Summary Information

California Department of Water Resources

The COYOTE Project: a Unified Approach to Monitoring Floodplain and Freshwater Tidal Marsh Restoration in the Cosumnes Preserve and Yolo Bypass

Amount sought: $5,107,577

Duration: 36 months

Lead investigator: Dr. Ted Sommer, California Department of Water Resources

Short Description

This "COYOTE" project will monitor connectivity and key ecological response variables at various spatial and temporal scales within the Yolo Bypass and the Cosumnes Preserve. The program will take advantage of comparisons between like ecosystems in the Yolo Bypass and Cosumnes River to assess project performance and the impacts of seasonal and interannual hydrologic variability. This project will be an integrated, multi−institutional, long term monitoring program for these two regions that: 1) assesses the response of ecosystems to management activities and hydrologic change, 2) develops indicators and performance measures to evaluate progress toward restoration objectives, 3) supports adaptive management of on−going restoration programs, and 4) develops new tools and methods to help guide floodplain and marsh restoration efforts throughout the CALFED region of interest.

Executive Summary

The COYOTE Project: a Unified Approach to Monitoring Floodplain and Freshwater Tidal Marsh Restoration in the Cosumnes Preserve and Yolo Bypass

A coalition of university, agency and foundation partners

The North Delta and its tributary rivers incorporate the dynamic transition from lowland river and floodplain habitats to river−dominated tidal freshwater marsh. Recognizing the importance of this ecotone to numerous CALFED goals and objectives, the CALFED Ecosystem Restoration Program (ERP) has supported multiple habitat conservation and restoration initiatives within the Yolo Bypass and the Cosumnes River Preserve. We seek support for an integrated, multi−institutional, long term monitoring program for these two regions that: 1) assesses the response of ecosystems to management activities and hydrologic change, 2) develops indicators and performance measures to evaluate progress toward restoration objectives, 3) supports adaptive management of on−going restoration programs, and 4) develops new tools and methods to help guide floodplain and marsh restoration efforts throughout the CALFED region of interest.

The Cosumnes−Yolo Terrestrial−aquatic Ecotone (COYOTE) Project is based on a simple conceptual model for floodplain and marsh restoration. In the North Delta and its tributary floodplains, hydrologic connectivity—defined as the exchange of water, sediment, nutrients, food resources and organisms between floodplain and marsh habitats and their surrounding river channels—is the primary driver of ecosystem function and structure and the impact of invasive species. Re−establishment and management of connectivity dictates the success of restoration efforts. The COYOTE program monitors connectivity and key ecological response variables at various spatial and temporal scales within the Yolo Bypass and the Cosumnes Preserve. The program takes advantage of comparisons between like ecosystems in the Yolo Bypass and Cosumnes River to assess project performance and the impacts of seasonal and interannual hydrologic variability. These same studies guide adaptive management programs and form the basis for predictions of ecosystem response to future restoration efforts.

The COYOTE Project will eventually have four Program Elements supported by data gathering and analysis in five or more Component Programs. The four Program Elements are: (1) observation, the gathering and aggregation of ecosystem data; (2) assessment, analysis of data and performance indicators, and feedback into adaptive management; (3) forecasting, development of hydrologic and ecologic models to support forecasting of ecosystem response to management efforts; and (4) methods, development of new technology and methods for assessment. This request for funding will establish the observation and assessment elements of the COYOTE Project. Five component programs−− hydrology/geomorphology, water quality, aquatic resources, terrestrial resources and data management−−integrate and systematize data gathering and reporting for the two regions. The project involves structured interaction with stakeholder groups and ERP staff to guide development of indicators and performance measures and to support adaptive management and program refinement. Data reporting will be compliant with BDAT and SWAMP standards. The program is modeled, in part, after the National Science Foundation Long−Term Ecological Research Program, and is designed to allow for adaptive program adjustments and expansions and to facilitate collaboration with other regional and national monitoring programs.

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A. Project Description: Goals and Scope of Work

A.1 Problem, Goals and Objectives

The North Delta and its tributaries make up the most significant regional ecotone of the Bay-Delta and its watershed. Historically, this region contained the transition between the lowland floodplains and channels of the Sacramento, Cosumnes, Mokelumne and Calaveras Rivers and the tidal fresh water marshes of the North Delta (Fig. 1.1). Interannual and seasonal variations in runoff, including winter and spring flood pulses, were superimposed on the tide and wave energy of the North Delta. This created a mosaic of diverse, dynamic floodplain, riverine and tidal marsh habitats that supported exceptionally high biological productivity and influenced food webs of the entire estuary (Jassby and Cloern, 2000; Kimmerer, 2004). Since the mid-1800s, the North Delta ecotone has been fundamentally changed. Wetland reclamation, levee construction, invasive species, flow regulation, and flood control have altered the historic sources of productivity, and impacted the life histories of numerous native plants and animals (The Bay Institute, 1998; CALFED, 2001).

Recognizing the importance of the North Delta ecotone, the CALFED Ecosystem Restoration Program (ERP[1]) has committed significant resources to restoring key ecosystem attributes within the region (CALFED, 2001, 2004), particularly within the Yolo Bypass and the Cosumnes River Preserve. The Yolo Bypass is a 59,000-acre flood bypass structure that diverts floodwaters from the Sacramento River, Cache Creek and Putah Creek around the metropolitan areas of Sacramento, Woodland and Davis[2] (Figure 1.2). The Bypass, which occupies the extensive historic floodplain of the lowermost Sacramento River, is managed for a mix of uses, including farming, riparian and managed wetland habitat, tidal marsh habitat (Liberty Island—see Figure 1.3), upland and grassland habitat, and flood control. In recent years, it has become the focus of interest in managing seasonally flooded habitat, particularly for native fish rearing and spawning. The Cosumnes Preserve is a 40,000 acre area managed by a mix of foundation, federal, state and private partners[3] (Figure 1.4). The bulk of the Preserve lands are located on the lower Cosumnes River and its floodplain and two large North Delta islands, Staten Island and McCormack-Williamson Tract. The Cosumnes retains a relatively intact hydrograph and extensive tracts of seasonally-flooded riparian and floodplain habitat. The actions of the ERP in the Yolo Bypass and the Cosumnes Preserve have included land acquisition to protect existing habitat and restorable lands, restoration of riparian, and wetland and tidal marsh habitat (Table 1.1). In addition to these habitat projects, ERP has funded monitoring and research (e.g. UCD's Cosumnes I and II Projects; Yolo Bypass Fish Habitat Study) and provided support for planning and outreach (e.g. Yolo Bypass Working Group). These projects have played a major role in the adaptive management and development of habitat projects funded by ERP and others (e.g. CDFG's Yolo Bypass Wildlife Area). This proposal seeks funding to monitor and assess the efficacy of these ERP actions and to establish a long-term program to support adaptive management in the region.

[1] A partial list of abbreviations used in this document is provided in Appendix A.
[2] http://www.yolobasin.org
[3] http://www.cosumnes.org; http://www.watershed.ucdavis .edu/crg

A multi-institution, integrated program, termed the Cosumnes-Yolo Terrestrial-aquatic Ecotone (COYOTE) Project, will be developed to evaluate the effectiveness of historic restoration activity, monitor change within existing ERP projects, develop baseline information for assessments of future ERP projects, identify regional threats to ecosystem health and further restoration opportunities, and provide input into on-going adaptive management of the Yolo Bypass and Cosumnes Preserve. This effort will involve government, university and foundation partners who will share expertise and resources. COYOTE is a pioneer program that will serve as a model for other collaborative ERP monitoring programs and complement other existing long-term monitoring efforts[4,5].

The COYOTE Project will eventually have four Program Elements supported by data gathering and analysis in five or more component programs. The four Program Elements are: (1) *observation,* (2) *assessment,* (3) *forecasting,* and (4) *methods* development and evaluation. This request for funding will establish the observation and assessment elements of the COYOTE Project and will create the infrastructure necessary for eventual development of the forecasting element. Funding for methods development and evaluation will be requested separately.

A.2 Justification

The COYOTE Project is designed as an integrated long-term, multi-institutional, and adaptable ecological monitoring program for the floodplain and freshwater tidal marsh ecotones of the North Delta and its tributaries. It is based on four conceptual models about effective (1) ecosystem restoration, (2) ecosystem restoration indicators and performance measures, (3) monitoring design, and (4) monitoring organization.

Conceptual Model for Ecosystem Processes. The restoration of critical habitat and ecosystem attributes in lowland rivers and river-dominated tidal marshes hinges on hydrologic connectivity. In the North Delta ecotone, hydrologic connectivity—defined here as the exchange of water, sediment, nutrients, food resources and organisms between floodplain and marsh habitats and their surrounding river channels—is fundamentally altered by land use activities and flow regulation. Conceptual models that underlie restoration activity covered in this proposal are based on the hypothesis that reestablishment of hydrologic connectivity at proper spatial and temporal scales will create functional floodplain and tidal wetland habitats within the Yolo Bypass and the Cosumnes Preserve and reduce the impacts of non-native plants and animals (Fig. 2.1, 2.2).

Hydrologic connectivity between rivers and their floodplains is a critical driver of ecologic integrity in large, lowland floodplain systems in tropical and temperate environments (Tockner et al., 2000; Ward et al., 2001; Amoros and Bornette, 2002). The seasonal flood pulse is the principal mechanism for disturbance (Rood et al., 1998), as well as the source of subsidies between the channel and floodplain. The flood regime, including the timing, magnitude, frequency, duration and predictability of floodplain inundation defines the distribution and composition of plant communities, structure and productivity of aquatic food webs (Power et al., 1995), and the quality and productivity of spawning and rearing habitat for fish (Poff et al., 1997; Lytle and Poff, 2004).

[4] http://www.lternet.edu
[5] http://www.nsf.gov/bio/neon/start.htm

Research on both floodplains has shown that the patterns of seasonal inundation and water quality drive the structure of aquatic food webs (Mueller-Solger et al., 2002), overall aquatic productivity and standing biomass, and the quality and quantity of native fish spawning and rearing habitat (Harrell and Sommer 2003; Moyle et al., 2004, Schemel et al., 2004). Riparian forest communities also benefit from hydrologic connectivity, which stimulates forest regeneration and dynamic floodplain topography (Tu, 2000; Swenson et al., 2001, Trowbridge, 2002; Florsheim and Mount, 2002; Mount et al., 2003). The timing and magnitude of flooding plays a key role in encouraging native fishes and herbaceous vegetation, while discouraging non-native invasives (Trowbridge, 2002; Sommer et al., 2001a; Moyle et al., 2004). Based on this research, changes in land use activity or flow management that alter the timing, magnitude and duration of hydrologic connectivity can be used to enhance ecosystem attributes. Alternatively, changes in runoff patterns due to climate or land use change may adversely impact restoration efforts, requiring adaptive responses.

Similarly, in river-dominated tidal freshwater marsh systems, hydrologic connectivity between marsh habitats and adjacent tide and river-influenced channels controls the marsh conditions (Pethick and Crooks, 2000). The evolution of marsh plain and tidal channels reflect the energy and sediment supply from adjacent channels along with seasonal flooding effects from the adjacent river (Orr et al., 2003). Restoring connectivity between reclaimed marshes reintroduces wave, tide and river energy, along with sediment, to the marsh. Coupled with vegetation establishment, this creates self-forming dynamic tidal channel networks and marsh habitats (Knighton, 1998).

The physical processes that control restoration of river-dominated freshwater tidal marshes of the North Delta have not been systematically evaluated in the peer-reviewed literature. Analysis of sediment cores from McCormack-Williamson Tract (Brown and Pasternack, 2004) has shown that sedimentation patterns in North Delta islands have historically been heavily influenced by riverine processes. The best documented effort to date includes the study by Reed (2002) of Lindsey Slough and Prospect Island West, as part of the CALFED-funded BREACH program. This work demonstrated that the Yolo Bypass islands experience relatively low tidal energy, with high sediment supply. Rapid accretion is associated with restoration of hydrologic connectivity, principally due to the high availability of inorganic sediment. Undocumented, but widely-observed feedback between sediment accretion, tidal channel formation and rapid development of marsh plant communities controls the patterns of geomorphic evolution of the marshes. The emphasis of freshwater tidal marsh monitoring will be on Liberty Island (Figure 1.1), where multiple breaches have reintroduced tidal and fluvial processes. Our conceptual model envisions that dynamic tidal marsh topography and associated habitats can be linked to the complex interaction between sediment-laden flows in the Yolo Bypass and daily modification by wind waves and tides.

Ecosystem Restoration Indicators and Performance Measures. The CALFED ERP has not developed ecosystem indicators and performance measures for lowland floodplain and freshwater tidal marsh systems similar to those found in the North Delta and its tributaries. Based on our conceptual models we will derive a set of indicators and performance measures for CALFED-funded ecosystem restoration projects within the Cosumnes Preserve and Yolo Basin. Measuring project effectiveness necessarily includes assessing the status of target systems and species, both before and after implementation of restoration actions (Parrish et al. 2003). Our starting point will be indicators proposed by TNC's Cosumnes River project (TNC 2002) (Table 2.1) and developed using TNC's "Measures of Success" framework for assessing conservation impact (TNC 2000, 2003). This framework has been used to develop measures of status and effectiveness at hundreds of landscape-scale projects worldwide. TNC has recently refined this framework to strengthen its scientific rigor and improve its use in adaptive management (Parrish et al. 2003, TNC 2003). All indicator and performance measure efforts will involve direct consultation with stakeholder groups and ERP staff.

Integrated "BACI" Monitoring Design. One of the most significant challenges for restoration assessment monitoring and adaptive management is to demonstrate the impacts of management activity relative to natural conditions or variability. The COYOTE Project is a unique opportunity to address this challenge. Modern BACI (Before-After, Control-Impact) monitoring designs stress the importance of being able to collect and analyze data from locations that are considered beyond the influence of specific management activity and not subject to its impacts (Underwood, 1991; Stewart-Oaten and Bence, 2002, Downes et al., 2002). When coupled with good quality baseline information, comparisons between impacted and non-impacted reference sites provide the most reliable method of assessment.

Because there are limited baseline data on historic conditions in the North Delta and its tributaries, and no functionally intact reference sites for lowland floodplain and tidal marsh ecosystems (Florsheim et al., 2003), we propose a modified BACI design. Comparisons between altered, but like systems will assess status and trends in ecosystem variables. In this way, the Cosumnes Preserve and the Yolo Bypass provide reciprocal 'control' or, more precisely, 'comparison' sites for assessment of restoration activities. Integrated long term monitoring between the two regions, using like methods, shared expertise and similar indicators, provides the best opportunity for synoptic assessment of restoration success and adaptive management.

Monitoring organization. Figure 2.3 summarizes the organizational design (solid arrows) and refinement (broken arrows) process for the COYOTE Project. This process integrates the adaptive management process for ecosystem restoration with a monitoring program organized around the ecosystem restoration, indicator, and monitoring design concepts explained above. The COYOTE Project design process is driven by ecosystem restoration goals, hypotheses, conceptual models, and actions. These are constantly refined as new COYOTE information becomes available and new restoration needs and opportunities arise. By introducing "Program Elements," "Component Programs," and a "Management Team" (explained in detail in section A.4) it also adopts and refines proven organizational strategies of other monitoring programs.

A.3. Previously Funded Monitoring

Perhaps more so than any other regional restoration projects in the Bay-Delta, the Yolo Bypass and Cosumnes River have been the foci of intense research and monitoring. Table 3.1 describes the sampling frequency, period of record and location that major variables have been collected by collaborators. Specific methods and analyses are summarized in numerous peer-reviewed publications (Table 3.2). Data analyses have yielded new insight into a variety of complex topics including hydrological modeling, geomorphology, water quality trends, food web relationships and fish life history. These ongoing monitoring efforts underpin the conceptual models and performance indicators described in the previous section. Present CBDA funding will allow these monitoring activities to continue through late 2005, after which new funding will be needed While similar in many aspects (Table 3.1), most past and present monitoring and research activities in the Yolo Basin and the Cosumnes River region have proceeded independently of each other, hampering effective cross-system comparisons.

A.4. Approach and Scope of Work

The COYOTE Project builds upon the extensive past investment of the Ecosystem Restoration Program in the Cosumnes River, North Delta, Liberty Island and Yolo Bypass and current and evolving institutional relationships between the University of California, Davis, California Departments of Water Resources (CDWR) and Fish and Game (CDFG), U.S. Fish and Wildlife Service, The Nature Conservancy (TNC), the Cosumnes River Preserve Partners, and multiple stakeholder groups.

The overall project will have four Program Elements. The *Observation Element* will involve the collection, aggregation and dissemination of project data. This will dominate the day-to-day activity of the project. The *Assessment Element* involves the periodic evaluation of indicators and performance measures and the refinement of conceptual models in a transparent manner accessible by stakeholders and decision-makers. The *Forecasting Element* utilizes hydrologic and ecologic models to forecast the potential impacts of proposed management actions, and changes in key stressors such as land use activity, climate change and invasive species. By closely involving stakeholders and decision-makers, the Assessment and Forecast Elements are integral to long-term adaptive management of ERP projects in the two regions. Finally, the *Methods Element* is intended to develop and evaluate data collection and analysis methods for potential additional COYOTE monitoring in the future. The COYOTE Project is not seeking support for the Forecasting and Methods Elements in this proposal; funding will be sought from other sources for these Elements.

The four Program Elements are incorporated into the combined monitoring program through the following common questions for the two major study areas, Yolo Bypass/Liberty Island and Cosumnes River (Program Elements in parentheses):

- Within each study area, what are the temporal and spatial patterns of the major monitoring variables at locations representing a range of habitat types, and what are the relationships between them? (*observation*)
- How do the monitored variables respond to habitat restoration and environmental variability, and how do these responses differ for Yolo Bypass/Liberty Island and the Cosumnes River? (*observation* and *assessment*)
- How well are restoration actions attaining their objectives? (*observation* and *assessment*)
- What adjustments can be made to improve the performance of restoration projects in Yolo Bypass, Cosumnes River and other Bay-Delta locations? (*assessment* and *forecasting*)
- How can monitoring be improved (e.g. different sampling locations, different variables, different methods)? (*observation*, *assessment, and methods*)

The four Program Elements will be executed through five Component Programs: (1) Hydrology/Geomorphology, (2) Water Quality, (3) Aquatic Resources, (4) Terrestrial Resources and (5) Data Management. Component Programs (1)-(4) collect information on key monitoring variables, assess key indicators, and test hypotheses about the effectiveness of restoration actions.

These hypotheses will be refined as the development of restoration indicators and performance measures progresses. The Data Management Component Program addresses the critical issue of data analysis, protocols, decision support, and integration with agency data management programs and is described in section A.7. The development of Component Programs enables the sharing of expertise and resources, reducing redundancies in staff and equipment, and improving the integration of the overall monitoring program. Each Component Program has a lead scientist, responsible for overseeing coordination and data sharing. These lead scientists form part of a management team that meets quarterly and prepares annual reports and assessments (described below). The management team serves as the principal contact with CALFED staff and is responsible for outreach to local stakeholder groups.

The COYOTE Project will consist of integrated monitoring efforts that evaluate change in ecologic indicators and the drivers of change, at varying spatial and temporal scales using a modified BACI design (see section A.2). The Project will be guided by the previously described conceptual models that relate the response of key ecological indicators to intra- and interannual variations in the hydrologic connectivity, and the influence of management activities on that connectivity. Following the NSF LTER model, monitoring programs will be simple in design, relatively low-cost, and use only well-established and comparable methods in order to insure monitoring feasibility, consistency, repeatability and durability.

The data collection efforts and staff responsibilities of the project are summarized in Table 4.1, with each Component Program constituting a major study task. The specific sampling locations are identified in Figures 1.2-1.4. Sampling locations were targeted based on prior knowledge about habitat representativeness and prior use as monitoring stations rather than through a statistical survey design. Specifically, target sampling locations were chosen to (1) identify the major temporal trends of selected environmental variables and organisms at sites representing a range of habitat types; (2) quantify general trends in system inputs and outputs; (3) provide a basic comparison of the patterns in each location; and (4) to avoid "orphaning" prior data (e.g. Table 3.1). Inferences and forecasts about system properties and dynamics will be made using hydrological and ecological models.

To the extent possible, COYOTE monitoring will employ the same study methods in each location. However, in some cases unique characteristics of each site or system lead to some differences in approach (examples: screw trap fish monitoring in the Yolo Bypass, electrofishing in the Cosumnes). Because of the limited funding available in the present PSP, we have chosen to exclude several monitoring variables. These include biological variables such as microbial abundance and biomass (bacteria and protozoa smaller than 40 μm), benthos abundance and biomass, and algal primary productivity. While these variables are potentially important to understanding ecologically responses to restoration, monitoring methods have not yet been firmly established for the Yolo Bypass and/or the Cosumnes system. We intend to seek additional funding for method development and evaluation. In the future, these monitoring variables may be included within existing Component Programs or added as stand-alone programs. Most notably, we have not included analysis of contaminants in our Project. Instead, we will coordinate closely with several on-going CBDA-funded studies on heavy metals and pesticides that already focus on Yolo Bypass and Cosumnes River and invite participation in our quarterly and annual meetings.

Hydrology/Geomorphology

Program Component Hypothesis: Successful restoration of lowland floodplains and freshwater tidal marshes leads to a substantial increase in floodplain and marsh areas with a high degree of hydrologic connectivity and complexity at important spatial and temporal scales. The Hydrology/Geomorphology Component Program seeks to characterize and assess the physical processes that drive ecosystem structure and function. The program emphasizes evaluating seasonal and interannual variation in climatologic and hydrologic conditions and the geomorphic response to these conditions with particular emphasis on evaluating hydrologic connectivity between lowland floodplains and their adjacent rivers and freshwater tidal marshes and adjacent river channels. This work will form the foundation for water quality, aquatic resource and terrestrial resource sampling and analysis.

Meteorology: Meteorological conditions on the Cosumnes Preserve and Yolo Bypass play a critical role in water quality, flow conditions, and productivity and structure of riparian communities. Currently there is sparse information about meteorological conditions. A network of telemetered meteorological stations will be installed to record climate gradients within both regions. Two new stations will be installed on the Cosumnes River to augment the existing station on the floodplain maintained by the Cosumnes Research Group. Three new stations will be installed on the Yolo Bypass. Each station will record temperature, rainfall, barometric pressure, solar radiation, humidity, wind speed and direction. Where appropriate, additional water quality and depth sensors will be added.

Stage and Flow: In order to characterize hydrologic conditions on the Yolo Bypass and Cosumnes Preserve floodplains, hydrologic indicators will be developed and tested. Summarized in Table 4.2, floodplain hydrologic indicators are grouped into two categories: flood event hydrology and annual hydrologic characterization. These indicators were developed on the Cosumnes Preserve floodplain and will be evaluated for the Yolo Bypass (Trowbridge et al., in review; Mount et al., in prep.). On the Cosumnes floodplain, the existing telemetered gage network will be augmented by three additional stage gages that will be used to calibrate and validate an existing Mike-11 1-D unsteady flow model. On the Yolo Bypass, the ongoing CDWR Aquatic Restoration Planning and Implementation Program will complete installation and rating of gages at all inlet points. All gages will be surveyed into existing control networks. Enhanced gage data will be used to support better low flow modeling. A UNET model is currently calibrated for high flow. The long-term goal of this program is to develop nested hydrologic models that will support simulations necessary for the forecasting element of the project.

To date, there has been no significant data collection on the hydrodynamic and geomorphic conditions on Liberty Island. To assess flow conditions in the island and their influence on sediment transport, four tide gages will be installed (Figure 1.3). One gage will be a telemetered, continuously recording gage, with the other three deployed at various time intervals. All gages will be surveyed into a control network.

Geomorphology: Sedimentation and scour within the floodplain and marsh control the distribution and quality of aquatic and riparian habitat. Given the scale of the Yolo Bypass and Cosumnes River Preserve and budget constraints, it is not feasible to assess bathymetric and topographic change over the entire area. Instead, a stratified approach will focus on systematic sampling in areas of known or projected change based on field and air photo observations. On the Cosumnes Preserve, multiple monumented transects have been established to evaluate dynamic floodplain topography in areas impacted by levee breaches (Florsheim and Mount, 2002). Five additional transects will be established in the floodplain reaches of the Preserve upstream of Twin Cities Road. Transects will be resurveyed every third year or following winters with high flow events. In addition to survey transects, the Cosumnes Research Group has established a gridded network of sediment tiles that will continue to be surveyed and sampled annually. Sediment budgets for the Cosumnes and the Mokelumne Rivers have been developed from multiple sources, including USGS data at the Michigan Bar gage, optical backscatter sensor surveys on the Cosumnes at Twin Cities Road and the Mokelumne gage (upstream of the Benson Ferry), and suspended sediment sampling at multiple localities throughout the Cosumnes watershed (Cosumnes Research Group, 2003). We will continue to monitor sediment fluxes at Twin Cities Road using optical backscatter sensors.

The CDWR Aquatic Restoration Planning and Implementation Program (ARPI) has initiated monitoring of floodplain sedimentation at several sites in the Yolo Bypass floodplain, via replicate surveys of transects, and plans to install four event-based sediment samplers to estimate annual sediment flux and texture. ARPI coordinates with USGS optical backscatter studies of suspended sediment at the I-80 bridge over the Sacramento River and in Cache Slough (D. Schoellhamer) and RWQB mercury and suspended sediment transport studies within the Bypass (C. Foe).

On Liberty Island, tidal scour and deposition will be assessed in multiple ways. A network of 20 transects will be surveyed at the beginning of this project and resurveyed at least once every three years. These include: six elevation transects to capture changes in sedimentation patterns associated with vegetation changes and associated shifts in tidal/wind energy and fluvial influence; five bathymetric transects across the lower end of the island to record evolution of the intertidal and subtidal sections; and three marsh or minor channel transects and six major channel transects to monitor evolution of tidal channel geometry. All surveys will be either monumented or tied into local control points to facilitate accurate resurveying. In order to assess sedimentation rates on the island, three S.E.T. and two sedimentation plates will be installed and monitored quarterly. This information, in conjunction with survey transects, will be used to estimate annual sedimentation rates on the island after the third year.

Water Quality

Program Component Hypothesis: Successful restoration of lowland floodplains and freshwater tidal marshes leads to water quality characterized by sufficient but not excessive nutrient supplies for primary production in the floodplains and marshes, substantial exports of phytoplankton-rich particulate organic matter to subsidize the downstream riverine and estuarine foodwebs, and low exports of potentially harmful constituents such as dissolved organic carbon and contaminants. The primary goal of the Water Quality Component program will test and refine this hypothesis by establishing a long-term monitoring record for important water quality constituents in lowland floodplain and tidal marsh systems in the Yolo Bypass and Cosumnes River. Given the large spatial scales and the high cost of rigorous water quality monitoring, we acknowledge that we can not measure the entire range of water quality constituents at an intensive time-step, nor will we measure pesticides and certain other contaminants in this study. When possible, we will collaborate with other research teams active in the Yolo Bypass and Cosumnes River floodplains to fill in those constituents that may affect aquatic species (e.g. Table 8.1). We will also coordinate our monitoring activities and analytical methodologies with the Interagency Ecological Program. An initial inter-laboratory comparison will be performed to assure that analytical results are consistent among laboratories in the study. While there are some differences in the overall water quality monitoring approach in the Yolo Bypass and Cosumnes River floodplains due to differences in spatial scale, the data collected from each site will be complementary allowing us to evaluate any scaling issues.

A combination of continuous monitoring, discrete sampling (grab samples) at regular intervals and event based sampling will be integrated to characterize daily, seasonal and annual variations of water quality throughout the study area, with an emphasis on all aquatic resource monitoring sites (Table 4.1). The continuous monitoring stations will be utilized to assess basic physical, chemical and biological water quality conditions (water temperature, specific conductance, pH, dissolved oxygen, turbidity and fluorescence). Fluorescence has been shown to provide a reliable, rapid measure of chlorophyll *a* concentration that can be used to estimate phytoplankton biomass. This information will allow evaluation of any changes in magnitude and variability of basic physical, chemical and biological conditions in the river, channel, floodplain and wetlands over time. In addition, these data in combination with continuous flow measurements will allow for an evaluation of constituent fluxes and the influence of hydrologic exchange processes on water quality across various habitat types.

Samplings sites and Variables: Continuous monitoring stations of water temperature, specific conductance, pH, dissolved oxygen, turbidity and fluorescence will be established at the upper inlet and two outlets of the Cosumnes River preserve using YSI 6600 water quality sondes. Yolo Bypass sampling will occur at eight continuous monitoring sites including four in Liberty Island, two in Little Holland Tract, one above Little Holland Tract, and one in the northern Bypass. Discrete samples will be collected from both locations on at least a monthly basis for nutrient and organic carbon analysis. For Cosumnes River Preserve, ISCO automatic pump samplers will also provide higher resolution sampling during flood events. They will collect one composite sample every four hours during flood events, with each composite consisting of hourly subsamples. The composite sampling strategy has been shown to produce a cost-effective method to determine fluxes during events (Dahlgren et al., 2004). In addition, six fixed Cosumnes sites representing habitats with different hydrologic residence times and vegetation (grassland versus forest) will be monitored daily during events and weekly during floodplain draining and disconnection. These fixed sites are the same sites utilized for aquatic resource sampling. Variables monitored at these six sites will include all variables monitored at the continuous sites, plus additional measurements of photic zone depth to estimate primary productivity from chlorophyll *a* concentrations and light availability per Jassby et al. (2002).

All analytical analyses will follow standard methods (Clesceri et al., 1998; APHA 1998). These methodologies have been utilized for past studies on the Cosumnes Watershed and the long-term monitoring programs by the Department of Water Resources in the Delta and have appropriate limits of detection (LOD) for important water quality constituents (Ahearn et al., 2004). Nutrient concentrations (total N, NH_4/NH_3, NO_3, DON, total P, SR PO_4 and Si) will be measured to assess their influence on primary production. Total and dissolved organic carbon will be measured and the ratio of these variables will be used to assess potential changes in material processing among particulate and dissolved fractions within the wetlands. Chlorophyll-*a* and phaeophytin concentration will be used to estimate the development of phytoplankton biomass at the base of the food web and will be analyzed by standard fluorometry and/or spectrophometric techniques. Major cations (Ca, Mg, K, Na) and anions (Cl, Br, SO_4) will be measured that affect the chemical reactivity of organic and inorganic substances in the wetlands. Laboratory QA/QC will implement SWAMP approved and EPA certified field and laboratory protocols including spikes, blind samples, reference materials, setting of control limits, criteria for rejection, data validation and chain of custody.

Aquatic Resources

Program Component Hypothesis: Successful restoration of lowland floodplains and freshwater tidal marshes leads to a high diversity and abundance of native aquatic organisms, including fish. These organisms are some of the key elements in terms of CALFED goals, public interest, and their interactions with each other and other parts of the ecosystem. To test this hypothesis, the aquatic resources component will characterize and assess long-term spatial and temporal patterns of several important groups of aquatic organisms in the Yolo Bypass, and Cosumnes study areas and relate them to all other monitored components. Unfortunately budgetary constraints and methodological and logistical difficulties make it impossible to monitor all potentially important organism groups or use more intense temporal and spatial scales. Most notably, we decided to withhold monitoring of benthic organisms until methodological and logistical issues are resolved. Until then, fish diet analysis will yield some insights into patterns of benthic organisms used as food for fish.

Phytoplankton: As described under Water Quality, chlorophyll *a* will be used as an index of phytoplankton biomass. Primary productivity, the rate of biomass accumulation per unit time, will not be assessed. We recommend that primary productivity be included in the monitoring program once the methodology is developed and validated.

Zooplankton: Zooplankton will be collected using plankton nets with 160 micron mesh nets and a flow meter, weekly during high flow periods, and monthly during low flow periods (Sommer et al. 2001a; 2004). Sampling will be conducted in seven sites in Yolo Bypass and five sites in the Cosumnes River (Figure 4.1). When velocities are sufficient (e.g. > 0.5 m/sec), nets will be placed passively in the drift; otherwise, the nets will be towed. Unlike previous sampling years, additional samples will be taken using a 40 micron net to collect rotifers and zooplankton nauplii. Samples will be concentrated and stored in 5% formalin. Crustaceans and rotifers will be counted and identified to class or order using procedures similar to those of the IEP Environmental Monitoring Program[6] .

Drift Invertebrates: Invertebrates will be collected using 500 micron drift nets on a weekly basis during high flow periods, and a monthly basis during low flow periods (Sommer et al. 2001a; 2004). When velocities are sufficient (e.g. > 0.5 m/sec), nets will be placed passively in the drift; otherwise, the nets will be towed. Drift samples will be stored in ethanol or buffered formalin, and the invertebrates will be identified to family or order using a dissecting microscope.

Fish: Two common methods with be used to characterize fish communities in Yolo Bypass and the Cosumnes River: 1) larval nets; and 2) beach seines. Both methods will be conducted weekly during high flow periods and monthly during low flow periods. For larvae, a 500 micron mesh net (4 m long, 0.65 m diameter mouth) will be used at the same locations where invertebrates are collected

[6] http://www.iep.water.ca.gov/emp/Metadata/

(Figure 4.1). Larval sampling will be conducted either passively or alongside a boat, depending on water velocity (Sommer et al. 2003). Fishes will be stored in formalin before being counted and identified to species using a dissecting microscope. Sampling will also be performed using 15 m beach seines 4.75 mm mesh) (Sommer et al. 2001a). Samples will be collected weekly at 10 core locations in Yolo Bypass during periods when the basin is flooded. After the Bypass drains, sampling will be conducted monthly at 7 core locations. Comparative data in the adjacent reach of Sacramento River will be collected at five beach seine sites using similar techniques by U.S. Fish and Wildlife Service as part of standard IEP monitoring. Cosumnes sampling will occur at six core locations.

Screw trap sampling will be used as an independent approach to collect data on the fish assemblage in the Yolo Bypass (Sommer et al. 2003). We will operate a 2.4 m diameter rotary screw trap (EG Solutions, Corvallis Oregon) five to seven days each week, with daily effort varying from 1-24 hours, depending on debris load and safety considerations. Because screw trapping is relatively inefficient for larger fish (>150mm), we propose to use a fyke trap located near the mid-point of the Yolo Bypass (Lisbon Weir in Figure 4.1) to capture adult fishes (Harrell and Sommer 2003). The trap will be checked three to five days per week depending on species being captured, numbers of fish and debris load. At high flows ($>1{,}000 m^3 \cdot s^{-1}$), fyke trap sampling will be suspended because debris loads create risk of losing or collapsing the fyke trap. Smaller fyke traps will be utilized at Liberty Island and Little Holland Tract to determine utilization by the fish of channels in the tule marsh. These smaller fyke nets will be set during one tidal cycle generally once per week on Liberty and every other week on Little Holland. For all gear types, fish in each sample will be identified to the lowest practicable taxon, measured (FL) and counted.

Electrofishing will be used on the Cosumnes floodplain because it has proven to be the most effective way to collect adult and yearling fish using the floodplain for spawning and foraging. Sampling is conducted with a shallow draft 5 m boat upon with a 5.0 GPP Smith-Root electrofishing array that samples fish effectively at depths of 0.5-2.0 m. Fish are captured by a person standing in the bow of the boat with a long-handled dipnet. At each station, the appropriate environmental variables will measured, e.g. depth, bottom type, amount of current and vegetation type, using a standard form.

The diets of young fish will be used as a measure of feeding success in both locations (Sommer et al. 2001a). During December-April, at least 20 juvenile Chinook salmon will be taken from beach seining (see above) in each region. For the March-June period, juvenile splittail will also be a target species. Fish samples will be tagged and stored individually in a deep freeze. After thawing, stomachs will be removed from fish and contents and identified with a dissecting microscope to Order (insects and arachnids), Genus (crustaceans) or Phylum (rarely eaten taxa such as oligochaetes). As time permits, diets of other abundant fishes in the two study areas will also be monitored to provide a better understanding of the benthos and of food-web links.

Terrestrial Resources

Program Component Hypothesis: Successful restoration of lowland floodplains and freshwater tidal marshes leads to increased biodiversity, improved ecosystem function, and stabilized critical habitat, including wetlands, riparian forests, and tidal mudflats. Monitoring of terrestrial resources in the

COYOTE Program will focus on riparian and wetland elements of the vegetation, and intertidal mudflats. Use of various habitats by native birds and bats indicates success in establishing habitat structure and foodwebs that will support the larger goals of restoration of full native biota.

Vegetation and bird populations have been systematically monitored in the Cosumnes River Preserve for over a decade, and bat population records date back several years, making the Cosumnes floodplain a key reference site against which variability in riparian, wetland, and floodplain biota elsewhere in the Delta and major river systems can be compared. The Cosumnes provides the long-term comparison/control site in a modified BACI study design suitable for evaluating large-scale, incompletely replicated actions in the Bypass and other floodplain, island, and levee-setback sites. In an explicit BACI design, core observations from the Cosumnes protocols will be repeated throughout the study region.

Vegetation, Habitat, and Land Cover. Rapid vegetation changes in the Cosumnes floodplain have been documented through a combination of standardized vegetation transects (see Trowbridge, 2002), remote sensing (Keller 2003; Noujdina, 2003) and fine-scale mapping of infestations of invasive species (Mount et al., 2003; Keller, Waegell, unpublished). Structural habitat and forest composition have been documented for all bird transect and next survey sites using methods widely applied throughout the CALFED region by PRBO, RHJV, and their collaborators (Ralph et al., 1993). Similar patterns are evident but undocumented in newly established wetland and riparian vegetation in the Liberty Island area and near creek outlets and weirs in the bypass.

The COYOTE Program will:

- Continue annual Cosumnes vegetation transects, to document change in the largest restored riparian area in the CALFED region and provide a baseline for multiple projects. More detailed invasive species surveys are separately funded.
- Replicate the Cosumnes transects annually along revegetating parts of fish and aquatic sampling transect lines in the Yolo Bypass, and at up to 12 sites identified as changing most rapidly under the change detection component (see below).
- With additional support from CDFG, use available imagery to map natural (non-agricultural, non-urban) habitat (Sawyer and Keeler-Wolf, 1995; Thorne, et al., 2004) for important vegetation types (e.g. the various riparian, wetland, and tidal flat types.)
- Apply low resolution change-detection methods developed by Noujdina (2003), Rogan et. al (2003) to assess rapid change in vegetation properties, to get time-series of cover and productivity estimators for the region, and to identify rapidly changing sites for focused field assessments.
- Utilize high resolution meter-scale, spectrally rich, imagery from a Dept. of Boating and Waterways-funded study of invasive aquatics in the Delta (Underwood and Ustin, in prep.) to examine the feasibility of monitoring stand-level changes in distributions of selected habitats of high importance (tules, willow-cottonwood riparian, tidal flats, invasive species)

A combination of software (ENVI, ERDAS Imagine, Image Analyst), hardware, and multi-spectral imagery sources (Landsat, MODIS, and ASTER) will depict land use – land cover, vegetation type, phenology and structure. Remote sensing activities will be coordinated with CalSpace and the Center for Spatial Technologies and Remote Sensing. Other collaborators using related methods and sharing data, licenses, and expertise include the UC Division of Agriculture and Natural Resources

Monitoring Landscape Change Workgroup and the Remote Sensing Lab of the US Forest Service (particularly for change-detection technology.)

Frequent, low-resolution (30m) imagery available back into the early 1990s will be used to assess gross changes in land cover and ecosystem properties, and to generate estimates of historic change in the Yolo Bypass such as are already in use in the Cosumnes watershed (e.g. Noujdina,2003). For estimating species composition, higher resolution imagery sources such as QuickBird will be used. Textural measures, such as lag variance and entropy, from these data are anticipated to correlate to ground observations of structural elements of canopied forests. HyMap hyperspectral imagery, provided by CalSpace, will be used to extract profiles for focal habitats, such as late-serial riparian forests (i.e. valley oak – *Quercus lobata*), early successional riparian forests (i.e. cottonwoods – *Populus spp.* – and willows – *Salix spp.*), mudflats, and infestations of invasive plant species (e.g. *Arundo, pepperweed, water hyacinth*).

Avian Communities. Coordinated monitoring of avian communities in riparian and intertidal/mudflat habitats will be used to assess diversity and relative abundance of avian resources as well as correlate avian diversity to habitat type and structure in the COYOTE study area. Avian data gathered will also aid other UCD projects in assessing Riparian Habitat Joint Venture focal species as indicators and to develop multimetric indices of biotic integrity. Methodologies have been coordinated between groups monitoring the Yolo Bypass and Cosumnes River floodplain to ensure data is comparable between regions of the study area.

Standard sampling techniques already used along Putah Creek and on the Cosumnes River floodplain will be used to assess riparian avian communities. In addition to collecting diversity, relative abundance, and trend information, a species list for each area will be maintained. The lists will include those species found during formal surveys and augmented with informal observations. Techniques to be employed on the study area include banded transects, monitoring avian productivity and survivorship (MAPS), variable circle plot point counts (VCP), nest searches, and breeding bird atlasing. Specific methods are described in Ralph, et al. (1995), MAPS[7] and the Breeding Bird Atlas[8]. Surveys will be conducted throughout the year but will emphasize the breeding season (March – August). Compatible VCPs for riparian birds, and area searches for wetland and mudflat birds, will be used at all sites shown in Figs. 1.3 and 1.4. Use of other monitoring techniques will be determined by local conditions in the target habitat.

CDWR ARPI is funding UCD to study the riparian community in the upper Yolo Bypass using these methods, and PRBO will continue to monitor the Cosumnes River floodplain. The COYOTE Project proposes to expand the study to Liberty Island, Little Holland Tract, and Prospect Island. TNC is separately proposing to support more detailed bird monitoring in the Cosumnes.

Monitoring of inter-tidal mudflat areas will link the aquatic food web to avian use patterns. Surveys will be coordinated with benthic and fisheries sampling to look for trends in avian use in response to benthic invertebrate populations. Area counts targeting shorebirds will be used to gather shorebird diversity. Shorebirds in the area count will be enumerated by species. Data will be gathered on other birds using the mudflats, such as waterfowl, opportunistically during scheduled surveys.

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[7] http://birdpop.org/maps.htm
[8] http://www.americanbirding.org/norac/atlasintro.htm

Bats. Passive acoustical techniques will be combined with mist netting and visual surveys to assess seasonal trends in bat activity across habitats in the study area. Acoustic monitoring will be conducted by placing passive acoustical detection systems (PADS) in riparian and wetland habitats to monitor bat activity. PADS are remote sensing devices requiring only periodic maintenance and data retrieval after installed. PADS allow reliable long term monitoring with minimal disturbance. Mist netting and visual surveys will be used to validate results found by the PADS and to identify species using riparian and wetlands habitats that are difficult to identify from acoustic data[9].

A.5. Feasibility

The proposed integrated monitoring program is a more coordinated continuation of multiple individual efforts that have been successfully conducted since 1998. The research team has extensive experience with all of the proposed methods and sampling locations. In Yolo Bypass, sampling has been designed with emphasis on publicly owned lands and navigable bodies of water, where property access is not an issue. Liberty Island is presently owned by Trust for Public Lands, who have given permission for the proposed sampling effort. Presentations will be made each year at meetings of the CBDA-funded Yolo Bypass Working Group to inform adjacent private landowners about the sampling program and to review indicators and performance measures. The Cosumnes Research Group will continue coordinating and communicating activities and results with TNC and the Cosumnes River Preserve, as specified in the 1999 MOU between TNC and UCD[10], in order to support adaptive management of the Preserve, including the development of the CBDA-funded Cosumnes River Preserve Management Plan.

A.6 Expected Outcomes

The monitoring and assessment program developed by this multi-institutional collaboration will yield a range of products and deliverables. The lead scientist management team described above is responsible for the timely completion of all deliverables and serves as the principal contact for CALFED staff and local stakeholder groups. The deliverables can be grouped into five general categories:

Reports. The UCD Watershed Center will coordinate and prepare quarterly and annual reports for the ERP and their contracting agencies. Quarterly reports will include regular activities of all program elements and component programs. Annual reports will include a summary of data gathered in the component programs, summaries of stakeholder and decision-maker workshops and products (Section A.8), and recommendations for adjustments in monitoring and assessment programs. The annual reports will also include updates, where appropriate, of conceptual models as well as indicators and performance measures.

Indicators and Performance Measures. The Watershed Center will direct the development of a series of reports on Indicators and Performance Measures for ERP restoration projects on the Yolo Bypass and the Cosumnes Preserve. Building upon current efforts by The Nature Conservancy, a draft set of

[9] Sacramento River Ecological Indicators Pilot Study Report
http://www.sacramentoriverportal.org/reports/chico_landing/apdx11/final_text.pdf
[10] http://baydelta.ucdavis.edu/documentation/TNC_MOU.pdf

indicators and performance measures will be submitted for public review by the end of first year of the program, with a final report submitted to ERP by the end of the second year.

COYOTE Project. By the third year of the monitoring program, the consortium will have established, tested and refined an integrated, multi-objective monitoring and assessment program for CALFED ERP projects on the Yolo Bypass and the Cosumnes preserve. As described above, the COYOTE project is a nested program designed to assess process-response relationships in aquatic and terrestrial ecosystems, principally due to land use/land cover change and seasonal and interannual hydrologic variability. A final technical report will be prepared for CALFED and submitted for peer-review publication in the on-line journal that describes the structure and technical details of the system, including recommendations for improvement or refinement, and requirements for developing forecasting models to support real-time management objectives.

COYOTE Website. In order to support the diverse stakeholder groups and decision-makers in the region, the consortium will establish a COYOTE Website. This website will display quarterly and annual reports, publications by the consortium, and foundation documents or related links. The website will be an expanded version of the Cosumnes Research Group website[11]). Additionally, the website will display all available real-time hydrologic, meteorologic and water quality data in graphical form. This will be incorporated into the UCD Real-Time Educational Monitoring Of The Environment (REMOTE[12]) program so that the information is available for classroom use.

Publications and Conferences. The researchers in this consortium place high value on regular peer-reviewed publication of results and sharing of information and ideas at conferences. Each component program will publish three or more analyses in peer-reviewed journals. One or more members of each program will also present their results annually at either the State of the Estuary or the CALFED Science conference. In addition, each program has budgeted to present their results at one statewide and one national conference annually.

A.7 Data Handling, Storage and Dissemination

Data Management is an integral Component Program of the COYOTE project as explained in section A.4. Information systems for this project will be provided through a collaborative effort between BDAT and UCD/ICE.

Distributed data management and sharing for environmental monitoring data sets (such as: fisheries, water quality, hydrodynamic, real-time data as examples) will be provided by BDAT using its distributed technologies and integrated into the COYOTE website. Local data systems may be developed by BDAT, UCD or TNC for project scientists, who will have primary control over data content from their respective studies; appropriate data will be exported to BDAT directly through thin-client technology, indirectly by the investigators or through UCD/ICE. BDAT spatial data will also be provided using ESRI ARC SDE to UCD and other interested parties.

Data sets with extensive GIS content will be developed by the Information Center for the Environment (ICE) at UCD, housed both within ICE and Watershed Center facilities on the UCD

[11] http://watershed.ucdavis.edu/crg/
[12] http://remote.ucdavis.edu/

campus and BDAT. Geospatial data will be managed by the UCD group and housed in a project GIS using ESRI ArcGIS 9 (personal geodatabase version, which uses Microsoft Access as the database engine), with Federal Geospatial Data Committee (FGDC)-compliant metadata. Existing GIS data holdings include orthophotographs, digital raster graphics of USGS maps, digital elevation models, digital information regarding hydrography, transportation networks, land use and parcel boundaries. Specialized data bases include GPS-located biological monitoring sites, telemetric micro-meteorological sites, and permanent vegetation transects. The maintenance, upgrade and protocols for these databases are coordinated with a variety of consortia and agencies, including the Riparian Habitat Joint Venture, Vegetation MOU Working Group and Wetlands Regional Monitoring Program.

Collaboration between UCD and BDAT participants will save human resources, as each will be working on complementary components and thus reduce redundancy and improve both group coordination and data management capabilities. Both data management entities support the ability to integrate data components proposed for this project and, as such, it is anticipated that the proposed data infrastructure will become fundamental to a planned interagency IT facility proposed for the Bay-Delta Science Consortium at UCD. Current facilities already have separately-funded, high-performance communications capabilities and robust security and backup procedures.

Information management and access principles for the project include:

- The information system will be distributed, with primary data held by those with the most experience with the information whenever possible, but federated, QA/QC-ed, standardized, and made available through a common portal.
- Data will be freely shared within the COYOTE group and throughout the CBDA research and resource management community and integrated to other data sets already available through BDAT.
- Data will be made generally available in real time when possible and always within two years (unless restricted by legal considerations, such as endangered species locations or confidentiality agreements with private landowners.) Short restrictions in data availability may occur to allow graduate students to complete and publish time series analyses.
- Any data posted will be accompanied by standardized metadata (see below.)

All fish, water quality and hydrology data are currently being collected with standards that comply with BDAT and will be integrated into the BDAT system. Riparian and wetland bird data are currently coordinated with Partners in Flight and the Riparian Habitat Joint Venture, and comply with national standards under development by the National Biological Infrastructure (NBII[13]) and may be provided to the UCD group and/or BDAT. Metadata will continue to comply with FGDC standards, making them available through other FGDC clearinghouse sites, such as CERES and NBII). Metadata will also be searchable through the COYOTE website. Some datasets will be kept in custom GIS applications, which can be exported to BDAT and other users through XML and other standard Web technologies. Additionally, real-time transmission of preliminary data from Yolo Bypass telemetered sites will be made accessible on the COYOTE website.

[13] http://cain.usgs.gov

A.8 Public Involvement and Outreach

The COYOTE team has been particularly active in public outreach for the two study regions. As in previous years, the primary public outlet for information about Yolo Bypass will be the Yolo Bypass Working Group (YBWG), a CDBA-funded stakeholder group. The monitoring team commits to continue to attend all meetings of the YBWG, and give frequent oral presentations. YBWG will help review and develop performance measures for the Yolo Bypass ERP restoration efforts. The Cosumnes Research Group will continue coordinating and communicating activities and results with TNC and the Cosumnes River Preserve, as specified in the 1999 MOU between TNC and UCD, in order to support adaptive management of the Preserve (e.g. development of the CBDA-funded Cosumnes River Preserve Management Plan). The team will also communicate findings through other local venues, such as the North Delta Improvements Group, the Mokelumne Cosumnes Watershed Alliance, and the Cosumnes River Task Force.

Outreach to resource managers will occur at regional and national meetings, and through publication (see Expected Outcomes and Product section). Additional information will be distributed through the UC Davis Information Center for the Environment and the online journal, San Francisco Estuary and Watershed Science, co-edited by one of the Principal Investigators (Quinn). A special effort will be made to coordinate closely with other groups involved with planning, resource management, and studies in Yolo Bypass and Cosumnes River (Please see Table 8.1).

A.9 Work Schedule

The work schedule for the implementation of the monitoring program is presented in Table 9.1. This schedule assumes a three-year program with a start date of January 2006 for the program. The tasks are identified for each component program, including science support and data handling/data management. The important milestones for the project are identified under each program.
Given the scope and scale of restoration activity in the Yolo Bypass and Cosumnes Preserve, the period of time it takes to document trends in indicators, and the goal of eventually developing forecasting capabilities for the COYOTE Project, we anticipate continuing monitoring activity beyond the end of this three-year period. As part of our final report for this project, we will present a modification of the design and a finance plan for future activity.

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

B.1 ERP and CVPIA Priorities

The COYOTE Project will intersect a diverse range of priorities for the ERP and the CVPIA. Both programs place a high priority on integrated monitoring and assessment in support of adaptive management. To date, outside of the Interagency Ecological Program, there has been no multi-institutional effort that focuses specifically on moving from coordination (discussion and communication) to integration (joint data collection and analysis efforts). This project directly addresses this need.

The CALFED ERP Draft Stage 1 Implementation Plan (CALFED, 2001) has identified eight restoration priorities for the Delta and the East Side Tributaries Region. The information and assessment needs for each priority is specifically and directly addressed by the monitoring program outlined in this proposal. The priorities that this program supports include:

1. *Restore habitat corridors in the North Delta, East Delta and San Joaquin River.*
2. *Restore and rehabilitate floodplain habitat in eastside tributaries and the lower Sacramento and San Joaquin rivers.*
4. *Restore habitat that would specifically benefit one or more at-risk species; improve knowledge of optimal strategies for these species.*
5. *Implement actions to prevent, control and reduce impacts of non-native invasive species in the Delta.*
6. *Restore shallow water habitats in the Delta for the benefit of at-risk species while minimizing potential adverse effects of contaminants.*
8. *Ensure restoration and water management actions in the Delta can be maintained under future climate conditions.*

The monitoring program is designed to monitor ecosystems and assess project performance within two high priority areas identified in Chapter 2 of the 2004 PSP, the Cosumnes River and the North Delta. The monitoring program also addresses the information needs regarding species identified for recovery by the Multi-Species Conservation Strategy. These species include:

Central Valley Fall-/late-fall-run Chinook Salmon ESU
Central Valley Steelhead ESU
Central Valley Spring-run Chinook Salmon ESU
Delta smelt
Green Sturgeon
Sacramento Splittail
Sacramento Perch
Giant Garter Snake
Greater Sandhill Crane
Valley Elderberry Longhorn Beetle
Swainson's Hawk

B.2 Relationship to Other Ecosystem Restoration Actions, Monitoring Programs, or Systemwide Ecosystem Benefits

The COYOTE Project is intended as a model for other multi-institutional projects in the Bay-Delta and its tributaries. We expect that the information and techniques developed will be of particular use to future floodplain and tidal wetland projects within the North Delta and tributaries. The proposed monitoring is well-integrated with the Interagency Ecological Program, which has been a sponsor of Yolo Bypass studies for the past eight years. Additional linkages are discussed in sections A.7 and A.8.

C. Qualifications

The COYOTE team consists of individuals in institutions, agencies and companies uniquely qualified for this long-term monitoring program. This monitoring program combines the experience and expertise of staff and researchers at UCD, CDWR, CDFG, U.S. Fish and Wildlife Service and Philip Williams & Associates, Ltd. (PWA). Researchers at UCD have gained an increasing amount of knowledge of processes and interactions in the lower floodplains of the Cosumnes River as these floodplains are reconnected to the river. The CDWR has conducted research and monitored the Yolo Bypass since 1997, providing major insight into the important role of seasonal floodplain wetlands in the estuary. In the lower reaches of the Yolo Bypass, CDWR, CDFG and U.S. Fish and Wildlife Service are monitoring the natural restoration of freshwater tidal marsh and its native fauna. PWA has great experience and expertise in physical processes in the Delta. Personnel on this team have been involved in long-term monitoring of the delta and the estuary by CDWR, CDFG and USFWS. Abbreviated biographies for key staff are provided in Appendix B.

D. Cost

D.1 Budget

The budget for this proposal has been completed on the PSP website including information on the overall budget and justification. The overall request for the COYOTE project is: $1.8M (Year 1); $1.6M (Year 2); and $1.7M (Year 3).

D.2. Cost Sharing

The University of California, Davis is currently constructing a Watershed Science Research Center on the Davis campus. This $3M facility is funded by Proposition 13 bond funds, and is dedicated to ecosystem monitoring and research in the North Delta and its tributaries. Faculty salaries during the course of the academic year are paid by the University of California. Substantial support (3.5M) to the COYOTE Project would be provided by the CDWR Aquatic Restoration, Planning and Implementation Program (ARPI), a CBDA ERP-funded program that will be covering much of the Yolo Bypass meteorology and sediment work, as well as a portion of the terrestrial surveys in support of Yolo Bypass restoration measures.

D.3. Long-term funding strategy

The goal of this project is to establish a long-term (decadal) monitoring program that is scalable and adaptable. It is anticipated that the Yolo Bypass and Cosumnes Preserve will continue to be the focus of restoration activity into the indefinite future, requiring continuity of monitoring programs and funding sources. However, the Component Programs in this program are intended to be modular, with the ability to incorporate new Component Programs. These may include programs that focus on fate and transport of metals and pesticides, flood management, waterfowl, groundwater, etc. Additional Component Programs will diversify the funding base for the overall program, maintaining its stability.

The construction of the monitoring program is following the current design of NSF Long Term Ecological Research programs. A goal of the COYOTE Project is to eventually transition the monitoring activity to federal sources of funding, with the possible inclusion into the NSF LTER network. Several additional programs, such as the proposed National Ecological Observation Network (NEON), the proposed Hydrologic Observatories being considered by the Consortium of Universities for the Advancement of Hydrologic Sciences, Inc (CUAHSI), and the proposed expansion of the Interagency Ecological Program ("IEP Plus") may be appropriate future funders of this activity.

E. Compliance with Standard Terms and Conditions.

If this proposal is funded, it would be the intent of the project partners to implement the project via at least two contracts, one between ERP and CDWR and the other between ERP and UCD. All state and federal agencies funded under this proposal are willing and able to comply with the terms of standard ERP grant agreements, as described in the PSP attachments. Terms and conditions that will need to be negotiated between the University and ERP include the following proposed "standard" clauses:

> Exhibit A – Scope of Work Section III, Project Officials (*We request that a third individual be added as the administrative contact and will act on behalf of the Grantee in lieu of the Project Director*.)
> Exhibit B – Attachment 3 – State Travel & Per Diem Expenses Guidelines (*Delete*)
> Exhibit C – General Terms and Conditions for ERP Grants (*Replace with GIA 101*)
> Exhibit D – Special Terms and Conditions for ERP Grants (*Replace with UC IP Clause*)

Please note with the exception of Exhibit A the above has previously been negotiated with CALFED/GCAPS on behalf of the University of California and agreeable language has been included in the following current ERP agreements with UCD (ERP-02D-P31, ERP-02D-P32, ERP-02D-P33, ERP-02D-P35, and ERP-02D-P51).

F/G. Literature Cited

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Table 1.1: Previously Funded Restoration Actions

Yolo Bypass/Liberty Island				
Project I.D.	**Year**	**Title**	**Description**	**Amount**
ERP-96-M02	1996	Prospect Island - Shallow Water Habitat/Wetlands Restoration Plan	Design, implement, and monitor restoration of shallow water habitat/wetlands on Prospect Island. **Planning; monitoring for Prospect is in project ERP-99-A02	2,500,000
ERP -97-B03	1997	Liberty Island Acquisition	Protect and restore tidally influenced wetlands, riparian corridors, and upland habitats. This project would acquire the 4760 acres of Liberty Island.	8,926,000
ERP-00-FO6	2000	Liberty Island Acquisition and Restoration Phase I	Purchase the two remaining private properties on Liberty Island;conduct restoration planning, implementation and monitoring. Operate and manage the restored island for three years, and acquire fee title interest in two additional properties within the proposed North Delta National Wildlife Refuge. The intent is to restore tidal influence to this strategically-located 5,209-acre island in the North Delta corridor.	2,701,734
ERP-02D-P54	2002	Restoring Ecosystem Integrity in the Northwest Delta: Phase II - see also 02-P21	Acquire conservation easements within the Cache Slough complex, along the Barker, Lindsey and Calhoun Sloughs, north Delta tidal channels located west of the Yolo Bypass. These sloughs harbor Delta smelt, juvenile chinook salmon and steelhead, and other native plants and animals, which benefit from the tule marsh, riparian habitats, and grazing lands that border the sloughs. The sloughs also anchor the eastern end of a habitat corridor that stretches west through Jepson Prairie through Suisun Marsh. This project will also assess the feasibility of restoring tidal marsh and improving habitat at the DFG's Calhoun Cut Ecological Reserve, adjacent to Barker Slough. Was ERP-02-P11-D.	1,563,506
			TOTAL	15,691,240

Table 1.1 page 2: Previously Funded Restoration Actions

Cosumnes/McCormack Williamson Tract				
Project I.D.	**Year**	**Title**	**Description**	**Amount**
ERP-96-M06	1996	Cosumnes River Preserve (Valensin Ranch Acquisition)	Protection of the few remaining examples of Central Valley topography without significant human intervention including 500 acres of seasonal and permanent wetlands, 270 acres of mature, closed canopy valley oak forest and 60 acres of vernal pools. **Acquisition only	1,500,000
ERP-97-N14	1997	Cosumnes Start-up Stewardship and Restoration	Completion of this project would result in the acquisition and enhancement of approximately 11,000 acres of fisheries, riparian, and wetland habitats along the lower Cosumnes River floodplain and adjacent Delta lands.	1,985,100
ERP- 98-B17	1998	Cosumnes Floodplain Acquisition and Restoration	Acquisition only. Restore and improve floodplain funcitons. Restore riparian and wetland vegetation.	3,500,000
ERP-98-B25	1998	Cosumnes River Salmonid Barrier Program	This project would evaluate and implement construction of structures to improve adult salmonid passage over existing diversion structures in the Cosumnes River. Tasks include evaluation of alternatives, finalizing engineering specifications; bidding and construction.	188,255
ERP-98-F19	1998	Cosumnes River Acquisition, Restoration Planning and Demonstration	Acquire and restore floodplain and wetland habitat and functions. This project associated with 1997 is intended to acquire and restore 4600 acres of property adjacent to the Cosumnes River. Tasks include acquisition, initial cleanup of properties, and restoration planning. 1998 funding provides for the acquisition of 300 acres of wetlands habitat along the lower Cosumnes River floodplain. Tasks include acquisition, initial cleanup of properties, restoration and management planning, an outreach program and monitoring.	750,000
ERP-01-N10	2001	Cosumnes/Mokelumne Corridor Floodplain Acquisitions, Management,and Restoration Planning	This is phase I of a two-part flood management and ecosystem restoration project in Sacramento County, which will ultimately result in 600 acres of land along the Cosumnes and Mokelumne Rivers, incorporated into non-structural flood management practices of the Cosumnes River Preserve. This project will identify and acquire, from willing sellers, suitable parcels and conduct start-up stewardship activities, including baseline monitoring and preliminary restoration planning. The primary objectives of this project are to protect existing riparian, wetland, and aquatic habitats and associated species; increase the capacity of the floodplain to store floodwaters by restoring channel-floodplain connectivity; reestablish riparian, wetland, and aquatic habitats through restoration of natural processes and the reconnection of river to floodplains and tidal marshes; facilitate population expansion of species associated with the Cosumnes and Mokelumne Rivers; and protect the habitat values on existing farmland by purchasing conservation easements that promote wildlife-friendly farming practices. All restoration sites will be monitored to establish baseline c	3,044,042
ERP-02D-P66	2002	Cosumnes River Preserve Perennial Pepperweed Control Project	Seek to control pepperweed, an invasive plant that is infesting riparian areas and wetlands in the Cosumnes River Preserve. The project will survey pepperweed infestations, test different pepperweed control practices, including use of different weed killers in combination with mowing and other mechanical control practices.	418,995
ERP-98-C17	1998	Assist in Developing Appraisal & Planning with TNC for the McCormack-Williamson Property	DWR will provide services and support for Project 97-N14, acquisition and initial site planning for the McCormack-Williamson Tract, including an appraisal, a legal transaction review, and initial planning activities.	24,000

Table 1.1 page 3: Previously Funded Restoration Actions

Cosumnes/McCormack Williamson Tract, Continued				
Project I.D.	**Year**	**Title**	**Description**	**Amount**
ERP-99-F04	1999	McCormack-Williamson Tract Acquisition/Cosumnes River Floodplain Acquisitions and Management	Expand the floodplain to help establish a naturally functioning ecosystem for native fish and terrestrial species, and create a buffer of agricultural land. See 99-F03. The recording of deed & title transfer to TNC for the McCormack-Williamson Tract (1512 acres)	5,356,000
ERP-02-P25	2002	McCormack-Williamson Tract Restoration: Wildlife-Friendly Levee Management	The McCormack-Williamson Tract (MWT) was acquired in 1999 and resloped 5,000 linear feet in 2001. The purpose fo this project is to reslope 20,000 linear feet of the backslope of the levess on the McCormack-Williamson tract (MWT) to a 5:1 slope using on-site fill, and to plant the resloped levees with native vegetation to protect levees from the interior wave erosion and maximize desired habitat attributes. Doing so will increase the strength and stability of the MWT levee system while increasing riparian habitat.The MWT levees need significant improvements to bring them up to acceptable levels of flood protection before tidal inundation or flood flows can be returned to the MWT. The goal is to restore tidal freshwater wetlands on the MWT by restoring tidal circulation to the leveed island; to make the island availabel for use as a floodway. The McCormack-Williamson Tract provides opportunity to restore tidal freshwater wetlands, enhance riparian habitat, and potentially reduce flood damage to neighboring private land.	2,476,835
ERP-01-N23	2001	Staten Island Acquisition	Purchase Staten Island in fee. Execute and record a conservation easement to be held by the DWR; start-up stewardship tasks; participate in the North Delta Planning process being implemented by DWR and coordinated through the Delta Protection Commission. Staten Island is located in northern San Joaquin County, surrounded by the north and south forks of the Mokelumne River. This project will facilitate restoration of 9,106 acres of significant acreage of riparian, freshwater tidal emergent wetland, shallow water, and aquatic habitats. This project will also protect critical agricultural wetlands. Phase II is ERP-02-P08.	35,110,873
ERP-02-P08	2002	Staten Island Wildlife-Friendly Farming Demonstration	The goals of the project include: improving the wildlife-friendly agriculture to foster recovery of at-risk species and to investigate effects of agriculture on water quality. The project objectives are: 1) to develop an efficient and cost effective water management infrastructure on Staten Island to maintain and improve sustainable agriculture and wildlife-friendly farm practices. This will increase habitat availability by allowing 2,500-5,000 acres of corn to be flooded for a longer duration than is presently possible. 2) To determine the effect of winter flooding strategies on target bird species, namely greater sandhill crane and northern pintail. Task 1: Project management; Task 2: Environmental Permitting; Task 3: Construction of cross levee on Staten for management units for independently controlled water level units; Task 4: Mapping all relevant existing data into a single GIS relational database; Task 5: Crane and waterfowl monitoring; Task 6: Water quality monitoring of island discharge; Task 7: Project report.	1,507,450
ERP-02-P49	2002	East Sacramento County Blue Oak Legacy Acquisition Area-Deer Creek Hills Project	Acquisition of 294 +/- acres of the Deer Creek Hills property in the Eastside Delta tributaries ecozone, Cosumnes River watershed. Protection of this land will provide downstream watershed benefits including instream water quality and ecosystem health benefits.	800,000
			TOTAL	56,661,550

Table 2.1 – Key ecological attributes and proposed indicators for the Cosumnes River Floodplain (adapted from TNC 2002).

Indicator Category	Key Ecological Attribute	Indicator
Ecological Function or Processes	Hydrologic Regime: Flooding	Timing, magnitude, and duration of flood flows
	River channel morphology (ability of river to adjust geomorphology freely)	Number of channels, entrenchment, and contiguous intact levees (14 river miles total)
	Groundwater availability (shallow)	Amount of riparian floodplain habitat with ground water levels within 10 feet of surface.
Ecosystem Structure	Amount and distribution of different vegetation and land use (habitat and/or threats)	Acres and location of existing habitat (riparian forest, wetlands, seasonal floodplain habitat), restored and restorable land, agriculture (by crop and practice), and urban
	Riparian Vegetation: Community Composition	Composition and structure of riparian forest communities, detection of invasive weeds
	Riparian Vegetation: Recruitment	Seedlings and saplings of willow and cottonwood (on fresh sediment deposits), oak and Oregon ash (in existing forests and uplands)
	Water Quality	Nutrients and organic matter (nitrogen, phosphorus, carbon, chlorophyll *a*)
Species-based indicators	Nonnative Invasive species	Abundance and diversity of non-native fish and macroinvertebrates in relation to native species.
Species-based indicators	"R" fish species	Spawning and growth of Sacramento splittail and growth and condition of juvenile chinook salmon
	Riparian Bird Community	Breeding success of resident and migratory birds (songbirds, Swainson's hawk)

Table 3.1: History of Core Floodplain Monitoring Activities.
Dates in parentheses indicate when sampling was initiated.

Activity	Task	Yolo Bypass/L. Island	Cosumnes
Primary Sampling Period	n/a	January-June	February-May
Hydrology and Geomorphology	Flow		
	Gages	Daily (1980s)	Daily (1900s)
	Acoustic doppler	Continuous (2002)	Event (2000)
	Sediments	Event (2004)	Event (2000)
Water Quality	Secchi	2-3x/week (1998)	Variable (1999)
	Turbidity		Daily-weekly (2000)
	Conductivity	2-3x/week (1998)	Daily-weekly (2000)
	Temperature	Continuous (1998)	Continuous (2000)
	pH	Continuous (2004)	Continuous (2000)
	Chlorophyll a	1-2x/month (2000)	
		Continuous (2004)	Continuous (2000)
	Nutrients	Variable (2000)	Variable (2000)
	Cations	Variable (2000)	Variable (2000)
	Organic matter	Variable (1999)	Variable (2000)
Aquatic Resources	Zooplankton	Weekly-monthly (1998)	1-2x/week (2000)
	Drift invertebrates	Weekly-monthly (1998)	1-2x/week (2000)
	Benthic invertebrates	Quarterly (2004)	1-2x/week (2000)
	Larval fishes	Weekly-monthly (1999)	1-2x/week (2000)
	Beach seine	Weekly-monthly (1998)	Variable (1999)
	Fyke trap/net	Daily (1999)	n/a
	Screw trap	Daily (1998)	n/a
	Electrofishing	n/a	Variable (1999)
Terrestrial Resources	Aerial photos	Variable (1998)	Variable (1998)
	Vegetation		
	relevé	Riparian Areas (2004)	annual (1995)
	gradsect		annual (2000)
	transect		annual (1999)
	areal field survey		various, annual (1987)
	point center quarter		one time (2000)
	aerial survey		sporadic (2001)
	Birds	Monthly (2004)	PRBO (1993)(full time field crew ~6 mo./year)
Data Management	***Geographic data***		
	Field Plots		Custom databases (2000)
	Framework Datasets	Farmlands (2000)	Farmlands (2000)
	Elevation	Airborne1 via DWR (2002)	Airborne1 via DWR (2002)
	Land Use Land Cover	NLCD 2000; Vernal Pools (1997); NWI (ongoing)	NLCD 2000; Vernal Pools (1997); NWI (ongoing)
	Change Detection	DOC Farmlands Mapping	See Noujdina (2004)
	Imagery		
	Aerial Photos	Opportunistic -- typically every few years	Opportunistic -- typically every few years
	Multispectral	Satellite data available	Landsat, MODIS, others, better than annual (1992)
	Hyperspectral	HyMap (2004, possible annual updates)	HyMap (2004, possible annual updates)
	LiDAR	Airborne1 via DWR (2002)	Airborne1 via DWR (2002)

Table 3.2: Tasks and Selected Products of Previous Floodplain Monitoring Activities.

Activity	Task	Yolo Bypass	Cosumnes
Hydrology and Geomorphology	Flow	Sommer et al. (2004)	Moyle et al. (2003);Crain et al. (2004); Hammersmark et al (in press), Fleckenstein et al (2004); Anderson et al (in press); CRG (2003)[1]
	Geomorphology		Florsheim and Mount (2002, 2003); Mount et al.,(2003); Constantine et al., (2003); CRG (2003)[1]
Water Quality	Turbidity	Schemel et al. (2003)	Moyle et al. (2003);Crain et al. (2004); Ahearn et al. (in press a,b); CRG (2003)[1]
	Conductivity	Schemel et al. (2003)	Moyle et al. (2003);Crain et al. (2004); Ahearn et al. (in press a,b); CRG (2003)[1]
	Temperature	Sommer et al. (2001a;2003a;2004)	Moyle et al. (2003);Crain et al. (2004); Ahearn et al. (in press a,b); CRG (2003)[1]
	pH	Schemel et al. (2003)	Moyle et al. (2003);Crain et al. (2004); Ahearn et al. (in press a,b); CRG (2003)[1]
	Chlorophyll a	Schemel (2003);Sommer et al. (2004a), Mueller-Solger et al. (2002)	Mueller-Solger et al. (2002), Grosholz et al (2004), Gallo and Dahlgren (2004); CRG[1] (2003)
	Nutrients	Schemel et al. (2003)	Moyle et al. (2003);Crain et al. (2004); Ahearn et al. (in press a,b); CRG (2003)[1]
	Cations	Schemel et al. (2003)	Ahearn et al. (in press a,b); CRG (2003)[2]
	Organic matter	Mueller-Solger et al. (2002), Sobzack et al. (2002)	Mueller-Solger et al. (2002)
Aquatic Resources	Zooplankton	Mueller-Solger et al. (2002), Sommer et al. (2001a;2004a)	Mueller-Solger et al. (2002), Grosholz et al (2004), Gallo and Dahlgren (2004); CRG[1] (2003)
	Drift invertebrates	Sommer et al. (2001a;2004a)	Grosholz et al (2004), Gallo and Dahlgren (2004); CRG[1] (2003)
	Larval fishes	Sommer et al. (2004b), Hansen et al. (2004)	Crain et al. (2004); CRG[1] (2003), Ribiero et al (2004)
	Beach seine	Sommer et al. (2001a;2001b; 2003;2004b), Hansen et al. (2004)	Moyle et al. (2003), CRG[1] (2003)
	Fyke trap/net	Harrell and Sommer (2003), Hansen et al. (2004)	n/a
	Screw trap	Sommer et al. (2004b)	n/a
	Electrofishing	n/a	Moyle et al. (2003), CRG[1] (2003)
Terrestrial Resources	Vegetation		
	Riparian	Initiated in 2005	Moyle et al. (2003), Keller (2004), Trowbridge (2003), Tu (2002), Noujdina (2004), CRG[1] (2003) Kalman et al. (2004)
	Wetlands	Initiated in 2005	Underwood et al. (2002); DiPietro et al. (2002)
	Invasives	Initiated in 2005	
	Bats	Initiated in 2005	Power et al. (2004)
	Birds	Initiated in 2005	Ralph et al. (1993); Nur et al. (1999)
Data Management	***Field data***		
	Fisheries	Sommer et al. (2004a); BDAT	Moyle et al. (2003); BDAT
	Water Quality	BDAT	
	Telemetered Data		http://remote.ucdavis.edu/
	Geographic data		
	Field Plots		http://watershed.ucdavis.edu/crg
	Framework Datasets		http://casil.ucdavis.edu
	Elevation		http://watershed.ucdavis.edu/crg
	Land Use Land Cover		http://ice.ucdavis.edu/
	Change Detection		Noujdina (2003); Rogan et al. (2003)
	Imagery		
	Aerial Photos	Sommer et al. (2004a)	Moyle et al. (2003), CRG[1] (2003), Florsheim and Mount (2003)
	Multispectral		Rogan et al. (2003)
	Hyperspectral		Underwood et al. (2002); DiPietro et al. (2002)
	LiDAR		Roering et al. (2002)

Footnote: [1]Cosumnes Research Group

Table 4.1: Summary of Proposed Floodplain Monitoring Activities.
Footnotes indicate the responsibilities for each task.

Activity	Task	Yolo Bypass/Liberty	Cosumnes
Primary Sampling Months	n/a	January-June	February-May
Hydrology and Geomorphology	Met station	Continuous [1]	Continuous [2]
	Flow		
	Gages	Daily [1,3]	Daily [3]
	Acoustic doppler	Continuous [1]	Continuous [2]
	Geomorphology	Event [1,3,4]	Event [2]
Water Quality	Secchi	2-3x/week [1]	
	Turbidity	Continuous [1]	Continuous [2]
	Conductivity	2-3x/week [1]	Continuous [2]
	Temperature	Continuous [1]	Continuous [2]
	pH	Continuous [1]	Continuous [2]
	Chlorophyll a	Continuous [1]	Continuous [2]
	Nutrients	Monthly [1]	Event-Monthly [2]
	Cations	Monthly [1]	Event-Monthly [2]
	Organic matter	Event [1]	Event-Monthly [2]
Aquatic Resources	Zooplankton	Weekly-monthly [1,5]	Weekly-monthly [2]
	Drift invertebrates	Weekly-monthly [1,5]	Weekly-monthly [2]
	Larval fishes	Weekly-monthly [1,5]	Weekly-Monthly [2]
	Beach seine	Weekly-monthly [1]	Weekly-monthly [2]
	Screw trap	Daily [1]	n/a [2]
	Fyke trap/net	Daily [1,5]	n/a [2]
	Electrofishing		Frequency? [2]
	Fish Diets	Monthly [1,5]	Monthly [2]
Terrestrial Resources	Aerial photos	One set [1]	as available [2]
	Vegetation		
	permanent plot	Annually [2]	Annually [2]
	transect		Annually [2]
	areal survey		Annually [2]
	remote sensing	One time to >annual, varies with resolution [2]	One time to >annual, varies with resolution [2]
	Bats	Continuous accoustic recording [6]	Continuous accoustic recording [6]
	Passerine Birds	Biweekly-Monthly [2]	Biweekly-Monthly [9]
	Waterfowl	Monthly [6]	Monthly [8]
Data Management	***Geographic data***		
	Field Plots	GPS data files [10]	GPS data files [10]
	Framework Datasets	Updates as warranted [2]	Updates as warranted [2]
	Elevation	Existing USGS 10m; LIDAR 2002; Annual if [2]	Existing USGS 10m; LIDAR 2002; Annual if Available [2]
	Land Use Land Cover	MCV Vegetation Protocol; one time map [2]	MCV Vegetation Protocol; one time map [2]
	Change Detection	High-resolution QuickBird; Annual if available [2]	High-resolution QuickBird; Annual if available [2]
		Low-resolution ASTER; 1-4x Annual [2]	Low-resolution ASTER; 1-4x Annual [2]
	Imagery		
	Aerial Photos	one set [1,2]	as available [2]
	Multispectral	Landsat 5 & 7, MODIS as available [2]	Landsat 5 & 7, MODIS as available [2]
		NDVI, FPAR, & LAI as available [2]	NDVI, FPAR, & LAI as available [2]
	Hyperspectral	HyMap and AVIRIS (2004, and as available) [2]	HyMap and AVIRIS (2004, and as available) [2]
	LiDAR	Airborne1 (2002, and as available) [2]	Airborne1 (2002, and as available) [2]

[1]CDWR
[2]UCD
[3]USGS
[4]PWA
[5]USFWS
[6]CDFG
[7]UCB
[8]TNC
[9]PRBO
[10]All groups

Table 4.2: Floodplain Hydrologic Indicators

Variable	Definition	Response	Information Sources	Frequency
Flood Event Hydrology				
Timing	Date of initial connection between mainstem channel and floodplain.	Controls availability of spawning and rearing habitat for native and non-native fish; contrtols primary productivity through temperature; influences transport and germination of riparian seeds	Existing and new stage gages; thermister network on floodplain; improved or anticipated hydraulic models	Event
Antecedent Conditions	Volume of water stored on the floodplain at time of initial connection	Controls magnitude of impact of initial flows on geomorphology, exchange between river and floodplain, water quality	Existing and new stage gages, DEM, and hydraulic models.	Continuous
Mean Age of Water (Residence time)	Calculated mean age of water of floodplain based on flux/volume ratio. Calculated as an average age over course of filling and draining	Influences structure of aquatic food webs and productivity. High residence time increases zooplankton production.	Existing and new stage gages, DEM, and hydraulic models.	Continuous
Meteorologic Conditions	includes air temperature, solar radiation, humidity, wind velocity and direction	Primary control on terrestrial and aquatic productivity, growth rates. Controls wave energy on open floodplain and tidal marsh	Existing and new meteorological stations	Continuous
Floodplain Filling	Magnitude and duration of period involving initial flow onto floodplain. Occurs during rising stage on river.	Most significant transfer of sediment onto floodplain, scour and creation of bare ground. Passive transport of larvae onto floodplain. Dilution of high mean age water.	Existing and new stage gages; thermister network.	Event
Floodplain Recession	Magnitude and duration of period when inflow to floodplain declines and is exceeded by outflow of floodplain	Lowers mean age of floodwater and displaces antecedent waters from floodplain. Extsnive exchange of nutrients, zooplankton and fish between channel and floodplain.	Existing and new stage gages; thermister network.	Event
Floodplain Draining	Magnitude and duration of period when no inflow occurs but floodplain drains into river	Depending upon complexity of flow and floodplain topography, supports highest mean ages of floodwaters, increases in water temperature, productivity. Supports extensive rearing habitat.	Existing and new stage gages; thermister network.	Event
Disconnection	Period when floodplain is completely disconnected from river	Water confined to depressions, ponds and wetlands with no influence from river other than groundwater. Signifcant changes in water quality, temperature, aquatic food webs. Rates of drawdown control distribution of herbaceous plant communities, primary successional species, and growing season of riparian trees.	Existing and new stage gages; thermister network.	Event
Annual Hydrologic Characterization				
Initial Connection	Date when channel exceeds bankfull stage or overflow weirs connect channel to floodplain	Controls timing of access to floodplain for native fish.	Existing stage gages	Annually
Final Disconnection	Date when overland connection between channel and floodplain ceases	Influences riparian establishement, overall productivity of floodplain waters, spawning and rearing success of native fish, influence of non-native fish.	Existing and new stage gages	Annually
Days of Flow	Total number of days when water flows from river to floodplain	Defines wet vs dry years for floodplains. Controls annual productivity and availabiltiy of rearing habitat for native fish. Also controls recruitment and survivorship of riparian vegetation.	Existing and new stage gages	Annually
Average Duration	Average duration of floodplain filling and recession for year	Duration of individual floods controls volume of water on floodplain and primary and secondary productivity.	Existing and new stage gages	Annually
Number of Events	Total number of flow events that result in flow from channel onto floodplain	Separates wet from dry years on floodplain. Number of floods dictates primary and secondary productivity and impact on riparian communities.	Existing stage gages	Annually

Table 8.1: Public Involvement and Outreach

Activity	Yolo Bypass/Liberty Island	Cosumnes
Outreach		
Local Community, Governmental & Landowner groups	Yolo Basin Working Group (Project PI is member) Yolo Basin Foundation (advice, presentations) SAFCA (regional habitat planning advice)	Cosumnes Preserve Partners (advice, presentations) --- TNC, BLM, DWR, DFG, SacCo, SLC, DU North Delta Improvements Group (advice, presentations) Mokelumne/Cosumnes Watershed Alliance (briefings) Cosumnes River Task Force (briefings) East Bay Municipal Utility District (advice, collaboration)
CBDA Area-wide	Interagency Ecological Program (2 PIs on mgmt team) Water Education Foundation (talks & workshops) Floodplain Management Asso. (presentations)	Bay-Delta Science Consortium (2 project PIs are on Board) CBDA Independent Science Board (1 PI is Board member) State Reclamation Board (1 PI is Board member) Water Education Foundation (talks & workshops) Floodplain Management Asso. (presentations)
Research Collaborations		
Hydrology and Geomorphology	2-D Flood Modeling (ACOE/DWR/Rec Bd) Sediment sampling/modeling (UCSB Singer) Sacramento River sedimentation (USGS) Breach Study (UW -- if funded)	North Delta Flood Modeling (RD2110/ DWR/ CBDA) M/W Tract sediment and flow regime (TNC/ DWR) Cosumnes floodplain topography (TNC) Cosumnes breach studies (TNC) Regional groundwater mapping (TNC)
Water Quality	Pesticides (USGS Kuivila) Pesticides (USGS NAWQA) Contaminants (Colusa Drain Study) (ACWA/NCWA) Contaminants (City of Woodland) (CBDA LWA) Mercury loading (RWQCB Foe) Mercury bioaccumulation (UCD Slotten) Mercury bioaccumulation-salmon (UCD/DWR)	Mercury (USGS Stewart) Nutrients (USBR)
Aquatic Resources	Yolo Bypass research (DWR Aquatic Ecology) IEP Monitoring (DFG/FWS/UCD) Yolo Bypass fish movement (DWR Habitat Restor.)	Floodplain primary productivity (DWR/UCD) M/W Tract fish and invertebrate surveys (TNC/ FWS) Fish use of the Cosumnes floodplain (TNC)
Terrestrial Resources	Lower Putah Ck Coord. Comm. (CBDA funding)	Cosumnes riparian forest regeneration (TNC) Cos. & M/W Tract bird surveys (PRBO) Cosumnes bat surveys (UCB)
Habitat Restoration Planning		
Habitat Restoration	Yolo Management Plan (DFG) Yolo Basin Working Group (Yolo Basin Foundation) Conaway JPA (Counties,UCD,SAFCA) SAFCA regional habitat planning Wildlands, Inc. North Delta Refuge Planning	Cosumnes Preserve Management Plan (Cosumnes Partners) Decision Support Tree (TNC -- if funded) McCormack-Williamson Tract restoration options (TNC/DWR) Cosumnes fall flows restoration (TNC/ FWS) Mokelumne restoration of gravels (EBMUD/ FWS)

ACWA -- Association of California Water Agencies
BLM - Bureau of Land Management
CBDA – California Bay-Delta Authority
DWR – Department of Water Resources
DFG – Department of Fish and Game
DU - Ducks Unlimited
ERP – CBDA Ecosystem Restoration Program
FWS – U.S. Fish and Wildlife Service
IEP – Interagency Ecological Program
JPA - Joint Powers Authority
LWA - Larry Walker Associates
NAWQA - USGS National Water-Quality Assessment Program
NCWA - Northern California Water Association
PRBO - Pt. Reyes Bird Observatory
SacCo - Sacramento County
SAFCA – Sacramento Area Flood Control Agency
SLC - State Lands Commisssion
TNC - The Nature Conservancy
UCB - U.C. Berkeley
UCD – U.C. Davis
UCSB – U.C. Santa Barbara
USBR - U.S. Bureau of Reclamation
USGS – U.S. Geological Survey

Table 9.1: Work Schedule

Task #	Task Descriptions	Scheduled Deadlines	Year 1 Jan 06-07		Year 2 Jan 07-08		Year 3 Jan 08-09	
Task 1	**Project Administration**							
1.1	Finalize Contracts	31-Jan-06						
1.2	Finalize Workplan	31-Jan-06						
1.3	Prepare Monitoring and Evaluation Plan	31-Jan-06						
1.4	Prepare Quarterly Financial and Progress Reports	31-Mar, 30-Jun, 30-Sept, 31-Dec						
1.5	Project Management and Communication	Ongoing						
1.6	Prepare Draft and Final Report	31-Dec-09						
1.7	Outreach and Disseminate Final Products	Ongoing						
Deliverable	Quarterly Reports	31-Mar, 30-Jun, 30-Sept, 31-Dec						
Deliverable	Draft and Revised Workplan with Schedule for Project	31-Jan-06						
Deliverable	Draft Report: Indicators and Performance Measures	1-Jan-07						
Deliverable	Final Report: Indicators and Performance Measures	1-Jan-08						
Deliverable	Final Project Report: COYOTE SYSTEM	1-Jan-09						
Milestone	Quarterly and Final Reports Completed							
Milestone	Outreach Conducted and Final Products Disseminated							
Milestone	Completion of Indicators and Performance Measures							

Table 9.1 page 2: Work Schedule

Task #	Task Descriptions	Scheduled Deadlines	Year 1 Jan 06-07		Year 2 Jan 07-08		Year 3 Jan 08-09	
Task 2	**Hydrology/Geomorphology**							
2.1	Meteorological Monitoring	on-going						
2.2	Stage and Flow Monitoring	on-going						
2.3	Geomorphology	on-going						
2.4	Data entry into GIS, BDAT and SWAMP	on-going						
2.5	Prepare Quarterly Progress Reports	31-Mar, 30-Jun, 30-Sept, 31-Dec						
Deliverable	Real-time hydrologic and meteorologic network	30-Jul-07						
Deliverable	Geomorphic Monitoring Network	30-Jul-07						
Deliverable	3 manuscripts, hydrologic and geomorphic analysis of restored floodplain/freshwater tidal marsh	30-Jul-07 on						
Deliverable	Final Report: COYOTE Hydrologic and Geomorphic Monitoring Program	1-Jan-09						
Milestone	Telemetered flow, stage and met gage network							
Milestone	Installation of geomorphic monitoring network							
Milestone	Web-based real-time monitoring							
Task 3	**Water Quality**							
3.1	Install data sondes and autosampler network	1-Dec-06						
3.2	Integrate water quality sampling with aquatic resource sampling	on-going						
3.3	Laboratory analysis of collected water samples	on-going						
3.4	Data Entry in GIS, BDAT and SWAMP	on-going						
3.5	Prepare Quarterly Progress Reports	31-Mar, 30-Jun, 30-Sept, 31-Dec						
Deliverable	Water quality monitoring network	30-Jul-07						
Deliverable	3 manuscripts, water quality analysis of restored floodplain/freshwater tidal marsh	30-Jul-07 on						
Deliverable	Final Report: COYOTE Water Quality Monitoring Program	1-Jan-09						
Milestone	Integration of water quality monitoring collection and analysis into single database							
Milestone	Interlaboratory comparison and QA/QC proceedures							

Table 9.1 page 3: Work Schedule

Task #	Task Descriptions	Scheduled Deadlines	Year 1 Jan 06-07		Year 2 Jan 07-08		Year 3 Jan 08-09	
Task 4	**Aquatic Resources**							
4.1	Zooplankton monitoring		■	■	■	■	■	■
4.2	Drift invertebrate monitoring		■	■	■	■	■	■
4.3	Fish monitoring		■	■	■	■	■	■
4.4	Laboratory analyses of field samples		■	■	■	■	■	■
4.5	Data Entry in GIS, BDAT and SWAMP		■	■	■	■	■	■
4.6	Prepare Quarterly Progress Reports		■	■	■	■	■	■
Deliverable	Aquatic monitoring network		■					
Deliverable	3 manuscripts, hydrologic and geomorphic analysis of restored floodplain/freshwater tidal marsh					■	■	■
Deliverable	Final Report: COYOTE Aquatic Resources Monitoring Program							■
Milestone	Integration of aquatic monitoring collection and analysis into single database							
Task 5	**Terrestrial Resources**							
5.1	Finalize design and layout for vegetation, bird, and bat monitoring	1-Mar-06	■					
5.2	Vegetation field monitoring	ongoing		■	■	■	■	■
5.3	Bird field monitoring	ongoing		■	■	■	■	■
5.4	Bat field monitoring	ongoing		■	■	■	■	■
5.5	Acquire and standardize imagery	1-Jan-07	■	■				
5.6	Adapt , test, and deploy change-detection software and analyses				■	■	■	■
Deliverable	Terrestrial monitoring network	30-Jul-07				■		
Deliverable	3 manuscripts, vegetation and bird/bat population dynamics of floodplain ecosystems	30-Jul-07 on				■	■	■
Deliverable	Final Report: COYOTE Terrestrial Quality Monitoring Program	1-Jan-09						■
Deliverable	COYOTE Vegetation Map	1-Jan-09						■
Milestone	Integration of water quality monitoring collection and analysis into single data system							
Milestone	Framework for data sharing with other floodplain monitoring programs							

Table 9.1 page 4: Work Schedule

Task #	Task Descriptions	Scheduled Deadlines	Year 1 Jan 06-07		Year 2 Jan 07-08		Year 3 Jan 08-09	
Task 6	**Data Handling, Storage and Dissemination**							
6.1	Construction of project data base	31-Jul-06	■	■				
6.2	Establishment of data and metadata protocols	31-Jul-06	■	■				
6.3	Integration with BDAT and SWAMP programs	on-going	■	■	■	■	■	■
6.4	Construction of project website	1-Jan-07	■	■	■			
6.5	Update project website	on-going	■	■	■	■	■	■
6.6	Construction of project GIS	1-Jan-07	■	■	■			
6.7	Update project GIS	on-going	■	■	■	■	■	■
6.6	Prepare Quarterly Progress Reports	31-Mar, 30-Jun, 30-Sept, 31-Dec	■	■	■	■	■	■
Deliverable	COYOTE System Website	on-going		■	■	■	■	■
Deliverable	COYOTE System GIS	on-going		■	■	■	■	■
Deliverable	Final Report: COYOTE System Data Handling and Management Program	1-Jan-09						■
Milestone	Integration of data protocols and handling							
Milestone	Functional website with real-time gage and sensor information							
Milestone	Functional, accessible geodatabase for entire project							
Task 7	**Science Support**							
7.1	Maintenance of gage and sensor network	on-going	■	■	■	■	■	■
7.2	Management of field support staff	on-going	■	■	■	■	■	■
7.3	Repair and cleaning of field equipment	on-going	■	■	■	■	■	■

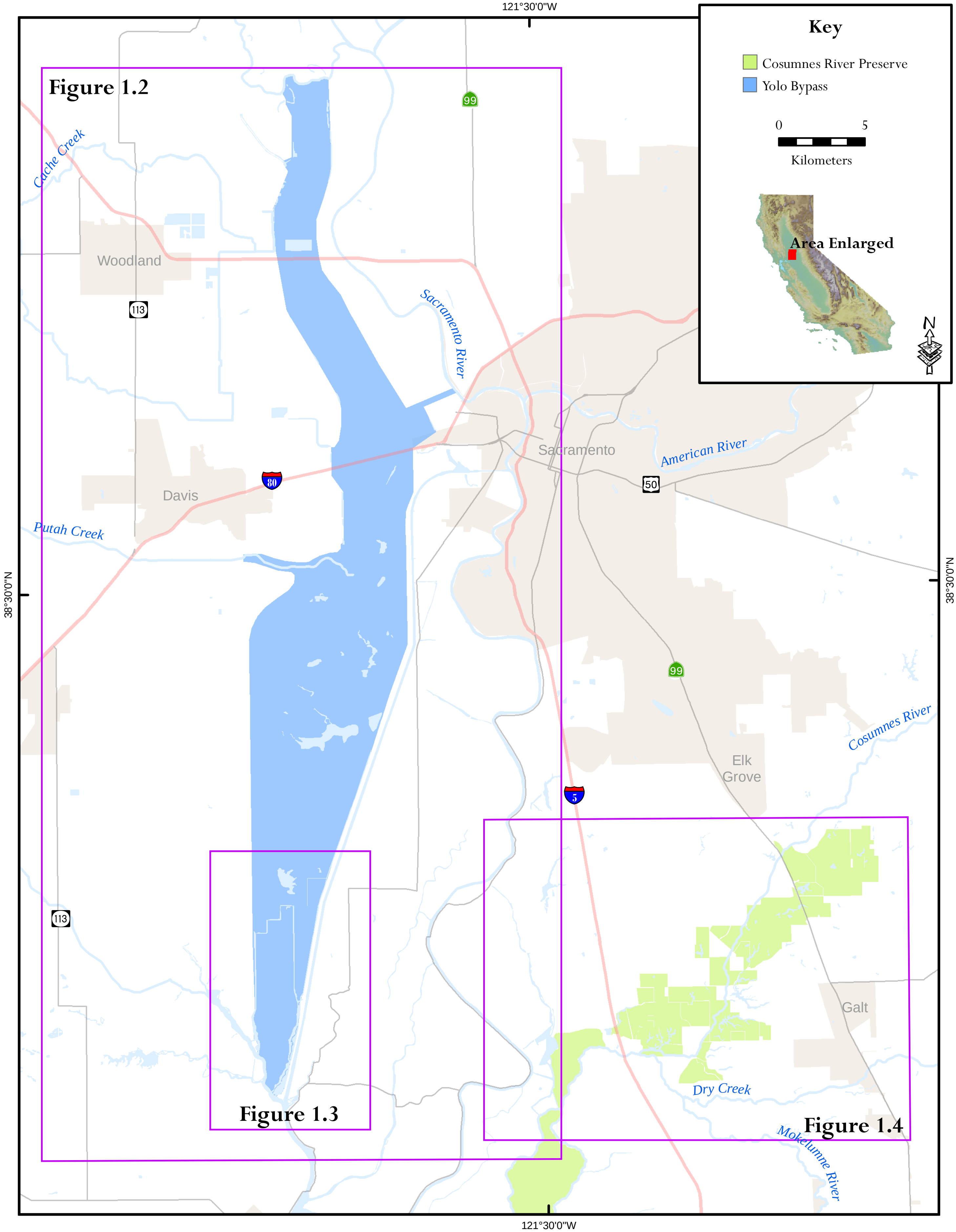

Figure 1.1: Overview

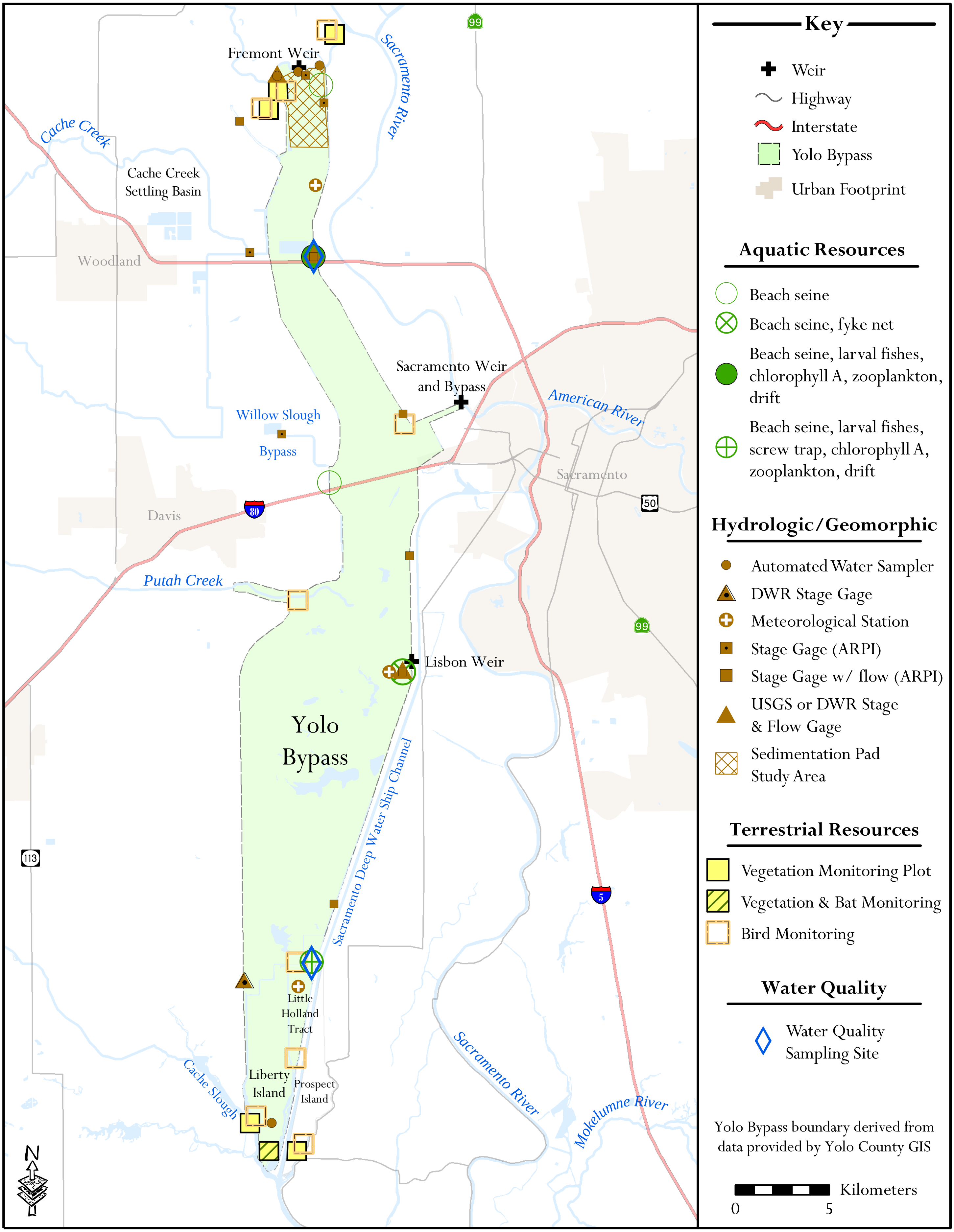

Figure 1.2: Schematic of Yolo Bypass Monitoring Activities

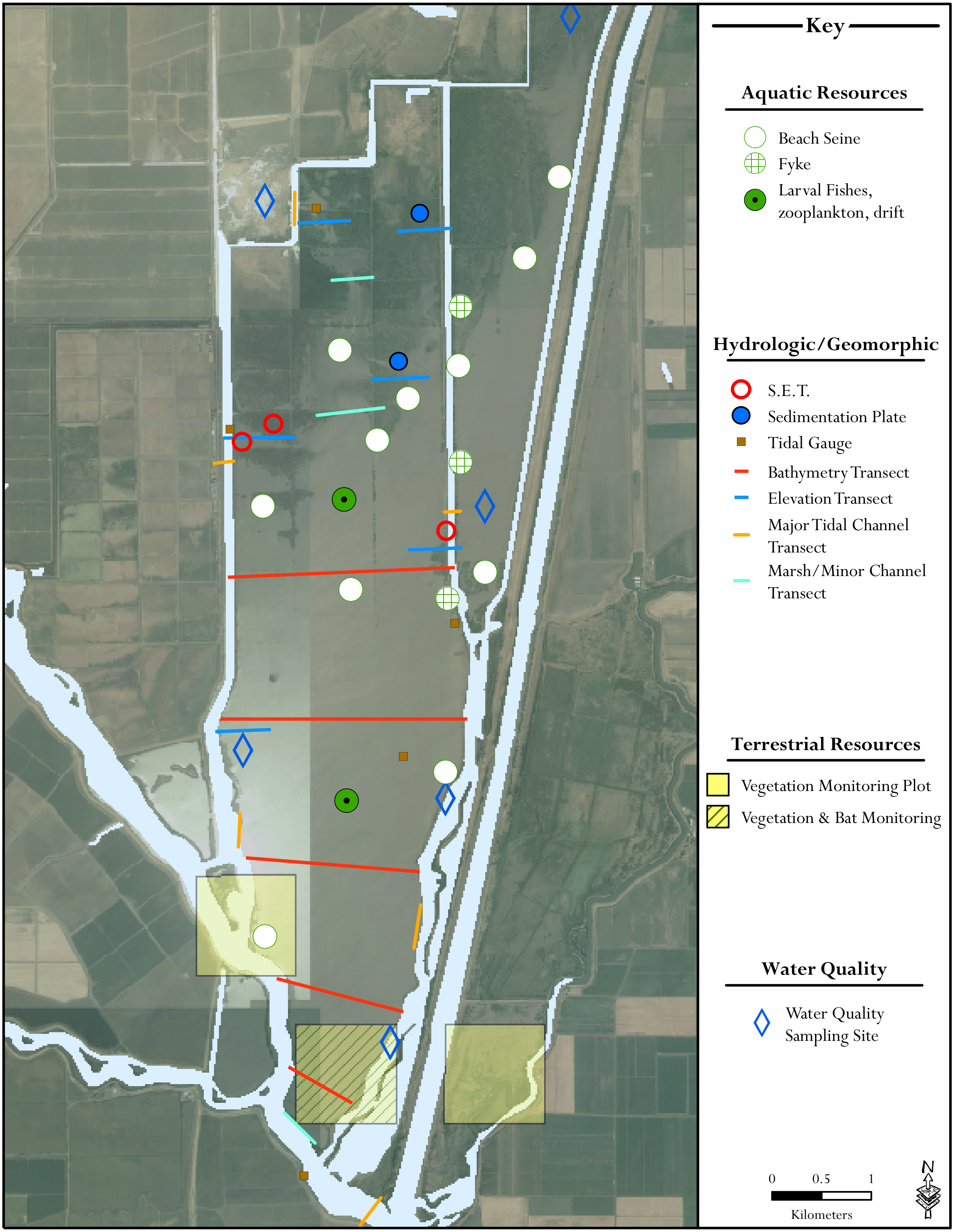

Figure 1.3: Schematic of Liberty Island Monitoring Activities

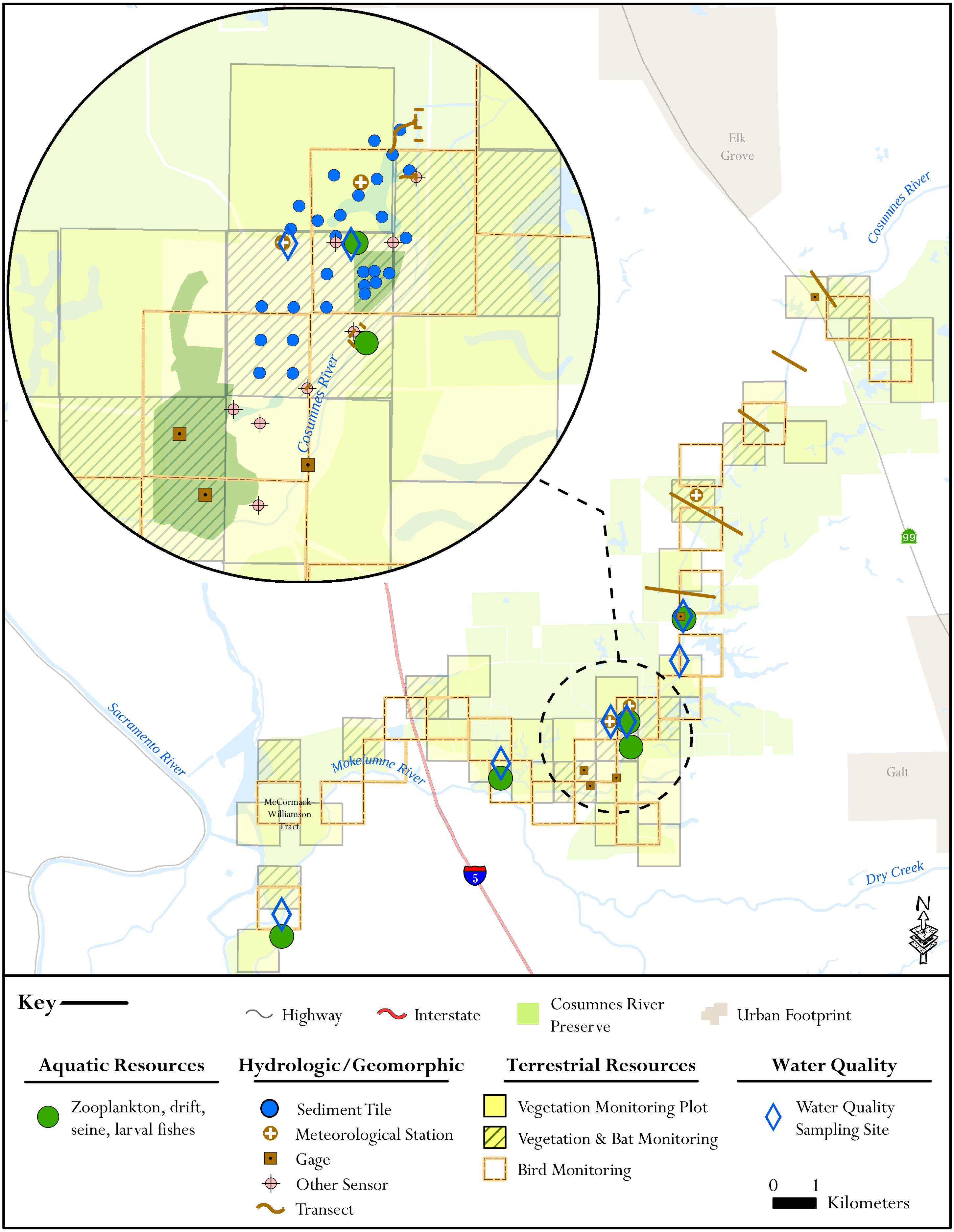

Figure 1.4: Schematic of Cosumnes River Preserve Monitoring Activities

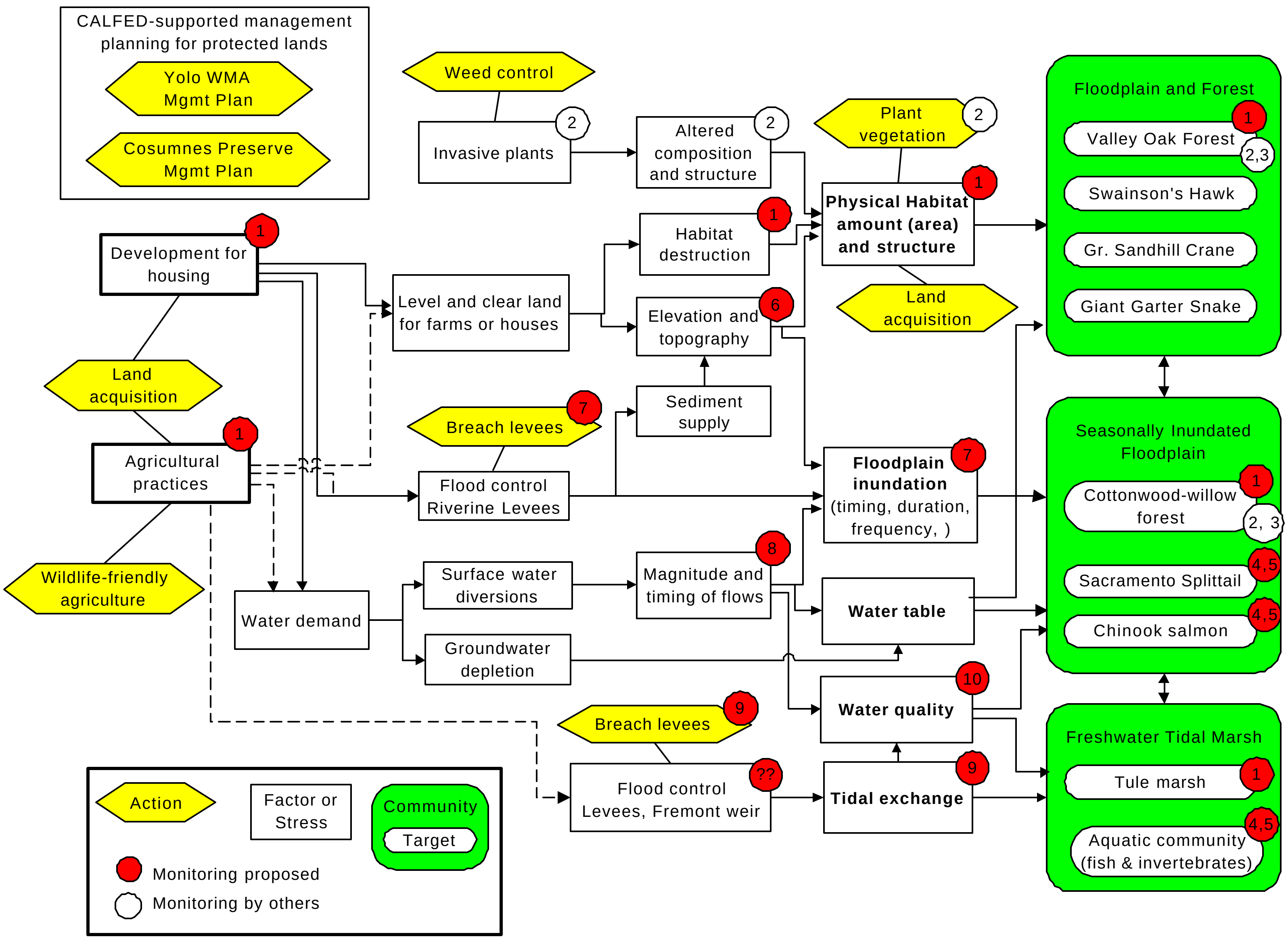

Figure 2.1 – Conceptual model of floodplain and tidal wetland systems.

Figure 2.1 (continued) - Hydrologic processes of tidal exchange and floodplain inundation are the driving forces that shape and sustain tidal wetland and floodplain systems. These are impacted by a number of stressors, including construction of levees that prevent tidal exchange and floodplain inundation, clearing riparian forests, filling in channels, draining wetlands, leveling of floodplain topography, and land conversion to agriculture. (Sommer et al 2002, TNC 2001)

Red circles – Indicators to be monitored with this grant

1. Habitat types and land use patterns – aerial photos or remote imagery to quantify area of different habitats, crops, and urban centers).
2. Forest composition – on-the-ground vegetation mapping
3. Riparian breeding birds – indicators of forest health, PRBO standardized methodology
4. Fish sampling for splittail and salmon
5. Aquatic invertebrate sampling
6. Floodplain topography and stream elevations
7. Channel-floodplain hydrology - Frequency and duration of inundation
8. Surface flows – USGS stream gaging on Cosumnes and Yolo
9. Tidal regime and inundation
10. Water quality monitoring

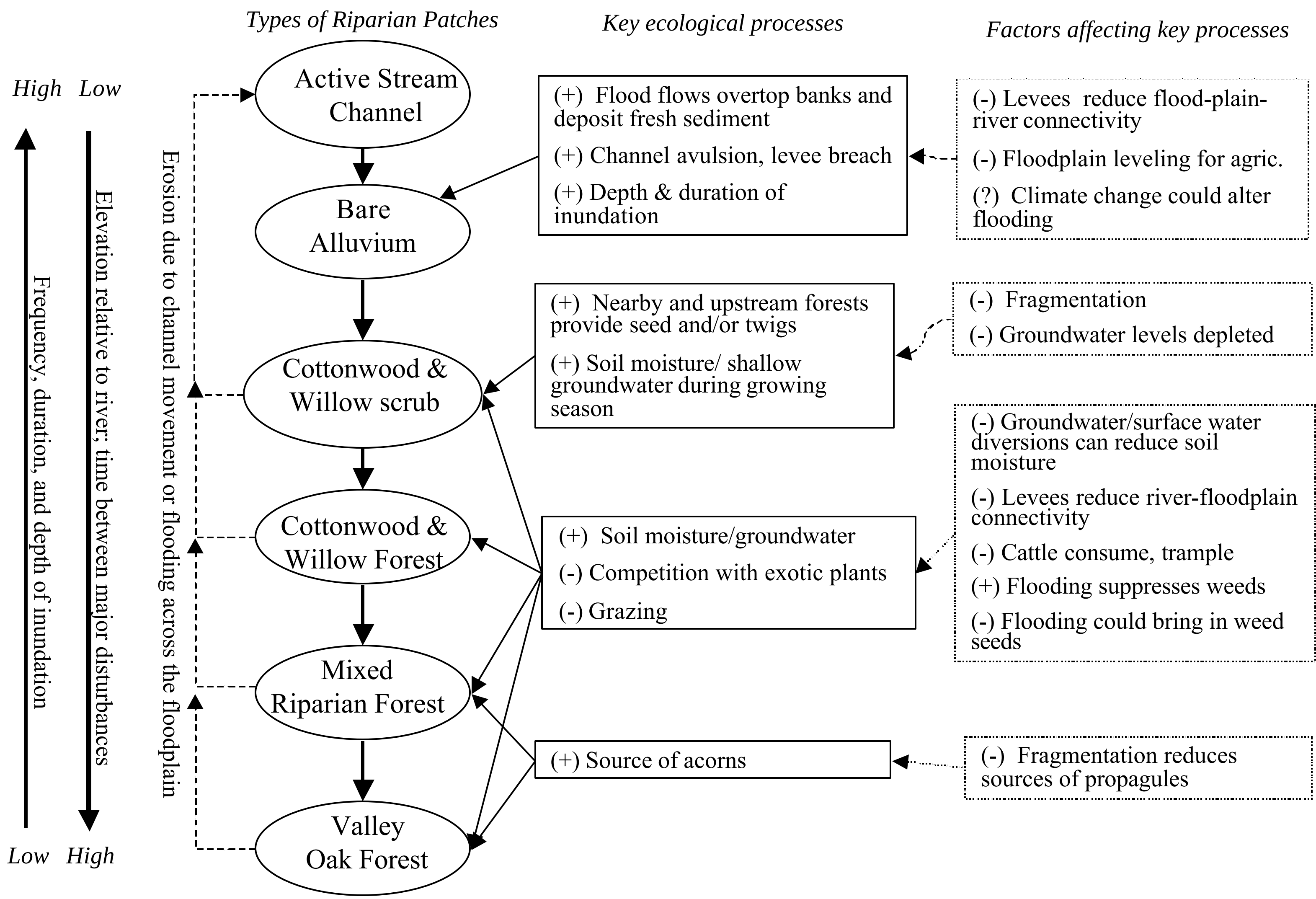

Figure 2.2 – Riparian forest succession on the Cosumnes River floodplain. (based on Florsheim & Mount 2003, Richter & Richter 2000, SRAC 2000, Tu 2000, Trowbridge 2002, and UC Davis Cosumnes Research Group pers. comms.). The Cosumnes River is a multiple-channel, anastomosing river system rather than a meandering river with point bars (Florsheim and Mount 2003).

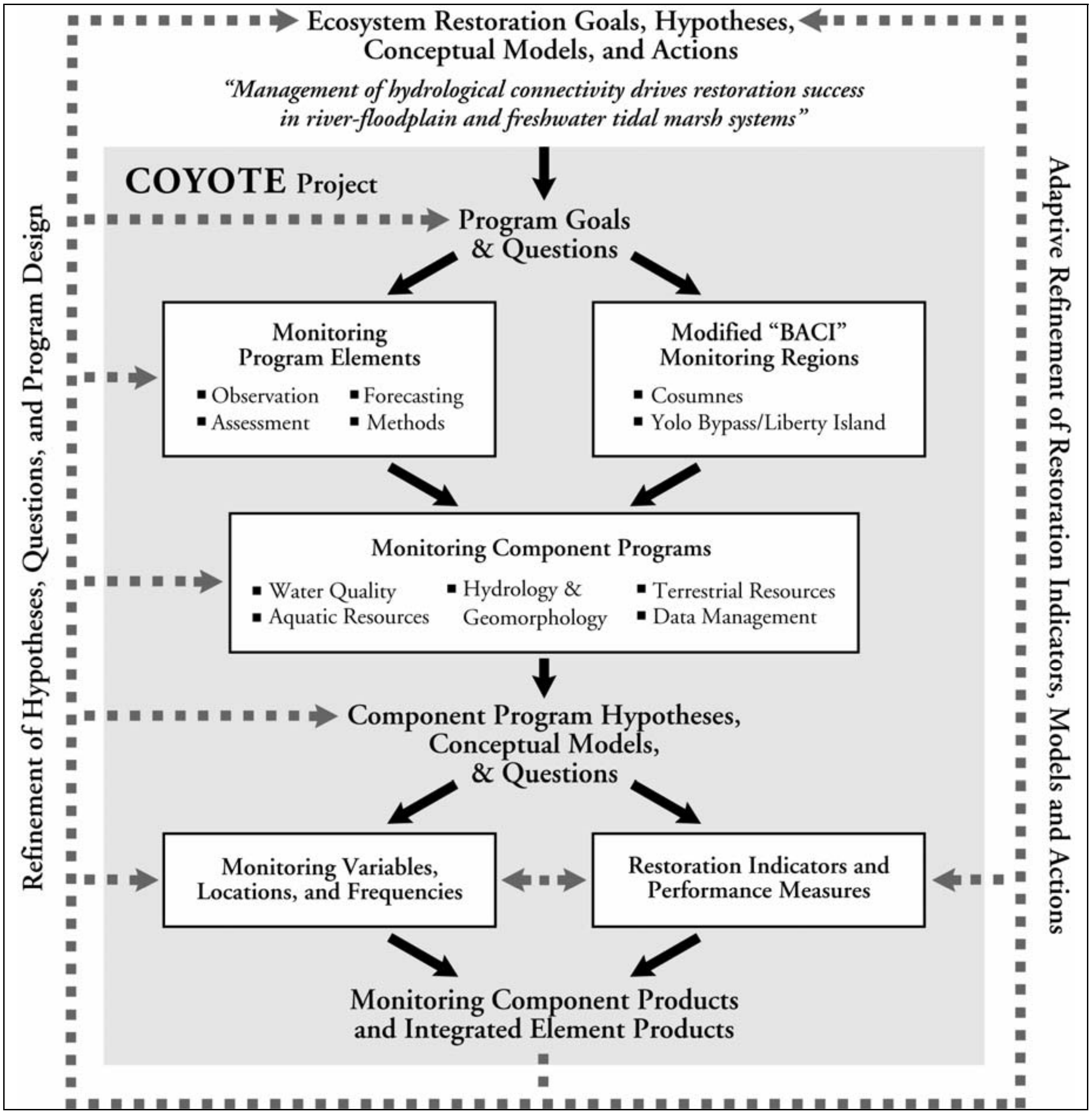

Figure 2.3 – Conceptual model for monitoring organization.

APPENDIX A. Partial List of Acronyms/Abbreviations for The COYOTE Project

ARPI – Aquatic Restoration Planning and Implementation Program
ASTER – Advanced Spaceborne Thermal Emission and Reflection
BACI – Before After Control Impact
BDAT – Bay Delta And Tributaries Project
BREACH – Sacramento–San Joaquin Delta Breached Levee Wetland Study
CALFED – the California-Federal program that CBDA implements
CBDA – California Bay Delta Authority
CDFG – California Department of Fish and Game
CDWR – California Department of Water Resources
CERES – California Environmental Resources Evaluation System
COYOTE – Cosumnes-Yolo Terrestrial-aquatic Ecotone Project
CRG – Cosumnes Research Group
CVPIA – Central Valley Project Improvement Act
Delta – Sacramento-San Joaquin Delta
DFG – Department of Fish and Game
DWR – Department of Water Resources
ENVI – Environment for Visualizing Images, Research Systems Inc. (Boulder, CO)
EPA – Environmental Protection Agency
ERDAS Imagine – remote sensing software package from Leica Geosystems (Atlanta, GA)
ESRI ARC SDE – Environmental Systems Research Institute (Redlands, CA) Spatial Data Engine
ERP – CALFED Ecosystem Restoration Program (ERP)
FGDC- Federal Geospatial Data Committee
FL – Fork Length
GPS – Global Positioning System
HyMap – hyperspectral remote sensing imagery from HyVista (Sydney, AUS)
ICE – UC Davis Information Center for the Environment
IEP – Interagency Ecological Program
Landsat –satellites and imagery products operated by Earth Observing System USGS
LOD – Limit of Detection
LTER – Long Term Ecological Research
MAPS – Monitoring Avian Productivity and Survivorship
MODIS – Moderate Resolution Imaging Spectrometer
MOU – Memorandum of Understanding
NBII – National Biological Infrastructure
NEON – National Ecological Observation Network
NSF – National Science Foundation
PADS – Passive Acoustical Detection Systems
PIF – Partners in Flight
PRBO – Point Reyes Bird Observatory
Preserve – The Cosumnes Preserve
PSP – Proposal Solicitation Package
QA/QC – Quality Assurance/Quality Control
REMOTE – UC Davis Real-Time Educational Monitoring Of The Environment (REMOTE) program

RHJV – Riparian Habitat Joint Venture
SWAMP – Surface Water Ambient Monitoring Program
TNC – The Nature Conservancy
UCD – University of California at Davis
UC Davis – University of California at Davis
UNET – a USACE one-dimensional model of Unsteady NETworks of open channels
USACE – United States Army Corps of Engineers
USGS – United States Geological Study
VCP – variable circle plot point counts
XML – Extensible Markup Language
YBWA – Yolo Bypass Wildlife Area
YBWG – Yolo Bypass Working Group

Appendix B: Brief Biographies for COYOTE Team

Hydrology and Geomorphology

Jeff Mount

EDUCATION:

BA, University of California, Santa Barbara Geosciences, 1976
MS, University of California, Santa Cruz, Earth Science, 1978
PhD, University of California, Santa Cruz, Earth Science, 1980

EXPERIENCE:

1996-2000, Chair, Department of Geology, UC Davis
1980-present: Professor, Department of Geology, UC, Davis
1987-1988: Visiting Fellow, School of Earth Sciences, The Flinders University

SELECTED PUBLICATIONS:

Florsheim, J.L., and Mount, J.F., Changes in lowland floodplain sedimentation process, pre-disturbance to post-rehabilitation: Cosumnes River, California, Geomorphology, in press.

Rains, M.C., and J.F. Mount. 2002. Origin of Shallow Ground Water in an Alluvial Aquifer as Determined by Isotopic and Chemical Procedures. Ground Water 40, p.552-563.

Florsheim, J.L., and Mount, J.F., 2002, Restoration of floodplain topography by sand splay complex formation in response to intentional levee breaches, Lower Cosumnes River, California: Geomorphology, v. 44, p. 67-94.

Mount, J.F.,1995, California Rivers and Streams:The Conflict Between Fluvial Process and Land Use. Berkeley: University of California Press, 400 pp.

Philip Williams

EDUCATION:

Ph. D. University College Civil and Municipal Engineering, University of London, UK, 1970
B. Eng. Civil and Structural Engineering, Sheffield University, UK, 1966

EXPERIENCE:

President, Philip Williams & Associates, Ltd. (1979 – present)

SELECTED PUBLICATIONS:

Orr, M.K., Crooks, S., and Williams, P.B., 2003. Will Restored Tidal Marshes be Sustainable. Volume 1, Issue 1, *San Francisco Estuary and Watershed Science*, CALFED Online Journal, CA.

P.B. Williams, and M.K. Orr, 2002. Physical Evolution of Restored Breached Levee Salt Marshes in the San Francisco Bay Estuary. *Restoration Ecology,* Society for Ecological Restoration, Vol. 10 No. 3, 527–542.

P.B. Williams, M.K. Orr, and N.J. Garrity, 2002. Hydraulic Geometry: A Geomorphic Design Tool for Tidal Marsh Channel Evolution in Wetland Restoration Projects. *Restoration Ecology,* Society for Ecological Restoration, Vol. 10, No. 3, 577–590.

Williams, P.B., 2001. Restoring Physical Processes in Tidal Wetlands. Journal of Coastal Research. Vol. SI, No. 27, 149–161.

Williams, P.B., and P. Faber, 2001. Salt Marsh Restoration Experience in the San Francisco Bay Estuary. Journal of Coastal Research. Vol. SI, No. 27, 203–211.

Chris Bowles

EDUCATION:

Ph.D. Civil and Structural Engineering, Nottingham Trent University, 1998
B.Eng Civil and Structural Engineering, Nottingham Trent University, 1995
HND Engineering Surveying, Nottingham Trent University, 1989

EXPERIENCE:

Associate Principal, Philip Williams & Associates, Ltd. (1998 – present)
Flood Defense Technician, National Rivers Authority, UK (1996 – 1997)
G.F. Tomlinson & Sons, Civil Engineers, UK (1989 – 1993)

SELECTED PUBLICATIONS:

Bowles, C.B., Daffern, C., Ashforth-Frost, S., 1997. The Independent Calibration of the Acoustic Doppler Velocimeter, *XXVII International Association of Hydraulic Research Congress*, San Francisco California, 8pp.

Bowles, C.B., Daffern, C., Ashforth-Frost, S., 1998. The Independent Validation of SSIIM, a 3D Numerical Model. *Hydroinformatics 1998,* Copenhagen, Denmark.

Bowles, C.B., 1999. An Investigation into the Flow Structure at a Generalized Open Channel Intake, Ph.D. Thesis.

Bowles, C.B., Richardson, R., Rungo, M., 2000. Two Dimensional Modeling of an Alluvial Fan. *Hydroinformatics 2000,* Cedar Rapids, Iowa, USA.

Lowney, C.L., Andrews,E. S., Bowles, C. B., Haas, J. A., 2004. Evaluation of a Non-Structural Flood Management and Habitat Enhancement at the San Joaquin River National Wildlife Refuge. *California Riparian Systems*, Faber, CA, pp. 152-158.

Marianne Kirkland

EDUCATION:

MS Civil and Environmental Engineering, UC Davis, 1998
BS Civil Engineering March 18, 1994 University of Washington, Seattle, 1994

EXPERIENCE:

Senior Engineer, California Department of Water Resources (2003-present)
Engineer, California Department of Water Resources (1997-2003)

ADDITIONAL QUALIFICATIONS:

Professional Civil Engineer Feb 4, 2000

SELECTED PUBLICATIONS:

Kirkland, M. 1998. The value of Pacific salmon and implications for restoration efforts. M.S. thesis, University of California, Davis.

Water Quality

Randy A. Dahlgren

EDUCATION:

PhD College of Forest Resources, University of Washington, Forest Soils, 1987
MS College of Forest Resources, University of Washington, Forest Soils, 1984
BS College of Agriculture, North Dakota State University, Soil Science, 1981

EXPERIENCE:

Professor of Soil Science, University of California-Davis (1997-present)
Associate Professor of Soil Science, University of California-Davis (1994-1997)
Assistant Professor of Soil Science, University of California-Davis (1989-1994)
Post-doctoral Research Associate, Dept. of Environmental Engineering, Syracuse University (1987-1988)

SELECTED PUBLICATIONS:

Dahlgren, RA, Tate, K.W. and Ahearn, D.S. 2004. Watershed Scale, Water Quality Monitoring – Water Sample Collection. *In,* Handbook of Environmental Instrumentation. John Wiley and Son, NY. pp. 547-564.

Dahlgren, RA, Tate, K.W. and Ahearn, D.S. 2004. Watershed Scale, Water Quality Monitoring – Water Sample Collection. *In,* Handbook of Environmental Instrumentation. John Wiley and Son, NY. pp. 547-564.

Dahlgren RA, Van Nieuwenhuyse E, Litton G (2004) Transparency tube provides reliable measure of water clarity and suspended solids concentration in California waterways. California Agriculture (in press)

Kratzer CR, Dileanis PD, Zamora C, Silva S, Kendall C, Bergamaschi BA, Dahlgren RA (2004) Sources and transport of nutrients, organic carbon, and chlorophyll-a in the San Joaquin River upstream of Vernalis, California, during Summer and Fall, 2000 and 2001. U.S.G.S. Water-Resources Investigations Report 03-4127. 113p.

Peggy Lehman

EDUCATION:

BS, MS and PhD University of California, Davis CA

EXPERIENCE:

Senior Environmental Specialist at California Department of Water Resources 1986-present

ADDITIONAL QUALIFICATIONS:

Current project manager for water quality and primary productivity in the current CALFED funded Liberty Island monitoring program ; Principal Investigator for CALFED funded San Joaquin River Dissolved Oxygen Program 2000-2001 (completed).

SELECTED PUBLICATIONS:

Lehman, P. W., G. Boyer, C. Hall, S. Waller and K. Gehrts. In press. Distribution and toxicity of a new colonial Microcystis aeruginosa bloom in the San Francisco Bay Estuary, California. Hydrobiologia

Lehman, P. W., J. Sevier, J. Giuliannotti and M. Johnson. 2004. Sources of oxygen demand in the lower San Joaquin River, California. Estuaries 27:405-418.

Lehman, P. W. 2004. The influence of climate on mechanisms that affect lower food web production in estuaries. Estuaries 27:312-325.

Lehman, P. W. 2000. The influence of climate on phytoplankton community carbon in San Francisco Bay Estuary. Limnology and Oceanography 45:580-590.

Aquatic Resources

Ted R. Sommer

EDUCATION:
PhD Ecology, UC Davis, 2002
MS Ecology, UC Davis, 1983
BA Aquatic Biology, UC Santa Barbara, 1980

EXPERIENCE:
Environmental Specialist, Department of Water Resources (1991-present)
Senior Scientist, Western Biotechnology, Australia (1985-1990)

ADDITIONAL QUALIFICATIONS: Certified Fisheries Scientist: American Fisheries Society 1994.

SELECTED PUBLICATIONS:

Sommer, T., R. Baxter, and B. Herbold. 1997. The resilience of splittail in the Sacramento-San Joaquin Estuary. Transactions of the American Fisheries Society 126:961-976.

Sommer, T. R., W. C. Harrell, M. Nobriga, R. Brown, P.B. Moyle, W. J. Kimmerer and L. Schemel. 2001. California's Yolo Bypass: evidence that flood control can be compatible with fish, wetlands, wildlife and agriculture. Fisheries 26(8):6-16.

Sommer, T. R., M. L. Nobriga, W. C. Harrell, W. Batham, and W. J. Kimmerer. 2001. Floodplain rearing of juvenile chinook salmon: evidence of enhanced growth and survival. Canadian Journal of Fisheries and Aquatic Sciences 58(2):325-333

Peter Moyle

EDUCATION: PhD, Minnesota, 1969

EXPERIENCE: Professorships--Fresno State, 1969-72; UC Davis 1972-present

SELECTED RECENT PUBLICATIONS:

Moyle, P. B. 2002. Inland Fishes of California. Revised and expanded. Berkeley: University of California Press; Matern, S. A., P. B. Moyle, and L. C. Pierce. 2002. Native and alien fishes in a California estuarine marsh: twenty-one years of changing assemblages. Transactions of the American Fisheries Society 131:797-816

Moyle, P.B., R. D. Baxter, T. Sommer, T. C. Foin, and S. A. Matern. 2004. Biology and population dynamics of Sacramento Splittail (Pogonichthys macrolepidotus) in the San Francisco Estuary: a review. San Francisco Estuary and Watershed Science [online serial] 2(2):1-47.

Crain, P.K., K. Whitener, P.B. Moyle. 2004. Use of a restored central California floodplain by larvae of native and alien fishes. Pages 125-140 in F. Feyrer, L.R. Brown, R.L. Brown, and J.J. Orsi, editors. Early life history of fishes in the San Francisco Estuary and watershed. American Fisheries Society Symposum 39

Moyle, P. B., P. K. Crain, K. Whitener, and J. F. Mount. 2003. Alien fishes in natural streams: fish distribution, assemblage structure, and conservation in the Cosumnes River, California, USA. Envir. Biol. Fish. 6:277-288

Gonzalo C. Castillo

EDUCATION:

PhD Fisheries Science, Oregon State University, Corvallis, OR. 2000
MS Fisheries Science, Oregon State University, Corvallis, OR, 1992
BA B .S. and Post B.S. Marine Biology, University of Concepcion, Chile. 1986

EXPERIENCE:

Delta Smelt Biologist. Interagency Ecological Program, U.S. Fish and Wildlife (2004-present)

Habitat Restoration Coordinator. Anadromous Fish Restoration Program, USFWS (2001-2004)

Faculty Research Assistant. Hatfield Marine Science Center. Newport, OR. (1998-2000)

ADDITIONAL QUALIFICATIONS: Steering Committee. National Program Review on Fisheries and Aquatic Resources, USGS (1998)

SELECTED PUBLICATIONS:

McLain, J. and G .C. Castillo, 2002. Length composition and nearshore areas used by fry Chinook salmon in the Sacramento San-Joaquin Delta. Draft. U.S. Fish and Wildlife Service, Stockton CA. 19 p

Castillo, G.C., H.W. Li and P.A . Rossignol. 2000. Absence of overall feedback in a benthic estuarine community: A system potentially buffered from impacts of biological invasions. Estuaries 23:275-291

Castillo G., H. Muñoz, H. Gonzalez and P .A. Bernal. 1991. Daily analysis of abundance and size variability of fish larvae in relation to oceanic water intrusions in coastal areas. Biologia Pesquera 20:19-34

Anke Mueller-Solger

EDUCATION:

PhD Ecology University of California, Davis, 1998
MS (Diplom) in Biology, Georg-August-University, Goettingen, Germany)1994)

EXPERIENCE:

Staff Environmental Scientist, California Department of Water Resources (2000-present)

Staff Research Associate and Postdoctoral Researcher, Department of Environmental Science and Policy, UC Davis (1998-present)

SELECTED PUBLICATIONS:

Müller-Solger, A. B., A. D. Jassby, and D. C. Müller-Navarra. 2002. Nutritional quality of food resources for zooplankton (Daphnia) in a tidal freshwater system (Sacramento-San Joaquin River Delta, USA). Limnology and Oceanography 47:1468-1476.

Sobczak, W. V., J. E. Cloern, A. D. Jassby, and A. B. Müller-Solger. 2002. Bioavailability of organic matter in a highly disturbed estuary: The role of detrital and algal resources. Proceedings of the National Academy of Sciences 99: 8101-8105.

Jassby, A.D., Cloern, J. E., and A. Müller-Solger. 2003. Phytoplankton and the food web in Delta waterways. California Agriculture 57: 104-109.

Sommer, T.R., Harrell, W. C., Mueller Solger, A.B., Tom, B. and W. Kimmerer. 2004. Effects of flow variation on channel and floodplain biota and habitats of the Sacramento River, California, USA. Aquatic Conservation: Marine and Freshwater Ecosystems 14: 247?261.

Larry J. Hansen

EDUCATION:

MA Biological Sciences, California State University, Sacramento, 1983
BS Biological Sciences, California State University, Sacramento, 1974

EXPERIENCE:

Fishery Biologist, USFWS IEP Monitoring Supervisor US Fish and Wildlife Service (2002-present)

Private consultant, bottlenose dolphin research (2000-2001),

Research Fishery Biologist. Program Leader for Marine Mammals at the Southeast Fisheries Science Center (1990-1999).

SELECTED PUBLICATIONS:

Hansen, L.J., L.H. Schwacke, G.B. Mitchum, A.A. Hohn, R.S. Wells, E.S. Zolman, and P.A. Fair. 2004. Geographic variation in polychlorinated biphenyl and organochlorine pesticide concentrations in the blubber of bottlenose dolphins from the U.S. Atlantic coast. Science of the Total Environment 319(1-3):147-172.

Wells, R.S., H.L. Rhinehart, L.J. Hansen, J.C. Sweeney, F.I. Townsend, R. Stone, D. Casper, M.D. Scott, A.A. Hohn, and T.K. Rowles. 2004. Bottlenose dolphins as marine ecosystem sentinels: developing a health monitoring system. Ecohealth 1:246-254.

Mullin, K.D., B.W. Hoggard, and L.J. Hansen. 2004. Seasonal abundance of cetaceans in outer continental shelf and slope waters of the north-central and northwestern Gulf of Mexico. Gulf of Mexico Science 2004(1):62-73.

Schwacke, L.H., E.O. Voit, L.J. Hansen, R.S. Wells, G. Mitchum, A.A. Hohn, and P.A. Fair. 2002. Probabilistic risk assessment of reproductive effects of polychlorinated biphenyls on bottlenose dolphins (*Tursiops truncatus*) from the southeast United States coast. Environmental Toxicology and Chemistry 21(12):2752-2764.

Terrestrial Resources

James F. Quinn

EDUCATION: BA, MA, PhD : AB Harvard, Biology 1973; Ph.D., University of Washington, Zoology 1979.

EXPERIENCE: Professor -- University of Pennsylvania, 1979-1981. UC Davis, 1981-present

ADDITIONAL QUALIFICATIONS: Director, Information Center for the Environment, UC Davis; Head, California Node, National Biological Information Infrastructure; co-Editor in Chief San Francisco Estuary and Watershed Science; UC Representative -- Bay-Delta Science Consortium; Chair, Faculty Senate, College of Agriculture and Environmental Science, UC Davis.

SELECTED PUBLICATIONS:

Keating, Kim A., James F. Quinn, Michael A. Ivie and LaDonna L. Ivie, 1998. Estimating the effectiveness of further sampling in species inventories. Ecological Applications 8:1239-1249.

Donohoe, Regina M., Julie T. Yamamoto, K. E. Ricker and James F. Quinn. 2000. Exposure factor and toxicity data for California wildlife: Data availability and sources of uncertainty for ecological risk assessment. Bulletin of Environmental Contamination and Toxicology 64:834-841.

Harrison, Susan, Joshua L. Viers and James F. Quinn, 2000. Climatic and spatial patterns of diversity in the serpentine plants of California. Diversity and Distributions 6(3), 153-162

Hunter, John C., Karen B. Willett, Michael C. McCoy, James F. Quinn, and Kaylene E. Keller, 1999. Prospects for preservation and restoration of riparian forests in the Sacramento Valley, California, USA. Environmental Management 24:65-75

Thorne, James H., Jeffery A. Kennedy, James F. Quinn, Michael McCoy, Todd Keeler-Wolf And John Menke, A new vegetation map of Napa County using the Manual of California Vegetation classification and its comparison to other digital vegetation maps. Madroño. (in press)

Andrew Engilis, Jr.

EDUCATION:

BS Avian Science, UC Davis, 1982

EXPERIENCE:

Curator, Museum Wildlife and Fish Biology, UC Davis (2000-present)

Research Associate, Division of Vertebrate Zoology, Bishop Museum, (Honolulu, Hawaii) (1996-present)

Conservation Manager Pacific Northwest and Pacific Islands (1997-2000

Regional Biologist, Ducks Unlimited (1991-1997)

SELECTED PUBLICATIONS:

Engilis, Jr. A. and T.K. Pratt. 1993. Status and trends of Hawaii's native waterbirds, 1977-1986. Wilson Bull. 105:142-158

Engilis, Jr., A. and F. A Reid. 1995. Hawaii Endangered Waterbird Recovery Plan, Second Revision. U.S. Fish and Wildlife Service. Portland. 170pp

Engilis, Jr., A. L. W. Oring, E. Carrera, J. W. Nelson, and A. Martinez Lopez. 1998. Shorebird surveys in Ensenada, Pabellones, and Bahia Santa Maria, Sinaloa, Mexico: Critical habitats for Pacific Flyway shorebirds. The Wilson Bull. 110:332-341.

Cole, R. E., A. Engilis, Jr., & F. J. Radovsky. 1997. Report on mammals collected during the Bishop Museum Expedition to Mt. Dayman, Milne Bay Province, Papua New Guinea. Bishop Museum Occasional Papers. No. 51. 36 pp.

Deborah L. Elliott-Fisk

EDUCATION:

PhD Geography, Institute of Arctic and Alpine Research, University of Colorado, 1979
BA Geography/Biology, California State University, Fullerton, 1975

EXPERIENCE:

Professor (Associate to Associate to Full) Dept. of Geography to Dept. of Wildlife, Fish and Conservation Biology and Graduate Groups in Geography, Plant Biology, and Ecology, University of California, Davis; chairperson, WFCB and GGG. (1981-present)

Interim Director to Director, Natural Reserve System, Division of Agriculture and Natural Resources, Office of the President, University of California (1991-1996)

ADDITIONAL QUALIFICATIONS: Research specializatios: biogeography, physical geography, ecosystem analysis and management, restoration ecology, conservation biology,

SELECTED PUBLICATIONS:

Toft, Catherine A., and Deborah L. Elliott-Fisk. 2000. Patterns of Vegetation Along a Spatiotemporal Gradient on Shoreline Strands of a Desert Basin Lake. Plant Ecology (in press).

Elliott-Fisk, Deborah L. 1995. Mono Lake Compromise: A Model for Conflict Resolution. California Agriculture, Vol. 49, No. 6, pp. 15-16.

Elliott-Fisk, Deborah L. 1991. Geomorphology. pp. 27-41 In: Clarence A. Hall, Jr. ed. Natural History of the White-Inyo Range, Eastern California. Berkeley: University of California Press. 536 pp.

Bale, A., G. T. Orlob, and D. L. Elliott-Fisk. 1988. Paleoecological Modeling of Hydrologic Processes. pp. 29-42 In: Mariani, A. (ed.). Advances in Environmental Modelling, Amsterdam: Elsevier.

Science Support

Ramona O. Swenson

EDUCATION:
PhD Integrative Biology, UC Berkeley,1995
BA Biology, Swarthmore College, 1986
EXPERIENCE:
Ecoregional Ecologist, Central Valley Ecoregion, The Nature Conservancy (2004-present) Senior Ecologist, Cosumnes River Project The Nature Conservancy (1999-2003)
Project Aquatic Biologist, ENTRIX, Inc. (1997-1999)
Associate Aquatic Biologist ,Trihey and Associates (1995-1997)
Fish and Wildlife Biologist US Fish and Wildlife Service (1988-1989)
SELECTED PUBLICATIONS:
Swenson, R.O., K. Whitener and M. Eaton. 2001. Restoring Floods to Floodplains: Riparian and Floodplain Restoration at the Cosumnes River Preserve. pp.224-229. In: Faber, P.M. (ed.) 2003. California Riparian Systems: Processes and Floodplain Management, Ecology and Restoration. 2001 Riparian Habitat and Floodplains Conference Proceedings, Riparian Habitat Joint Venture, Sacramento, CA.
Reiner, R. and R. Swenson. 2000. Saving a vernal pool landscape in the Cosumnes River watershed – New planning and acquisition strategies. Fremontia. January 2000
Swenson, R.O. 1999. The ecology, behavior, and conservation of the tidewater goby, Eucyclogobius newberryi. Environmental Biology of Fishes 55:99-114

Randall C Mager

EDUCATION:
PhD Ecology, UC Davis, 1996
MS Animal Science, UC Davis, 1991
BA Psychobiology, UC Santa Cruz, 1981
EXPERIENCE:
Environmental Specialist, Department of Water Resources (1999-present)
Post Graduate Researcher, UC Davis (1996-1999)
Research Assistant, UC Davis (1989-1996)
SELECTED PUBLICATIONS:
Mager, R.C., Doroshov, S.I., Van Eenanaam, J.P., Brown, R. 2004. Early life stages of delta smelt, pp 169-180 in: F. Feyrer, L. Brown, R. Brown and J. Orsi (eds). Early life stages of fish in the San Francisco estuary and watershed. American Fisheries Society, Symposium 39. Behtesda, MD.
Faulkenberry, K. and Mager, R.C. 2001. Salmon habitat enhancement of the Merced River Mining Reach: design and implementation consideration. pp 333-338. In: Faber, P.M. (ed.) 2003. California Riparian Systems: Processes and Floodplain Management, Ecology and Restoration. 2001 Riparian Habitat and Floodplains Conference Proceedings, Riparian Habitat Joint Venture, Sacramento, CA.

Data Management

Joshua H. Viers

EDUCATION:

PhD Ecology, UC Davis, 2003
BS Int'l Ag Development, UC Davis, 1994

EXPERIENCE:

Research Analyst III – Supervisor, UC Davis (2003 – present)
Post Graduate Researcher ? Analyst II, UC Davis (1996 – 2003)

SELECTED PUBLICATIONS:

Viers, J.H., Thorne, J.H., Quinn, J.F. 2004 *Submitted*. CalJep: A Spatial Distribution Database of Calflora and Jepson Plant Species. San Francisco Estuary and Watershed Science.

Kalman, N.B., Hogle, I.B., Viers, J.H. 2004. Designing a Geodatabase for your Project: A Wetlands Delineation Example. 2004 ESRI User Conference Proceedings.

Viers, J.H., Sailer, C.T., Ramirez, C.M., Quinn, J.F., Johnson, M.L. 2002. An Integrated Approach to the Discrimination of Riparian Vegetation in the Navarro River Watershed, Mendocino County, California, USA. In Proceedings of the 2002 AVIRIS Airborne Geoscience Workshop. Edited by Robert O. Green, Jet Propulsion Laboratory, Pasadena, CA.

Harrison, S.P., Viers, J.H., Quinn, J.F. 2000. Climatic and spatial patterns of diversity in the serpentine plants of California. Diversity & Distributions 6(3), 153-162 (c) Blackwell Science Ltd.

Joshua H. Johnson

EDUCATION:

MA Geography & Water Resources, Wyoming, 1999
BS Geography, Wyoming, 1996

EXPERIENCE:

Analyst II, UC Davis (2001 – present)

SELECTED PUBLICATIONS:

Johnson, J.H., Baxter, J.C., Wilkerson, G.V. 2001. Erosion Potential Modeler, v2.0: An ArcView Application for Modeling Erosion Potential in the Powder River Basin, Wyoming. Laramie, WY: University of Wyoming.

Johnson, J.H. and Hamerlinck, J.D. 2001. Global Positioning System (GPS) Mapping of Public Water System Sources for the Sourcewater Assessment Program (SWAP) Phase III, final technical report - *in progress*. Laramie, WY: Wyoming Geographic Information Science Center.

Johnson, J.H., Hamerlinck, J.D., Gillham, J.H. 2001. An ArcView-Based Application for the Management of Noxious Weed Species in Wyoming. Proceedings from the ESRI User Conference.

Johnson, J.H. and Hamerlinck, J.D. 2000. Global Positioning System (GPS) Mapping of Public Water System Sources for the Sourcewater Assessment Program (SWAP), final technical report. Laramie, WY: Spatial Data and Visualization Center.

Ingrid B. Hogle

EDUCATION:

MS Ecology, UC Davis, 2002

BS Natural Resources & Environment, Michigan, 1994

EXPERIENCE:

Analyst I, UC Davis (2003 – present)

SELECTED PUBLICATIONS:

Kalman, N.B., Hogle, I.B., Viers, J.H. 2004. Designing a Geodatabase for your Project: A Wetlands Delineation Example. 2004 ESRI User Conference Proceedings.

Hogle, I.B. 2002. Habitat Requirements of *Neostapfia colusana*. Proceedings Bay Area Conservation Biology Symposium.

Hogle, Ingrid. 2003. Roles & Responsibilities of Consultants in Developing NCCP/HCPs. (Document available online at www.dfg.ca.gov/nccp.)

Tasks And Deliverables

The COYOTE Project: a Unified Approach to Monitoring Floodplain and Freshwater Tidal Marsh Restoration in the Cosumnes Preserve and Yolo Bypass

Task ID	Task Name	Start Month	End Month	Deliverables
1	Project Management	1	36	Quarterly reports; Draft and revised Workplan with Schedule; Draft report: Indicators and Performance Measures; Final report: Indicators and Performance Measures; Final project report: COTOTE SYSTEM
2	Hydrology/Geomorphology	1	36	Real-time hydrologic and meteorologic network; Geomorphic monitoring network; 3 manuscripts: hydrologic and geomorphic analysis of restored floodplain/freshwater tidal marsh; Final Report: COYOTE Hydrologic and Geomorphic Monitoring Program
3	Water Quality	1	36	Water Quality Monitoring Network; 3 manuscripts: water quality analysis of restored floodplain/freshwater tidal marsh; Final Report: COYOTE Water Quality Monitoring

				Program
4	Aquatic Resources	1	36	Aquatic monitoring network; 3 manuscripts: aquatic resource analysis of restored floodplain/freshwater tidal marsh; Final Report: COYOTE Aquatic Resources Monitoring Program
5	Terrestrial Resources	1	36	Terrestrial monitoring network; 3 manuscripts: vegetation and bird/bat population dynamics of floodplain ecosystems; Final report: COYOTE Terrestrial Quality Monitoring Program; COYOTE Vegetation Map
6	Science Support	1	36	No independent deliverables. The purpose of this task is to provide field support to all investigators and to coordinate and maintain shared resources, including field gear and equipment.
7	Data Management	1	36	COYOTE System Website; COYOTE System GIS; Final Report: COYOTE System Data Handling and Managment Program

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
$2,221,801	$521,042	$74,460	$355,450	$637,332	$284,273	$0	$72,999	$4,167,357	$940,220	$5,107,577

Do you have cost share partners already identified?
Yes.

If yes, list partners and amount contributed by each:

This project is not dependent upon formal matching or cost−sharing. However, substantial support (3.5M) will be provided by the CDWR Aquatic Restoration, Planning and Implementation Program (ARPI), a CBDA ERP−funded program that will be covering much of the Yolo Bypass meteorology and sediment work, as well as a portion of the terrestrial surveys in support of Yolo Bypass restoration measures. In addition, the project will benefit from the in−kind contribution of: University faculty salaries (at least 4 UCD faculty members are participating) and the utilization of existing agency and University boats, vehicles, sensor networks, analytical equipment and field gear. Finally, UC Davis is currently constructing a Watershed Science Research Center on the Davis campus. This $3M facility is funded by Proposition 13 bond funds, and is dedicated to ecosystem monitoring and research in the North Delta and its tributaries

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.

The COYOTE Project: a Unified Approach to Monitoring Floodplain and Freshwater Tidal Marsh Restoration in the Cosumnes Preserve and Yolo Bypass

The COYOTE Project: a Unified Approach to Monitoring Floodplain and Freshwater Tidal Marsh Restoration in the Cosumnes Preserve and Yolo Bypass

Year 1 (Months 1 To 12)

Task	Labor	Benefits	Travel	Supplies And Expendables	Services And Consultants	Equipment	Lands And Rights Of Way	Other Direct Costs	Direct Total	Indirect Costs	Total
1: project management (12 months)	52515	12765	2500	3900	0	0	0	0	$71,680	17920	$89,600
2: Hydrology/Geomorphology (12 months)	82897	11310	1500	11000	127350	20010	0	8406	$262,473	30274	$292,747
3: Water Quality (12 months)	95655	21803	3000	24950	40000	62500	0	0	$247,908	46643	$294,551
4: Aquatic Resources (12 months)	281726	69637	6000	49300	37000	62800	0	8406	$514,869	109215	$624,084
5: Terrestrial Resources (12 months)	111988	28832	8380	9940	43678	31223	0	7225	$241,266	58225	$299,491
6: Science Support (12 months)	57076	14420	1500	14500	0	1500	0	0	$88,996	34706	$123,702
7: Data Management (12 months)	47840	12875	2860	6290	0	28600	0	0	$98,465	17467	$115,932
Totals	**$729,697**	**$171,642**	**$25,740**	**$119,880**	**$248,028**	**$206,633**	**$0**	**$24,037**	**$1,525,657**	**$314,450**	**$1,840,107**

Year 2 (Months 13 To 24)

Task	Labor	Benefits	Travel	Supplies And Expendables	Services And Consultants	Equipment	Lands And Rights Of Way	Other Direct Costs	Direct Total	Indirect Costs	Total
1: project management (12 months)	52515	12765	2500	3900	0	0	0	0	$71,680	17920	$89,600
2: Hydrology/Geomorphology (12 months)	83256	11390	1500	11000	44649	0	0	8406	$160,201	30503	$190,704
3: Water Quality (12 months)	98346	22446	3000	24600	40000	24000	0	0	$212,392	47763	$260,155
4: Aquatic Resources (12 months)	289246	71816	6000	46300	37000	0	0	8700	$459,062	111101	$570,163
5: Terrestrial Resources (12 months)	103616	25542	7980	7220	33678	8520	0	7225	$193,781	48048	$241,829
6: Science Support (12 months)	58281	14688	1500	15300	0	1500	0	0	$91,269	35549	$126,818
7: Data Management (12 months)	47840	12875	2860	6290	0	28600	0	0	$98,465	17466	$115,931
Totals	**$733,100**	**$171,522**	**$25,340**	**$114,610**	**$155,327**	**$62,620**	**$0**	**$24,331**	**$1,286,850**	**$308,350**	**$1,595,200**

Year 3 (Months 25 To 36)

Task	Labor	Benefits	Travel	Supplies And Expendables	Services And Consultants	Equipment	Lands And Rights Of	Other Direct Costs	Direct Total	Indirect Costs	Total

							Way				
1: project management (12 months)	**52515**	**12765**	**1500**	**3900**	**0**	**0**	**0**	**0**	$70,680	**17670**	$88,350
2: Hydrology/Geomorphology (12 months)	**83626**	**11472**	**1500**	**11000**	**113299**	**0**	**0**	**8406**	$229,303	**30739**	$260,042
3: Water Quality (12 months)	**103185**	**23184**	**3000**	**31600**	**40000**	**5000**	**0**	**0**	$205,969	**52468**	$258,437
4: Aquatic Resources (12 months)	**297031**	**74074**	**6000**	**46300**	**37000**	**0**	**0**	**9000**	$469,405	**114091**	$583,496
5: Terrestrial Resources (12 months)	**115284**	**28545**	**7020**	**6370**	**43678**	**8520**	**0**	**7225**	$216,642	**48596**	$265,238
6: Science Support (12 months)	**59523**	**14963**	**1500**	**15500**	**0**	**1500**	**0**	**0**	$92,986	**36390**	$129,376
7: Data Management (12 months)	**47840**	**12875**	**2860**	**6290**	**0**	**0**	**0**	**0**	$69,865	**17466**	$87,331
Totals	**$759,004**	**$177,878**	**$23,380**	**$120,960**	**$233,977**	**$15,020**	**$0**	**$24,631**	**$1,354,850**	**$317,420**	**$1,672,270**

Budget Justification

The COYOTE Project: a Unified Approach to Monitoring Floodplain and Freshwater Tidal Marsh Restoration in the Cosumnes Preserve and Yolo Bypass

Labor

Below are positions, hours/year and Year 1 hourly compenstion rates. It should be assumed that the position will be employed on the project for three years unless otherwise noted.

Task 1 − Project Management Analyst −− 692 hr @ $25.67/hr Coordinator −− 692hr @33.45 Faculty −− 173hr @67.10

Task 2 −− Hydrology Environmental Scientist − 263hr @$40.33 Research Engineer − 624hr @36.10 Jr. Specialist − 1300hr @15.91 Graduate Student Researcher III − 1300hr @16.80 Undergraduate Assistants − 1000hr @10.00 Aides − 100hr @ $13.45

Task 3 − Water Quality Staff Research Associate − 2080hr @18.07 (changes to 624hr in Year3) Lab Assistant − 625hr @8.00 Sr. Control System Engineer − 60hr @ 45.71 Control Syst Engineer − 250hr @45.71 Environmental Scientist − 120 hr @45.71 Aides − 655hr @11.83 Control System Engineer − 82hr @40.35 Environmental Scientist − 1090hr @40.35 Aides − 2000hr @13.45

Task 4 − Aquatic Resources Staff Research Associate −2080hr @21.16 Jr. Specialist − 2080hr @15.91 Graduate Student Researcher − 1040hr @16.80 Undergraduate Assistants − 1000hr @10.00 Environmental Specialist − 1091hr @40.34 Control System Engineer − 82hr @40.34 Aides − 2000hr @13.45 Aides − 500hr @11.83 Bio Tech GS−5 3128hr @15.98 (changes to 1091hr in Y3) Bio Tech GS−7 576hr @19.81 (changes to 82hr in Y3) Biologists GS−9 799hr @24.22 (changes to 1204hr in Y2 and 2704hr in Y3) Bio. Tech GS−5 581hr @15.98 Biologist GS−11 238hr @29.31

Task 5 Terrestrial Resources Research Ecologist 1040hr @32.00 Analyst I 1040hr @18.00 Undergraduate Assistants 1040hr @10.00

Environmental Scientist 165hr @40.35 (changes to 1040hr in Y3) Environmental Scientist 300hr @45.71 (changes to 1040hr in Y3) Aides 300hr @13.45 (changes to 1040hr in Y3) Science Aide 402hr @12.55 (changes to 914hr in Y2 &Y3) Specialist 1055hr @17.86 (changes to 977hr in Y2 and 800hr in Y3) Aide 400hr @10.00

Task 7 Data Management Analyst 260hr @22.00 Systems Administrator 520hr @21.00 Programmer II 1040hr @20.00 Undergraduate Assistants 1040hr @10.00

Benefits

Benefit rates are expressed as a range where appropriate. Experience has shown that benefit costs may vary depending upon the employee's length of service, number of dependents and choice of health plan.

Senior Control System Engineer 23.10 Control System Engineer 22.20−23.10 Environmental Scientist 22.20 −23.10 Scientific Aides 22.20−23.10 Specialist 25.60 Analyst 25.00 Coordinator 25.00 Faculty 9.00 Research Engineer 17.50 Jr. Specialist 17.00−22.00 GSR III 3.00 Staff Research Associate 25.00−32.50 Lab Assistant 3.00 Student Assistants 5.00 Analyst I 33.00 Research Ecologist 33.00 Programmer II 33.00 Systems Administrator 33.00 Administrative Analyst 33.00 Undergrad Assistants 2.40 Bio. Tech GS−5 30.00 Bio. Tech GS−7 30.00 Biologist GS−9 30.00 Biologist GS−11 30.00

Travel

Travel costs for each of the seven tasks are detailed in the on−line budget. The typical amount budgeted for non−local travel ranges from $1500−2500/per year, per task. These funds would permit investigators to present results to resource managers and scientists and to learn from peers at out−of−area meetings and professional conferences such as: the American Fisheries Society, American Geophysical Union, Ecological Society of America, International Association of Hydrologic Sciences, the Estuarine Research Federation and the State of the Estuary. Budgeted travel costs for Tasks 4 &5 are somewhat

higher because the totals include some funds budgeted for the cost of travel to and from the research site.

Supplies And Expendables

Task 1 Project Management Local travel (fleet vehicle rental) $2400/yr Copying, office supplies, phone, meeting expense $1500/yr.

Task 2 Hydrology Truck rental, travel to research sites $3000/yr Gas, expendable field supplies, maintenance $8000/yr

Task 3 Water Quality Truck rental $3250/yr Filters and reagents $6750/yr Analytical standards $535/yr Autosampler tubes $1200/yr Collection bottles $1000/yr Pumpsampler maintenance $2500/yr Pumpsampler batteries $217/yr Sonde maintenance $1667/yr Analytical equipment service contrac $4200/yr Misc. field supplies $1867/yr Haz. Waste disposal $667/yr Publication costs $1000/yr Glassware $2000/yr Office supplies $200/yr

Task 4 Aquatic Resources Truck rental and gas $6500/yr Nets and seines $4000/yr Laboratory supplies $5000/yr Waste disposal $2000/yr Electrical &boat repairs $1000/yr Miscellaneous field supplies $4000/yr Office supplies $1000/yr Boat and vehicle fuel $10,200/yr Boat and equipment maintenance $13,600/yr

Task 5 Terrestrial Resources Banding supplies $2153/yr Miscellaneous field supplies 4190/yr Computer supplies $1000/yr Office supplies $500/yr

Task 6 Science Support Truck lease $6000/yr Truck and ATV fuel $3267/yr Field supplies and cell phone $2833/yr Equipment repair and maintenance $3000/yr

Task 7 Data Management Software licensure $2000/yr Office supplies $1000/yr Computer supplies $3290/yr

****In some cases, the figures above represent a 3−year average. For example, 2/3 of the total Task 5 funds budgeted for**

banding supplies will be expended in the first year of the grant.

Services And Consultants

Task 2 − Hydrology: Phil Williams Associates ($285,298 over 3 years) Service: Hydrology/Geomorphology Task: PWA will be responsible for monitoring tidal scour and deposition in Liberty Island and the immediate vicinity, including the rate of marshplain evolution. This will be achieved using a series of bathymetric and marshplain transects in conjunction with sedimentation stations monitored at frequencies varying from each quarter to the end of the three−year monitoring period. Rates: $100/hour x 2380 hours = $238,000 Other Costs: Travel, supplies, equipment, miscellaneous = $48,000

Task 3 − Water Quality: Bryte Lab ($120,000 over 3 years) Service: Analysis of a suite of water quality parameters: chlorophyll 1, nitrate, ammonia, orthophosphate, silica, suspended solids, dissolved and total organic carbon, total nitrogen, total organic nitrogen, total organic phosphate, anions (Cl, Br,SO4) and cations (Na, K, Mg,Ca). Rate: $345/sample x 116 samples/year = $40,000/year

Task 4 − Aquatic Resources: W. Fields, ($66,000 over three years) Service: Invertebrate Identification Rate: $220/sample X 100 samples/year = $22,000/year J. Wang ($45,000 over 3 years)Service: Larval Fish Identification Rate: $150/sample x 100 samples/year = $17,000/year

Task 5 − Terrestrial Resources: DWR Photogrammetry ($20,000 over 3 years). Service: Aerial photographs Rate: $10,000 each x 2 sets = $20000 RADARSTAT International or a similar provider ($45,000 over 3 years). Service: time relevant, high resolution imagery such as QuickBird. Rate: approx. $30 per square km, allowing for the purchase of imagery to cover 500 square km per annum. UC Berkeley, Dr. William Rainey, Specialist in Integrative Biology ($56,034 over three years). Service: bat monitoring. Rate: 50% of salary and benefits for 6mo/yr.

Equipment

Listed below are items budgeted under Equipment. Because the University of California defines Equipment as items over $5000, most UC purchases of items between $1000 and $5000 are budgeted under Supplies and Expendables. Meteorological Station $7710 3 Telemetered Flow Gauges $12,300 4 YSI Water Quality Sondes $48,000 2 Water Quality Loggers $10,000 3 YSI Water Quality Sondes $28,500 DWR vehicle replacement share $5000 (Task 3) DWR boat replacement share $8500 (Task 4) DWR vehicle replacement share $8500 (Task 4) Nets $1200 Mud boat with mud motor $20,000 12 Fyke traps with wings and fences $4800 18 8' block nets $1350 4 larval trawl nets $1600 6 beach seine/lampara nets $7200 6 Beach seines $3000 Modifications to boat for larval sampling $1200 Scales to weigh fish $1000 Temperature/conductivity meter $2000 Temperature data loggers $2000 DWR boat and vehicle replacement share (Task 5) $4500 10 Remote bat sensors $20,503 Binoculars $1200 Spotting scope $1000 Task 5 mapping and surveying equipment (icl. field laptops, GPS systems, storage devices, laser rangefinders and/or range−finding binoculars) $21,060 Replacement of field equipment $4500 Data management equipment, including hardware in support of data storage, maintenance &back up; network infrastructure with Gigabit Ethernet; networked data and Internet servers; telemetric repeaters and servers; remote sensing workstations and visualization equipment; specialized processors; and digital image capture devices $57,200

Lands And Rights Of Way

None.

Other Direct Costs

Task 2− Hydrology and Task 4 − Aquatic Resources: Student fees for 2 Graduate Student Researchers ($51,324 over three years). Part of the compensation for graduate student researchers is coverage of student fees, which are currently at about $8400/year, but have been increasing annually. Task 5 − Terrestrial Resources: $21,675 for maintenance, operation and

fuel for Department of Fish and Game boats used for terrestrial monitoring.

Indirect Costs/Overhead

University of California Indirect Cost policy. Rates. For contracts with Federal agencies, the University of California uses rates based on OMB Circular A−21; the research rate in effect until June 30, 2005 is 48.5%, after which it increases to 51.5 until June 30, 2007, and then to 52% until June 30, 2008. For contracts with all State Agencies except the Department of Food and Agriculture, the University applies a rate of 25%. (A special 10% rate for State Resources agencies which has been in effect in recent years was revoked by the Office of the President on May 9,2003 viaOperating Guidance memo No. 03−02.) Application. These rates are applied to modified total direct costs (MTDC), which consists of all salaries and wages, fringe benefits, materials and supplies, services, travel, subgrants and subcontracts up to the first $25,000 of each subgrant or subcontract. Equipment and student fee remissions are excluded from the MTDC.

DWR Indirect Costs

• DWR distributes indirect costs in six categories; Staff Benefits, Pro−Rated Operating Expenses, General Management, and three levels of line management (Division Chief, District/Field Chief, and Branch Chief). • All Organizational Cost Centers receive the Staff Benefit Assessment based on Salaries and Wages. All Non−Overhead Organizational Cost Centers receive Pro−Rated Operating Expense and General Management. Based on how each Organization is set up, they could receive Line Management Assessments. Again, most assessments are based on Salaries and Wages. • The California Energy Resources Scheduling Division is unique. It has only one program, and therefore only one non−overhead cost center. This means everyone working for CERS has an hourly rate, there are no Line Management assessments, only SB, POE and GM. • Non−Overhead Organizational Cost Centers working on State Water Project (SWP) funded programs are assessed line management costs for only SWP related Overhead Organizational

Cost Centers. • Pro−Rated Operating Expenses and General Management are assessed equally to SWP and appropriated fund programs.

Comments

The principal collaborators on the COYOTE project are the Department of Water Resources and the University of California, Davis. If this proposal is funded, it intended that it be implemented by means of two separate contracts: one ERP−DWR contract and one ERP−UCD contract.

Environmental Compliance

The COYOTE Project: a Unified Approach to Monitoring Floodplain and Freshwater Tidal Marsh Restoration in the Cosumnes Preserve and Yolo Bypass

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	–	–	
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	–	–	
ESA Compliance Section 10 Permit	–	–	
Rivers And Harbors Act	–	–	
CWA 404	–	–	
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	–	–	

If you have comments about any of these questions, enter them here.

Land Use

The COYOTE Project: a Unified Approach to Monitoring Floodplain and Freshwater Tidal Marsh Restoration in the Cosumnes Preserve and Yolo Bypass

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.

With two exceptions, all DWR and UC monitoring sites are on public land owned and managed by cooperating agencies (e.g. Department of Fish and Game, USFWS, State Lands Commission, etc. One exception is Nature Conservancy property at the Cosumnes River Preserve, which the University has explicit permission to access for research purposes via a 1999 Memorandum of Understanding. The other exception is Trust for Public Land property in the Yolo Bypass, to which DWR has been granted access for sampling. Both DWR and UC maintain regular liaison with these collaborating land owners and their

neighbors.

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?
– No.
X Yes.

Land Designation	Acres	Currently In Production?
Prime Farmland		–
Farmland Of Statewide Importance		–
Unique Farmland	unknown	–
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?
– 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.

Some lands in the Yolo Bypass fall under the category of Unique Farmland as defined under the California Department of Conservation's Farmland Mapping and Monitoring Program. The exact acreage could not be obtained in time to be included in this proposal. Based on our research we were unable to establish if any land parcels in the Yolo Bypass are protected by the Williamson Act. To the best of our knowledge there is not. However, if there is, our monitoring efforts will not affect Williamson Act contracts because all sampling is conducted on public lands or by boat over flooded lands and will not effect land use practices. We are advised that none of our sampling sites at the Cosumnes Preserve are under the Williamson Act; and we have been unable to document whether any sampling sites at the Cosumnes are on land that is special status farmland. In any case, the monitoring activities proposed under this project will not require any change in land use; and all monitoring activities at the Cosumnes Preserve are conducted in such a way as to not interfere with agricultural operations.