately monitored using specialized techniques. Taxa that will be surveyed separately from the general surveys may include waterfowl, large waterbirds, passerines, rails, and shorebirds. Methods employed depend upon the specific taxa and may use one or more of the following: ground surveys, aerial surveys, targeted colony monitoring, breeding pair monitoring, point counts, area surveys, and listening stations. The specialized surveys are to be conducted in the season for maximum densities for the particular targeted species at least once in the year.

Pressure Indicators

The Bird Team will work with other Science Teams to monitor pressures on the key bird metrics listed above. Pressures to be monitored are:

1) Landscape-level metrics including:
    a. Proximity to habitat edge (each body of water , upland, urban, etc.) within a specified distance of a survey point or set of points:
    b. Amount of tidal and non-tidal wetlands
    c. Salt ponds presence
    d. Agriculture presence
    e. Urbanized area presence
2) Marsh-specific metrics including
    a. Patch size and configuration
        1. Size of marsh
        2. Perimeter/area ratio of marsh
        3. Fractal dimension
        4. Distance to closest adjacent marsh
    b. Channel network
        1. Length of channels of various sizes (widths) per unit area
        2. Branching complexity (or sinuosity) of channels
        3. Area of channel "cover" (i.e., 2-dimensional)
    c. Other marsh-specific metrics
        1. pond/panne cover
        2. total vegetation cover
    d. Flooding and other measures of inundation
3) Vegetation structure, species composition, determined per plot or averaged across site
    a. General

1. Vegetation structure in vertical dimension (number of stems per height category)
2. Highest herb or shrub, or measure of overall height
3. Shrub cover
4. Number of shrubs
5. Vegetation species diversity
6. Amount of channel cover within 50 m

b. Species-specific plant composition including cover of key plant species

V. Fish and Invertebrate Communities

Many native and non-indigenous fishes in the SFE use tidal wetlands for at least part of their life histories (Matern *et al.* 2002), especially early in their ontogeny, hence the ascribed "nursery function" of estuarine wetlands (however, see Beck *et al.* 2001). Although sampling of shallow water systems of the SFE has not been as extensive as in deeper waters, and until recently has not been conducted to any degree at restoration sites, emerging results from IEP and CALFED projects such as BREACH, BREACH II, and IRWM are documenting variation in fish assemblage structure, diet and prey resources over broad regions of the SFE.

We propose to conduct field sampling and experiments that will provide data for a suite of metrics that 1) assess the strength and direction of trophic connectivity between the restored wetlands and open waters, 2) document the occurrence, abundance and population structure of fish and motile macroinvertebrates, 3) determine the net exchange in abundance and biomass of fish and motile macroinvertebrates between open and marsh waters, and 4) evaluate the consumption of wetland prey resources by transient fishes.

Our approach will be to compare fish and macroinvertebrate exchanges between and among the selected IRWM pairs of restoration and reference wetlands as the means to generate metrics of food web interactions These investigations of fish, macroinvertebrate and other food web structures and processes will interface with the existing IRWM investigations of controlling/limiting factors on processes affecting nekton access to and utilization of wetlands, as well as the internal wetland processes that support that function.

Although our focus will be on the exchanges of biota and organic matter between wetlands and adjacent open waters, the changes in fish and macroinvertebrate utilization of recovering wetlands should track the physicochemical, geomorphological, and vegetation changes in these restoration sites. The interactions we propose to document will be both directly measurable and inferential and should lead to basic insights into how estuarine wetlands contribute to the productivity of the SFE ecosystem.

Fish

Fish assemblage and life history structure and behavior in tidal channel drainage systems will be determined by quantitatively sampling with channel fyke nets (3.1-mm mesh) deployed to sample fish emigrating from the marsh through ebb tide. If required, where tidal channels do not completely dewater, we will sample shallow shoreline areas with a 3.1-mm mesh pole seine. Length and weight measurements will be taken on a subset of the fish caught. Fishes will be identified, enumerated and immediately released alive at the sampling site. If opportunity arises for supplemental processing of otoliths for either/both microstructure or microchemistry to elucidate additional information on the physiological, ontogenetic or environmental history of captured fish (e.g., Kalish 1989), these will be retained for

possible daily increment enumeration and interpretation through collaboration with other interested investigators (e.g., IEP, CDFG, USGS, NMFS). The opportunity to pursue this investigative thread, via funding support supplemental to that proposed here under the IRWM, could further develop powerful tools and metrics of the ecological history of fishes found to utilize restoration marshes and other SFE wetlands. Subsamples of representative species and life history types will also be retained for diet analyses performed in the laboratory. Sampling will occur in the early spring (high runoff, low salinity) and fall (low runoff and higher salinity) seasons to capture the seasonal variation in the fish assemblages.

Invertebrates

Benthic and epibenthic invertebrate populations will be sampled using a 0.0024-m2, 10-cm deep benthic core, and neuston and emergent insects will be sampled using a 0.20m2, 333-μm neuston net. Zooplankton sampling within the tidal channel water column will employ vertical hauls with a 0.5-m diameter, 333-μm zooplankton net. Samples will be sorted and enumerated later under a dissecting microscope. These sampling techniques have been deployed successfully during the BREACH and IRWM studies of restoring and reference wetlands in the SFE and have been found to efficiently characterize the predominant macroinvertebrates that appear in fish diets. Sampling for invertebrates will correspond to the fish sampling occurring both in the early spring and the fall seasons

Food Web

Food web linkages will be based on two forms of measurement: (1) stomach contents analyses of fish and large macroinvertebrates, and (2) stable isotope analyses. Systematic analyses of fish stomach contents—measuring frequency of occurrence, abundance and biomass for all taxa identifiable under a dissecting microscope with illuminated light—will be conducted on either whole preserved fish or gastric lavage samples, interpreted though the Index of Relative Importance (IRI; Pinkas *et al.* 1971) or similar measures. Stable isotope analysis will also be perfomred, measuring $\delta^{13}C$, $\delta^{15}N$ and $\delta^{34}S$ signatures of consumer (fish, macroinvertebrate) organisms that are broadly represented in fish and invertebrate collections

VI. Primary Productivity and Nutrients

The primary tasks of the Primary Productivity and Nutrients Team (PPN) are to estimate primary production by wetland autotrophs, determine the concentrations of various inorganic nutrients in marsh waters; and compare the relative importance of allochthonous versus autochthonous sources of organic matter assimilated by key components of the fish and macroinvertebrate assemblages.

Primary Productivity

Primary production plays a central role in regulating the abundance and health of salt marsh vegetation and the productivity of higher trophic levels, yet other than the IRWM project, this has not been well studied in tidal marshes in the SFE. We know very little about the relative importance of different groups of primary producers (e.g., phytoplankton, benthic microalgae, submerged aquatic plants, cordgrasses, and macroalgae) within the SFE, and almost nothing about the effects of restoration stage (age) on primary productivity in the SFE. Assessing primary productivity will require using different techniques depending upon the habitat and/or group of producers present.

Low marsh macrovegetation productivity. Low marsh areas are tidally flooded with seawater on a daily basis. To accurately assess net productivity in marsh plants, we will measure CO_2 uptake using an infrared gas exchange technique (Geider and Osborne 1992). We will sample at regular intervals through the day

to determine total daily C fixation. Plant tissue will be weighed as wet and dry and the extracted chlorophyll *a* content per unit plant weight will be determined by fluorometry, thus allowing the calculation of rate of photosynthesis per three biomass parameters. To relate the photosynthetic rate per unit weight to area of marsh, the total biomass per unit area in the low marsh will be determined by harvesting random plots of *Spartina* spp. at each sampling date. Measurements of photosynthesis will be made at bi-monthly intervals through the growing season (ca. March-October).

Mudflat productivity. Diatoms and cyanobacteria are important primary producers on mudflats and in vegetated areas in salt marshes growing dense enough on mudflats to form a felt-like covering. In other marsh locations such as vegetated areas, diatoms predominate and form a golden brown sheen on muds as the vertically migrate through the mud (at low tide) to photosynthesize on the mud surface. Primary productivity will be measured using a ^{14}C technique specifically developed for marsh muds (VanRaalte *et al.* 1974). Several cores will be incubated at each location to assess variability in C fixation, then an appropriate number (in regard to sample variability) of incubations will be taken at each site.

Floating (FAV) and submerged aquatic vegetation (SAV) and macroalgae productivity . In some tidal wetland sites in the SFE, FAV and SAV can represent a significant component of the macrophytic production process. We plan to use the O_2 uptake (oxygen evolution) technique because it can be used with SAV that are either exposed and in the air (at low tide) or submerged. To measure total productivity in an area, we will subsample random plots in a gridwork at each of the study sites. In this way we will be able to relate the SAV productivity measurements to the standing crop of SAV.

Phytoplankton productivity. The ^{14}C light-dark bottle method (JGOFS protocols, IOC 1996) will be adapted for use with Bay phytoplankton and used to measure phytoplankton primary productivity. The chlorophyll *a* content of water from each station will be determined so that photosynthetic activity (assimilation number) per unit biomass can be determined. Since many of the sample sites are in relatively low salinity water, the DIC content (required to calculate C fixation) will be determined with a (DIC converted to methane) methanizer system coupled to a Shimadzu FID gas chromatograph.

Nutrients

Inorganic nutrients such as nitrate, ammonium, silicate and phosphate are essential to primary production and productivity of higher trophic levels. Yet very little is known of the relative contribution of wetlands to nutrients in the SFE. Changes due to restoration efforts may impact the different inorganic sources entering the SFE, which in turn will influence the aquatic primary producers (both macro and micro) that grow and feed higher trophic levels (Cloern *et al.*, 1983). $Si(OH)_4$ is required for diatoms, the key primary producers in short energetically efficient pelagic food chains that may also be important in wetland channels, and PO_4 may modulate the amount of atmospheric N_2 fixation that can occur in salt marshes. The balance of various constituents of the nitrogen cycle (e.g., NO_3 vs. NH_4) may be important in determining the food web that results.

We will sample nitrate, ammonium, silicate and phosphate at two locations – inside the restoration and at the mouth of the breach on a bi-monthly basis through the growing season (ca. March-October). In addition, on at least three occasions, nutrients will be sampled over a diurnal tidal cycle to evaluate hourly/diurnal changes. Finally, on at least we will also sample nutrients daily (at HHW) over a 14-day period during spring/neap cycles.

List of Project-Specific Performance Measures

- Data is collected on schedule
- Data from different teams is integrated and analyzed
- Data is reported in a timely fashion and made available to CALFED, its implementing agencies, and the general public
- The original IRWM conceptual model is fleshed out and refined

Changes to the Original Restoration Monitoring Plan

The original MMP (detailed above in "Previously Funded Monitoring") calls for monitoring basic physical and biological parameters such as tidal inundation, channel cross-sections, and vegetation communities. While this monitoring is adequate to fulfill USACE requirements, it does not dive as deeply into the complex forces driving marsh evolution as the IRWM scope of work. IRWM monitoring builds on the MMP, researching parameters such as salinity, channel density, fish communities, and primary productivity. These additions to PMEP monitoring will result in a better understanding of tidal salt marsh evolution at the PMEP, and will provide data that will help the IRWM team understand the effects of similar restoration projects throughout the SF Bay Estuary.

How the Project Will Increase Knowledge of the Ecosystem, Be Useful to Ecosystem Managers, and Disseminate Information to Managers and ERP's Implementing Agencies

The development of the Integrated Regional Wetland Monitoring pilot project was based on the assumption that effective understanding and (eventually) effective and predictive conceptual models depend on detailed, intensive data. Integrating such data together into a single conceptual model should provide answers to questions about how restoration is and in the future would impact ecosystem processes, and further, suggest the important processes that different groups of organisms respond to regardless of spatial and temporal scale. Finally, responses of different groups of organisms may lag behind other groups because of indirect linkages in food webs or other interaction webs. Integrating different groups together permits recognition of these linkages.

The data collected during the pilot stage of the IRWM project is currently being used to further refine these linkages and conceptual models. The second stage of IRWM aims to:

- Develop rapid and efficient, but informative restoration/monitoring methodology
- Develop system metrics that indicate composition of different groups of organisms
- Develop metrics that are indicative of key ecological processes and therefore of responses such as productivity and abundance
- Develop frameworks that link this metrics together into predictive models
- Apply and validate our predictive model (metrics) at sites at which we have not been collecting intensive data

This last aspect of IRWM is why monitoring at PMEP is so critical. PMEP provides the IRWM team with a clean slate for monitoring, where the desired monitoring protocols can be carried out immediately following the end of construction activities. The information generated by IRWM monitoring at PMEP will not only provide information about the site's evolution, but will help restoration scientists, engineers, and managers to understand ecological processes at other restoring tidal salt marshes throughout the SF Bay Estuary. Knowing what physical conditions lead to which biological communities (and vice-versa)

can inform the restoration design process and help move CALFED and its associated agencies meet the goals of the Ecological Restoration Program.

The results of IRWM research will be disseminated to managers and the ERP's implementing agencies in a variety of ways. The San Francisco Estuary Institute (SFEI) created an IRWM website (www.irwm.org) that includes both a public and a private side. The public side provides basic background descriptive and team leader contact information, and access to public files such as the aerial photography. The private side provides a file exchange, calendar, and a roster of all participants with full contact information. In addition, members of the IRWM team plan to continue presenting IRWM research at a variety of conferences and professional gatherings. Already, IRWM research has been presented at conferences sponsored by CALFED, the Ecological Society of America, the American Geophysical Union, and the American Ecological Engineering Society.

Feasibility

As mentioned above, one of the main purposes of IRWM is to develop rapid, efficient monitoring methodology. The PMEP will be a test site for these methods, which we believe to be more than feasible and appropriate for the three-year IRWM period. Commencement of monitoring, of course, requires that project construction be completed. The final construction activity (breaching of the levee surrounding the site) should occur in September 2005. If the 2004-2005 water year is exceptionally wet, then final breaching of the levee may not occur until 2006. In either event, timing will work well for integration with IRWM-II.

The existing IRWM permits from the USACE, BCDC, RWQCB, CDFG, USFWS, and NOAA-NMFS can all be extended to the second round of IRWM at PMEP, with a few minor exceptions. The only outstanding permitting issue involves adding Jules Evans to the Bird Team's USFWS permit.

All necessary access easements have been secured from the landfill and the Corda family (see attached). The Corda family was paid for both construction and access easements, both of which are legally recorded. The only third-party impacts from monitoring would be to the two adjacent landowners over whose properties the IRWM team must pass. These impacts would be minor: presence of the people driving through the landfill and over a small area of the Corda property to reach our property. As mitigation for the monitoring, we have agreed to provide notice to the property owners of when team members will be passing through their properties.

Agencies aware of the PMEP include the California Coastal Conservancy, US Fish and Wildlife Service, NOAA-National Marine Fisheries Service, Marin-Sonoma Mosquito Abatement District, and all permitting agencies: the Regional Water Quality Control Board, Bay Conservation and Development Commission, CalTrans, and the Army Corps of Engineers. Organizations aware of the PMEP include Marin Baylands Advocates, WaterKeepers, and the Sonoma Land Trust, Marin Agricultural Land Trust. All groups who commented on the project have been supportive. No opposition to the PMEP has ever been made public.

The public is informed about the project through Marin Audubon's newsletter and articles in the local press. Because the property is remote and there is no access or visibility from any public road or view area, there is not much public interest or concern. All adjacent landowners support the project.

Expected Outcomes and Products
We anticipate numerous outcomes and products with the additional funds requested in this proposal. First and foremost, we expect a far greater understanding of how the PMEP restoration project contributes to ecosystem recovery in the San Francisco Estuary. Second, we expect to learn about exterior channel scour necessary to provide unrestricted tidal access to the restoration, a concern that has arisen at several restoration projects. Third, we expect that the IRWM-II project will advance its understanding of predictive metrics and thereby tools for determining how tidal marsh restoration projects contribute to ecosystem processes that support target species conservation and recovery in the Estuary and Delta. Finally, we will make all monitoring results publicly available in a timely manner via the IRWM web site at www.irwm.org.

Data Handling, Storage, and Dissemination
One of the key features of the IRWM project is the level of integration between different teams. This integration exists through all levels of the project (planning, implementation, etc.) but is especially important to the data analyses that are central to the questions IRWM is trying to answer.

Currently, data handling and storage for the IRWM project is managed by SFEI. SFEI maintains a database that compiles data from all teams, serving as an off-site backup. The afore-mentioned IRWM web site and its associated FTP site also serve as data repositories. Data will be disseminated through the deliverables listed above in "Expected Outcomes and Products".

Public Involvement and Outreach
Because the project site is remote and there is no way for the public to see the activities, the only public information concerning PMEP restoration activities is generated by MAS in their newsletter and the local news media. Adjacent landowners are kept informed of PMEP progress through private communication. MAS will continue to informing the press of restoration milestones and will consider informing local watershed groups, landowners (limited though they may be), local governments, and special districts about the restoration and monitoring results. Several public meetings can also be arranged to educate the public about the PMEP and its importance to local ecosystems. Finally, the IRWM website will continue to provide the public with up-to-date news about IRWM progress and performance, including monitoring efforts at PMEP.

Work Schedule
The work schedule is presented in Appendix A. The total timeline from initiation of work is 12 months. Work will begin in Year 2 of the PRM MMP. Per overall design of this proposal, the IRMW supplementary data collection will augment the existing MMP and occur concurrently with planned Year 2 data collection. The work schedule is presented in Appendix A outlines MMP data collection parameters and timeline, the supplementary IRWM parameters and timeline, and identifies by task the duration in months.

B. Applicability to CALFED Bay-Delta Program ERP Goals, the ERP Draft Stage 1 Implementation Plan, and CVPIA Priorities

Implementation and subsequent monitoring of the PMEP achieves a number of ERP and goals, including the following:

ERP Draft Stage 1 Implementation Plan

Strategic Goals

- Strategic Goal 1: *"Achieve recovery of at-risk native species, support recovery of at-risk native species in San Francisco Bay and the watershed above the estuary, and minimize the need for future endangered species listings by reversing downward population trends of native species that are not listed."*

- Strategic Goal 2: "*Rehabilitate natural processes in the Bay-Delta system to support, with minimal ongoing human intervention, natural aquatic and associated terrestrial biotic communities and habitats, in ways that favor native members of those communities."*

- Strategic Goal 4: *"Protect and restore functional habitat types in the Bay-Delta estuary and its watershed for ecological and public values such as supporting species and biotic communities, ecological processes, scientific research, and aesthetics."*

Restoration Priorities for the Bay Region

- Restore wetlands in critical areas throughout the Bay
- Understand performance of wetlands restoration efforts on a local and regional scale
- Restore shallow water, local stream and riparian habitats for the benefit of at-risk species while minimizing potential constraints to successful restoration
- Improve scientific understanding of the linkages between populations of at-risk species and inflows
- Use monitoring, evaluations of existing monitoring data, and new investigations to develop improved strategies for restoring Bay fish populations and at-risk species

ERP Plan Volume II: Ecological Management Zone Visions

Petaluma River Ecological Management Unit Vision

- Restore tidal marsh along the Petaluma river
- Provide upland buffers and provide natural transitional habitat between marshes and upland areas

Tidal Perennial Aquatic Habitat Vision

- Restore large areas of presently leveed land to tidal influence, which may increase important fish species production by providing more spawning, feeding and migrating habitat and increasing foodweb production throughout the Bay

Visions for Species

- Assist in the recovery of Delta smelt, longfin smelt, and splittail by offering alternative habitat
- Provide steelhead trout rearing habitat, contributing to a larger and more stable population
- Contribute to the recovery of California clapper rail, California black rail, San Pablo song sparrow, and salt marsh harvest mouse by expanding habitat for these species.
- Assist in maintaining and restoring shorebird, wading bird, and waterfowl populations, which will benefit from increased wetland acreage

C. Qualifications

Qualifications of IRWM principal investigators can be found in Appendix B.

D. Cost

Details about the budget can be found in the online forms. CALTRANS has approved $185,000 for monitoring as part of the afore-mentioned mitigation for Sonoma Creek bridge retrofits. There is no way we can increase CALTRANS funding for this project because of the state's poor financial situation and the fact that CALTRANS has already increased the amount of their funding several times.

E. Compliance With Standard Terms and Conditions

The Marin Audubon Society is willing and able to comply with the terms and clauses of standard ERP grant agreements as described in the PSP's Attachment 3.

F. Literature Cited

Literature cited in this document can be found in Appendix C.

G. Non-profit Verification

Non-profit verification for the Marin Audubon Society is attached.

Appendix A – Work Plan Schedule

Integrated Regional Wetland Monitoring - Petaluma Marsh Expansion Project Supplement Monitoring

PMEP Regulatory Mitigation and Monitoring Plan			PMEP Project Year 0 1 2 3 4 5 6 7 8 9 10
	Parameter	**ACTIVITIES**	
Hydrology			
	Tidal Range	Tide gauge deployment	
Geomorphology			
	Tidal Channel Development	Aerial photography/plan view analysis	
		Channel cross-section/thalweg surveys	
	Marshplain accretion	Marshplain transect surveys	
		Sedimentation plates	
	Levee condition	Cross-section surveys	
		Cross-section and crest surveys	
Biology			
	Plant Species composition, frequency	Field survey, releve	
		Field survey, releve, cover class	
		Field survey, releve, cover class, weed mapping	
	Vegetation cover	Aerial photography/GIS analysis	
		Line-intercept field sampling	
		High marsh, upland transition	
		W. levee breach, seasonal wetlands	
	Vegetation height	Line-intercept field sampling	
		High marsh, upland transition	
		W. levee breach, seasonal wetlands	
		W. levee breach grasslands	
	Cordgrass survivorship	Quadrat (plot) sampling, census	
	Bird use	Volunteer surveys	<---- *To be determined* ---->
Photo Documentation			
	Ground photography	Site visit and observation photography	
		Station re-photography	
	Aerial photography	High-resolution color infrared, fly-over	
Reporting			
	Comprehensive report		
	Memorandum		
PMEP Supplemental Monitoring Activities			
Photo Documentation	Aerial photography	High resolution, orthorectified	
Geomorphology	External Slough Evolution	Channel cross sections (6)	
		Longitudinal profile	
IRWM Proposed Supplemental Monitoring Activities			***Figure in box represents total number of months during which an IRWM monitoring activity will occur.***
Physical Processes Team			
Continuous Monitoring			
Water Column at the Mouth	Water Level *(pending MMP compliance)*	Tide gauge/pressure transducer deployment	*12*
	Suspended sediment/Turbidity	Turbidity sensor deployment	*12*
	Surface Water salinity	Conductivity sensor deployment	*12*
	Temperature	Sensor deployment	*12*
Within Marsh	Water Level	Tide gauge/pressure transducer deployment	*12*
Single-Event and Periodic Monitoring			
Sediment Sampling	Sediment characteristic	Extract sediment cores for analyses	*1x*
Pore Water	Salinity	Periodic measurement with handheld sensor	*4x*
Plant Team			
Habitat Structure	Plant height	Field sampling	*3*
	Light attenuation	Field sampling	*3*
Biodiversity	Plant cover by species	Field sampling, census	*3*
Productivity	Aboveground biomass	Field sampling	*3*
Bird Team			
Migrating and Wintering Waterbirds and Raptors	Community assemblage, abundance, use	Semi-annual surveys	*3*
Non-Breeding Passerines	Community assemblage, abundance, use	Semi-annual surveys	*3*
Predation during Winter and Breeding Seasons	Seasonal predation dynamics	Semi-annual surveys	*3*
Reproductive Success Assessment	Reproductive success	Semi-annual surveys	*3*
LET Team			
Data Inventory and Gap Identification	Indentify, inventory, charcterize existing data	Review and document existing information	3
Site-Scale Approach			
Review aerial imagery	Site characterization and analyses	Review orthorectified CIR site photo	2
Maps	Vegetation, partial topography, geomorphic attributes, inundation, sampling locations	Aerial imagery analysis, collaboration with plant, physical processes and other teams to develop site attribute maps	*12*
Metrics	Geomorphic attributes, Vegetation, Edge/ecotone	GIS analyses, data integration/collaboration with other teams	*12*
Landscape-Scale Approach	Wetland patch methods, patch metrics, maps	GIS analyses, data integration/collaboration with other teams	*12*
	Methods, Scale relationships, Habitat maps, Predictive model, Integrative report		
Fish, Invertebrate, Primary Productivity, Nutrients Teams			
Fish Utilization	Community assemblage, abundance, use	Semi-annual fish sampling	2
Macroinvertebrates	Community abundance and structure	Semi-annual sampling insects,benthos, zooplankton	2
Food Web	Community structue and dynamics	Semi-annual sampling	2
Primary Productivity	Comminity productivity	Semi-annual sampling	3
Low Marsh Macrovegetation Productivity	Comminity productivity	Semi-annual sampling	3
Mudflat Productivity	Comminity productivity	Semi-annual sampling	3
Floating (FAV) and Submerged (SAV) Aquatic Vegetation	Community abundance and structure	Semi-annual sampling	3
Phytoplankton Productivity	Comminity productivity	Semi-annual sampling	3
Nutrients	Nutrients dynamics	Semi-annual sampling nitrate, silicate, ammonium, phosphate	3
Data Management		Data storage, web-site maintenance	12
All Team Collaborative Planning, Data Integration, Analysis, Reporting Distribution and Presentation			12

Appendix B – Qualifications

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EDUCATION

Ph.D. Geography, 2002 University of California at Berkeley
Dissertation: *Slough Channel Network and Marsh Plain Morphodynamics in a Rapidly Accreting Tidal Marsh Restoration on Diked, Subsided Baylands, San Francisco Estuary, California*

M.A. Geography, 1993, University of California at Berkeley
Thesis: *Tidal Marsh Restoration and Dredge Disposal in the San Francisco Estuary, California*

B.A. Environmental Science, 1986, University of California at Berkeley
Thesis: *Rising of the tide – study of a salt marsh restoration*

B.S. Chemistry, 1986, University of California at Berkeley

PROFESSIONAL HISTORY

1996-present:	President, Wetlands and Water Resources, San Rafael, California
1999-2000:	Research Associate, San Francisco Estuary Institute, Richmond, California
1996-1998:	Intern, Wetlands Division, San Francisco Bay Regional Water Quality Control Board, Oakland, California
1989-1996:	Technical Discipline Leader for Ecological Restoration Group Levine-Fricke, Inc.
1987-1989:	Environmental Analyst, ICF Technology, San Francisco, California
1987:	Ichthyology Instructor, Marine Ecological Institute, Redwood City, California
1985-1987:	Permit Analyst, Environmental Planner Intern, San Francisco Bay Conservation and Development Commission, San Francisco, California

AWARDS

Switzer Leadership Fellow, 2000-2002
California Sea Grant Fellow, 1997-1999
Carl O. Sauer Memorial Fellow, 1994
Switzer Environmental Fellow, 1992-1993
California Environmental Internship Program Fellow, 1985-1986

CERTIFICATIONS

Professional Wetland Scientist #000196, Society of Wetland Scientists
Scientific Scuba Diver #749, University of California at Berkeley
Habitat Evaluation Procedures, U.S. Fish and Wildlife Service

BOARD AND COMMITTEE MEMBERSHIPS

Wetlands Regional Monitoring Program of the San Francisco Estuary, Co-Chair, Physical Processes Focus Team. U.S. Environmental Protection Agency and others. 1999-present.

National Oceanic and Atmospheric Administration, San Francisco Airport Science Panel, 1999. Wetlands representative. See http://www.bcdc.ca.gov/ic/ic_sfo/noaa/noaapanel19991019.htm.
Port of Oakland Middle Harbor Habitat Enhancement Technical Advisory Committee, 1997-2000 (representing Save San Francisco Bay Association)
Regional Wetlands Goals Project Hydrogeomorphic Advisory Team, San Francisco Estuary Institute, 1996-1999
UC Berkeley Diving Control Board, 1994-1998

BIOGRAPHY

Stuart Siegel began working in estuarine tidal marshes in 1984 and received his Professional Wetland Scientist certification in 1994. Mr. Siegel has developed his career in the field of wetland hydrology, geomorphology and restoration through work experience as a regulator and environmental consultant and through graduate studies. These complementary experiences have built his expertise as a physical scientist focusing on estuarine wetland hydrology and geomorphology with considerable emphasis on the related disciplines of ecology, environmental regulation and policy, management, and business. This professional history has provided Mr. Siegel with considerable expertise in integrating numerous disciplines into a comprehensive systems understanding. His work has focused primarily on estuarine wetland restoration but has also included other wetland types and riparian and terrestrial ecosystems. His geographic focus has been the San Francisco Estuary, with additional work elsewhere in California, French Polynesia, and Micronesia.

Fundamental to Mr. Siegel's graduate research and many of his consulting projects is field data collection using the latest instrumentation and methods combined with aerial photograph-based remote sensing and digital terrain modeling. He is very experienced in the design and operation of complex field instrumentation deployments in estuarine settings that require stand alone power supplies and data loggers. Equipment used includes acoustic doppler velocimeters, electromagnetic velocity meters, impeller meters, optical backscatter sensors, pressure transducers, multi-parameter water quality sensors, and conductive bed level sensors. For aerial photography, Mr. Siegel relies on professional service providers for large format, metric photography and he designed and built a tethered helium balloon low-altitude remote control aerial photography system for small format, non-metric photography.

Mr. Siegel has headed his own wetlands restoration company since 1996. Though he has no employees, he routinely works with and directs a number of subcontractors and partners to fulfill each project's needs, such as biology, engineering, hydrogeology, and toxicology. His services include providing senior peer review and strategic planning, field-based wetland assessments, restoration planning, design and construction oversight, monitoring, and regulatory processing. The larger projects on which he has worked include the 2,600-acre Hamilton-Bel Marin Keys Wetland Restoration, the 1,400-acre Bair Island Wetland Restoration, the 850-acre Eden Landing Wetland Restoration, the 1,800-acre Montezuma Wetlands Project, a feasibility study to evaluate restoring 26,000 acres of South Bay Salt Ponds, and the Aimeliik Mangrove Hydrologic Assessment (in Palau). In addition to his graduate research and these and other restoration projects, he co-chairs the Physical Processes focus team of the San Francisco Estuary served on the Hydrogeomorphic Advisory Team for the San Francisco Estuary Regional Wetlands Goals Project, an interagency regional planning effort to help direct the future pattern of wetlands restoration in the San Francisco Estuary.

SUMMARY OF DISSERTATION RESEARCH

Hydrology and Geomorphology of Estuarine Tidal Marshlands. Stuart Siegel's dissertation research addresses the question, *what processes control the evolution and maintenance of channel morphology in tidal marsh restoration projects in the San Francisco Estuary, California?* Research conducted to date suggests that answers to this question lie in sediment transport dynamics in the marsh environment. This research was conducted at the Petaluma River Marsh, located at the northwestern corner of San Pablo Bay with the San Francisco Estuary. This research topic is applicable to the design and monitoring of tidal channel networks in marsh restoration efforts, and it contributes to our understanding of mechanistic processes that control channel evolution. The need for this research stems largely from the uncertainties inherent in the empirically-based hydraulic geometry models currently used in this Estuary and around the United States for tidal marsh channel design and on the upcoming demand for restoring between 55,000 and 65,000 acres of tidal marsh in the San Francisco Estuary. This research consists of combined remote sensing-geographical information system data collection and analysis with extensive field data instrumentation. This research has included the following activities:

- Field instrumentation deployments of acoustic doppler velocimeters to measure average and turbulent velocities; optical backscatter sensors to measure suspended sediment concentrations; pressure transducers to measure water levels; and conductivity sensors to measure salinity.
- Topographic surveys of channel cross sections, marsh plain surfaces, other site features, and air photo control point network.
- Installation and measurement of sedimentation monitoring pins.
- Periodic stereo-pair aerial photography used as the basis for vegetation mapping, digital elevation modeling, sediment budget calculations, channel network evaluation, and hydrologic and geomorphic conditions analyses.
- Data base design for data management.
- Statistical analyses of collected data to test research hypotheses.

Mr. Siegel sought and received major funding from the National Sea Grant Program (with major professor as principal investigator) and additional funding from the United States Geological Survey, the San Francisco Bay Regional Water Quality Control Board, and the U.S. Fish and Wildlife Service.

SUMMARY OF PREVIOUS RESEARCH PROJECTS

Master's Thesis on Estuarine Tidal Marshland Hydrology. Mr. Siegel completed a field project examining tidal marsh channel hydraulic geometry and hydrologic processes linked with an assessment of wetland vegetation and soils. This applied research helped inform design and long-term monitoring planning for tidal marsh restoration projects, and its conclusions that hydraulic geometry is not applicable in tidal marsh channels formed the basis for his dissertation research. He conducted this field research at Rush Ranch, located within the Suisun Marsh area of the San Francisco Estuary. A chapter of his thesis addressed the policy and regulatory arena for wetland restoration in the San Francisco estuary then considered both how to incorporate new scientific knowledge and scientific uncertainty into decision making and how existing regulatory programs operate to promote or discourage the restoration of natural tidal marshlands.

Undergraduate Senior Thesis and Followup on Tidal Marsh Restoration Overall Success and Site Hydrology. Mr. Siegel completed two tidal salt marsh field research projects at Hoffman Marsh, Richmond, California. In the first project (for undergraduate Environmental Science senior thesis) he addressed the question of marsh restoration success through bird use, soils and vegetation data collected by collaborators, and water chemistry data he collected. In the second project he and another researcher examined the hydrologic effects of tidal dampening caused by water control structures.

Fluvial Sedimentation Impacts to Coral Reefs. This research in Moorea, French Polynesia, examined the impacts to coral reefs from soil erosion originating from agriculture, roads, and other human activities. It is a collaborative project headed by Professor John Harte at UC Berkeley. Mr. Siegel served as project leader for assessing the magnitude of fluvial sediment loading into the marine system. This role required preparation of a field, laboratory and analytical study design, construction and installation of field equipment, data collection, training and oversight of three field personnel, and data analysis and interpretation.

REPRESENTATIVE CONSULTING EXPERIENCE

Wetland and Estuarine Ecosystem Restoration and Assessment. The following are a selection of representative projects.

- **South Bay Salt Pond Restoration Feasibility Analysis.** This project consisted of an original evaluation of restoration feasibility for the entire 26,000-acre Cargill salt pond complex in South San Francisco Bay. The purpose of the analysis was to provide a third party (non Cargill and non San Francisco Airport) technical evaluation of restoring the South Bay salt ponds. Analysis consisted of compiling extensive existing data sets, utilizing GIS to analyze much of these data, two restoration case studies, and engineering analysis (performed by report co-author). Project funded by Save San Francisco Bay Association and the California State Coastal Conservancy.
- **GIS Map of North Bay Wetland Restoration Projects.** This project consisted of compiling a detailed GIS map with accompanying data base showing all constructed and planned tidal and nontidal wetland restoration projects around San Pablo Bay. The purpose of the map is to provide a spatial framework for tracking progress toward meeting regional restoration goals and for conducting scientific evaluations of the ecological effectiveness of these restoration efforts. Project funded by CalFed.
- **Restoration Monitoring for East Bay Regional Park District.** These projects consist of restoration progress monitoring at two recent EBRPD tidal and seasonal marsh restoration projects – Oro Loma Marsh in Hayward and Martin Luther King, Jr. Marsh in Oakland. Both projects are following established monitoring plans and, since monitoring is in the early years following restoration, this work nicely complements dissertation research that included monitoring the Petaluma River Marsh in Sonoma County.
- **Aimeliik Mangrove Hydrology.** The overall project is the preparation of an Environmental Impact Statement for a proposed golf course at Aimeliik on the island of Babeldaob in Palau. Mr. Siegel's role has been to evaluate mangrove hydrology through original field data collection to determine the potential for upland runoff to impact the mangrove ecosystem. Field data collected include water levels, salinity, water quality parameters, and surface and subsurface flow velocities.
- **Hamilton-Bel Marin Keys Wetland Restoration.** The overall project is the planning and implementation of a 2,600-acre tidal and seasonal wetland restoration project in Marin County,

California being carried out by the State and federal governments. Mr. Siegel's role has been strategic planning and peer review throughout the planning process, with an emphasis on hydrologic and geomorphic design elements.

- **Seasonal Wetland Enhancement Projects.** These projects consist of designing two seasonal wetland enhancement projects on diked historic baylands in the San Francisco Estuary – the 280-acre North Parcel project in Sonoma County (sponsored by the Sonoma Land Trust) and the 150-acre Olive-Atherton project in Marin County (sponsored by the Marin Audubon Society). Both projects are unique and require new scientific analysis to address achieving ecological goals on landscapes in which such systems did not occur historically and for which many of the natural processes associated with freshwater runoff wetlands (e.g., vernal pools) are not well represented.
- **USGS Sediment Transport Data Analysis.** The overall project is the collection and analysis of original field data pertinent to sediment transport conditions adjacent to one constructed tidal marsh restoration project (Sonoma Baylands) and one planned restoration (Hamilton Wetland Restoration discussed above). These data were collected to assist with the technical planning for the Hamilton Wetland Restoration project. Mr. Siegel's role has been to process and analyze data from three field locations. Data collected include water level, conductivity, suspended sediment concentration, velocity, and temperature. When completed, these data will be published as an USGS Open File Report.

Regulatory Affairs. Environmental regulation of wetlands in California and the United States plays a very large role in ecological restoration; consequently, Mr. Siegel has worked on numerous projects that required understanding and application of many environmental regulatory programs. These programs include the Clean Water Act, Rivers and Harbors Act, National Environmental Policy Act, Fish and Wildlife Coordination Act, California Environmental Quality Act, McAteer-Petris Act, Porter-Cologne Water Quality Act, Fish and Game Code, as well as the state and federal toxics laws and local government regulations.

Project Management. Mr. Siegel has managed numerous projects with budgets ranging from a few thousand dollars to over three million dollars. Management efforts have included personnel management on project tasks, cost tracking, contracting, and technical performance.

Riparian Ecosystems Restoration and Assessment. Mr. Siegel has worked on five riparian system assessments and restoration plans in California and one in French Polynesia. This work has included geomorphic mapping, vegetation surveys, hydrology, and sediment transport.

TEACHING ACTIVITIES

- Guest Lecturer. Numerous dates 1993-1999 at UC Berkeley. Courses included Introduction to Environmental Sciences, Graduate Engineering Seminar in Wetland Restoration, Coral Reefs and Islands, Methods in Environmental Science.
- Course Collaborator, 1996, 1997. Field Methods course, UC Berkeley Department of Geography. Helped develop, plan, execute several intensive field training segments of field course.
- Graduate Student Instructor, 1992. Tropical Island Ecology and Geomorphology, UC Berkeley Interdisciplinary Studies. Course involved two months in field in Moorea, French Polynesia.
- Ichthyology Instructor, 1987. Taught San Francisco Bay fisheries ecology and taxonomy to primary and secondary students during on-Bay cruises. Marine Ecological Institute.

PROFESSIONAL SOCIETIES

American Geophysical Union
Coastal Education and Research Federation
Estuarine Research Federation
Society for Ecological Restoration
Society of Wetland Scientists

PUBLICATIONS

In preparation. Siegel. S.W. Role of initial conditions in establishing slough channel morphology in tidal marsh restoration on diked, subsided baylands. (For submission to peer-review journal).

In preparation. Siegel. S.W. Testing the dominant discharge assumption of hydraulic geometry in tidal marsh systems. (For submission to peer-review journal).

In preparation. Siegel. S.W. The Petaluma River Marsh Restoration: a case study of restoration success. (For submission to peer-review journal).

2002 Siegel, S.W. *Slough Channel Network and Marsh Plain Morphodynamics in a Rapidly Accreting Tidal Marsh Restoration on Diked, Subsided Baylands, San Francisco Estuary, California.* Ph.D. dissertation, University of California at Berkeley. 360 pp.

2002 Siegel, S.W. and P.A.M. Bachand. Feasibility Analysis: South Bay Salt Pond Restoration, San Francisco Estuary, California. Wetlands and Water Resources, San Rafael, CA. 228 pp.

1995 Malamud-Roam, K., S. Siegel, M. Goman, and L. Wells. Tidal Marshes: the Marginal Landscapes of San Francisco Bay. Pp. 251-269 in: Sangines, E.M. and D.W. Anderson, eds., *Recent Geologic Studies in the San Francisco Bay Area*. Pacific Section SEPM, Oakland, CA.

1994 Siegel, S.W. and L.E. Wells. The Limited Applicability of Hydraulic Geometry Principles to Tidal Marsh Channel Design. *Eos* **75**(44) Supplement: 266.

1993 Siegel, S.W. *Tidal Marsh Restoration and Dredge Disposal in the San Francisco Estuary, California: Selected Scientific and Policy Principles for Implementation of the Montezuma Wetlands Project*. Masters thesis, University of California at Berkeley.

1991 Siegel, S.W. and J.D. Levine. Wetlands creation: achieving success with innovative approaches. In: Coastal Zone 91 Pre-Conference Proceedings, American Society of Civil Engineers, New York, pp. 164-175.

1989 Siegel, S.W. Wetlands restoration: a case study of turning failure into success. In: Coastal Zone 89 Pre-Conference Proceedings, American Society of Civil Engineers, New York.

1985 Siegel, S.W. Rising of the tide – study of a salt marsh restoration. In: D. Sloan, ed., *Open Space and Development in the Bay Area*, Environmental Science Department, University of California at Berkeley.

CONFERENCE PRESENTATIONS

2001 *Inventory and Status of North Bay Wetland Restoration Projects.* Presentation and poster at the State of the Estuary Conference, San Francisco, California. San Francisco Estuary Project. October.

2001 *Tidal Channel Network Evolution at the Restored Petaluma River Marsh, Sonoma County, California.* Poster presentation at the State of the Estuary Conference, San Francisco, California. San Francisco Estuary Project. October.

2000 *Tidal Datum Reckoning Case Studies, Petaluma River Marsh and Eden Landing Marsh.* Presented at the Geodetic and Tidal Datum Methods Workshop, Novato, California. National Oceanic and Atmospheric Administration. September.

2000 *The NOAA Science Panel Report on the San Francisco Airport.* Presented at SFO Runway Expansion: Impacts and Alternatives Conference, San Mateo, California. Save San Francisco Bay Association. March.

1999 *Using High Resolution Digital Elevation Models for Wetland Restoration Monitoring.* Poster presentation at the San Francisco Estuary Project State of the Estuary Conference, San Francisco, California.

1996 *Monitoring of Geomorphic Evolutionary Processes, Petaluma River Marsh Restoration Site*. Society of Wetland Scientists Western Region Annual Conference, Sausalito, California.

1994 *The Limited Applicability of Hydraulic Geometry Principles to Tidal Marsh Channel Design*. Presented as Invited Abstract at the American Geophysical Union 1994 Fall Meeting, San Francisco, California, December.

1994 *Montezuma Wetlands Project Overview*. Presented at the Society of Wetland Scientists Western Chapter Annual Meeting, Berkeley, California, September.

1994 *Are Hydraulic Geometry Principles Applicable to Tidal Channel Design in the San Francisco Estuary?* Presented at the Society of Wetland Scientists Western Chapter Annual Meeting, Berkeley, California, September.

1994 *Are Hydraulic Geometry Principles Applicable to Tidal Channels in The San Francisco Estuary?* Presented at the Association of American Geographers Annual Meeting, San Francisco, California, April.

1993 *Tidal Brackish Marshes: Bringing Back Nature to the San Francisco Estuary*. Presented at Association of Pacific Coast Geographers Annual Meeting, Berkeley, California, September.

1992 *Innovative Funding of Wetlands Restoration Projects*. Presented at Beneficial Uses of Dredged Material for Habitat Creation and Restoration, sponsored by the U.S. Environmental Protection Agency and U.S. Army Corps of Engineers, New Orleans, Louisiana, December.

1991 *Wetlands Creation: Achieving Success with Innovative Approaches*. Presented at Coastal Zone 91, Long Beach, California, July.

1989 *Wetlands Restoration: A Case Study of Turning Failure into Success*. Presented at Coastal Zone 89, Charleston, South Carolina, July.

PHILIP A.M. BACHAND, PH.D

Principal Wetland Engineer
Wetlands and Water Resources
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Davis, California 95616
(530) 758-1336; (530) 759-8301 fax
phil@swampthing.org

EDUCATION

University of California at Berkeley

Ph.D. Environmental Engineering, Civil and Environmental Engineering, 1996

Effects of Managing Vegetative Species, Hydraulic Residence Time, Wetland Age and Water Depth on Removing Nitrate from Nitrified Wastewater in Constructed Wetland Macrocosms in the Prado Basin, Riverside County, California

M.S. Civil Engineering, 1992

University of California at Davis

B.S. Mechanical Engineering, 1984

PROFFESIONAL AND RESEARCH INTEREST

- Nitrogen, phosphorus, carbon and metals cycling, interactions and transport in aquatic systems
- BMPs for enhancing water quality improvements in semi-natural and constructed treatment wetlands
- Aquatic systems water-plant-soil interactions and their effect on system biogeochemistry and performance
- Bridging theory and application

RESEARCH AND EMPLOYMENT SUMMARY

Dr. Philip Bachand has been involved in applied wetland research in tidal and non-tidal systems for over ten years. Dr. Bachand's primary interest has been in developing wetland BMPs through a mechanistic understanding of system processes and constraints to enhance wetland water treatment performance. Towards this end, he has conducted applied research in both California and Florida on managing wetlands to sequester nutrients and carbon in order to improve downstream water quality. In California, Dr. Bachand used large-scale wetland mesocosm to investigate management practices for improving denitrification rates in the 400 acre Prado Basin wetlands in Southern California. The research goal was to provide Orange County Water District (OCWD) a cost-effective means to reduce nitrogen concentrations and decrease downstream eutrophication and health concerns in the Santa Ana River. The findings provided pertinent information for the OCWD redesign of the wetland system. Dr. Bachand was also the Principal Investigator and Project Manager for a one million dollar four-year study by the Duke University Wetland Center on investigating low intensity chemical dosing of aluminum and ferric iron salts within stormwater treatment wetlands to reduce phosphorus loadings from agricultural runoff into the Northern Everglades. The study's goal was to develop cost-effective and practical methods to reduce phosphorus concentrations to threshold levels considered harmless to Everglades biota (in the range of 8 to 20 ppb). The study combined laboratory and remote mesocosm experiments investigating water and sediment biogeochemical processes and was closely integrated with Florida governmental organizations

(Department of Environmental Protection, South Florida Water Management District and Everglades Protection District). For this study, Dr Bachand directed and coordinated research efforts amongst several researchers; developed the experimental design; designed experimental sites integrating a broad range of equipment (e.g.YSI data sondes, Campbell CR10X controllers, signet flow sensors, pumps and solar panels); developed the Quality Assurance Project Plan; developed a database and statistically analyzed a diverse data set (e.g. water quality, sediment, climate, operational); and provided reports to involved governmental agencies. Dr. Bachand is also interested in the physical processes constraining wetland restoration in tidal wetland systems. He has been involved in examining the relationships between tidal flow and tidal prism with channel morphology and geometry in local estuarine tidal marshes and in that capacity gained training in surveying, flow measurement, and unattended tidal stage measurement.

Dr. Bachand is currently independently working with the University of California Tahoe Research Group and the U.S. Geological Survey to investigate wetland BMPs to reduce phosphorus, carbon and nitrogen loading to natural waters and drinking water systems. He has been focusing these studies on the Tahoe Basin and the Central Valley. He is also currently managing several wetland restorations in the North Bay and is a co-author on an extensive on investigation the environmental and ecological feasibility of restoring the Cargill Salt Ponds in the South Bay.

PROFESSIONAL HISTORY

- Principal Environmental Engineer/Scientist. Wetlands and Water Resources, Davis and San Rafael, CA. 2000 - present.
- Principal Investigator, Duke University Wetland Center, Durham, NC. 1996 – present.
- Treatment Wetland Instructor. In association with Professor A.J. Horne of the University of California, Berkeley and of Alex Horne and Associates. 2000.
- Graduate Student Researcher, Civil Engineering, University of California, Berkeley, CA. 1990 – 1995.
- Assistant Farm Manager, Madsen Farms, Winton, CA. 1993 – 1996.
- Consulting Engineer, John Carollo Engineers, Walnut Creek, CA. 1990 – 1992.
- Designs Engineer, Chevron USA, Richmond, CA. 1987 – 1989.

SELECTED PUBLICATIONS

Refereed Publications

Bachand, P.A.M. and A.J. Horne. 2000. Denitrification in constructed free-water surface wetlands: I. Very high nitrate removal rates in a macrocosm study. Ecological Engineering 14(1-2):9-15.

Bachand, P.A.M. and A.J. Horne. 2000. Denitrification in constructed free-water surface wetlands: II. Vegetation community effects. Ecological Engineering 14(1-2): 17-32.

Bachand, P.A.M., 1996. Effects of managing vegetative species, hydraulic residence time, wetland age and water depth on removing nitrate from nitrified wastewater in constructed wetland macrocosms in the Prado Basin, Riverside County, California. Ph.D. Dissertation. University of California, Berkeley, Univ. Microfilms. Ann Arbor, Mich.

Professional Reports and Non-Refereed Publications

Siegel, S.W. and P.A.M. Bachand. 2001. Ecological Restoration of Salt Ponds in South San Francisco Bay – A Feasibility Analysis. Wetlands and Water Resources, San Rafael, CA. 20 June.

Bachand, P.A.M., C.J. Richardson and P. Vaithiyanathan. 2000. Phase II Low Intensity Chemical Dosing (LICD): Development of Management Practices. Final report submitted to Florida Department of Environmental Protection in fulfillment of Contract No. WM720. December.

Bachand, P.A.M., S. Madsen Bachand, S. Swanback and P. McGovern. 2000. Exploring tertiary treatment wetlands as a means to meet NTR/CTR metals requirements. CWEA Bulletin 37(1).

Bachand, P.A.M., P. Vaithiyanathan, R.G. Qualls and C.J. Richardson. 1999. Final Report: Phase I Low Intensity Chemical Dosing of Stormwater Treatment Areas. Final report submitted to Florida Department of Environmental Protection in fulfillment of Contract No. WM694, Tallahassee, FL. December.

Bachand, P.A.M. and A.J. Horne. 1996. Recommended Practices for Managing Vegetation, Wetland Age, Hydraulic Residence Time and Water Depth to Improve Water Quality by Denitrification in the Prado Basin Constructed Wetlands. Submitted to Orange County Water District in fulfillment of Proposal No. UCB-ENG-9198, Department of Civil and Environmental Engineering, University of California, Berkeley.

Jeremy P. Lowe
Senior Associate

Mr. Lowe is a coastal geomorphologist with a detailed knowledge of estuarine and coastal geomorphology, process modeling and coastal engineering. His 14 years of international consulting experience spans a wide range of coastal projects in the UK, Italy, Lebanon and Hong Kong. Among his achievements include the design of sea defenses to reduce flood hazards in Venice, Italy; coastal erosion protection for the new Hong Kong airport; and, policy recommendations to the UK for intertidal habitat restoration.

In this role he has studied many aspects of the coastal environment – covering geomorphology, oceanography, sedimentology and engineering. He has carried out fundamental and applied research in coastal and nearshore processes in both academic research institutes and consultancy firms. These research ideas have been developed and used in modeling of coastal and estuarine evolution.

Mr. Lowe has considerable experience in the management of large and complex projects for commercial and government clients. As project manager, Jeremy has responded to all aspects of a study – from the initial liasing with the client, project planning and administration, technical and scientific quality, report writing and presentation, to personnel and financial management. The results of his work have been communicated to a wider audience in research reports, at conferences, in seminars, at lay teaching and at the peer-group level.

Education

BA, 1983	Geography (Hons), University of Hull

Professional Experience

2000-Present	Senior Associate Philip Williams & Associates, Ltd., Corte Madera, CA
1997-2000	Deputy Director, Coastal Geomorphology Partnership, Department of Marine Science and Coastal Management, University of Newcastle (Principal Research Associate)
1996-1997	Deputy Director, Cambridge Coastal Research Unit, Department of Geography, University of Cambridge
1994-1996	Deputy Director, Institute of Estuarine and Coastal Studies, University of Hull
1992-1994	Senior Scientist, Coastal Group, HR Wallingford
1989-1992	Scientist, Coastal Group, HR Wallingford
1988-1989	Research Assistant, Department of Geography, University of Hull
1987-1988	Research Assistant, Department of Geography, Royal Holloway and Bedford New College, University of London

Selected Project Experience

Hamilton Airfield Wetland Restoration, California, 2000-present. For the U.S. Army Corps of Engineers and the California State Coastal Conservancy. Providing project management and engineering support for the design of a 900-acre tidal and seasonal wetland restoration in north San Francisco Bay. The design includes placement of 16 MCY of dredged material to raise subsided ground elevations. Graded peninsulas are used in the tidal wetland design to limit wind-wave re-suspension of sediments and to guide tidal channel formation away from existing infrastructure. Design analyses include 2-dimensional hydrodynamic and cohesive sediment transport modeling, geomorphic tidal channel and inlet design, wind-wave analysis, levee design, long-term sedimentation modeling, seasonal water balance analysis, and flood management.

Napa-Sonoma Marsh Restoration Project, California, 2001-present. For the U.S. Army Corps of Engineers, San Francisco District and the California State Coastal Conservancy. Project involves 1- and 2-dimensional hydrodynamic modeling of potential alternatives for restoration of over 10,000 acres of disused salt ponds in the north of San Francisco Bay. The study also included morphological prediction of the evolution of the site. Managed the sediment budget tasks.

Fisherman's Wharf Water Quality Modeling, California, 2000-2001. Project manager of a study of water circulation and wave propagation patterns, winds, and related dispersion in the Fisherman's Wharf, Hyde Street Pier and Aquatic Park on the northern side of San Francisco waterfront. The study will be used by the Port of San Francisco to make decisions regarding the new Hyde Street Harbor berthing facility for the fishing fleet at Fisherman's Wharf. Alternative modifications of existing coastal structures are being reviewed in terms of impacts on local coastal processes and related impacts to water quality. Potential dispersion patterns due to waves and tidal currents have been estimated. Changes in water quality and its implications due to modification of coastal structures will be established.

EA Crouch And Roach Study, United Kingdom, 1999-2003. Development of a geomorphological model of the Crouch and Roach estuaries to inform future management strategies. Options were developed for the sustainable development of the system with rising sea levels. Modeling of roll-over, channel meandering and intertidal development undertaken.

MAFF/NERC/EPSRC/EN/EA Estuary Processes And Morphology, United Kingdom, 1999-2002. Contributions on the modeling of long-term evolution of estuaries. Part of a consortium with HR Wallingford, Associated British Ports, Proudman Oceanographic Laboratory and British Geological Survey. Specific development of roll-over, tidal asymmetry, regime and mudflat models.

EA Cothele Managed Retreat, **United Kingdom**, 2000. Commissioned by the Conservation Department of the Environment Agency (South West Region) to undertake a feasibility study for two managed retreat sites on the River Tamar estuary. Specific considerations were the frequency of inundation of the sites; predicted habitat formation; suitability of methods for engineering a retreat; effects on local hydrodynamics and sediment transport; investigation of possible estuary wide impacts and implications.

EN Solent Dredging, **United Kingdom**, 2000. Pilot study of the sediment budget of estuaries in the Solent area. Predictions of future demand of sediment with rising sea levels and analysis of the present dredging regime were made. Advice was given on the likely impacts, sensitivity and significance of geomorphological functioning and the conservation value of the estuaries to future dredging regimes.

Lebanon Sand Study, Lebanon, 1999. Strategic study of the marine sand resources of the Lebanon. Provided geomorphology and physical impact input to impact study. Assessed the dredging operations in terms of damage to the coastal system and provided acceptable alternatives. Developed a mitigation package for each of the remaining damaging operations. Part of a multi-disciplinary team based in Beirut.

EN Northey Island, **United Kingdom**, 1999. Continuation of monitoring of a managed retreat site in the Blackwater Estuary, Essex. Analysis of long-term (1991 to 1999) morphological evolution. Management guidelines written for future retreat projects.

EA Humber Geomorphological Studies, **United Kingdom**, 1997-1999. Research into the long term and large-scale evolution of the Humber Estuary. Responsible for the development of geomorphological models of the evolution of the Humber Estuary with particular emphasis on sea level rise. Calculation of the transgression of the estuary landward and the consequent change in form over periods up to a century.

Binnie, Black And Veatch Humber Habitat Migration, **United Kingdom**, 1998. Project manager for a study to predict the extent and zonation of inter-tidal vegetation that would develop without the constraints of existing flood defenses in the Humber estuary. Predicted the migration of the habitats with rising sea levels and the consequences of the removal of flood defenses.

EA Highlands Farm, **United Kingdom**, 1998. Study of the options available for the realignment of a meander bend west of Hullbridge on the River Crouch. Identification of potential impacts on the estuarine system and development of options which allow the estuary to evolve in a sustainable manner.

Humber Estuary SMP Geomorphology, **United Kingdom**, 1997-1998. Project manager for a study of the estuarine processes for the Humber Estuary Shoreline Management Plan. Responsible for the report on the geomorphology and coastal processes. Reviewed current knowledge of physical processes, coastal landforms and assessed the effects of changes in sea level, wave climate and storm surge frequency. Management recommendations were made.

NRA Tollesbury, **United Kingdom**, 1995-1998. Responsible for the design and execution of long term monitoring of the evolution of Tollesbury Creek, Blackwater Estuary, following the managed realignment in 1995. Involved the co-ordination of wave, current, sediment flux and morphological change measurements.

EA Intertidal Habitat Creation Strategy, **United Kingdom**, 1996-1997. Responsible for the development of a national intertidal habitat creation strategy for the Environment Agency and English Nature. This was an important step towards implementing soft defense options such as beneficial use of dredged disposal and managed realignment. Provided specialist support for the working group.

MAFF Tollesbury, **United Kingdom**, 1995-1997. Responsible for the design and execution of continuous monitoring of the sedimentation processes within the Tollesbury managed realignment site. This was a full scale trial of this soft defense option between MAFF, English Nature and the Institute of Terrestrial Ecology. Involves the monitoring of water levels, currents, waves, suspended sediment concentrations, accretion rates, sediment pathways and morphological change.

MAFF Medway Beneficial Disposal Of Dredged Spoil, **United Kingdom**, 1996. Responsible for the design and execution of an experiment to determine methodologies for the beneficial disposal of dredged material in the Medway Estuary. Involved the use of fine tracer material to determine the fate of the dredged material deposited close to the mudflats. This work was carried out in conjunction with the Department of Oceanography, University of Southampton.

MAFF/NERC/EPSRC/EN/EA Estuary Processes And Morphology, **United Kingdom**, 1995-1996. Contributed to the report on estuary processes and morphology. Part of a consortium with HR Wallingford, Associated British Ports and the Department of Oceanography, University of Southampton. Wrote chapter on estuarine morphology and contributed to the development of a ten-year national research strategy.

St Valery-En-Caux, France, 1994. Project manager of a study of downdrift erosion and harbor wave disturbance. The study required extensive 3D wave and current basin testing of a mobile beach model. Responsible for all aspects of study. First major French study by HR Wallingford.

Montalto Di Castro, Italy, 1992. Project manager of a study of a proposed LNG berthing jetty and associated deep water breakwaters. Responsible for the 3D model studies to investigate the effect of the proposed structures on the local beaches. Close liaison with the clients, an Italian government hydraulic laboratory, and subsequently provided consultancy on a regular basis for them. Responsible for training and supervising a resident engineer from the client for the duration of the study. Developed new measurement techniques which were used on many subsequent projects. Experience in presenting results to foreign government agencies in conjunction with the client.

Venice Breakwaters, Italy, 1992. Project manager for a 3D physical model study of the breakwaters at the inlets of the Venice Lagoon at Malamocco and Chioggia. This work was as a direct result of the success of the 3D model work carried out for Pellestrina in 1991. Responsible for 3D mobile bed physical model built at Voltabarozzo hydraulic laboratory in Padova, Italy. Designed alterations to the existing wave basin to make it suitable for the study. Managed the construction and testing of the model over a continuous period of 6 months in Italy. Managed and trained subcontracted engineer from a local consulting engineers. Acted as liaison with the Italian consulting engineers and clients. Produced interim reports locally. Further experience of working independently in a foreign country.

Pellestrina Beach, Italy, 1991. Project manager in a study of the proposed renourishment of a perched beach with groynes. This was a large project involving the interactive use of 2D and 3D numerical and physical models. Responsible for 3D mobile bed physical model built at Voltabarozzo hydraulic laboratory in Padova, Italy. Managed the construction and testing of the model over a continuous period of 7 months in Italy. Managed and trained subcontracted engineer from a local consulting engineers. Acted as liaison with the Italian consulting engineers and clients. Developed the mobile beach scaling methodology used in this and subsequent studies. Experience of working as part of a large project team and independently in a foreign country. First major Italian study by HR Wallingford.

Hong Kong Chek Lap Kok Airport, Hong Kong, 1991. Project manager for a study of the sea wall for Chek Lap Kok airport. Responsible for 2D studies to test and optimize the cross-section for hydraulic performance and armor stability. Later responsible for 3D test on the internal and external corners of a section of the reclamation. Close liaison with the Hong Kong-based client was necessary for this project. Responsible for training resident engineer representing the client. Experience in managing a large and complex project.

Gibraltar East Side, Gibraltar, 1990. Project scientist for a study of a proposed land reclamation. Responsible for 2D and 3D physical model testing of a variety of rock armored sea walls and low crested breakwaters. Experience of testing and analyzing static and dynamic rock structures. Close liaison with engineering consultants from the Netherlands and Norway

Selected Papers and Published Reports

Townend, I.H., J.S. Pethick and J.P. Lowe, 2001. Estuarine Response to Sea Level Rise: The Rollover Model. (in Prep).

Lowe, J.P., D.L. Leggett, N.C. Cooper, 1998. Macro Review Of Medium Term Beach Profile Evolution Along The UK Southern North Sea Coast. Proceedings Of The International Conference Of Coastal Engineering, Copenhagen.

Lowe, J.P., 1997. Intertidal Habitat Creation Strategy. Prepared for Environment Agency and English Nature,

Peterborough.

Lowe, J.P., G. Harding and J. Tilbury, J., 1994. Decision Support For Coastal Management. Proceedings Of The 1st Hydroinformatics Conference, Delft.

Lowe, J.P., 1993. Sand Beach Dynamics. Strategic Research Report SR339, HR Wallingford.

Lowe, J.P., 1993. Physical Modeling Of Cohesive Sediments. In Proceedings 1st Project Workshop, MAST II, MCS-Project: Monolithic (Vertical) Coastal Structures, Copenhagen, Denmark.

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EDUCATION

1996 Ph.D. Department of Geography. University of Colorado, Boulder, Colorado.
1991 M.A. Department of Geography. University of North Carolina, Chapel Hill, North Carolina.
1988 Cartography Certificate. California State University, Hayward, California.
1988 B.A. Department of Geography, University of California, Berkeley, California.

AREAS OF RESEARCH AND OUTREACH SPECIALIZATION

My research and outreach activities concentrate on the monitoring and assessment of natural resource conditions in California landscapes - particularly watersheds and wetlands. Specifically, my research focuses on linking landscape patterns, obtained through remote sensing and ecological mapping, with ecological and social processes, particularly within environmental management regimes. I am interested in GIS mapping and modeling of the environment, and use of all geospatial technologies for multi-scale monitoring of environment. My research also addresses questions about availability, utility, and accuracy of geospatial datasets and environmental datasets, and scale in natural resource and environmental research. My outreach goal is to extend these methods and results to clientele groups throughout California.

RESEARCH EXPERIENCE

1999-pres. Assistant Extension Specialist and Adjunct Assistant Professor, Natural Resource Monitoring, Ecosystem Sciences Division of the Department of Environmental Sciences, Policy and Management, UC Berkeley. Co-Director of the College of Natural Resources' Center for the Assessment and Monitoring of Forest and Environmental Resources.
1998-1999 Lecturer, Department of Geography, San Diego State University, San Diego CA.
1996-1998 National Research Council Postdoctoral Associate, National Oceanic and Atmospheric Administration: National Marine Fisheries Service, Beaufort NC Laboratory.
1996 Physical Scientist, National Geophysical Data Center. National Oceanic and Atmospheric Administration. Boulder, Colorado.
1996 GIS Lab Manager and GIS facilitator, National Marine Fisheries Service Southeast Fisheries Office in Beaufort, NC.
1991-1995 Teaching Assistant and Research Assistant, Department of Geography, University of Colorado, Boulder.
1989-1991 Research Assistant and Laboratory Manager, Remote Sensing / Geographic Information Systems Laboratory, Department of Geography, University of North Carolina, Chapel Hill.

PUBLICATIONS

Fonseca, M. S., P. E. Whitfield, N. M. Kelly, and S. S. Bell. 2002. Statistical modeling of seagrass landscape pattern and associated ecological attributes in relation to hydrodynamic setting. Forthcoming in Ecological Applications.

Kelly, N. M. 2002. Monitoring Sudden Oak Death in California using high-resolution imagery. Forthcoming in the Proceedings from the Fifth Symposium on Oak Woodlands.

McPherson, B. A., D. L. Wood, A. J. Storer, N. M. Kelly, and R. B. Standiford. 2002. Sudden Oak Death: Disease trends in Marin County plots after one year. Forthcoming in the Proceedings of the Fifth Symposium on Oak Woodlands.

Kelly, N. M., M. Fonseca, P. Whitfield. 2001. Predictive mapping for management and conservation of seagrass beds in North Carolina. Aquatic Conservation: Marine and Freshwater Ecosystems. 11 (6): 437-451.

Kelly, N. M. 2001. Changes to landscape pattern of coastal North Carolina wetlands under the Clean Water Act. Landscape Ecology. 16 (1): 3-16.

Kelly, N. M., 2001. Linking biogeography and environmental management in the wetland landscape of coastal North Carolina: the difference between nationwide and individual wetland permits. pp. 281-294 in GIS and Remote Sensing Applications in Biogeography and Ecology. A. Millington, S. Walsh and P. Osborne (Editors), Kluwer Academic Press, Boston MA.

Helly J. H., N. M. Kelly, D. Sutton, T. Elvins. 2001. Collaborative management of natural resources in San Diego Bay. Coastal Management. 29 (2) 117- 132.

Kelly, N. M. 2001. Spatial pattern of forest clearing and potential sediment delivery in watersheds containing essential fish habitat for Pacific salmon. Proceedings of the 1999 International Symposium on Geographic Information Systems (GIS) in Fishery Sciences, Seattle WA. pp. 281-294. Fishery GIS Research Group, Saitama, Japan.

Kelly N. M. and B. A. McPherson. 2001. Multi-scale approach taken to Sudden Oak Death monitoring. California Agriculture. January-February 2001. 15-16.

Kelly, N. M. 2000. Spatial accuracy assessment of wetland permits. Cartography and Geographic Information Systems. 27 (2): 117-128.

McPherson, B. A., D. L. Wood, A. J. Storer, D. M. Rizzo, N. M. Kelly, R. B. Standiford. 2000. Oak mortality syndrome: Sudden Oak Death of oaks and tanoaks. Tree Notes. Number 26, August 2000. 6 pp.

Kelly, N. M., F. Cross, D. Field, R. Emmett, 1999. Remote sensing of forest clearing effects on essential fish habitat of Pacific salmon. pp. 252-267 in Fish Habitat: Essential Fish Habitat and Habitat Rehabilitation, L. Beneka (Editor), American Fisheries Society, Bethesda MD.

Kelly, N. M., 1996. An assessment of the spatial changes to estuarine emergent wetland in coastal North Carolina under Section 404 of the Clean Water Act. Ph.D. thesis. Department of Geography, University of Colorado, Boulder.

CURRENT RESEARCH FUNDING

Multi-scale, Multi-source monitoring of landscape change. 2001-2003. PI: N. M. Kelly. DANR funds through the Monitoring Landscape Change Workgroup: $58,000.

Development of WebGIS for SOD monitoring. 2001-2002: PI: N. M. Kelly. USDA-FS: $50,000.

Continuation of Intensive Research Plot Monitoring Across the range of Sudden Oak Death. 2002. R. Standiford and N. M. Kelly, (Co-PIs). USDA-FS: $51,542.

Auto-detection of Perennial Pepperwood from Aerial imagery Using ERSAR Plant Canopy Analysis Software. 2001-2002. M. Horney and N. M. Kelly (PI and Co-PI). University of California, Center for Pest Management Research and Extension Center: $7,000.

Examining the relative influence of riparian and upland landcover and landuse on instream habitat: improved methods for the Russian River Basin. 2000-2002. PIs: N. M. Kelly and A. Merenlender. University of California Center for Water Resources: $43,488.

COURSES TAUGHT

GIS for Environmental Management. ESPM 298 UC Berkeley.
GIS for Natural Resource Systems. ESPM 275 UC Berkeley. Taught with Professor Peng Gong.
GIS and Environmental Management. Geography, San Diego State University.
Environmental and Natural Resources Conservation. Geography, SDSU.
Environmental Conservation. Geography, SDSU.
Introduction to ArcView and Arc/INFO. Duke University Marine Lab, Beaufort, NC.
Environmental Management and GIS. Geography, University of North Carolina, Chapel Hill.
Geographic Information Systems. Department of Geography, CU-Boulder.
Mapping From Remotely Sensed Imagery. Geography, CU-Boulder.
Introductory Cartography. Geography, CU-Boulder.

PROFESSIONAL ACTIVITIES

Member, Association of American Geographers (AAG), and Secretary / Treasurer of the GIS Specialty Group.
Member, American Society for Photogrammetric Engineering and Remote Sensing (ASPRS).
Member, Ecological Society of America (ESA).
Member, Steering Committee, SF Bay Wetland Regional Monitoring Program.
Chair, Landscape Ecology Team, SF Bay Wetland Regional Monitoring Program.
Co-Chair, Monitoring Committee of the California Oak Mortality Task Force.
Reviewer for: Conservation Biology, Geocarto, International Journal of Remote Sensing, Kluwer Academic Publishers, Landscape Ecology, Journal of Plant Ecology.

OTHER ACTIVITIES

1999 – pres.	Volunteer Coach, U C Berkeley's Women's Water Polo Team
1985 - 1994,	
1997 – 1998	Member of the United States National Women's Water Polo Team
1999	Scout Coach, United States National Women's Water Polo Team
1992 – 2000	Member of the Executive Council of United States Water Polo, Inc.
1992 – 1995	Coach of the CU Men's and Women's Water Polo Clubs

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PROFESSIONAL EXPERIENCE

Department of Environmental Science, University of San Francisco
Assistant Professor, August 1999 - present

Pacific Estuarine Research Laboratory, San Diego State University
Associate Director, January 1998 - July 1999
Assistant Director, January 1996 - December 1997
Post-doctoral Fellow, July 1994 - January 1996

Department of Oceanography and Coastal Sciences, Louisiana State University
Board of Regents Graduate Fellow, August 1990 - August 1994

Romberg Tiburon Center For Environmental Studies, San Francisco State University
Research Assistant, September 1987 - February 1990

Department of Biology, San Francisco State University
Lecturer, Summer 1989
Teaching Assistant, September 1988 - December 1989

EDUCATION

Louisiana State University
Ph.D., Oceanography and Coastal Sciences, 1994
Dissertation: Sedimentation Processes in Selected Coastal Wetlands from the Gulf of Mexico and Northern Europe.

San Francisco State University
M.A., Biology, 1990
Thesis: The Introduction of *Spartina alterniflora* in South San Francisco Bay.

University of California, Berkeley
B.A., Biology (Marine Biology Field Major), 1985
B.A., Slavic Languages and Literature, 1985

PUBLICATIONS

Peer-Reviewed Publications

Callaway, J.C. In press. Restoration ecology. Chapter 5 *in:* K. McGlothlin and S. Spray, editors. *Wetlands*: *Exploring Environmental Challenges: A Multidisciplinary Approach*. Rowman and Littlefield, Lanham, MD.

Ward, K.M., J.C. Callaway and J.B. Zedler. In press. Episodic colonization of an intertidal mudflat by a native cordgrass (*Spartina foliosa*) at Tijuana Estuary. *Estuaries*.

Zedler, J.B., and J.C. Callaway. In press. Adaptive restoration: A strategic approach for integrating research into restoration projects. Pages 163-170 *in:* D.J Rapport, W.L. Lasley, D.E. Rolston, N.O. Nielsen, C.O. Qualset, and A.B. Damania, editors. *Managing for Healthy Ecosystems*. CRC Press, Boca Raton, FL.

Callaway, J.C. 2001. Hydrology and substrate. Pages 89-117 *in:* J.B. Zedler, editor. *Handbook for Restoring Tidal Wetlands*. CRC Press, Boca Raton, FL.

Callaway, J.C., and G. Sullivan. 2001. Sustaining wetland restoration projects: identifying and solving management problems. Pages 337-362 *in:* J.B. Zedler, editor. *Handbook for Restoring Tidal Wetlands*. CRC Press, Boca Raton, FL.

Callaway, J.C., J.S. Desmond, G. Sullivan, G.D. Williams, and J.B. Zedler. 2001. Assessing the progress of restored wetlands: hydrology, soil, plants, and animals. Pages 271-335 *in:* J.B. Zedler, editor. *Handbook for Restoring Tidal Wetlands*. CRC Press, Boca Raton, FL.

Weis, D. A., J.C. Callaway, and R.M. Gersberg. 2001. Vertical accretion rates and heavy metal chronologies in wetland sediments of the Tijuana Estuary. *Estuaries* 24: 840-850.

Zedler, J.B., and J.C. Callaway. 2001. Tidal wetland functioning. *Journal of Coastal Research* Special Issue 27: 38-64.

Zedler, J.B., J C. Callaway, and G. Sullivan. 2001. Declining biodiversity: Why species matter and how their functions might be restored in Californian tidal marshes. *Bioscience* 51: 1005-1017.

Boyer, K.E., J.C. Callaway, and J.B. Zedler. 2000. Evaluating the progress of restored cordgrass (*Spartina foliosa*) marshes: Belowground biomass and tissue N. *Estuaries* 23: 711-721.

Zedler, J.B., and J.C. Callaway. 2000. Evaluating the progress of engineered tidal wetlands. *Ecological Engineering* 15: 211-225.

Zedler, J.B., and J.C. Callaway. 1999. Tracking wetland restoration: do mitigation sites follow desired trajectories? *Restoration Ecology* 7: 69-73.

Zedler, J.B., J.C. Callaway, J.S. Desmond, G. Vivian-Smith, G.D. Williams, G. Sullivan, A. Brewster, and B. Bradshaw. 1999. California salt marsh vegetation: an improved model of spatial pattern. *Ecosystems* 2: 19-35.

Callaway, J.C., and J.B. Zedler. 1998. Interactions between a salt marsh native perennial (*Salicornia virginica*) and an exotic annual (*Polypogon monspeliensis*) under varied salinity and hydroperiod. *Wetlands Ecology and Management* 5: 179-194.

Callaway, J.C., R.D. DeLaune, and W.H. Patrick, Jr. 1998. Heavy metal chronologies in selected coastal wetlands from northern Europe. *Marine Pollution Bulletin* 36: 82-96.

Rybczyk, J.M., J.C. Callaway, and J.W. Day, Jr. 1998. A relative elevation model for a subsiding coastal forested wetland receiving wastewater effluent. *Ecological Modelling* 112: 23-44.

Callaway, J.C., J.B. Zedler, and D.L. Ross. 1997. Using tidal salt marsh mesocosms to aid wetland restoration. *Restoration Ecology* 5: 135-146.

Callaway, J.C., R.D. DeLaune, and W.H. Patrick, Jr. 1997. Sediment accretion rates from four coastal wetlands along the Gulf of Mexico. *Journal of Coastal Research* 13: 181-191.

Haltiner, J., J.B. Zedler, K.E. Boyer, G.D. Williams, and J.C. Callaway. 1997. Influence of physical processes on the design, functioning and evolution of restored tidal wetlands in California. *Wetlands Ecology and Management* 4: 73-91.

Nuttle, W.K., M.M. Brinson, D. Cahoon, J.C. Callaway, R.R. Christian, G.L. Chmura, W.H. Conner, R.H. Day, M. Ford, J. Grace, J.C. Lynch, R.A. Orson, R.W. Parkinson, D. Reed, J.M. Rybczyk, T.J. Smith, III, R.P. Stumpf, and K. Williams. 1997. Conserving coastal wetlands despite sea level rise. *EOS* 78: 257, 260-261.

Callaway, J.C., R.D. DeLaune, and W.H. Patrick, Jr. 1996. Chernobyl ^{137}Cs used to determine sediment accretion rates at selected northern European coastal wetlands. *Limnology and Oceanography* 41: 444-450.

Callaway, J.C., J.A. Nyman, and R.D. DeLaune. 1996. Sediment accretion in coastal wetlands: a review and a simulation model of processes. *Current Topics in Wetland Biogeochemistry* 2: 2-23.

Callaway, J.C., and M.N. Josselyn. 1992. The introduction and spread of *Spartina alterniflora* in south San Francisco Bay. *Estuaries* 15: 218-226.

Publications in Review and in Preparation

Callaway, J.C., G. Sullivan, and J.B. Zedler. In review. Species-rich plantings increase biomass and nitrogen accumulation in a wetland restoration experiment. Submitted to *Ecological Applications*. Accepted with revisions, October 2002.

Morzaria-Luna, H. J.B. Zedler, J.C. Callaway, and G. Sullivan. In review. Topographic heterogeneity effects on community patterns in a Californian salt-marsh. Submitted to *Journal of Vegetation Science*, June 2002.

Grewell, B., J.C. Callaway, W.R. Ferren, Jr. and P.L. Fiedler. In preparation. Coastal wetlands of California *in:* M.G. Barbour, T. Keeler-Wolf, and A. Schoenherr, editors. *Terrestrial Vegetation of California*. 3rd edition. California Native Plant Society and University of California Press, Berkeley, CA.

Sullivan, G., J.C. Callaway, and J.B. Zedler. In preparation. The effects of species composition and richness on functional attributes of salt marsh microcosms. To be submitted to *Ecology*.

Other Selected Publications

Callaway, J.C. In press. Improving restoration evaluation through the incorporation of experiments and simulation modelling. Report of the Third Joint Meeting of the Coastal Environmental Science and Technology (CEST) Panel of the United States-Japan Cooperative Program in Natural Resources. National Oceanic and Atmospheric Administration, Washington, DC.

Zedler, J.B., and J.C. Callaway. 1997. Restoration ecology (Biology 539): combining the teaching of ecological principles with group experiments and native plant restoration on the SDSU campus. *Bulletin of the Ecological Society of America* 78: 67-69.

Callaway, J.C., and J.B. Zedler. 1996. Experimental approaches with mesocosms. Pages 75-77 *in:* Zedler, J.B., principal author. *Tidal Wetland Restoration: A Scientific Perspective and Southern California Focus*. California Sea Grant College System, La Jolla, CA.

Callaway, J.C. 1991. Introduced *Spartina* species in San Francisco Bay. Page 25 *in:* T.F. Mumford, Jr., P. Peyton, J.R. Sayce, and S. Harbell, editors. *Spartina Workshop Record: Seattle, WA, November 14-15, 1990*. Washington Sea Grant Program, Seattle, WA.

Meiorin, E.C., M. Josselyn, R. Crawford, J. Callaway, K. Miller, R. Pratt, T. Richardson, and R. Leidy. 1991. *Status and Trends Report on Wetlands and Related Habitats in the San Francisco Estuary*. Prepared for the San Francisco Estuary Project, Oakland, CA, under cooperative agreement #815406-01-0 with the U.S. Environmental Protection Agency. 209 p.

Josselyn, M., and J. Callaway. 1988. *Ecological Effects of Global Climate Change: Wetland Resources of San Francisco Bay*. Prepared for the Environmental Research Laboratory, U.S. Environmental Protection Agency. Romberg Tiburon Center for Environmental Studies, Tiburon, CA. 39 p.

GRANTS AND CONTRACTS

Ambrose, R. F., and Callaway, J.C. Wetland mitigation in California: Assessment of compliance with Clean Water Act Section 401(c) permits and wetland functions. State Water Resources Control Board, Division of Water Quality. $250,000 requested for one year. Revised proposal to be submitted November 2002.

Parker, V.T., J.C. Callaway, and M. Vasey. Influence of restoration on wetland vegetation processes in the San Francisco Estuary and Delta. CALFED Bay-Delta Science Program. $439,000 requested for two years. Approved pending revisions. Revised proposal submitted August 2002.

Zedler, J.B., S.P. Madon, and J.C. Callaway. Manipulation of vertical and horizontal heterogeneity in a large-scale restoration experiment. National Science Foundation. $390,000. September 2002 - August 2005.

Callaway, J.C., V.T. Parker, and M. Vasey. West coast pilot 2002 intertidal assessment: California intensification for wetland sampling for EMAP (Environmental Monitoring and Assessment Program), EPA. Funded through the San Francisco Estuary Institute. $68,000. August 2002 - January 2003.

Callaway, J.C. Sediment dynamics in natural wetlands of south San Francisco Bay. USF Faculty Development Fund. $2,400. January 2001 - December 2001.

Callaway, J.C. Wetland sediment accretion at the restored tidal wetland, Crissy Field, Golden Gate National Recreation Area. National Parks Association. $3,000. August 2000 - February 2002.

Callaway, J.C. Modeling sediment processes in newly restored salt marshes in the Mississippi River Delta. Subcontract from Wetland Biogeochemistry Institute, Louisiana State University. $3600. August 2000 - July 2001.

Zedler, J.B., J.C. Callaway, and G. Sullivan. The role of diversity in ecosystem function. National Science Foundation. $250,000. July 1997 - June 2001.

Callaway, J.C., J.B. Zedler, and G.D. Williams. Tijuana River National Estuarine Research Reserve Monitoring. $60,000. February 1998 - January 2000.

Ingmanson, D., J.C. Callaway, and J. Kepper. Wetland restoration by public school teachers and students. California Sea Grant Program. $34,000. October 1997 - September 1999.

Zedler, J.B., and J.C. Callaway. Impacts of non-point source pollution on the salt marsh at Tijuana Estuary. NOAA, Office of Coastal Zone Management. $41,000. September 1995 - August 1996.

INVITED PRESENTATIONS AND SEMINARS

Callaway, J.C. 2002. Improving restoration evaluation through the incorporation of experiments and simulation modelling. Third Joint Meeting of the Coastal Environmental Science and Technology (CEST) Panel of the United States-Japan Cooperative Program in Natural Resources. Yokosuka, Japan. July 2002.

Callaway, J.C. 2002. Restoring salt marshes: the importance of plant species diversity. California Botanical Society Seminar Series. Berkeley, CA. May 2002.Callaway, J.C. 2001. Wetland restoration in southern California: the importance of plant species diversity. U.S. Geological Service. Menlo Park, CA. February 2001.

Callaway, J.C. 2001. The challenge of restoring functioning ecosystems. Xiamen Environmental Protection Bureau. Xiamen, China, January, 2001.

Callaway, J.C. 2000. The restoration of wetland habitats in California. University of California, Davis. Department of Environmental Science and Policy, Wetlands Ecology Class, November 2000.

Callaway, J.C. 2000. Wetland restoration in southern California: learning from experiments and natural disturbances. San Francisco State University, Department of Biology, April, 2000.

Callaway, J.C. 2000. Restoring wetland habitats: Lessons from southern California. Hungarian Academy of Sciences, Special Symposium on the Restoration of the Danube River. Budapest, Hungary, January 2000.

Callaway, J.C. 1999. Restoring wetlands for endangered clapper rails and other lessons from San Diego County. San Francisco Regional Water Quality Control Board, Workshop for visitors from China, December 1999.

Callaway, J.C. 1999. Soil concerns for the restoration of coastal salt marshes. Sixth Symposium on the Biogeochemistry of Wetlands. Fort Lauderdale, FL, July 1999.

Callaway, J.C., G. Sullivan, G.H. Keer, and J.B. Zedler. 1999. Wetland restoration at Tijuana River National Estuarine Research Reserve: The Tidal Linkage and the Model Marsh. Southern California Academy of Science Annual Meeting. California State University, Dominguez Hills, CA, May 1999.

Callaway, J.C. 1998. Restoration of southern California coastal wetlands: the value of experimentation. Scripps Institute of Oceanography, Ecology Seminar Series, April 1998.

Callaway, J.C., and J.M. Rybczyk. 1997. Evaluating the effects of sea-level rise on coastal wetlands: a modeling approach. OECD Workshop on Global Climate Change and Coastal Wetlands, Fifth Symposium on the Biogeochemistry of Wetlands. Royal Holloway College, London, England, September 1997.

Callaway, J.C. 1997. Southern California salt marshes: a restoration perspective. Wetland Soils Seminar, Department of Soil and Environmental Sciences, University of California Riverside, April 1997.

Callaway, J.C. 1994. Sediment processes in coastal wetlands: potential impacts of sea-level rise. Department of Biology, San Diego State University, September 1994.

Callaway, J.C. 1991. The introduction and spread of *Spartina alterniflora* in south San Francisco Bay. Department of Oceanography and Coastal Sciences, Louisiana State University, March 1991.

Callaway, J.C. 1990. Introduced *Spartina* spp. in San Francisco Bay. Spartina Workshop, Washington State Sea Grant. Seattle, WA, November 1990.

SELECTED CONFERENCE PRESENTATIONS

Callaway, J.C. 2002. Sediment dynamics in San Francisco Bay salt marshes. Annual Meeting of the Western Chapter of the Society of Wetland Scientists. Tiburon, CA, September 2002.

Callaway, J.C. 2002. Ecological insights from salt marsh restoration. Annual Meeting of the Ecological Society of America. Tucson, AZ, August 2002.

Callaway, J.C., G. Sullivan, and J.B. Zedler. 2001. Effects of plant species diversity on the functioning of a restored salt marsh. 16th Biennial Conference of the Estuarine Research Federation. St. Petersburg, FL, November 2001.

Callaway, J.C., G. Sullivan, and J.B. Zedler. 2001. Species-rich plantings increase biomass accumulation in a salt marsh restoration experiment. Annual Meeting of the Ecological Society of America. Madison, WI, August 2001.

Callaway, J.C., G. Sullivan, G.H. Keer, and J.B. Zedler. 1999. Diversity and species affect ecosystem functioning in a salt marsh restoration site. 15th Biennial International Estuarine Research Federation Conference. New Orleans, LA. September 1999.

Callaway, J.C., J.S. Desmond, G. Sullivan, K. Ward, G.D. Williams, and J.B. Zedler. 1999. Coordinated monitoring, research and restoration at Tijuana River National Estuarine Research Reserve. Coastal Zone '99. San Diego, CA. July 1999.

Callaway, J.C., and J.B. Zedler. 1998. Tidal wetland sedimentation impacts: flood-caused bare zones sustained by trampling and high salinities. ASLO/ESA Joint Conference on the Land-Water Interface. St. Louis, MO. June 1998.

Callaway, J.C., and J.B. Zedler. 1997. Exotic species competition with native plants in southern California salt marshes: effects of salinity and hydroperiod. 14th Biennial International Estuarine Research Federation Conference. Providence, RI, October 1997.

Callaway, J.C., R.D. DeLaune, and W.H. Patrick, Jr. 1995. Sediment accretion in coastal wetlands: a simulation model of processes. 13th Biennial International Estuarine Research Federation Conference. Corpus Christi, TX, November 1995.

Callaway, J.C., R.D. DeLaune, and W.H. Patrick, Jr. 1993. Sediment accretion rates from Northern European coastal marshes using ^{137}Cs profiles. 12th Biennial International Estuarine Research Federation Conference. Hilton Head Island, SC. November 1993.

Callaway, J.C., R.D. DeLaune, and W.H. Patrick, Jr. 1992. An analysis of accretionary processes in coastal wetlands using multivariate statistics. INTECOL IV International Wetlands Conference. Columbus, OH. September 1992.

Callaway, J.C., R.D. DeLaune, and W.H. Patrick, Jr. 1992. Accretionary processes along the Gulf Coast: a comparison of rates from coastal wetlands in Louisiana, Mississippi and Florida. 13th Annual Meeting of Society of Wetland Scientists. New Orleans, LA. June 1992.

Callaway, J.C. 1990. The introduction of *Spartina alterniflora* in south San Francisco Bay. 11th Annual Meeting of the Society of Wetland Scientists. Breckenridge, CO. June 1990.

AWARDS

Nominee for the Cronin Award for Early Career Estuarine Scientist. Estuarine Research Federation. 1997.

Board of Regents Fellowship in Coastal Processes. Louisiana State University, Department of Oceanography and Coastal Sciences. 1990 - 1994.

Best Student Poster, Second Place. 12th Biennial International Estuarine Research Federation Conference. Hilton Head Island, SC. 1993.

Joe Lipsey, Sr. Memorial Scholarship for Academic Achievement in the Study of Marine Sciences. Louisiana State University, Department of Oceanography and Coastal Sciences. 1993.

Best Student Paper. Society of Wetland Scientist's 11th Annual Meeting. Breckenridge, CO. 1990.

Paul F. Romberg Scholarship in Environmental Studies. Romberg Tiburon Center for Environmental Studies, San Francisco State University. 1988.

Hardman Foundation Research Grant. Hardman Foundation. Woodland Hills, CA. 1988 and 1989.

Distinction in General Scholarship at Graduation and Honor Student. University of California, Berkeley, Graduation, May 1985.

PROFESSIONAL ACTIVITIES

Editor, *Madroño*, California Botanical Society. 2002-2004

Member:

Coastal Environmental Science and Technology (CEST) Panel of the United States-Japan Cooperative Program in Natural Resources. National Oceanic and Atmospheric Administration, Washington, DC. 2002-present.

Design Review Group of the San Francisco Bay Wetlands Restoration Program. 2002-present.

Technical Advisory Committee for the Tijuana Estuary Tidal Restoration Program, Tijuana River National Estuarine Research Reserve. 2002-present.

Scientific review panel for the proposed runway expansion at the San Francisco Airport, convened by the National Atmospheric and Oceanic Administration. 2001-present.

Board of Directors, Romberg Tiburon Center for Environmental Studies, 2000-present.

Vegetation and Physical Processes Teams for the Wetlands Regional Monitoring Program, coordinated by the San Francisco Estuary Institute. 2000-present.

Scientific Advisory Panel for the Southern California Wetlands Recovery Project, California State Coastal Conservancy. 1998-present.

Research Committee, Tijuana River National Estuarine Research Reserve. 1997-1999.

Board of Editors, *Madroño*, California Botanical Society. 1996-2000.

Hydrogeomorphic Assessment Team for the San Francisco Bay Area Wetlands Ecosystem Goals Project. 1996-1998.

Reviewer for:

Journals

American Journal of Botany
American Midland Naturalist
Canadian Journal of Botany
Ecological Applications
Environmental and Experimental Botany
Environmental Geochemistry and Health
Environmental Management
Estuaries
Estuarine, Coastal and Shelf Science
Journal of Coastal Research
Journal of Environmental Quality
Journal of Vegetation Science
Limnology and Oceanography
Madroño
Plant Ecology
Restoration Ecology
Wetlands Ecology and Management
Wetlands

Agencies

National Science Foundation
Nationa l Sea Grant Program
CALFED Bay-Delta Program
Georgia Sea Grant Program
Hudson River Foundation
Louisiana Sea Grant Program
Keck Foundation
California State Coastal Conservancy
San Francisco Bay Conservation and Development Commission
University of California: Coastal Environmental Quality Initiative

Society memberships:

Estuarine Research Federation	1989-present
Society of Wetland Scientists	1990-present
California Botanical Society	1990-present
Ecological Society of America	1991-present
Society for Ecological Restoration	1995-present

V. THOMAS PARKER

Present Position

Professor of Biology (Plant Ecology)
Department of Biology
San Francisco State University
1600 Holloway Ave
San Francisco, CA 94132
(415) 338-2375, 338-6406 (FAX)
Internet: parker@sfsu.edu

Education

Ph.D.	University of California, Santa Barbara, 1977 (Ecology)
M.A.	University of California, Santa Barbara, 1975 (Ecology)
B.A.	University of Texas, Austin, 1973 (Biology) (Cum Laude, Phi Beta Kappa)

Professional Experience

1980-	Full, Associate, and Assistant Professor, Department of Biology, San Francisco State University and Director, Sierra Nevada Field Station, 1980-84
1977-1980	Assistant Professor, Biology Department, Rider College, Lawrenceville, NJ
1976-1977	Regent's Fellow, University of California

Professional Societies and Organizations

Phi Beta Kappa
Fellow, California Academy of Sciences
Ecological Society of America
Society of Conservation Biology
International Society of Vegetation Scientists
Society for Ecological Restoration
Sigma Xi
California Botanical Society (Recording Secretary, 1985-1988)
Bay Area Biosystematists

Research Interests

Community ecology: community dynamics of plants including seed banks, seedling establishment and recruitment; mycorrhizal ecology and vegetation dynamics; restoration ecology and vegetation management of wetlands and chaparral; conservation biology, systematics and evolution of *Arctostaphylos* (Ericaceae) and *Ceanothus* (Rhamnaceae).

Honors

Cum Laude, University of Texas, Austin (1973)
Phi Beta Kappa, University of Texas, Alpha Chapter of Texas (1974)
Southern California Botanists Award for Best Paper, Southern California Academy of Sciences Annual Meeting (1976)
Regent's Fellow, University of California (1976-1977)
Recording Secretary, California Botanical Society (Jan 1985-May 1988)
Fellow, California Academy of Sciences (elected 1989)

Publications

Books

Ecological Scale: Theory and Applications. 1998. D. Peterson and V. T. Parker (eds.) Complexity in Ecological Systems series. Columbia University Press, NY.

Ecology of Soil Seed Banks. 1989. M. A. Leck, V. T. Parker and R. L. Simpson (eds). Academic Press, NY.

Articles in review

Clark, C. J., J. R. Poulsen, E. F. Connor and V. T. Parker. *in review* Fruiting trees as dispersal foci in a closed canopy tropical forest. Submitted to Ecology.

Clark, C. J., J. R. Poulsen, E.F. Connor, and V. T Parker. *In review*. Comparative seed shadows of bird-, monkey, and wind-dispersed trees in a central African tropical rain forest. Submitted to Ecology.

Cullings, K. W., V. T. Parker, Shilpa Makhija and S. K. Finley. . *in review.* Effect of little removal on mycorrhizal communities in a mixed conifer forest in Yellowstone National Park. Submitted to Applied Environmental Microbiology

Cullings, K and V. T. Parker. *in review*. Seasonal variation in ectomycorrhizal communities in a mixed conifer forest in Yellowstone National Park. Can. J. Bot.

Cullings, K., W. Stoll, K. Byrd, D. Vogler and V. T. Parker. *in review*. Spatial-temporal dynamics of ectomycorrhizae in a mixed conifer forest in Yellowstone National Park: implications for control of community development. Can. J. Bot.

Bradford, K. A. and V. T. Parker. *in revision*. Mycorrhizal fungal species composition and abundance in mature *Arctostaphylos glandulosa* stands. Can. J. Bot.

Articles in the past 5 years

Parker, V. T. *in revision*. Community of the individual: implications for the community concept. Oikos *tentative acceptance*.

Hardesty, B. D. and V. T. Parker. 2002. Seed rain of a central African tropical forest. Plant Ecology *in press*.

Parker, V. T. 2002. The concept of the ecological community and a clash of perspectives: A reply to Looijen and van Andel. Persp. Plant Ecol. Evol. Syst 5:139-143.

Parker, V. T. 2001. Conceptual problems and scale limitations of defining ecological communities: A critique of the CI concept (Community of Individuals). Perspectives in Plant Ecology, Evolution, and Systematics **4**, 80-96.

Clark, C. J., J. R. Poulsen, and V. T. Parker. 2001. Frugivore impact on seed rain patterns in a central African tropical forest. Biotropica 33: 606-620.

Cullings, K. W., V. T. Parker, Shilpa Makhija and S. K. Finley. 2001. Effect of defoliation on the ectomycorrhizal community in a mixed *Pinus contorta/Picea engelmannii* forest in Yellowstone National Parker. Oecologia 127: 533-539.

Hileman, L., V. T. Parker and M C. Vasey. 2001. Phylogeny and biogeography of Arbutoideae (Ericaceae); implications for the Madrean-Tethyan hypothesis. Systematic Botany 26: 131-143.

Cullings, K. W., D. R. Vogler, V. T. Parker and S. K. Finley. 2000. Specificity of ectomycorrhizal interactions in a mixed Pinus contorta/Picea engelmannii forest in Yellowstone National Parker. Applied Environmental Microbiology 66: 4988-4991.

Byrd, K. B., V. T. Parker, D. R. Vogler, and K. W. Cullings. 2000. The influence off clear-cutting on ectomycorrhizal fungus diversity in a lodgepole pine (*Pinus contorta*) stand, Yellowstone National Park, Wyoming, and Gallatin National Forest, Montana. Can. J. Bot. 78(2):149-156.

Baxter, J. W. and V. T. Parker. 1999. Canopy gaps and topography structure a northern coastal scrub community on California coastal bluffs. Madroño 46: 69-79.

Vasey, M. C. and V. T. Parker. 1999. Nascent inflorescences in *Arctostaphylos pringlei*: response to Keeley and Wells. Madroño 46: 51-54.

Hunter, J. C., V. T. Parker, and M. G. Barbour. 1999. Understory light and gap dynamics in an old-growth forested watershed in coastal California. Madroño 46: 1-6.

Markos, S. E., V. T. Parker, L. Hileman, and M. Vasey. 1999. Phylogeny of the *Arctostaphylos hookeri* complex (Ericaceae) based on nrDNA sequence data from the ITS region. Madroño 45: 187-199.

Horton, T. R., T. Bruns and V. T. Parker. 1999. Ectomycorrhizal fungi in *Arctostaphylos* patches contribute to the establishment of *Pseudotsuga menziesii*. Canadian Journal of Botany 77: 93-102.

Dunne, J. A. and V. T. Parker. 1999. Seasonal soil water potential patterns and establishment of *Pseudotsuga menziesii* seedlings in chaparral. Oecologia 119: 36-45.

Whitney, K. D., M. K. Fogiel, A. Lamperti, K. M. Holbrook, D. J. Stauffer, B. D. Hardesty, V. T. Parker, and T. B. Smith. 1998. Seed dispersal by *Ceratogymna* hornbills in the Dja Reserve, Cameroon. J. Trop. Biol. 14:351-371.

Peterson, D. L. and V. T. Parker. 1998. Dimensions of scale in ecology, resource management and society, pp. 499-522. In: D. L. Peterson and V. T. Parker (eds.) *Ecological Scale: Theory and applications*. Columbia Univ. Press, NY.

Parker, V. T. and S. T. A. Pickett. 1998. Historical contingency and multiple scales of dynamics in plant communities, pp. 171-191. In: D. L. Peterson and V. T. Parker (eds.) *Ecological Scale: Theory and applications*. Columbia Univ. Press, NY.

Parker, V. T. 1997. The scale of successional models and restoration objectives. Restoration Ecology 5: 301-306.

Wood, M. and V. T. Parker. 1997. Factors affecting the distribution of *Arctostaphylos myrtifolia* (Ericaceae): the role of fire in the maintenance of a proposed endangered species and its habitat. In: *Fire effects on rare and endangered species and habitats*. Int. Assoc. Wildland Fire; Fairfield, WA.

Parker, V. T. and S. T. A. Pickett. 1997. Restoration as an ecosystem process: implications of the current ecological paradigm. In: Urbanska, K. M., N. R. Webb and P. J. Edwards (eds.) *Restoration Ecology and Sustainable Development*, pp 17-32. Cambridge: Cambridge University Press.

Parker, V. T. and S. T. A. Pickett. 1996. Understanding implications of the modern ecological paradigm: viewing restoration as a process. In: Peterson, D. L. and C. V. Klimas (eds.) *The Role of Restoration in Ecosystem Management*, pp. 15-22. Madison: Society for Ecological Restoration, Publ.

Articles published more than 5 years ago:

Brand, T. and V. T. Parker. 1995. Scale and general laws of vegetation dynamics. Oikos 73: 375-380.

Pickett, S. T. A. and V. T. Parker. 1994. Avoiding the old pitfalls: Opportunities in a new discipline. Restoration Ecology 2: 75-79.

Parker, V. T. 1993. Conservation issues in land management. In J. E. Keeley (coord. ed.) *The Interface Between Ecology and Land Development*, pp. 53-60. Southern California Academy of Sciences, Los Angeles.

Hunter, J. and V. T. Parker. 1993. The disturbance regime of an old growth forest in coastal California. Journal of Vegetation Science 4: 19-24.

Pickett, S. T. A., V. T. Parker, and P. F. Fiedler. 1992. The new paradigm in ecology: implications for conservation biology above the species level. In: P. L. Fiedler and J. A. Jain (eds.) *Conservation Biology: the theory and practice of nature conservation, preservation and management,* pp. 65-88. Chapman and Hall, NY.

Parker, V. T. 1992. Allelopathy in plant communities. In: W. A. Nierenberg (ed.) *Encyclopedia of Earth System Science*, pp. 71-77. Academic Press, San Diego.

Kelly, V. R. and V. T. Parker. 1991. Percentage seed set, sprouting habit and ploidy level in Arctostaphylos (Ericaceae). Madroño 38:227-232.

Kelly, V. R. and V. T. Parker. 1990. Seed bank survival in sprouting and nonsprouting Arctostaphylos species. American Midland Naturalist 124:114-123.

Parker, V. T. 1990. Problems encountered while mimicking nature in vegetation management: an example from a fire-prone vegetation. In R. S. Mitchell, C. J. Sheviak and D. J. Leopold (eds.) *Ecosystem Management: Rare species and significant habitats*. Proc. 15th Ann. Natural Areas Conf. New York State Museum Bulletin 471: 231-234.

Parker, V. T. 1989. Maximizing vegetation response on management burns by identifying fire regimes, pp. 87-91. *Fire and Watershed Management*, Sacramento, CA, Watershed Management Council, October 1988.

Rogers, C. R., V. T. Parker, V. R. Kelly, and M. K. Wood. 1989. Maximizing chaparral vegetation response to prescribed burns: experimental considerations, p. 158. *Fire and Watershed Management,* Sacramento, CA, Watershed Management Council, October 1988.

Kelly, D. O., V. T. Parker and C. Rogers. 1989. Chaparral response to burning: a comparison of a summer wildfire to prescribed burns in Marin County, p. 151. *Fire and Watershed Management,* Sacramento, CA, Watershed Management Council, October 1988.

Simpson, R. L., M. A. Leck, and V. T. Parker. 1989. Seed banks: General concepts and methodological issues. In, M. A. Leck, V. T. Parker and R. L. Simpson (eds) *Ecology of Soil Seed Banks*., pp. 3-8. Academic Press, NY.

Parker, V. T. and V. R. Kelly. 1989. Seed banks in California chaparral and other mediterranean climate shrubslands. In, M. A. Leck, V. T. Parker and R. L. Simpson (eds) *Ecology of Soil Seed Banks*., pp. 231-255. Academic Press, NY.

Parker, V. T., M. A. Leck, and R. L. Simpson. 1989. Pattern and process in seed banks dynamics. In, M. A. Leck, V. T. Parker and R. L. Simpson (eds) *Ecology of Soil Seed Banks*., pp. 367-384. Academic Press, NY.

Leck, M. A., R. L. Simpson, and V. T. Parker. 1989. The seed bank of a freshwater tidal wetland and its relationship to vegetation dynamics. In R. R. Sharitz and J. W. Gibbons (eds.) *Freshwater wetlands and wildlife*, pp. 189-205. DOE Symp. Series No. 61. CONF-8603101, USDOE Office of Sci. and Tech. Inf., Oak Ridge, Tenn.

Parker, V. T. and M. P. Yoder-Williams. 1989. Inhibition of conifer regeneration by an herbaceous perennial, *Wyethia mollis*. American Midland Naturalist 121:105-111.

Parker, V. T. 1987. Effect of wet-season management burns on chaparral regeneration: implications for rare species, pp. 233-237. In T. E. Elias (ed.) *Conservation and Management of Rare and Endangered Plants,* Calif. Native Plant Society, Sacramento, CA.

Parker, V. T. and C. R. Billow. 1987. A comparative survey of soil nitrogen beneath evergreen and deciduous California oaks, pp. 98-102. In T. R. Plumb (ed.) *Multiple-use Management of California's Hardwood Resources*. USDA Forest Service General Technical Report PSW-100.

Yoder-Williams, M. P. and V. T. Parker. 1987. Allelopathic interference in the seedbed of *Pinus jeffreyi* in the Sierra Nevada, California, USA. Canadian Journal of Forest Research 17:991-994.

Parker, V. T. 1987. Can native flora survive prescribed burns. Fremontia 15(2):3-6.

Simpson, R. L., M. A. Leck, and V. T. Parker. 1985. Comparative ecology of *Impatiens capensis* Meerb. (Balsaminaceae) in central New Jersey. Bulletin of the Torrey Botanical Club 112:295-311.

Parker, V. T. and M. A. Leck. 1985. Relationships of seed banks to plant distribution patterns in a freshwater tidal wetland. American Journal of Botany 72:161-174.

Parker, V. T. 1984. Correlation of physiological divergence with reproductive mode in chaparral shrubs. Madroño 31:231-242.

Hopkins, D. R. and V. T. Parker. 1983. A study of the seed bank of a salt marsh in northern San Francisco Bay. American Journal of Botany 71:348-355.

Parker, V. T. and C. H. Muller. 1982. Vegetational and environmental changes beneath isolated live oak trees (Quercus agrifolia) in a California annual grassland. American Midland Naturalist 107:69-81.

Mahall, B. E., V. T. Parker, and P. J. Fonteyn. 1981. Growth and photosynthetic irradiance responses of *Avena fatua* L. and *Bromus diandrus* Roth. and their ecological significance in California savannas. Photosynthetica 15:5-15.

Parker, V. T. and C. H. Muller. 1979. Allelopathic dominance by a tree associated herb in a California annual grassland. Oecologia 37:315-320.

Other professional activity:

>10 Published Book Reviews

>20 Published Unrefereed Articles or Technical Reports

> 50 Published Abstracts of Presentations at National/International Meetings

> 30 Invited Talks

Grant Support (last 10 years):

National Science Foundation-Undergraduate Minorities in Environmental Biology Program: $400,000, with E.F.Connor and G. Lebuhn. (**funded February 2002**)

National Science Foundation, Integrative Biology-RUI-Faculty: $15,000, Proposal to Study Mycorrhizal Differentiation Among Fungal Species in Douglas-fir forest Using Stable Isotopic Ratios, with Todd Dawson, UC Berkeley. (**funded September 2000**)

Napa County Land Trust, $17,000, Impact of prescribed burning on shrub dominants at the Mt. George Botanical Preserve, Napa County. (**funded** June 1999)

USDA, National Resource Initiative, Competitive Grants Program, Forest, Range and Aquatic Ecosystems: $237,000 (3yr) Structure of Mycorrhizal Fungal Communities: A test of models. (written and **submitted** November 1998, **funded** May 1999 +2 yr extension)

National Science Foundation, Ecology-RUI: $350,000 (3yr) Mycorrhizal community structure and specificity of symbiotic relationships, Yellowstone National Park (**funded** February 1999 + 1 yr extension)

SFSU-Research, Scholarship and Creative Activity Mini-Grant: $5k (1yr) Impact of species specific fungal pathogen on the dynamics of a salt marsh, China Camp State Park, Marin Co, CA. (**Submitted** all 1996: funded, **funded** January 1997)

National Science Foundation, Research Experience for Undergraduates Program: $285,000 (3yr) (**funded** May 1996) Training Undergraduates in Science and Technology. (co-PI with numerous faculty)

NIH, Minority International Research Training ($210,000 of a $896,763 award), Co-PI with Tom Smith (PI), Influence of large hornbill frugivores on forest dynamics in the Dja Reserve, southern Cameroon, Africa (3 yr) (**funded** September 1995)

USDA, National Resource Initiative, Competitive Grants Program, Forest, Range and Aquatic Ecosystems: $170,000 (3yr) Disturbance and mycorrhizal facilitation of Douglas-fir invasion of chaparral. (**funded** July 1995)

National Science Foundation, Ecology-RUI: $350,000 (3yr) Mycorrhizal community structure and specificity of symbiotic relationships, Yellowstone National Park (**funded** February 1995)

National Science Foundation, Academic Research Infrastructure (ARI): $347,384, Acquisition of DNA analysis instrumentation for molecular studies. (**funded** 1995) (co-PI with numerous faculty)

Mendocino National Forest, $20,000; Evaluation of seasonal variation in prescribed burning of chaparral and its impact on plant diversity and ecosystem management. (**funded** March 1993).

World Wildlife International, $25,000 for home range, diet, and keystone aspects of the Black-Casqued Hornbill in the maintenance of a tropical rainforest, Camaroon, Africa. with T.B. Smith (SFSU) and Roger Fotso, (Katholieke Universiteit, Leuven, Belgium). (**funded** 1993-1996).

USDA, National Resource Initiative, Competitive Grants Program, Forest, Range and Aquatic Ecosystems: $172,000 (3yr) Mycorrhizal facilitation of Douglas-fir invasion of chaparral. (**funded** 1992-1995).

Missouri Botanical Garden and NSF, $20,000; plus 3 $5000 undergraduate fellowships; A molecular systematic study of the genus Arctostaphylos. (Ericaceae) with M. Vasey (SFSU). (**funded** November 1992).

Michael C. Vasey

Director of Special Projects, Conservation Biology Program
Department of Biology, San Francisco State University,
1600 Holloway Avenue, San Francisco, CA 94132
(415) 338-1957
(415) 338-2295 Fax
Email: mvasey@ sfsu.edu

Education: M.A., 1990, Ecology and Systematic Biology, San Francisco State University
Ph.D. Program, Plant Population Genetics (Dr. Subodh Jain), U.C. Davis (1982-1983)
A.B., 1969, History, Dartmouth College, Hanover, N.H.
Community Service Learning Colloquium, SFSU, 1995

Areas of Specialization:

Ecological Stewardship; Vascular Plan Systematics; Conservation Biology; Evolutionary Biology; Ecological Restoration; Landscape Ecology; Natural Areas Management; Wetlands Conservation

Research Interests:

Management of rare and endangered species, ecological restoration, stewardship, *Arctostaphylos* systematics, wetland monitoring and assessment**,** evolution of inbreeding, landscape assessments of biological diversity

Work Experience:

Director of Special Projects, Faculty Lecturer — 1994 - Present
Conservation Biology Program, SFSU

Coordinator, Faculty Lecturer — 1990 - 1994
Conservation Biology Program, SFSU

Instructor in the following courses from 1995 - Present:

Biology 318 (Our Endangered Planet)
Biology 150 (World of Plants)
Biology 314 (Ecological Stewardship)
Biology 315 – Tiburon Center (Conserving Biodiversity in the San Francisco Bay)
Biology 315 – Sierra Nevada Field Campus (Conserving Biodiversity in the N. Sierra)
Biology 300 (Nature Studies)
Biology 310 (Biology for Today's World)
Biology 530 (Conservation Biology)
Environmental Studies 300

Projects

Co-Principal Investigator, *Arctostaphylos* systematics project — 1991 - Present
Funded by Flora of North America (NSF)

Environmental Science Curriculum Coordinator — 1991 - 1993

"Corps to College" Program, San Francisco Conservation Corps	
Codirector, Lake Merced Water Quality Monitoring Project	1995 - 1997
Codirector and Acting Manager San Francisco Bay National Estuarine Research Reserve Project	1991 - Present
Project Director, Terrestrial Vegetation of the Presidio, San Francisco	1992 - 1997
Project Director, Seeds of Success Project, Native Plant Restoration	1993-1996
Project Co-Director, San Francisco Natural Areas Project (Developed monitoring plan and resource assessment)	1998 - Present
San Francisco Estuary Wetland Regional Monitoring Program Plant Team Chair	1999 - Present
Member, Lake Merced Science/Recreation Task Force	1999 – Present
Environmental Monitoring and Assessment Intensification Co-Principal Investigator – Tidal Wetland Monitoring	2002 – Present

Publications:

Parker, V.T. and M.C. Vasey. In prep. Volume IV. *Arctostaphylos*: Flora of North America, Missouri Botanical Garden.

Vasey, M.C. and V.T. Parker. 2002. The manzanitas of California, also of Mexico and the World, by P.V. Wells: Book review. Madrono 49(1): 46-47.

Vasey , M (text) and D. Littschwager (photography). 2002. O! Manzanita: Right where you belong. Bay Nature January-March Issue.

Vasey, M. 2002. Riparian and upland vegetation of the San Pedro Creek watershed. Unpublished report.

Hileman, L.C., M.C. Vasey, and V. T. Parker. 2001. Phylogeny and biogeography of the Arbutoideae (Ericaceae): Implications for the Madrean-Tethyan hypothesis. Systematic Botany 26(1): 131-143.

Vasey, M. 2001. On the Trail: Of hazelnuts, adder's tongue, and coastal scrub. Bay Nature April-June Issue.

Vasey, M.C. and V.T. Parker. 1999. Nascent inflorewcences in Arctostaphylos pringlei: Response to Keeley and Wells. Madrono 46(1): 51.

Markos, S., L.C. Hileman, M.C. Vasey and V.T. Parker. 1999. Phylogeny of the *Arctostaphylos hookeri* complex (Ericaceae) based on rDNA data. Madrono 45(3): 187-199.

Vasey, M. 1998. Baseline inventory of the terrestrial vegetation of the Presidio. Technical Report for Legacy Natural Heritage Program.

Vasey, M. 1996. The perils of *Potentilla hickmanii*. Fremontia 24 (1): 3 - 11.

Ornduff, R. and M.C. Vasey. 1995. The flora and vegetation of the Marin Islands. *Madrono* .

Vasey, M.C. 1994. Biological Assessment of Pedro Point Headland, San Mateo County, CA. Unpublished report to the Pacifica Land Trust, Pacifica, CA .

Vasey, M.C. 1991. The evolution of *Lasthenia maritima* (*Asteraceae*), an endemic of seabird breeding habitats. Master's Thesis, San Francisco State University.

Crawford, D.J., R. Ornduff, and M.C. Vasey. 1985. Allozyme variation within and between Lasthenia minor and its derivative species, Lasthenia maritima (Asteraceae). American Journal of Botany 72: 1177 - 1184

Vasey, M.C. 1985. The specific status of Lasthenia maritima (Asteraceae), an endemic of seabird-breeding habitats. Madrono 32:131-142.

Vasey, M.C. 1984. Vernal pools, seabird rocks, and a remarkable species of Lasthenia. In S. Jain and P. Moyle, eds., Vernal pools and intermittent streams: a symposium sponsored by the Institute of Ecology, Univ. California, Davis, 9 and 10 May 1981. Institute of Ecology Publ. No. 28.

Vasey, M.C. 1980. Natural hybridization between two evergreen black oaks in the north central coast ranges of California. pp. 30 - 35 in T.R. Plumb (Ed.)Proceedings of the symposium on ecology, management, and utilization of California oaks. USDA Forest Service. PSW Forest & Range Station General Technical Report PSW 44.

Invited and Contributed Presentations:

Co-Instructor: Parker, V.T. and M.C. Vasey, Jepson Herbarium Weekend Workshop on *Arctostaphylos*, Berkeley, CA, January, 2002

Co-Instructor: Parker, V.T. and M.C. Vasey, Jepson Herbarium Weekend Workshop on *Arctostaphylos*, Berkeley, CA, January, 2000.

Speaker: Milo Baker Chapter of the California Native Plant Society. Manzanitas: A California Treasure. June, 1999.

Speaker: Santa Clara and Santa Cruz Chapters of the California Native Plant Society. Manzanitas: A California Treasure. February, 1999.

Speaker: San Francisco Recreation and Park Dept, Significant Natural Resource Areas Docent Program. "Introduction to the Franciscan Landscape". December, 1998.

Speaker: Save the Bay/Pacific Institute event on San Francisco Bay and Global Climate Change. "Saving San Francisco Bay: For What and For Whom?". November, 1998.

Speaker: Restoration Workshop, Randall Museum, San Francisco Recreation and Parks Department, "Monitoring Design and Implementation"; February 1998.

Speaker: Fellow's Science Day, California Academy of Sciences, "Invasive plants in the San Francisco Bay Estuary - patterns and prospects"; February 1997.

Speaker: Gamma Ray San Francisco State Alumni, Natural History of Montara Mountain, January 1997.

Panelist: San Bruno Mountain Habitat Conservation Plan Forum, sponsored by the Sierra Club, Loma Prieta Chapter, Brisbane, March, 1996.

Speaker: Oakland Museum of Natural History, Guest Lecture, Patterns of Natural Diversity and Conservation Challenges in the Northern San Francisco Peninsula, October, 1995.

Presenter: Phylogenetic relationships in Arctostaphylos (Ericaceae) using molecular and morphological analyses, Amer. Soc. for Plant Taxonomy, San Diego, August, 1995.

Speaker: San Francisco Zoological Society, Docent Training Program. "Endangered Species and Biological Diversity: A Modern Dilemma". April, 1995.

Speaker: Bridges to Baccalaureate Program, City College of San Francisco, "Students practicing conservation science ... and getting paid for it", April 1995.

Panelist: San Bruno Mountain Habitat Conservation Plan Forum, sponsored by the Sierra Club, Loma Prieta Chapter, Brisbane, March, 1995.

Co-Instructor: Parker, V.T. and M.C. Vasey, Jepson Herbarium Weekend Workshop on *Arctostaphylos*, Berkeley, CA, January, 1995.

Presenter: Vasey, M.C., Parker, V.T. and Hileman, L.C. The application of molecular phylogeny to paleobotanical interpretation: an example using the Arbuteae (Ericaceae). GSA annual meeting, Seattle, WA. October, 1994.

Coauthor: Hileman, L.C., Parker, V.T., and Vasey, M.C. Preliminary generic relationships of the Arbuteae (Ericaceae) based on molecular sequence data. AIBS annual meeting, Knoxville, TN. August, 1994.

Coauthor: Fiedler, P.L., Laven, R.D., and Vasey, M.C. The implications of rare-common species differences for conservation and management. AIBS annual meeting, Knoxville, TN. August, 1994

Speaker: San Francisco Zoological Society, Docent Training Program. "Endangered Species and Biological Diversity: A Modern Dilemma". March, 1994.

Speaker: Cataloguing biodiversity: The Presidio as a case in point. Biology Colloquium, Sonoma State University. November, 1993

Speaker: Concepts on Biodiversity. Natural Resource Agencies and Biodiversity Conservation: What is the appropriate response? Sacramento, CA. January, 1993

Speaker: San Jose State University, Department of Bilogy Seminar Series. "Biodiversity of the Santa Cruz Mountains"; May, 1992

Speaker: San Francisco Zoological Society, Docent Training Program. "Endangered Species and Biological Diversity: A Modern Dilemma"; February, 1992

Speaker: University of California, Bodega Bay Marine Laboratory. "The evolution of *Lasthenia maritima*, an endemic of seabird-breeding habitats"; Winter, 1991

Speaker: California Botanical Society. "Origin by Quantum Speciation: The Case of *Lasthenia maritima*, an endemic of seabird-breeding habitats"; Fall, 1991.

Speaker: Pacific Grove Museum of Natural History, "Sliding Toward Extinction"series; "Rarity in the California Flora: A Perilously Common Phenomenon"; Summer, 1991.

Professional Affiliations:

Biosystematists
California Botanical Society (1st V.P. 1990-1991; Member at Large, 1992 - Present)
American Institute for Biological Sciences
Society for Conservation Biology
Society for Ecological Restoration
Natural Areas Association
League of Conservation Voters
Sigma Xi

Civic Involvement:

City Council, City of Pacifica	1990 - 1992
Steering Committee, Santa Cruz Mountain Region Bioregional Council	1990 - 1999
Co-Chair, Open Space Committee, Pacifica	1988-1990
Conservation Chair, Save San Francisco Bay Association	1992 - Present
Board Member, Institute for Ecological Health (Nonprofit)	1993 - Present
Sierra Club (Member of the Biological Diversity Committee)	1991-Present
California Native Plant Society	
San Mateo Conservation Chair, Yerba Buena Chpt.	1991-Present
Key Contact, Sierra Nevada Ecosystem Project	1994 - 1997
Board Member, Pacifica Chamber of Commerce (Chair, Sustainable Development Committee)	1995 - Present
Pacifica Land Trust, President	1997-Present
San Pedro Creek Watershed Coalition	1998-Present

14.
Nadav Nur
Curriculum Vitae of Principal Investigator

Born:	24 January 1953
Citizenship:	U.S.A.
Marital Status:	Married, Two Children
Social Security Number:	086-38-7537

Education:

Monroe High School, Rochester, New York, 1965-1970.
Graduated June 1970, ranked 2nd in class of 294.

Cornell University, College of Arts & Sciences, 1970-1974. Graduated June 1974, with B.A.
Major: Psychology. Concentration in Animal Behavior.
Topic of Senior Honors Research: Achromatic Color Perception and the Predatory Behavior of the Marine Toad, Bufo marinus.

Duke University, Graduate School, 1976-1981. Graduated December 1981 with Ph.D. in Zoology. Minor: Mathematics.
Dissertation Topic: The Adaptive Significance of Brood Size in the Blue Tit, Parus caeruleus.

University of Washington, Graduate School. Full time, fall 1987- winter 1989; part-time or on leave: spring 1989-fall 1991.
Graduated December 1991 with M.S. in Biostatistics.
Thesis Topic: On Estimating the Proportion of Variance Attributable to Identified Loci.

Professional History:

Laboratory Technician III in Psychobiology Research Laboratory, University of Rochester, Medical Center, Rochester, NY, 1974-1976. Carried out research in psychoimmunology in rats and mice; for Drs. R. Ader and L. Grota.

Teaching Assistant, Department of Zoology, Duke University, 1976-1981.

George S. Wise Postdoctoral Fellow, Department of Zoology, Tel Aviv University, November 1981 to November 1982. Investigated behavior and ecology of birds of prey and pursued theoretical studies of evolution of phenotypic plasticity.

Visiting Research Associate, Bureau of Biological Research, Rutgers University, New Brunswick, N.J., September 1983 to July 1984. Worked in Dr. Harry Power's lab on evolutionary aspects of avian reproductive strategies.

Assistant Professor in Biology, Biology Department, University of Rochester, August - December 1984 (Temporary Appointment).

Taught course in Animal Behavior; co-taught Introductory Biology Laboratory.

Professional History, continued

NATO Postdoctoral Fellow in Science, Biological Science Department, University of Stirling, January 1985 to March 1986.
Worked in laboratory of Dr. D.M. Bryant on Bank Swallow reproductive energetics.

Alexander von Humboldt Research Fellow, University of Tubingen, March 1986-July 1987.
Worked with Prof. K. Schmidt-Koenig on reproductive ecology of tits (Parus spp).

Research Associate, Dept. of Biostatistics, University of Washington, 1988 to 1989.

Quantitative and Population Ecologist, Point Reyes Bird Observatory, Stinson Beach, California. From February 1989.
Population modeling, quantitative ecology, and statistical analysis of ecological data of seabirds, landbirds and marine mammals; conservation Biology; life history strategies. Conservation biology of tidal marsh and riparian birds in fragmented landscapes.
As of January 2000, my job title was changed to: Director of Population Ecology Program

Adjunct Professor of Biology, San Francisco State University, San Francisco, CA. From January 1997.

Grants & Contracts (PI or Co-PI), since 1991 only:
NSF Academic Research Facilities Modernization Grant, $151,000, 1991-1993.
Alaska Dept. of Fish & Game, $35,000, 1991-92, "Recovery of Marine Bird Populations from Environmental Perturbation", for Exxon Valdez Restoration Working Group
National Geographic Society, $22,000, 1992-1994, co-PI, with Dr. Wes Weathers, "Annual Energetics of White-crowned Sparrows"
Gulf of the Farallones National Marine Sanctuary, $89,000, 1991-1994, "Computer Seabird Model" (developed stochastic population dynamic models of Common Murre, Brandt's Cormorant, Western Gull).
Calif. Dept. of Fish & Game, $310,000 total, 1992-1996, "Impact of Cantara Spill on Terrestrial Bird Populations" [3 contracts]
US Fish & Wildlife Service, $5,000, 1993, "Establishing Demographic Parameters of Marbled Murrelets"
US Fish & Wildlife Service, $51,000 total, 1992-1993; 1994-1995, "Validation of Constant-Effort Mist-Netting for Avian Population Monitoring" [2 contracts]
US Fish & Wildlife Service, $7,000, 1994-96, "Statistical Guide to Data Analysis for Avian Population Monitoring"
CA Dept. Fish & Game, $110,000, 1994-1996, co-PI, "Impact of Chronic Oiling on Murres"
National Biological Service, $48,000, 1995-96, "Status and conservation of five taxa of Tidal Marsh Birds" [Song Sparrow, Common Yellowthroat, Black Rail]
National Biological Service, $38,000, 1995-1996, co-PI, "Population viability analysis of Xantus' Murrelet and Ashy Storm Petrel"

Grants and Contracts, continued:

National Science Foundation, $443,000, 1996-1999, co-PI, "Factors regulating population size and colony distribution of Adelie Penguins"

National Biological Service, $25,000, co-PI, 1996-1997, "Pacific seabird database"

National Fish & Wildlife Foundation, $266,000, 1994-1999, "Songbird conservation in riparian habitat [3 grants]

Biological Resources Division, USGS, $62,000, 1997-1999, co-PI, "Metapopulation dynamics and population structure of two seabirds: Xantus' Murrelet and Ashy Storm Petrel"

Packard Foundation and Hewlett Foundation, $300,000, 1998-2000, co-PI, "Songbird conservation in riparian habitat in the West"

National Science Foundation, $599,000, 1999-2002, co-PI with Dr. David Ainley, "Factors regulating population size and colony distribution of Adelie Penguins, Renewal"

Osher Foundation, Gabilan Foundation, and Grand Foundation $335,000, 1997-2002, "Conservation Biology of Tidal Marsh Birds in San Francisco Bay," [multiple annual grants]

Environmental Protection Agency, $60,000 for PRBO portion [$660,000, total], co-PI, 1999-2002, CISNet: Development of a Monitoring Program for San Pablo Bay

National Science Foundation, $90,000, co-PI, 2000 to 2001, Biocomplexity Incubation grant: Multi-disciplinary study of riparian restoration

CALFED Bay-Delta Program, $145,000 for PRBO portion [$1,000,000, total], co-PI, 2001-2003, "BREACH Project: Comparative Study of Tidal Marshes and Tidal Marsh Restoration in San Francisco Estuary"

Mary E. Crocker Trust, $25,000, 2001, "Landscape studies of Tidal Marsh-Dependent Birds in San Francisco Bay"

US Fish and Wildlife Service, $15,600, 2001 to 2002. Black Rail Population and nesting studies.

CALFED Bay-Delta Program, $150,000 for PRBO portion [$2,341,000 total], co-PI, 2002 to 2004 "The influence of flood regimes, vegetative and geomorphic structures on the links between aquatic and terrestrial systems: Applications to CALFED restoration strategies"

Awards:

Dean's List, Cornell University, College of Arts & Sciences, 1970, 1971, 1972.
New York State Regents Scholarship, awarded 1970.
Bausch & Lomb Science Scholarship (Honorary), 1970.
Duke University, Graduate School, Teaching Assistantship, 1976-1981
George S. Wise Postdoctoral Fellowship in Life Sciences, Tel Aviv Univ. 1981-1982.
NATO Postdoctoral Fellowship in Science, (U.S. NSF), 1985-1986.
Alexander von Humboldt Research Fellowship, West Germany, 1986-1987.
NIH Traineeship in Cardiovascular Biostatistics, University of Washington, 1987-1989.
Elective Member, American Ornithologists' Union, 1990.

Teaching Experience:

University of Rochester, Department of Biology, fall 1984;
Taught "Animal Behavior" course.
Co-taught "Introductory Biology Laboratory"

Duke University, Department of Zoology, 1976-1981:

Guest lecturer in "Animal Diversity" course, fall 1979 and fall 1980.
Teaching Assistant to Dr. N. Christenson, Introductory Biology, fall 1976.
Teaching Assistant to Dr. J. Delson, Introductory Physiology, Spring 1977.
Teaching Assistant to Dr. M. Rausher, Animal Diversity, fall 1978, 1979 and 1980.
Teaching Assistant to Dr. C. Ward, Introduction to Genetics, spring 1978 and 1981.
Teaching Assistant to Dr. M. Adams, Genetics, spring 1980.
Teaching Assistant to Dr. H. Wilbur, Evolutionary Mechanisms, fall 1977.

Point Reyes Bird Observatory, spring 1994 – 1998; 2000 - 2002. Co-taught intensive course on population monitoring: data acquisition, data analysis and study design.

Invited Seminar Speaker, since 1992 only

Department of Avian Sciences, U.C. Davis, Davis, CA, May 1992
Department of Zoology, University of Washington, Seattle, November 1993
Department of Wildlife & Fisheries Biology, U.C. Davis, Davis, CA, November 1993
Museum of Vertebrate Zoology, University of California, Berkeley, April 1994
Department of Biological Sciences, University of Missouri, Columbia, MO, March 1996
Museum of Vertebrate Zoology, University of California, Berkeley, March 1996
Department of Biological Sciences, Simon Fraser University, Vancouver, October 1996
National Marine Fisheries Service, Tiburon, CA, November 1996
Center for Avian Sciences, U.C. Davis, Davis, CA, November 1997
Department of Environmental Science, Policy, and Management, U.C. Berkeley, March 2000
Romberg Tiburon Center, San Francisco State University, May 2001

Invited Speaker, International Symposia and Conferences:

2nd International Foraging Behavior Conference, Brown Univ., Providence, June 1984
International Workshop on "Causal and evolutionary aspects of the determination of bird numbers," Wageningen, Holland, October 1985
Symposium on Reproductive Fitness, XIX Int. Ornithological Congress, Ottawa, June 1986
International Symposium on Evolution, "Organizational Constraints on the Dynamics of Evolution," Budapest June 1987
Symposium on Long Term Ecological Studies in Birds, Cooper Ornithological Society, Moscow, Idaho, June 1989.
Symposium on costs of reproduction in plants and animals. Ecological Society of America, Toronto, ON, August 1989.
NATO Advanced Research Workshop in Demographical, Physiological and Genetical Aspects of Population Biology of Passerine Birds. Evisa, Corsica, October 1989.
Symposium on Population Biology of Sparrows, AOU, Montreal, August 1991
National Workshop on Status and Management of Neotropical Migrants, Estes Park, CO, September 1992
International Workshop on Mist-netting as a Monitoring Tool, Point Reyes, California, November 1993
EURING conference on State-of-the-Art Data Analysis, Patuxent, MD, September 1994
International Seabird Restoration Workshop for Exxon Valdez Trustee Council, Girdwood, Alaska, September 1995

International "Partners in Flight" Conference on Status and Management of Neotropical Migrant Birds, Cape May, NJ, October 1995
Symposium on Cormorant Biology, Joint Pacific Seabird Group/Colonial Waterbird Society meeting, Victoria, B.C., Canada, November 1995
EURING conference on large-scale studies of marked birds, Norwich, UK, April 1997
Population Biology of Song Sparrows – A Model System, North American Ornithological Conference, St. Louis, April 1998
Use of microcomputers in population modeling, 4th Conference on Microcomputers in Wildlife and Natural Resource Management, Stateline, NV, October 1999
International "Partners in Flight" Conference on Status and Management of Neotropical Migrant Birds, Asilomar, CA, March 2002
First International Conference on Ecology, Evolution and Conservation of Vertebrates to Salt-water marshes, Patuxent, MD, October 2002

Additional Professional Activities:

Founding member, National Research Working Group, and Member, National Monitoring Working Group, "Partners in Flight" (Neotropical Migrant Bird Conservation Program).
Founding member, US/Canada Migration Monitoring Council
Delegate to International Council of Bird Preservation (now Birdlife International), since 1990.
Organizer, Workshop on Population Data Analysis, 1994 Joint North American Ornithological Conference.
Convener, Roundtable Discussion on Avian Population Monitoring, International Ornithological Congress, Vienna, 1994.
Session organizer and sub-editor for Proceedings of 2nd International Partners in Flight Meeting, Cape May, October 1995.
Program Committee Member and Session Chair, EURING conference on the study of marked individuals, Norwich, England, April 1997.
Organizer, Symposium on Song Sparrow Population Biology -- A Model Species 1998 Joint North American Ornithological Conference, April 1998.
Board of Directors, Cooper Ornithological Society, term: 1998 to 2001.
Chairman of Local Committee, EURING conference on the study of marked individuals, Point Reyes, CA, Oct 2000.

Served as reviewer for Journal of Animal Ecology, Ecology, Evolution, American Naturalist, Behavioral Ecology, Auk, Ornis Scandinavica, Condor, Oikos, Journal of Wildlife Management, Quart. Rev. of Biology, Canadian Journal of Zoology, Wilson Bulletin, et al.,
Served as reviewer for NSF Population Biology Program, Animal Behavior Program, Division of Polar Programs.

Elective Member: American Ornithologists' Union
Member: American Statistical Association
Animal Behavior Society
Biometric Society
British Ecological Society
Cooper Ornithological Society
Ecological Society of America

International Society for Behavioral Ecology
Pacific Seabird Group
Society for Conservation Biology
Society of American Naturalists

List of Publications

Scientific Papers Published:

Nur, N. 1983. On parental investment during the breeding season. Animal Behaviour **31**, 309-311.

Nur, N. 1984. Increased reproductive success with age in the California Gull: due to increased effort or improvement of skill? Oikos **43**, 407-408.

Nur, N. 1984. Fitness, population growth rate and natural selection. Oikos **42**, 413-414.

Nur, N. 1984. The consequences of brood size for breeding blue tits: I. Adult survival, weight change and the cost of reproduction. Journal of Animal Ecology **53**, 479-496.

Nur, N. 1984. The consequences of brood size for breeding blue tits: II. Nestling weight, offspring survival and optimal brood size. Journal of Animal Ecology **53**, 497-517.

Nur, N. 1984. Non-territorial intruders in the great tit: Are they making the best of a bad lot? Animal Behaviour **32**, 918-919.

Nur, N. and Hasson, O. 1984. Phenotypic plasticity and the handicap principle. Journal of Theoretical Biology **110,** 275-297.

Nur, N. 1984. Feeding frequencies of nestling blue tits (Parus caeruleus): Costs, benefits and a model of optimal feeding frequency. Oecologia **65**, 125-137.

Nur, N. 1986. Is clutch size variation in the blue tit (Parus caeruleus) adaptive: An experimental study. Journal of Animal Ecology **55**, 983-999.

Nur, N. 1987. Alternative reproductive tactics in birds: Individual variation in clutch size. pp. 49-77, **in** Perspectives in Ethology, v. 7, (ed. by P.P.G. Bateson and P.H. Klopfer). Plenum Press, New York.

Nur, N. 1987. Parents, nestlings and feeding frequency: A model of optimal parental investment and implications for avian reproductive strategies. pp. 457-475, **in** Foraging Behavior, (ed. by A. Kamil, J.R. Krebs, and H.R. Pulliam). Plenum Press, New York.

Nur, N. 1987. Population growth rate and the measurement of fitness: a critical reflection. Oikos **48**, 338-341.

Nur, N. 1988. The cost of reproduction in birds: an examination of the evidence. Ardea **76**, 151-162.

Nur, N. 1988. The consequences of brood size for breeding blue tits. III. Measuring the cost of reproduction: survival, future fecundity and differential dispersal. Evolution **42**, 351-362.

Durant, J., Honore, E., Klopfer, L., Klopfer, M., Klopfer, P., Kohn, T., Lessley, B., Nur, N., and Oyama, S. 1988. Aggression: Conflict in Animals and Humans Reconsidered. Wiley, New York. (Published under the pseudonym, "John Klama".) (I was lead author for a chapter on the evolutionary biology of aggression, including applications of evolutionary game theory to human interactions.)

Nur, N. and Clobert, J. 1988. Measuring Darwinian fitness in birds: A field guide. Acta XIX Congressus Internationalis Ornithologici. H. Ouellet (Ed.) University of Ottawa Press. 2121-2130.

Nur, N. 1989. The sociobiology of human mate preference: on testing evolutionary hypothesis. Behavioral and Brain Sciences **12**,

Nur, N. 1990. The cost of reproduction in birds: Evidence from manipulative and non-manipulative studies. pp. 281-296 **in** Population biology of passerine birds, an integrated approach, (ed. by J. Blondel, A. Gosler, J-D. Lebreton, R. McCleery). Springer-Verlag, Heidelberg.

Sydeman, W., Huber, H., Emslie, S., Ribic, C. and Nur, N. 1991. Age-specific weaning success of northern elephant seals in relation to previous breeding experience. Ecology **72**, 2204-2217.

Nur, N. 1991. Lifetime reproductive success in birds (Book review). Evolution **45**, 1538-1539.

Spear, L., Nur, N. and Ainley, D.G. 1992. Estimating absolute densities of flying seabirds using analyses of relative movement. Auk **109**, 385-389.

Pyle, P., Nur, N., Henderson, and DeSante, D.F. 1993. The effects of weather and lunar cycle on nocturnal migration of landbirds at southeast Farallon Island, California. Condor **95**, 343-361.

Nur, N. and Geupel, G.R. 1993. Evaluation of mistnetting, nest-searching and other methods for monitoring demographic processes in landbird populations. pp. 237-244 **in** Status and Management of Neotropical Migrant Birds. D. Finch & P. Stangel (Eds.) USDA Forest Service Gen. Techn. Rep. RM-229. USDA, Fort Collins, CO.

Geupel, G. and Nur, N. 1993. Monitoring bird populations: the role of bird observatories and other nongovernmental agencies. pp. 237-244 **in** Status and Management of Neotropical

Migrant Birds. D. Finch & P. Stangel (Eds.) USDA Forest Service Gen. Techn. Rep. RM-229. USDA, Fort Collins, CO.

Spear, L. and Nur, N. 1994. Brood size, hatching order and hatching date: Survival and recruitment in four life-history stages of the Western Gull. Journal of Animal Ecology **63**, 283-298.

Pyle, P., Nur, N., and DeSante, D.F. 1994. Trends in nocturnal migrant landbird populations at southeast Farallon Island, California, 1968-1992. pp. 58-74 **in** A Century of Avifaunal Change in Western North America. N. K. Johnson & J. Jehl, Ed. Studies in Avian Biology **15**.

Sydeman, W.J. and Nur, N. 1994. Life history strategies of female northern elephant seals. pp. 137-153 **in** Elephant Seals: Population Ecology, Behavior and Physiology. (ed. by B. Le Boeuf and R. Laws). University of California Press, Berkeley.

Spear, L., Ainley, D.G., Nur, N. and Howell, S.N.G. 1995. Population size and the behavioral and physical factors affecting at-sea distributions of four threatened procellarids in the tropical Pacific. Condor **97**, 613-638.

Baker, M., Nur, N. and Geupel, G.R. 1995. Correcting biased estimates of dispersal and survival due to limited study area: Theory and an application using wrentits. Condor **97**, 663-674.

Ainley, D.G., Nur, N., and Woehler, E.C. 1995. Factors affecting the distribution and size of penguin colonies in the Antarctic. Auk **112**, 171-182.

Ainley, D.G., R. Podolsky, L. De Forest, G. Spencer, and Nur, N. 1995. Kauai Endangered Seabird Study, Vol. 2: The ecology of Newell's Shearwater and Dark-rumped Petrel on Kauai, Hawaii. Electric Power Research Institute, Palo Alto, CA, TR-105847-V2.

Cooch, E., Pradel, R. and Nur, N. 1996. A Practical Guide to Capture/Recapture Analysis using SURGE. 125 pages. *Centre d'Ecologie Fonctionelle et Evolutive* - CNRS, Montpellier, France.

Pyle, P., Nur, N., Sydeman, W.J, and Emslie, S. 1997. Cost of reproduction and the evolution of deferred breeding in the Western Gull. Behavioral Ecology **8**, 140-147.

Chase, M., Nur, N., and Geupel, G.R. 1997. Survival, productivity, and abundance of a Wilson's Warbler population. Auk **114**, 354-366.

Beissinger, S.R. and Nur, N. 1997. Appendix B: Population trends of the Marbled Murrelet projected from demographic analysis. Pages B1-B35 **in** *Plan for the Marbled Murrelet (*Branchyramphus marmoratus*) in Washington, Oregon, and California.* U.S. Fish & Wildlife Service, Portland, OR.

Spear, L., Pyle, P., and Nur, N.. 1998. Natal philopatry in the Western Gull: proximal causes and fitness consequences. Journal of Animal Ecology **67**, 165-179.

Podolsky, R., Ainley, D.G., DeForest, L., Spencer, G, and Nur, N. 1998. Mortality of Newell's Shearwaters caused by collisions with urban structures on Kauai. Colonial Waterbirds **21**, 20-34.

Sydeman, W.J., Nur, N., E.B. McLaren, and McChesney, G.J. 1998. Status and trends of the Ashy Storm-petrel on Southeast Farallon Island, California, based on capture-recapture analysis. Condor **100**, 438-447.

Ainley, D.G., Wilson, P.R., Barton, K., Ballard, G., Nur, N, and Karl, B. 1998. Diet and foraging effort of Adélie Penguins in relation to pack-ice conditions in the southern Ross Sea. Polar Biology **20**, 311-319.

Silkey, M., Nur, N., and Geupel, G.R. 1999. The use of mist-net capture rates to monitor annual variation in abundance: A validation study. Condor **101**, 288-298.

Nur, N. and Sydeman, W.J. 1999. Survival, breeding probability, and reproductive success in relation to population dynamics of Brandt's Cormorants *Phalacrocorax penicillatus*. Bird Study **46** (suppl.), S92-S103.

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.

Nur, N., Jones, S.L., and Geupel, G.R. 1999. A Statistical Guide to Data Analysis of Avian Monitoring Programs. Biological Technical Publication, US Fish & Wildlife Service, BTP-R6001-1999.

Nur, N., Geupel, G.R., and Ballard, G. 2000. The use of constant-effort mist-netting to monitor demographic processes in passerine birds: Annual variation in survival, productivity and floaters. pp. 185-194 **in:** Strategies for Bird Conservation: The Partners in Flight Planning Process; Proceedings of 3rd Partners in Flight Workshop. R. Bonney, D. Pashley, R.J. Cooper, and L. Niles, Eds. Proceedings RMRS-P-16. USDA Forest Service, Ogden, UT.

Cooper, R.J, and Nur, N. 2000. On the need for demographic approaches to answer questions about conservation and management of migratory landbirds. pp. 165-168 **in:** Strategies for Bird Conservation: The Partners in Flight Planning Process; Proceedings of 3rd Partners in Flight Workshop. R. Bonney, D. Pashley, R.J. Cooper, and L. Niles, Eds. Proceedings RMRS-P-16. USDA Forest Service, Ogden, UT.

Gardali, T., Ballard, G., Nur, N., and Geupel, G.R. 2000. Demography of a declining population of Warbling Vireos in coastal California. Condor **102**, 601-610.

Wijsman, E.M., and Nur, N. 2001. On estimating the proportion of variance in a phenotypic trait attributable to a measured locus. Human Heredity **51**, 145-149.

Ainley, D.G., Podolsky, R., DeForest, L., Spencer, G., and Nur, N. 2001. The status and population trends of the Newell's Shearwater on Kaua'i--Insights from modeling. Studies in Avian Biology **22**, 108-123.

Wilson, P.R., Ainley, D.G., Nur, N., Jacobs, S.S., Barton, K.J., Ballard, G., and Comiso, J.C. 2001. Population change in the Pacific sector of Antarctica: Relation to sea-ice extent and the Antarctic Circumpolar Current. Marine Ecology Progress Series **213**, 301-309.

Nur, N. and Geupel, G.R. 2001. Babblers (Wrentit). pp. 466-467 **in:** The Sibley Guide to Bird Life and Behavior. C. Elphick, J.B. Dunning, and D.E. Sibley, Eds. Knopf, NY.

Shuford, W.D., Humphrey, J.M., and Nur, N. 2001. Breeding status of the Black Tern in California. Western Birds 32, 189-217.

GARY W. PAGE
Point Reyes Bird Observatory
4990 Shoreline Highway
Stinson Beach, CA 94970-9701

Born: September 1943

EDUCATION:

BSc Zoology. University of Guelph, Ontario. 1966.

MSc Zoology. University of Guelph, Ontario. 1970. Thesis: "The relationship between fat deposition and migration in the Semipalmated Sandpiper".

EXPERIENCE:

January 1985 to present: Director of Wetland Program, Point Reyes Bird Observatory.

March 1971 to January 1985: Research Biologist. Point Reyes Bird Observatory, Stinson Beach, CA.

September to November 1970: Research station manager. Long Point Bird Observatory, Ontario, Canada.

June to August 1970: Natural history instructor. Sunbury Shores Art and Nature Center, Saint Andrews, New Brunswick, Canada.

September to October 1968: Research station manager. Long Point Bird Observatory.

June to August 1968: Research assistant. University of Michigan. Biology of arctic birds at Cape Sparbo, Devon Island, N.W.T., Canada.

January to May 1968: Research assistant. Kortwright Waterfowl Research Station, Ontario, Canada.

May to October 1967 and 1966: Research station manager. Long Point Bird Observatory.

May to August 1965: Research assistant. Department of Lands and Forests, Ontario, Canada. Evaluation of deer and grouse habitat.

CURRENT RESEARCH:

Quantifying shorebird use of Pacific Flyway wetlands; determining threats to wetlands; synthesizing the bird and threat data into a comprehensive picture of shorebirds' future prospects in the Pacific Flyway.

Research on the behavior and ecology of Snowy Plovers for application toward preservation of their habitat.

PUBLICATIONS -- In Refereed Scientific Journals:

1967. Mist netting shorebirds at Long Point, Lake Erie. *Ontario Bird Banding* 3:79-83.

1968. With M. Bradstreet. Size and composition of a fall population of Least and Semipalmated Sandpipers at Long Point, Ontario. *Ontario Bird Banding* 4:82--88.

1969. With A. Salvadori. Weight changes of Semipalmated and Least Sandpipers pausing during autumn migration. *Ontario Bird Banding* 5:52-58.

1971. With B. Fearis. Sexing Western Sandpipers by bill length. *Bird Banding* 42:297-298.

1972. With B. Fearis and R. M. Jurek. Age and sex composition of Western Sandpipers on Bolinas Lagoon. *Calif. Birds* 3:79-86.

1972. With A. L. A. Middleton. Fat deposition during autumn migration in the Semipalmated Sandpiper. *Bird-Banding* 43:85-96.

1974. Molt of wintering Least Sandpipers. *Bird-Banding* 45:93-105.

1974. Age, sex, molt, and migration of Dunlins at Bolinas Lagoon. *Western Birds* 5:1-12.

1975. With D. F. Whitacre. Raptor predation on wintering shorebirds. *Condor* 77:73-83.

1976. With D. J. T. Hussell. Observations on the breeding biology of Black-bellied Plovers on Devon Island, N. W. T., Canada. *Wilson Bull.* 88:632-653.

1976. With L. E. Stenzel and H. R. Huber. Feeding behavior and diet of the Long-billed Curlew and Willet. *Wilson Bull.* 88:314-332.

1977. With M. S. W. Bradstreet and W. G. Johnson. Shorebirds at Long Point, Lake Erie, 1966-1971: Seasonal occurrence, habitat preference and variation in abundance. *Canada Field-Natur.* 91:225-236.

1979. With L. E. Stenzel and C. M. Wolfe. Aspects of the occurrence of shorebirds on a central California estuary. *Studies in Avian Biol.* 2:15-32.

1981. With L. E. Stenzel. Breeding status of the Snowy Plover in California. *Western Birds* 12:1-40.

1983. With L. E. Stenzel, D. W. Winkler, and C. W. Swarth. Spacing out at Mono Lake:

Breeding success, nest density and predation in the Snowy Plover. *Auk* 100:13-24.

1984. With S. G. Allen, D. G. Ainley and C. A. Ribic. The effect of disturbance on harbor seal haul out patterns on Bolinas Lagoon, California. *Fish. Bull.* 82:493-500.

1984. With B. E. Kus, P. Ashman and L. E. Stenzel. Age-related mortality in a wintering population of Dunlin. *Auk* 101:69-73.

1985. With L. E. Stenzel and C. A. Ribic. Nest site selection and clutch predation in the Snowy Plover. *Auk* 102:347-353.

1986. With J. G. Evens. Predation on Black Rails during high tides in salt marshes. *Condor* 88:107-109.

1986. With J. S. Warriner, J. C. Warriner, and L. E. Stenzel. Mating system and reproductive success of a small population of polygamous Snowy Plovers. *Wilson Bull.* 98:15-37.

1986. With F. C. Bidstrup, R. J. Ramer, and L. E. Stenzel. Distribution of wintering Snowy Plovers in California and adjacent states. *West. Birds* 17:145-70.

1987. With H. C. Carter and R. G. Ford. The importance of rehabilitation center data in determining the impacts of the 1986 oil spill on marine birds in central California. *Wildlife Journal* 10:9-14.

1987. With R. G. Ford and H. R. Carter. Estimating mortality of seabirds from oil spills. Proceedings of the 1987 Oil Spill Conference, Am. Petroleum Inst., Washington, D.C. PP 547-551.

1988. With L. E. Stenzel. Results of the first comprehensive shorebird census of San Francisco and San Pablo bays. *Wader Study Group Bull.* 54:43-48.

1989. With P. L. Quinn and J. C. Warriner. Comparison of the breeding of hand- and wild-reared Snowy Plovers. *Conservation Biology* 3:198-201.

1989. With W. D. Shuford, J. G. Evens, and L. E. Stenzel. Seasonal abundance of waterbirds at Point Reyes: A coastal California perspective. *West. Birds* 20:137-265.

1990. With H.R. Carter and R.G. Ford. Numbers of seabirds killed or debilitated in the 1986 Apex Houston oil spill in Central California. *Studies in Avian Biology* 14:164-174.

1991. With B. A. Ramer and M. M. Yoklavich. Seasonal abundance, habitat use, and diet of shorebirds in Elkhorn Slough, California. *West. Birds* 22: 157-174.

1991. With L.E. Stenzel and W. D. Shuford. Distribution and abundance of the Snowy Plover on its western North American breeding grounds. *J. of Field Ornithology* 62:245-255.

1991. With J.G. Evens, S.A. Laymon and R.W. Stallcup. Distribution, relative abundance and status of the California Black Rail in western North America. *Condor* 93:952-966.

1994. With R. E. Gill Jr. Shorebirds in western North America: late 1800s to late 1900s. *Studies in Avian Biology* 15:147-160.

1994. With L.E. Stenzel, J.C. Warriner, J.S. Warriner, K.S. Wilson, F.C. Bidstrup. Long-distance breeding dispersal of Snowy Plovers in Western North America. *J. of Animal Ecology* 63:887-902.

1994. With E. Palacios and L. Alfaro. Distribution and abundance of breeding Snowy Plovers on the Pacific coast of Baja California. *J. of Field Ornithology* 65:490-497.

1995. With W. D. Shuford and C.M. Hickey. Distribution and abundance of Snowy Plovers wintering in the interior of California and adjacent states. *Western Birds* 26:82-98.

1995. With M. A. Stern and P.W.C. Paton. Differences in wintering areas of Snowy Plovers from inland breeding sites in western North America. *Condor* 97:258-262.

1995. With N. Warnock land L. E. Stenzel. Non-migratory movements of Dunlins on their California wintering grounds. *Wilson Bull.* 107:131-139.

1995. With J.S. Warriner, J.C. Warriner and P.W.C. Paton. Snowy Plover (Charadrius alexandrinus) In. *The Birds of North America, No. 154* (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, PA, and *The American Ornithologists' Union*, Washington, D.C.

1995. With L.E. Stenzel, H.R. Carter, R. P. Henderson, S. D. Emslie, M. J. Rauzon, and P.Y. O'Brien. Breeding Success of Double-crested Cormorants in the San Francisco Bay area, California. *Colonial Waterbirds* 18 (special publication 1): 216-224.

1996. With R. G. Ford, M L. Bonnell, D. H. Varoujean, H. R. Carter, B. E. Sharp, D. Heineman and J. L. Casey. Total direct mortality of seabirds from the Exxon Valdez oil spill. Pages 684-711 *in* S. D. Rice, R. B. Spies, D. A. Wolfe and B. A. Wright, eds. Proceedings of the Exxon Valdez oil spill symposium. *American Fisheries Society Symposium* 18.

1996. With W. D. Shuford, C. M. Hickey, and R. J. Safran. 1996. A review of the status of the White-faced Ibis in winter in California. *Western Birds* 27:169-196.

1997. With N. Warnock and B. K. Sandercock. 1997. Local survival of Dunlin wintering in California. *Condor* 90:906-915.

1997. With E. Palacios, L. Alfaro, S. Gonzalez, L. E. Stenzel. and M. Jungers. Numbers of wintering shorebirds in coastal wetlands of Baja California, Mexico. *J. Field*

Ornithology 68:562-574.

1998. With W. D. Shuford and J. E. Kjelmyr. Patterns and dynamics of shorebird use of California's Central Valley. *Condor* 100:227-244.

1999. With L. E. Stenzel and J. E. Kjelmyr. Overview of shorebird abundance and distribution in wetlands of the Pacific coast of the contiguous United States. *Condor* 101: 461-471.

2000. With R. I. G. Morrison, R. E. Gill, Jr., B. A. Harrington, S. Skagen, C. L. Gratto-Trevor and S. M. Haig. Population estimates of nearctic shorebirds. *Waterbirds* 23:337-552.

2001. With J. P. Kelly, N. Warnock, and W. W. Weathers. Effects of weather on daily body mass regulation in wintering Dunlin. *J. Exp. Biol.* 205:109-120.

2002. With H. Galbraith, R. Jones, R. Park, J. Clough, S. Herrod-Julius and B. Harrington. Global climate change and sea level rise: potential losses of intertidal habitat for shorebirds. *Waterbirds* 25:173-183.

In Press. With W. D. Shuford and L. E. Stenzel. Patterns of distribution and abundance of migratory shorebirds in the intermountain west of the United States. *Western Birds*.

2002. With L. E. Stenzel, C. M. Hickey and J. E. Kjelmyr. Abundance and distribution of shorebirds in the San Francisco Bay area. *Western Birds* 33:69-98.

In press. With N. Warnock, T. D. Ruhlen, N. Nur, J. Y. Takekawa and J. T. Hanson. Management and conservation of San Francisco Bay salt ponds: effects of pond salinity, area, tide and season on Pacific flyway waterbirds. *Waterbirds.*

PUBLICATIONS -- Selected Reports:

1975. With L. E. Stenzel. Aspects of the ecology of shorebirds on Bolinas Lagoon. Rept. to Dept. of Parks and Rec., County of Marin, 89 pp.

1977. With R. R. LeValley, R. M. Stewart, and D. G. Ainley. Marine and shore birds. Pp. VII-1 - VII-212 in A summary of Knowledge of the Central and Northern California Coastal Zone and Offshore Areas. Vol. II Biological Condition. Rept. to the Bureau of Land Management.

1978. With L. E. Stenzel (eds.). The status of breeding Snowy Plovers in California. Nongame Wildl. Invest. Rept., Calif. Dept. of Fish and Game. 111 pp.

1979. With D. W. Winkler and C. W. Swarth. Breeding success of Snowy Plovers at Mono Lake, California. Refuge and Wildl. Resources Dept., U. S. Fish and Wildl. Service. 21 pp.

1980. With D. G. Ainley, R. E. Jones, L. T. Jones, L. E. Stenzel, and R. R. LeValley. Beached marine birds and mammals of the North American West Coast: A manual for their census and identification. U. S. Fish and Wildl. Service, Biological Services Program, FWS/OBS-80/03. 207 pp.

1983. With J. Evens. The ecology of rail populations at Corte Madera Ecological Reserve. Scientific report of Point Reyes Bird Observatory. Prepared for Marin Audubon Society. 63 pp.

1983. With W. D. Shuford, J. G. Evens and L. E. Stenzel. The distribution and abundance of aquatic birds in wetlands of the Point Reyes to Bodega area. Scientific report of Point Reyes Bird Observatory. Prepared for Gulf of the Farallones National Marine Sanctuary.

1983. With L. E. Stenzel and J. Young. The trophic relationships between shorebirds and their prey on Bolinas Lagoon. Scientific report of Point Reyes Bird Observatory. Prepared for Gulf of the Farallones National Marine Sanctuary. pp. 164.

1985. With D. G. Ainley, D. A. McCrimmon, A. Berkner, S. G. Allen, R. J. Boekelheide, J. Young, D. B. Lewis and W. B. Tyler. The impacts of the T/V Puerto Rican oil spill on marine bird and mammal populations in the Gulf of the Farallones 6-19 November 1984. Special scientific report of Point Reyes Bird Observatory.

1985. With J. G. Evens. Quantifying Black Rail abundance in San Francisco Bay salt marshes. Scientific report of Point Reyes Bird Observatory. Prepared for Marin Audubon Society. 12 pp.

1986. With H. R. Carter. Impacts of the 1986 San Joaquin Valley Crude oil spill on marine birds in central California. Special scientific report of Point Reyes Bird Observatory. 53 pp.

1986. With J. E. Evens, L. E. Stenzel, and N. D. Warnock. Distribution, abundance, and habitat of California Black Rails in tidal marshes of Marin and Sonoma counties, California. Scientific report of Point Reyes Bird Observatory. Prepared for Marin Audubon Society. 40 pp.

1987. With J. E. Evens. The size of Clapper Rail populations at Corte Madera Ecological Reserve, Muzzi Marsh, San Clemente Creek, and Triangle Marsh. Scientific report of Point Reyes Bird Observatory. Prepared for Marin Audubon Society. 14 pp.

1988. With L. E. Stenzel, H. R. Carter, and D. G. Ainley. Seabird mortality in California as witnessed through 14 years of beached bird censuses. Scientific report of Point Reyes Bird Observatory. Prepared for Gulf of Farallones National Marine Sanctuary. 175 pp.

1988. With H. R. Carter. Central California oil spill contingency plan: Assessment of numbers and species composition of dead beached birds. Scientific report of Point Reyes Bird Observatory. Prepared for Gulf of Farallones National Marine Sanctuary. 175 pp.

1989. With J. G. Evens, L. E. Stenzel, R. W. Stallcup, and R. P. Henderson. Distribution and relative abundance of the California Rail *(Laterallus jamaicensis coturniculus)* in tidal marshes of the San Francisco Bay estuary. Scientific report of Point Reyes Bird Observatory. Prepared for the California Department of Fish and Game. 55 pp.

1990. With L. E. Stenzel, J. E. Kjelmyr, and W. D. Shuford. Shorebird numbers in wetlands of the Pacific Flyway: A summary of spring and fall counts in 1988 and 1989. A report of Point Reyes Bird Observatory. 11 pp.

1992. With L.E. Stenzel, W.D. Shuford, and J.E. Kjelmyr. Shorebird numbers in wetlands of the Pacific Flyway: A summary of counts from April 1988 to January 1992. A report of Point Reyes Bird Observatory. 20 pp.

1992. With T.E. Harvey, K.J. Miller, R.L. Hothem, M.J. Rauzon and R.A. Keck. Status and trends report on wildlife of the San Francisco Estuary. Report of U.S. Fish and Wildlife, Sacramento, CA.

1994. With D.G. Ainley, R.E. Jones, R. Stallcup, D.J. Long, L.E. Stenzel et al. Beached marine birds and mammals of the North American west coast: A revised guide to their census and identification, with supplemental keys to beached sea turtles and sharks. NOAA. U.S. Government Printing Office.

1994. With W.D. Shuford, J.E. Kjelmyr and C.M. Hickey. Seasonal abundance and habitat use of shorebirds in California's Central Valley, November 1993 to August 1994. A report of Point Reyes Bird Observatory. 17 pp.

1994. With W.D. Shuford, V.L. Roy and D.S. Paul. A comprehensive survey of shorebirds in wetlands at Great Salt Lake, Utah, 10-11 August 1994. A report of Point Reyes Bird Observatory. 9 pp.

1995. With R.E. Gill, Jr. and C.M. Handel. Western North American Shorebirds. pp 60-69 in E.T. LaRoe, G.S. Farris, C.E. Packett, P.D. Doran, and M.J. Mac (eds). Our living resources: a report to the nation on the distribution, abundance and health of U.S. plants, animals and ecosystems. U.S. Department of Interior, National Biological Service, Washington, D.C. 9 pp.

PROFESSIONAL AFFILIATIONS

Elective Member
American ornithologists Union

Member
Association of Field Ornithologists
Audubon Society
Cooper Ornithological Society
Wader Study Group
Waterbird Society
Western Field Ornithologists
Wilson Ornithological Society

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Curriculum Vitae

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EDUCATION

M.S. in Resource Ecology and Management, University of Michigan, 1999.
School of Natural Resources and Environment (SNRE). Conservation Biology Concentration.

Advisor: Dr. Terry L. Root
Thesis: A Landscape-level Analysis of Urbanization Influence and Spatial Structure in Chaparral Breeding Birds of the Santa Monica Mountains, CA.

B.S. *Magna Cum Laude* in Mathematics/Applied Science, UCLA, 1992.
Specialization in Computing. Ecology coursework.

Coursework in Environmental Management and Policy, University of Oslo, 1993.
Centre for Development and the Environment.

RESEARCH INTERESTS

Effects of landscape pattern and composition on species distribution and abundance.

Quantifying and modeling spatial dependence in animal populations.

PROFESSIONAL EXPERIENCE

Point Reyes Bird Observatory. Stinson Beach, CA.
GIS Specialist. Sept 2000 - Present.
Duties: Provide spatial analysis and mapping components to bird research, monitoring and planning projects; conduct landscape ecology research; assist other staff with GIS and GPS technologies. Primary projects: San Francisco Bay wetlands, Placer County oak woodlands, Marin Spotted Owls, Owens Lake Snowy Plovers, San Clemente Island Shrikes, Partners in Flight bird conservation plans.

Placer County Planning Department. Auburn, CA.
Resource Planner / GIS Specialist, Placer Legacy Open Space Program. Sept 1999 – Sept 2000.
Duties: Manage and analyze GIS database of open space resources in Placer County; coordinate ecological research projects and field surveys of Placer County biological resources; help write and implement County's Open Space Conservation Program.

Sierra Business Council / Sustainable Communities Leadership Program. Truckee/Auburn, CA.
GIS Coordinator**,** Placer Legacy Program. June-Sept 1999.
Duties: Create and analyze GIS database of open space resources in Placer County; conduct public outreach regarding Placer Legacy Open Space Program.

PROFESSIONAL EXPERIENCE (CONT.)

Department of Atmospheric, Oceanic & Space Sciences, University of Michigan. Ann Arbor, MI.

Graduate Student Instructor, Introduction to Global Change I & II. Jan 1997 – May 1999.
Duties: develop and grade GIS and modeling lab assignments; lead laboratory and discussion sections; write and grade exams; develop course curriculum and coordinate instruction; write grant applications; maintain website; develop and analyze educational assessment materials.

Inter-university Consortium for Political and Social Research, University of Michigan.

Computer Consultant, 1998 Statistics Summer Program. June-August 1998
Duties: assist summer program participants with statistical software (SPSS, SAS, Stata, et al.); solve general computing problems; provide statistical consulting.

School of Natural Resources and Environment, University of Michigan. .

Graduate Student Instructor, Natural Resources Statistics. Sept-Dec 1995, 1996.
Duties: lecture on topics in statistics; develop and grade laboratory assignments and problem sets; lead exam review sessions; meet with students.

PS Enterprises, Environmental Policy Consulting. Santa Monica, CA.

Account Executive. August 1993 - July 1995.

Ken Downing Development Co. Santa Monica, CA.

Bookkeeper and Office Manager. July 1985 - Nov 1992.

REFEREED PUBLICATIONS

Stralberg, D. and B. Williams. In Press. Effects of Residential Development and Landscape Composition on the Breeding Birds of Placer County's Foothill Oak Woodlands. Proceedings of the 5th Oak Symposium: Oaks in California's Changing Landscape. San Diego, CA.

Bao, S., L. Anselin, D. Martin and D. Stralberg. 2000. Seamless integration of spatial statistics and GIS: The S-PLUS for ArcView and the S+Grassland Links. Journal of Geographic Systems. 2(3):287-306.

Stralberg, D. and S. Bao. 1999. Identifying the Spatial Structure in Error Terms with Spatial Covariance Models: A Case Study on Urbanization Influence in Chaparral Bird Species. Journal of Geographic Information Sciences 5(2):106-120.

NON-REFEREED PUBLICATIONS

Stralberg, D. 2000. Landscape-Level Urbanization Effects on Chaparral Birds: A Santa Monica Mountains Case Study. *In* Keeley, J.E., M. Baer-Keeley, and C.J. Fotheringham (eds). 2nd Interface Between Ecology and Land Development in California. U.S. Geological Survey Open-File Report 00-62.

Stralberg, D. and S. Bao. 1999. Modeling Spatial Structure with Spatial Covariance Models: a Case Study on the Influence of Urbanization on Chaparral Bird Species. *In* Society for Chinese GIS Professionals (ed). Proceedings of the International Symposium on Geoinformatics and Socioinformatics. Ann Arbor, MI. (electronic distribution only)

Bao, S., D. Stralberg and D. Martin. 1998. S-PLUS for ArcView GIS: Spatial Data Analysis and

Statistical Modeling Get a Boost with GIS. ESRI ArcNews, Summer 1998.

PROFESSIONAL PRESENTATIONS

Effects of Residential Development and Landscape Composition on the Breeding Birds of Placer County's Foothill Oak Woodlands.

- 5th Oak Symposium: Oaks in California's Changing Landscape. San Diego, CA. October 1997. Oral presentation and paper.

Landscape-Level Predictors of Songbird Abundance in San Francisco Bay Tidal Marshes

- International Association for Landscape Ecology Annual Meeting, Tempe, AZ. April 2001. Poster presentation.
- Society for Conservation GIS Annual Meeting, Borrego Springs, CA. July 2001. Poster presentation.
- State of the Estuary Conference, San Francisco, CA. October 2001. Poster presentation.

M.S. Thesis: A Landscape-level Analysis of Urbanization Influence and Spatial Structure in Chaparral Breeding Birds of the Santa Monica Mountains, CA.

- The International Symposium on Geoinformatics and Socioinformatics. Ann Arbor, Michigan. June 1999. Oral presentation and paper.
- INTECOL VII International Congress of Ecology. Florence, Italy. July 1998. Poster presentation.
- International Association of Landscape Ecology Annual Meeting. Michigan State University. East Lansing, MI. March 1998. Oral presentation.
- Society for Conservation Biology Annual Meeting. Victoria, British Columbia. June 1997. Poster presentation.
- Second "Interface Between Ecology and Land Development in California" Conference. Occidental College. Los Angeles, CA. April 1997. Oral presentation and paper.

Introduction to Global Change Courses: Developing Web-Based Earth System Science Curricula

- Inter-American Institute Workshop. Earth System Science and Global Change: Building Capacity through Education. Rio Grande, Brazil. April 1999. Oral presentation.
- Earth System Science Education Annual Meeting. Ann Arbor, MI. June 1998. Oral presentation.
- Project ALERT (Augmented Learning Environment and Renewable Teaching) Workshop. NASA Jet Propulsion Laboratory. Pasadena, CA. March 1998. Oral presentation.
- Project Kaleidoscope Workshop: Reforming Earth and Planetary Science Curricula. Whitman College. Walla Walla, WA. Oct 1997. Oral presentation.

PROFESSIONAL MEMBERSHIPS

Society for Conservation Biology
International Association for Landscape Ecology
Cooper Ornithological Society
The Wildlife Society

CURRICULUM VITAE
Joshua Newman Collins, Ph.D

EDUCATION
Graduated University of California at Berkeley; B.S. Conservation and Resource Studies; Ph.D. Entomological Sciences.

EMPLOYMENT
1973-1978: Oceanographic and Engineering Technician, Biologist, Department of Engineering Research, Ecological Sciences Section, Pacific Gas and Electric Company, San Francisco, CA.

1978-1980: Research Associate, Department of Entomological Sciences, University of California at Berkeley; Ecological Consultant in private practice for wetlands and riverine impact assessment.

1980-1987: Teaching Assistant, Departments of Biology, Conservation and Resource Studies, Entomological Sciences, Zoology; Post Graduate Researcher, Departments of Geography, Geology and Geophysics; Coordinator of the Program for Biological Diversity, University of California at Berkeley.

1987-1990: Post Doctoral Research Fellow, Department of Geography, University of California at Berkeley and Institute of Ecology, University of California at Davis.

1989-1993: Consulting Ecologist in private practice for wetlands design and management.

1992-1999: Environmental Scientist, Director of Wetlands and Watersheds Programs, Coordinator of Geographic Information Systems, San Francisco Estuary Institute, Richmond, CA. Research Fellow, Department of Geography, University of California at Berkeley.

2000-present: Science Director, Wetlands Program, San Francisco Estuary Institute, Richmond, CA. Research Fellow, Department of Geography, University of California at Berkeley.

HONORS and AWARDS
1983. Award for Excellence in Teaching, Department of Conservation and Resource Studies University of California at Berkeley.

1984. Departmental Honors, Department of Entomological Sciences, University of California at Berkeley.

1. ARCO Award for Excellence in Applied Research, North American Benthological Society.

1. Harvey I. Magy Memorial Award for Scholastic Achievement, Department of Entomological Sciences, University of California at Berkeley.

1988. Award for Excellence in Teaching, Department of Entomological Sciences, University of California at Berkeley.

GRADUATE STUDENT SUPERVISION

1993. Daniel Ballard Scollon. Spatial analysis of the tidal marsh habitat of the Suisun Song Sparrow. Masters Thesis, San Francisco State University.

1995. Lisa Wayne. The Ecology of *Gendelia hirsutula* var. *maritima*. Masters Thesis, San Francisco State University

1995. Robin Mitchel Grossinger. Historical evidence of freshwater effects on the plan form of tidal marshlands in the Golden Gate Estuary. Masters Thesis, University of California at Santa Cruz.

2000. Steve Culberson. Interactions among tidal hydrology and tidal marsh plant growth. Doctoral Dissertation, University of California at Davis.

RECENT EXTRA-CURRICULAR ACTIVITIES

Federal Recovery Teams for California Clapper Rail, Light-footed Clapper Rail, and Salt Marsh Harvest Mouse; Office of the Regional Director, US Fish and Wildlife Service, Seattle, WA.

Science Coordinator, Bay Area Regional Wetlands Ecosystem Goals Project.

Implementation Committee, Bay Area Habitat Joint Venture, California Coastal Conservancy, Oakland, CA.

Comprehensive Monitoring and Research Team, CALFED Bay-Delta Program, Sacramento, CA.

Science Coordinator, Bay Area Wetlands Regional Monitoring Program

Liaison for Integration, Western Center for Estuarine Ecological Indictors Research, University of California at Davis, Bodega Marine Laboratory.

Science Panel Member, Ecosystem Services in San Francisco Bay, Global Change Research Program, National Center for Atmospheric Research, Boulder, CO.

SELECTED PUBLICATIONS

Resh, V.H., S.S. Balling, M.A. Barnby and J.N. Collins. 1980. Ecological impact of marshland recirculation ditches. California Agriculture 34(3):38-39.

Rosenberg, D.M., V.H. Resh, S.S. Balling, M.A. Barnby, J.N. Collins, D.V. Durbin, T.S. Flynn, D.D. Hart, G.A. Lamberti, E.P. McElravy, J.R. Wood, T.E. Blank, D.M. Shultz, D.L. Marrin, and D.G. Price. 1981. Recent trends in environmental impact assessment. Canadian Journal of Fisheries and Aquatic Sciences 38(5):591-624.

Collins, J.N., S.S. Balling and V.H. Resh. 1983. The Coyote Hills Marsh model: calibration of interactions among floating vegetation, waterfowl, alternative prey, and *Anopheles* mosquitoes. Proceedings and Papers of the California Mosquito and Vector Cotnrol Association 51:69-73.

Collins J.N. and V.H. Resh. 1984. Do waterfowl affect mosquitoes in Coyote Hills Marsh? Proceedings and Papers of the Calfiornia Mosquito and Vector Control Association 52:129-133.

Balling, S.S., J.N. Collins, and V.H. Resh. 1985. Wastewater mosquito problems and research in the twenty-first century. In: Mosquito Control Research Annual report. Division of Agriculture and Natural Resources, University of California. P. 74.

Barnby, M.A., J.N. Collins, and V.H. Resh. 1985. Aquatic macroinvertebrate communities of natural and ditched potholes in a San Francisco Bay salt marsh. Estuarine and Coast Shelf Science 20:331-347.

Collins, J.N., K.D. Gallagher, and V.H. Resh. 1985. Thermal characteristics of aquatic habitats at Coyote Hills Marsh: implications for simulation and control of *Anopheles* populations. Proceedings and Papers of the California Mosquito and Vector Control Association 53:83-86.

Collins, J.N. and V.H. Resh. 1985a. Factors that limit the role of immature damseflies as natural mosquito control agents at Coyote Hills Marsh. Proceedings and Papers of the California Mosquito and Vector Control Association 53:87-92.

Collins, J.N. and V.H. Resh. 1985b. Utilization of natural and man-made habitats by the salt marsh song sparrow *Melospiza melodia samuelis* (Baird). California Fish and Game 71(1):40-52.

Collins, J.N. 1986. Wetland hydrology and functional assessment: a Pacific Coast regional perspective. In: Proceedings of the Pacific Coast Wetlands Workshop. J.S. Larson (ed.). National Wetlands Technical Jcouncil, The Environmental Institute, Amherst, Massachusetts. 65 pp.

Collins, J.N., L.M. Collins, L.B. Leopold, and V.H. Resh. 1986. The influence of mosquito control ditches on the geomophology of tidal marshes in the San Francisco Bay Area: evolution of salt marsh mosquito habitat. Proceedings and Papers of the California Mosquito and Vector Control Association 54:91-95.

Collins, L.M., J.N. Collins, and L.B. Leopold. 1987. Geomorphic processes of an estuarine tidal marsh: preliminary results and hypotheses. In: International Geomorphology 1986 Part I. V. Gardner (ed.). John Wiley and Sons, LTD. Pp. 1049-1072.

Collins, J.N. 1988. Talk about wetlands! Long-term perspective for wetland enhancement and management at the Coyote Hills Regional Park. Proceedings of the Coyote Hills Wetlands Workshop. East Bay Regional Park District, Oakland, CA 22pp.

Collins, J.N., E.P. FMcElravy, B.K. Orr, and V.H. Resh. 1989 Preliminary observations on the effects of the intersection line upon predation of *Anopheles* mosquito larvae. In: Biological control vectors with predaceous arthropods. Loyola College, India. 1-7.

Collins, J.N. and V.H. Resh. 1989. Guidelines for the ecological control of mosquitoes in non-tidal wetlands of the San Francisco Bay Region. Special Publication of the California Mosquito and Vector Control Association. 93pp.

Collins, J.N. 1991. Guidelines for ecological Restoration of disturbed tidal marshlands, with an emphasis on mosquito source reduction. Special Publication of the California Mosquito and Vector Control Association. 67 pp.

Bergey, E.B., J.N. Collins, and V.H. Resh. 1992. Community structure of a palustrine wetland. Hydrobiologia.

Leopold, L.B., J.N. Collins, and L.M. Collins. 1993. Hydrology of some tidal marsh channels near San Francisco, California. Catena.

Foin, T.C., E.J. Garcia, R.E. Gill, S.D. Culberson and J.N. Collins. 1997. Recovery strategies for the California clapper rail (*Rallus longirostris obsoletus*) in the heavily urbanized San Francisco estuarine ecosystem. Landscape and Urban Planning 38:229-243.

Byrne, R., B.L. Ingram, S. Starratt, F. Malamud-Roam, J.N. Collins, amd M.E. Conrad. 2001. Carbon-isotope, diatom, and pollen evidence for late Holocene salinity change in a brackish marsh in the San Francisco Estuary. Quaternary Research 55: 66-76.

SELECTED REPORTS

Collins, J.N. 1979. Habitats and composition of the macroinvertebrate fauna. In: Report to the Nuclear Regulatory Commission on baseline research at the Stanislaus Nuclear Power Station project site. Pacific Gas and Electric Company, San Francisco, CA 315-432.

Collins, J.N. and R. Harris. 1983a. Atlas of natural habitat areas in Sonoma County. Report to the Sonoma County Planning Department, Santa Rosa, CA. 67 pp.

Collins, J.N. And R. Harris. 1983b. Whittemore Gulch: environmental resource analysis. Mid-peninsula Regional Open Space District, San Mateo, CA 81 pp.

Collins, J.N. 1988. Talk about wetlands! Long-term perspective for wetland enhancement and management at the Coyote Hills Regional Park. Proceedings of the Coyote Hills Wetlands Workshop. East Bay Regional Park District, Oakland, CA 22pp.

Collins, J.N. 1994. Potential environmental impacts of tidal marsh restoration in North Bay Area of the San Francisco Estuary. U.S. Army Corps of Engineers, San Francisco District, San Francisco, CA. 138 pp.

Collins, J.N. 1995. Tidal wetlands restoration potential using dredged sediments: a methodology for assessment with examples from the North Bay Area.. U.S. Army Corps of Engineers, San Francisco District, San Francisco, CA. 54 pp.

Collins, J.N. 1995. The Bay Area wetlands monitoring plan. U.S. EPA Region 9, San Francisco, CA. 52 pp. Plus appendices.

Collins, J.N., and R.M. Grossinger. 1998. Spatial analysis of historical, modern, and future wetlands landscapes of the Bay Area. Bay Area Wetlands Ecosystem Goals Project, Resource Managers Group, Bay Area Regional Water Quality Control Board, Oakland, CA.

Collins, J.N., Z. Der, R. Grossinger, and C. Wong. 1998. Cartographic analysis of historical and modern baylands boundaries for Marin County, California. Marin County Community Development Agency, San Rafael, CA. 31 pp.

Grossinger, R., J. Alexander, A.N. Chen and J.N. Collins. 1998. Introduced Tidal Marsh plants in the San Francisco Estuary. San Francisco Estuary Institute, Richmond, CA. 52 pp.

Monroe, M., P.R. Olofson, J.N. Collins, R. Grossinger, J. Haltiner, and C. Wilcox. Baylands Ecosystem Habitat Goals. 1999. U.S. Environmental Protection Agency, San Francisco, CA. 209 pp. plus appendices.

Collins, J.N., R. Grossinger, and E. Brewster. 1999. Conceptual models of freshwater influences on tidal marsh form and function, with san historical perspective. City of San Jose, San Jose, CA. 50 pp. plus appendices.

Collins, J.N., L.M. Collins, R.M. Grossinger, L. McKee, and A. Riley. 2000. Wildcat Creek landscape change: a history of sediment-water relations and the role of people in the Wildcat Watershed, Contra Costa County, CA. Contra Costa Country Clean Water Program, Concord, CA. 82 pp plus appendices.

Collins, J.N. and M. May. 2001. Guidelines to monitor the distribution, abundance, and treatment of non-indigenous species of cordgrass in the San Francisco Estuary. California Coastal Conservancy. 40 pp.

Collins, J.N. and M. May. 2001. Basic regional spatial analysis of NIS Spartina Invasions in the San Francisco Estuary. California Coastal Conservancy. 13 pp.

Wetlands Regional Monitoring Program Steering Committee (J.N. Collins Ed). 2001. Wetlands Regional Monitoring Program Plan 2001. California Coastal Conservancy and USEPA. 57 pp.

Wetlands Regional Monitoring Program Steering Committee (J.N. Collins Ed). 2001. Draft data collection protocols. California Coastal Conservancy and USEPA. 96 pp.

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EDUCATION

M.A., Geography, U.C. Berkeley, 1999. Thesis: Vegetation and salinity changes over the last 2000 years at two islands in the northern San Francisco Estuary, California.
B.A., Environmental Science, Physical Sciences Track, U.C. Berkeley, 1990.
A.S. Physics, A.S. Mathematics, Cañada College, 1988.

EMPLOYMENT

- January 2002–present: Information Technology Manager, San Francisco Estuary Institute, Oakland, CA.

The ensure the computing infrastructure of the Institute is well maintained, well suited to meet SFEI's needs, and effectively used to achieve the goals of the organization.

1991–2001: Assistant Environmental Scientist, San Francisco Estuary Institute, Richmond, CA.

Manage production and publication of annual monitoring report; author and co-author technical report articles; manage and design the presentation of data; statistically analyze monitoring data; plan public outreach of monitoring results; create computer graphics for a wide variety of documents and presentations.

1997–1998: Research Associate, Department of Geography, University of California at Berkeley. Complete palynological analyses of San Francisco Estuary wetland sediments to reconstruct past vegetation and salinity.

OTHER SKILLS

Computer skills: Working knowledge of DNS servers, email transfer protocols, IP addressing; Administration of networked computers and Macintosh file, print, and email servers; advanced proficiency in Mac OS, Excel ,PageMaker, Word, Canvas, HyperCard; proficiency in Windows, Unix, SAS JMP, desktop publishing for offset printing, Hypertalk scripting, Filemaker, FreeHand, Illustrator, DeltaGraph.

Photographer; X-ray operator.

PUBLICATIONS & PRESENTATIONS

May, M. ed. 2001. The Pulse of the Estuary: Monitoring and Managing Contamination in the San Francisco Estuary 1993–1999. San Francisco Estuary Institute, Richmond CA.

May, M., J. Davis, B. Thompson, R. Hoenicke. 2000. The Pulse of the Estuary: Tracking Contamination with the Regional Monitoring Program 1993–1998. San Francisco Estuary Institute, Richmond CA.

Davis, J., M. May, G. Ichikawa, D. Crane. 2000. Contaminant Concentrations in Fish from the Sacramento–San Joaquin Delta and Lower Sacramento River, 1998. San Francisco Estuary Institute, Richmond CA.

Collins, J. and M. May. 1998. Contamination of Tidal Wetlands. In: *1996 Annual Report, San Francisco Estuary Regional Monitoring Program for Trace Substances.* San Francisco Estuary Institute, Richmond CA.

Results of the San Francisco Bay Seafood Consumption Study. Presented at the Annual Meeting of the Society of Environmental Toxicology and Chemistry, Northern California Chapter, June 19, 2001.

Highlights of the *Pulse of the Estuary*. Presented at the Annual Meeting of the San Francisco Estuary Regional Monitoring Program for Trace Substances, San Francisco Estuary Institute, March 9, 2001.

Jules G. Evens

P.O. Box 839 Point Reyes Station, CA 94956 Telephone 415 663-1148 Telecopier 415 663-9235

Résumé

Date of birth: 22 Nov. 1947

Education

University of North Carolina, Chapel Hill	English Literature	BA
California State University, Sonoma	Vertebrate Biology	BA
University of San Francisco	English	MA

Employment

Avocet Research Associate	Principal	1985 - present
Point Reyes Bird Observatory	Research Associate	1974 - present
Marin Municipal Water District	Consulting Biologist	1983 - present
Audubon Canyon Ranch, Inc.	Research Associate	1984 - present
University of California, Berkeley	Field Biologist	1979

References

Sarah Allen, PhD., Resource Biologist
National Park Service, Point Reyes National Seashore, Point Reyes 94956
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San Francisco Estuary Institute, 1301 S. 46th St.,Richmond, CA 94804
Telephone 510/231-9539

John Kelly, PhD, Research Biologist
Audubon Canyon Ranch, P.O. Box 808, Marshall, CA 94940.
Telephone 415/663-8203

Don Neubacher, Superintendent
Point Reyes National Seashore, Pt. Reyes, CA 94956 Telephone 415/663-1094

Gary Page, Director, Estuarine Projects.
Point Reyes Bird Observatory, 4990 Shoreline Hwy, Stinson Beach, CA. 94970
Telephone 415/868-1221

Carmen Thomas
U.S. Fish and Wildlife Service, Endangered Species Office, Sacramento, CA
Telephone 916/979-2739 x 439

Appendix C – Literature Cited

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Cloern, J., A. Alpine, B. Cole, R. Wong, J. Arthur, and M. Ball. 1983. River discharge controls phytoplankton dynamics in the northern San Francisco Bay estuary. Estuarine Coastal Shelf Sci. 16: 415-429.

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Nur, N., S. Zack, J.G. Evens and T. Gardali. 1997. Tidal marsh birds of the San Francisco Bay region: status, distribution and conservation of five Category 2 taxa. Final report to the United States Geological Survey- Biological Resources Division (Formerly National Biological Service).

Pinkas, L.M., Oliphant, S., and Iverson, I.L.K. 1971. Food habits of albacore, bluefin tuna and bonito in Californian waters. Calif. Fish Game, 152: 1–105.

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Project. PWA Ref. #1478.

San Francisco Estuary Project Management Committee, 1993. Comprehensive Conservation and Management Plan. San Francisco: San Francisco Estuary Project.

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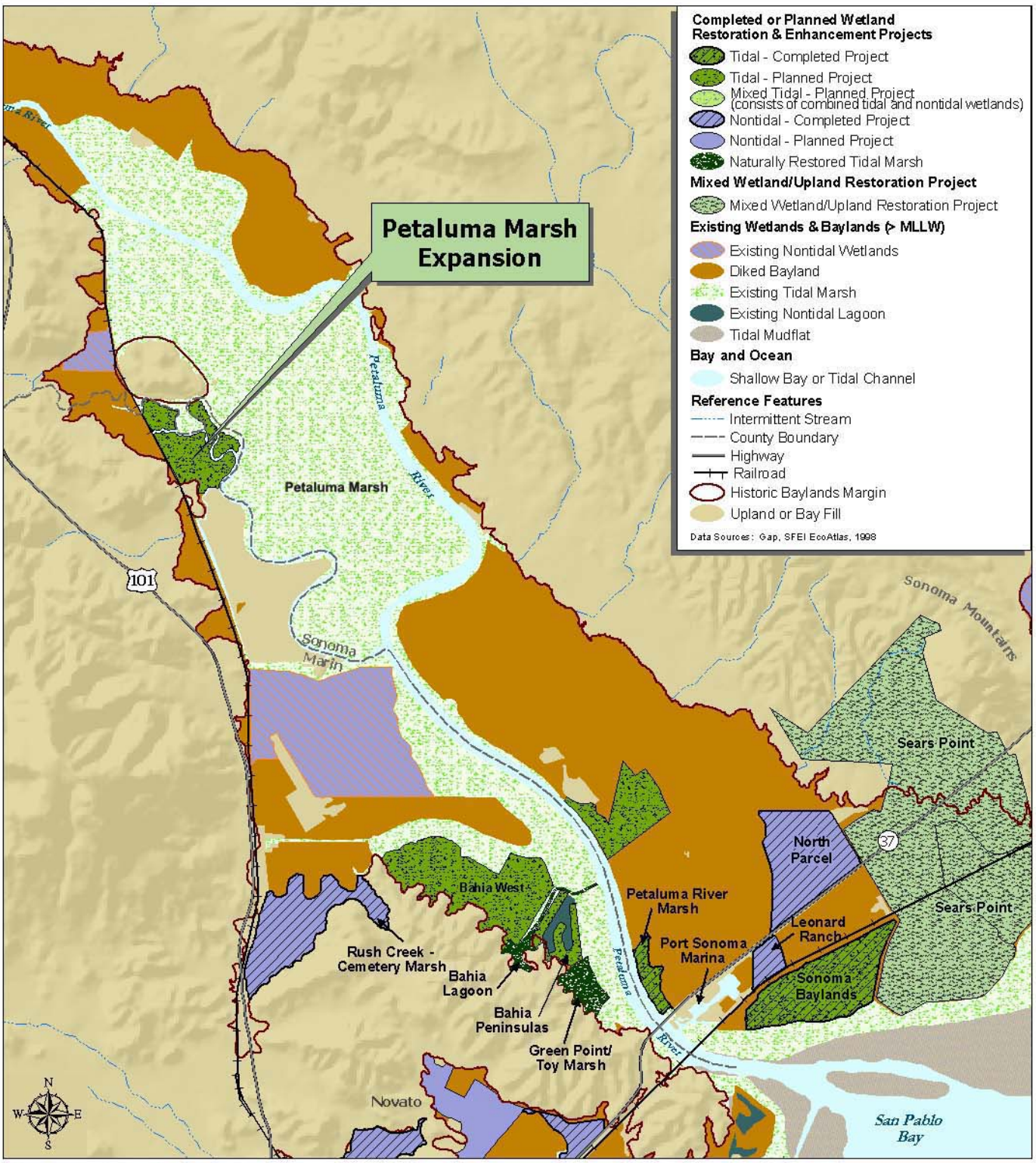
Toft, J.D., J.R. Cordell, and W.C. Fields. 2002. New Records of Crustaceans (Amphipoda, Isopoda) in the Sacramento/San Joaquin Delta, California, and Application of Criteria for Introduced Species. Journal of Crustacean Biology 22(1):190-200.

Toft, J.D., C.A. Simenstad, J.R. Cordell, and L.F. Grimaldo. 2003. The effects of introduced water hyacinth on habitat structure, invertebrate assemblages, and fish diets. Estuaries 26: 746-758.

Van Raalte, C. D., W. C. Stewart, I. Valiela, E. J. Carpenter (1974). A ^{14}C technique for measuring algal productivity in salt marsh muds. Botanica Marina 17: 186-188.

Figures



1:72,000 (1in = 6,000ft at letter-size)

Feet: 0 — 3,000 — 6,000

Meters: 0 — 1,500 — 3,000

WETLANDS AND WATER RESOURCES

PETALUMA MARSH EXPANSION PROJECT VICINITY MAP

Marin County, California

November 2004 | Project No. P04-117 | **Figure 1**

Produced by Wetlands and Water Resources
Map Produced: 11/17/04
GIS/Cartography by Jake Schweitzer
Vicinity_P04-117_A-P_111704.mxd

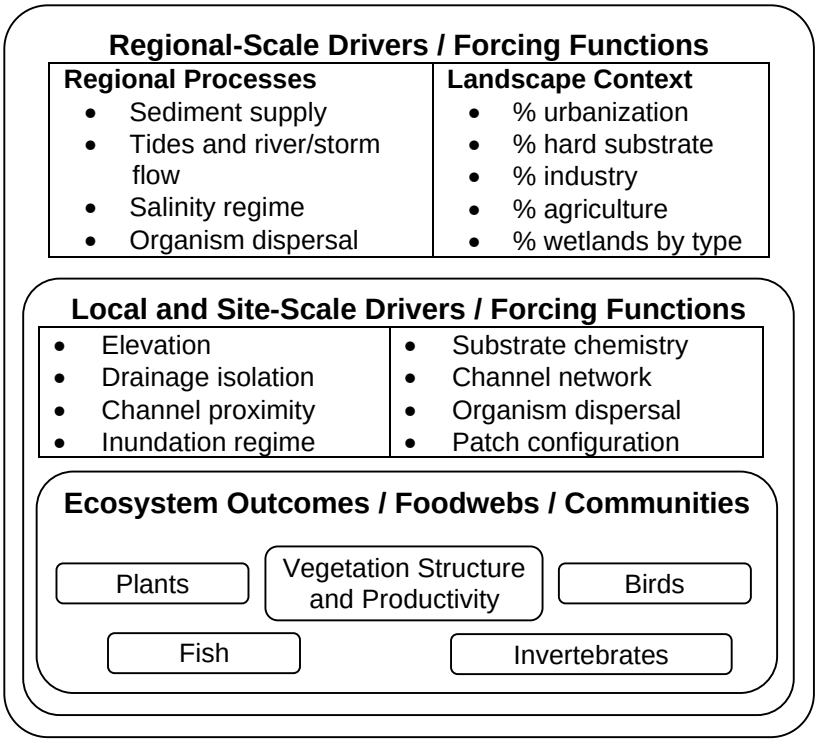


Figure 2. "Road map" of the nested IRWM integrated conceptual models showing drivers and outcomes. This figure shows the regional and local-scale drivers and the ecosystem outcomes for addressing the question *what are the effects of tidal marsh restoration on ecological processes at different scales*. The IRWM integrated conceptual models will identify the *linkages* within and between these drivers and outcomes.

Access Easements and Non-profit Verification

State of California

Franchise Tax Board

January 29, 1960

Marin Audubon Society
c/o Rogers and Clark
111 Sutter Street
San Francisco 4, California

Re: Exemption from Franchise Tax

Gentlemen:

It is the opinion of this office, based upon the evidence presented, that you are exempt from State franchise tax under the provisions of Section 23701d of the Revenue and Taxation Code, as it is shown that you are organized and operated exclusively as an educational organization.

Accordingly, you will not be required to file franchise tax returns unless you change the character of your organization, the purposes for which you were organized, or your method of operation. Any such changes should be reported immediately to this office in order that their effect upon your exempt status may be determined.

If in any year your gross income exceeds $25,000, you are required to file an information return on Form 199 on or before the 15th day of the 5th month following the close of your fiscal year. These forms will be mailed to you if you provide us with your current postal address.

If you have income from an unrelated trade or business that is taxable under the provisions of Section 23731 of the Revenue and Taxation Code, you must file a return on Form 109 on or before the 15th day of the 3rd month following the close of your fiscal year. Copies of this form may be obtained from this office or any of its branches.

Contributions made to you are deductible by the donors in arriving at their taxable net income in the manner and to the extent provided by Sections 17214, 17215, 17216 and 24357 of the Revenue and Taxation Code.

If the organization is not yet incorporated or has not yet qualified to do business in California, this approval will expire unless incorporation or qualification is completed within 30 days.

Very truly yours,

FRANCHISE TAX BOARD
John J. Campbell
Executive Officer

By C M Gray
C. M. Gray
Associate Tax Counsel

CMG:mp
cc: Secretary of State
(D)

2004-0011554

Recording Requested by:
Marin Audubon Society

WHEN RECORDED MAIL TO:
Marin Audubon Society
48 Ardmore Road
Larkspur, CA 94939

Recorded
Official Records
County Of
Marin
JOAN C. THAYER
Recorder

09:00AM 13-Feb-2004

REC FEE .00

DW
Page 1 of 5

APN: 125-130-06

SPACE ABOVE THIS LINE FOR RECORDER'S USE

ACCESS EASEMENT DEED

THE LESTER CORDA AND STELLA CORDA FAMILY LIMITED PARTNERSHIP, a California limited partnership (Grantor)

Hereby GRANT(S) to

MARIN AUDUBON SOCIETY, a non-profit corporation and the STATE OF CALIFORNIA (Grantees)

a permanent 20 foot wide non-exclusive right of way and easement over, upon and across the real property described in Exhibit A hereof for the following purposes and subject to the terms and conditions set forth below:

1. Grantees shall have the right to use said property for the purpose of ingress and egress for the following times and purposes:

   a. Between December 1, 2003 and November 30, 2006 for construction purposes by Grantees or their agents.

   b. Between December 1, 2006 and November 30, 2016 for monitoring purposes by Grantees or their agents.

   If monitoring shows that additional construction work or repair work is necessary then said access easement can be used for construction as necessary to effect the reconstruction and/or repairs.

2. Grantees' use shall be limited to Grantees' officials and Grantees' designees, not the general public, and shall be further limited to such times and under such circumstances as may be necessary for inspection, repair and maintenance of the levees on Grantees' property.

3. The rights granted hereby shall include but not be limited to the right to use said easement for such vehicles and equipment as the Grantees may require be used in its maintenance and repair of said levees.

4. Grantees shall take all reasonable precautions to avoid damage to Grantor's adjacent lands and improvements during the exercise of its rights hereunder; and in the event Grantee damages the surface of the subject right of way during Grantees' exercise of its easement rights, Grantee shall restore said surface to essentially the same condition in which it was prior to the exercise of said rights.

Tasks And Deliverables

Petaluma Marsh Expansion Project − monitoring and secondary test site for the integrated regional wetland monitoring project

Task ID	Task Name	Start Month	End Month	Deliverables
1	Project Management	1	12	Semiannual and final reports; Periodic invoices; Meeting agendas and summaries; General coordination; Work plan and monthly progress reports; Data inventory and gap identification; Site−scale data management; Landscape−scale data integration; and Management of collaborative planning, data integration, analysis, reports and distribution.
2	Physical Processes	1	12	Regional Baseline Maps; Permit applications, renewals, and amendments; Tidal water supply data summary statistics describing inundation frequency at monitored stations; Sediment accretion rate tables; Georeferenced field topographic tabular data; Soil water and pore water chemistry; Collaborative planning, data integration, analysis, reports and distribution.
3	Landscape Ecology	1	12	Review of data inventory; Review of collected imagery; Imagery maps; Rectified data imagery; Various GIS analyses; Vegetation maps; Partial topographic maps; Geomorphic

				attribute maps; Inundation maps; Inclusion with landscape–scale maps of wetland patches; Report of edge/ecotone metrics; Habitat maps; Report of scale relationships; Comparison with predictive model; Collaborative planning, data integration, analysis, reports and distribution.
4	Plants	1	12	Field sampling data and reports including point counts, listening stations, and ; Vegetation maps; Remote sensing ground truthing; Coordination with current PMEP monitoring project; Collaborative planning, data integration, analysis, reports and distribution.
5	Birds	1	12	Fall and spring general bird surveys for ; specialized bird surveys (predation, breeding birds, reproduction of Passerines, Heron and Egret colonies); Collaborative planning, data integration, analysis, reports and distribution.
6	Fish and Invertebrates, Primary Production and Nutrients	1	12	Fish community assemblage, abundance, and utilization; Macroinvertebrate (insects, benthos, and zooplankton) community abundance and structure; Fish and invertebrate food web linkages; Collaborative planning, Primary production measurements of low marsh macrovegetation, mudflats,

				floating and submerged vegetation, and phytoplankton; Nutrient (nitrate, silicate, ammonium, and phosphate) measurements; Analysis and synthesis of data; Collaborative planning, data integration, analysis, reports and distribution.
7	Data Management	1	12	Support for science teams; website maintenance and report layouts; Database design, production and maintenance; Production of presentations including graphic design and report postings; Collaborative planning, data integration, analysis, reports and distribution.

Comments

If you have comments about budget justification that do not fit elsewhere, enter them here.

Budget Summary

Project Totals

Labor	Benefits	Travel	Supplies And Expendables	Services And Consultants	Equipment	Lands And Rights Of Way	Other Direct Costs	Direct Total	Indirect Costs	Total
$0	$0	$0	$0	$235,000	$0	$0	$0	$235,000	$0	$235,000

Do you have cost share partners already identified?
Yes.

If yes, list partners and amount contributed by each:

California Department of Transportation – $185,000

Do you have potential cost share partners?
No.

If yes, list partners and amount contributed by each:

Are you specifically seeking non−federal cost share funds through this solicitation?
No.

Petaluma Marsh Expansion Project − monitoring and secondary test site for the integrated regional wetland monitoring project

Petaluma Marsh Expansion Project − monitoring and secondary test site for the integrated regional wetland monitoring project

Year 1 (Months 1 To 12)

Task	Labor	Benefits	Travel	Supplies And Expendables	Services And Consultants	Equipment	Lands And	Other Direct	Direct Total	Indirect Costs	Total

							Rights Of Way	Costs			
1: project management (12 months)	0	0	0	0	0	0	0	0	$0	0	$0
2: Physical Processes (12 months)	0	0	0	0	50000	0	0	0	$50,000	0	$50,000
3: Landscape Ecology (12 months)	0	0	0	0	40000	0	0	0	$40,000	0	$40,000
4: Plants (12 months)	0	0	0	0	40000	0	0	0	$40,000	0	$40,000
5: Birds (12 months)	0	0	0	0	45000	0	0	0	$45,000	0	$45,000
6: Fish and Invertebrates, Primary Production and Nutrients (12 months)	0	0	0	0	50000	0	0	0	$50,000	0	$50,000
7: Data Management (12 months)	0	0	0	0	10000	0	0	0	$10,000	0	$10,000
Totals	**$0**	**$0**	**$0**	**$0**	**$235,000**	**$0**	**$0**	**$0**	**$235,000**	**$0**	**$235,000**

Budget Justification

Petaluma Marsh Expansion Project − monitoring and secondary test site for the integrated regional wetland monitoring project

Labor

All MAS labor is in kind services.

Benefits

All MAS benefits are in kind services.

Travel

All MAS travel is in kind services.

Supplies And Expendables

All MAS supplies are in kind services.

Services And Consultants

Budget Justification

Petaluma River Marsh Expansion Plan Supplementary Monitoring Plan

Direct Labor Hours. Provide estimated hours proposed for each individual. Barbara Salzman, Marin Audubon Society – In kind.

Salary. Provide estimate rate of compensation proposed for each individual. Barbara Salzman, Marin Audubon Society – In kind.

Benefits. Provide the overall benefit rate applicable to each category of employee proposed in the project. Barbara Salzman, Marin Audubon Society – In kind.

Travel. Provide purpose and estimate costs for all non−local travel. Barbara Salzman, Marin Audubon Society – In kind.

Supplies &Expendables. Indicate separately the amounts proposed for office, laboratory, computing, and field supplies. Barbara Salzman, Marin Audubon Society – In kind.

Services or Consultants. Identify the specific tasks for which these services would be used. Estimate the amount of tie required and the hourly or daily rate.

Wetlands and Water Resources Principal $130 Senior $115 Project $100 Staff $75

PRBO Conservation Science Principal $60 Staff $30

Avocet Research Associates Principal $130

San Francisco State University Principal $65 Staff/Grad $30

University of California, Berkeley Staff/Grad $30

Philip Williams &Associates Principal $155/hr Director $140/hr Senior Associate $130/hr Associate, $105/hr Field Services/Surveyor $90/hr Hydrologist $80/hr Graphics/CADD Production $75/hr, Secretary/Report Production $65/hr Technicians $50/hr Expenses are invoiced at 115% of cost

University of San Francisco Principal $60

Peter Baye Principal $130

Barbara Salzman, Marin Audubon Society – In kind.

Equipment. Identify non−expendable personal property having a useful life of more than (1) year and an acquisition cost of more than $5,000 per unit. If fabrication of equipments is proposed, list parts and materials required for each and show costs separately from others.

Barbara Salzman, Marin Audubon Society – In kind.

Project Management. Describe the specific costs associated with insuring accomplishment of a specific project, such as inspection of work in progress, validation of costs, report preparation, giving presentations, response to project specific questions and necessary cost directly associated with specific project oversight. Barbara Salzman, Marin Audubon Society – In kind.

Other Direct Costs. Provide any other direct costs not already covered. Barbara Salzman, Marin Audubon Society – In kind.

Indirect Costs. Explain what is encompassed in the overheads rate (indirect costs). Overhead should include costs associated with with general office requirements such as rents phones, furniture, general office staff, etc. generally distributed by a predetermined percentage (or surcharge) of specific costs. Barbara Salzman, Marin Audubon Society – In kind.

Equipment

All MAS equipment is in kind services.

Lands And Rights Of Way

All MAS Lands are in kind services.

Other Direct Costs

All MAS direct costs are in kind services.

Indirect Costs/Overhead

All MAS indirect costs are kind services.

Comments

Environmental Compliance

Petaluma Marsh Expansion Project − monitoring and secondary test site for the integrated regional wetland monitoring project

CEQA Compliance

Which type of CEQA documentation do you anticipate?
X none
− negative declaration or mitigated negative declaration
− EIR
− categorical exemption

If you are using a categorical exemption, choose all of the applicable classes below.
− Class 1. Operation, repair, maintenance, permitting, leasing, licensing, or minor alteration of existing public or private structures, facilities, mechanical equipment, or topographical features, involving negligible or no expansion of use beyond that existing at the time of the lead agency's determination. The types of "existing facilities" itemized above are not intended to be all−inclusive of the types of projects which might fall within Class 1. The key consideration is whether the project involves negligible or no expansion of an existing use.
− Class 2. Replacement or reconstruction of existing structures and facilities where the new structure will be located on the same site as the structure replaced and will have substantially the same purpose and capacity as the structure replaced.
− Class 3. Construction and location of limited numbers of new, small facilities or structures; installation of small new equipment and facilities in small structures; and the conversion of existing small structures from one use to another where only minor modifications are made in the exterior of the structure. The numbers of structures described in this section are the maximum allowable on any legal parcel, except where the project may impact on an environmental resource of hazardous or critical concern where designated, precisely mapped, and officially adopted pursuant to law by federal, state, or local agencies.
− Class 4. Minor public or private alterations in the condition of land, water, and/or vegetation which do not involve removal of healthy, mature, scenic trees except for forestry or agricultural purposes, except where the project may impact on an environmental resource of hazardous or critical concern where designated, precisely mapped, and officially adopted pursuant to law by federal, state, or local agencies.
− Class 6. Basic data collection, research, experimental management, and resource evaluation activities which do not result in a serious or major disturbance to an environmental resource, except where the project may impact on an environmental resource of hazardous or critical concern where designated, precisely mapped, and officially adopted pursuant to law by federal, state, or local agencies. These may be strictly for information

gathering purposes, or as part of a study leading to an action which a public agency has not yet approved, adopted, or funded.
– Class 11. Construction, or placement of minor structures accessory to (appurtenant to) existing commercial, industrial, or institutional facilities, except where the project may impact on an environmental resource of hazardous or critical concern where designated, precisely mapped, and officially adopted pursuant to law by federal, state, or local agencies.

Identify the lead agency.

Is the CEQA environmental impact assessment complete?

If the CEQA environmental impact assessment process is complete, provide the following information about the resulting document.

Document Name
State Clearinghouse Number

If the CEQA environmental impact assessment process is not complete, describe the plan for completing draft and/or final CEQA documents.

NEPA Compliance

Which type of NEPA documentation do you anticipate?
X none
– environmental assessment/FONSI
– EIS
– categorical exclusion

Identify the lead agency or agencies.

If the NEPA environmental impact assessment process is complete, provide the name of the resulting document.

If the NEPA environmental impact assessment process is not complete, describe the plan for completing draft and/or final NEPA documents.

Successful applicants must tier their project's permitting from the CALFED Record of Decision and attachments providing programmatic guidance on complying with the state and federal endangered species acts, the Coastal Zone Management Act, and sections 404 and 401 of the Clean Water Act.

Please indicate what permits or other approvals may be required for the activities contained in your proposal and also which have already been obtained. Please check all that apply. If a permit is *not* required, leave both Required? and Obtained? check boxes blank.

Local Permits And Approvals	Required?	Obtained?	Permit Number (If Applicable)
conditional Use Permit	–	–	
variance	–	–	
Subdivision Map Act	–	–	
grading Permit	–	–	
general Plan Amendment	–	–	
specific Plan Approval	–	–	
rezone	–	–	
Williamson Act Contract Cancellation	–	–	
other	–	–	

State Permits And Approvals	Required?	Obtained?	Permit Number (If Applicable)
scientific Collecting Permit	X	X	SC-004361
CESA Compliance: 2081	–	–	
CESA Complance: NCCP	–	–	
1602	–	–	
CWA 401 Certification	–	–	
Bay Conservation And Development Commission Permit	–	–	
reclamation Board Approval	–	–	
Delta Protection Commission Notification	–	–	
state Lands Commission Lease Or Permit	–	–	

action Specific Implementation Plan	–	–	
other	–	–	

Federal Permits And Approvals	Required?	Obtained?	Permit Number (If Applicable)
ESA Compliance Section 7 Consultation	X	–	
ESA Compliance Section 10 Permit	–	–	
Rivers And Harbors Act	–	–	
CWA 404	X	–	
other	–	–	

Permission To Access Property	Required?	Obtained?	Permit Number (If Applicable)
permission To Access City, County Or Other Local Agency Land Agency Name	–	–	
permission To Access State Land Agency Name	–	–	
permission To Access Federal Land Agency Name	–	–	
permission To Access Private Land Landowner Name The Corda Family	X	X	

If you have comments about any of these questions, enter them here.

The property subdivision used to acquire the property with CALFED-ERP finds includes an access easement to the property through the Waste Management, Inc. landfill. The Corda family access easement is attached to the proposal text.

The IRWM team has already performed an ESA Section 7 consultation and received a USACE Nationwide Permit for research at its other sites; we do not anticipate any problems

adding PMEP to these existing permits/consultations.

Land Use

Petaluma Marsh Expansion Project − monitoring and secondary test site for the integrated regional wetland monitoring project

Does the project involve land acquisition, either in fee or through easements, to secure sites for monitoring?
X No.
− Yes.

How many acres will be acquired by fee?

How many acres will be acquired by easement?

Describe the entity or organization that will manage the property and provide operations and maintenance services.

Is there an existing plan describing how the land and water will be managed?
− No.
− Yes.

Will the applicant require access across public or private property that the applicant does not own to accomplish the activities in the proposal?
− No.
X Yes.

Describe briefly the provisions made to secure this access.

All necessary access easements have been secured from the landfill and the Corda family (see proposal document). The Corda family was paid for both construction and access easements, both of which are legally recorded. The only third−party impacts from monitoring would be to the two adjacent landowners over whose properties the IRWM team must pass. These impacts would be minor: presence of the people driving through the landfill and over a small area of the Corda property to reach our property. As mitigation for the monitoring, we have agreed to provide notice to the property

owners of when team members will be passing through their properties.

Do the actions in the proposal involve physical changes in the current land use?
X No.
– Yes.

Describe the current zoning, including the zoning designation and the principal permitted uses permitted in the zone.

Describe the general plan land use element designation, including the purpose and uses allowed in the designation.

Describe relevant provisions in other general plan elements affecting the site, if any.

Is the land mapped as Prime Farmland, Farmland of Statewide Importance, Unique Farmland, or Farmland of Local Importance under the California Department of Conservation's Farmland Mapping and Monitoring Program?
X No.
– Yes.

Land Designation	Acres	Currently In Production?
Prime Farmland		–
Farmland Of Statewide Importance		–
Unique Farmland		–
Farmland Of Local Importance		–

Is the land affected by the project currently in an agricultural preserve established under the Williamson Act?
X No.
– Yes.

Is the land affected by the project currently under a Williamson Act contract?
X No.
– Yes.

Why is the land use proposed consistent with the contract's terms?

Describe any additional comments you have about the projects land use.

The project is located between a landfill, railroad tracks, and an existing marsh and is not accessible to the public except via boat.