Summary Information

The Nature Conservancy

Cosumnes River Preserve restoration monitoring data integration for adaptive management

Amount sought: $885,420

Duration: 36 months

Lead investigator: Dr. Jaymee Marty, The Nature Conservancy

Short Description

This project will be implemented through a collaborative partnership with UCD (Information Center for the Environment) and PRBO Conservation Science. The primary objective is to monitor past restoration actions on the lower Cosumnes River floodplain by refining and measuring indicators for selected key ecological attributes and targets. This project will monitor: − Habitat distribution and amount by mapping and characterizing terrestrial land cover using aerial photos and remote imagery (UCD); − Habitat structure by establishing long−term permanent plots to monitor vegetation structure throughout riparian and floodplain habitat (TNC); and − Habitat function by monitoring riparian bird populations as indicators of ecosystem function (PRBO).

Executive Summary

Protection and restoration of floodplain and riparian habitat is a high priority for the CALFED ERP. The Cosumnes River retains a relatively intact hydrograph and extensive tracts of seasonally−flooded riparian and floodplain habitat. CALFED recognized the importance of the Cosumnes and has made substantial investments to support the early phases of restoration, principally acquisition of intact habitat and restorable floodplain lands (~7,800 acres on lower Cosumnes River), and some limited monitoring, planning, and forest restoration via natural recruitment. As we move into our next phase of planning for restoration and management of the Preserve, we need a means of integrating the monitoring data of past restoration actions to forecast how future restoration actions will affect the suite of target species and communities.

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measuring indicators for selected key ecological attributes and targets. We will monitor:

− Habitat distribution and amount by mapping and characterizing terrestrial land cover using aerial photos and remote imagery (UCD);

− Habitat structure by establishing long−term permanent plots to monitor vegetation structure throughout riparian and floodplain habitat (TNC); and

− Habitat function by monitoring riparian bird populations as indicators of ecosystem function (PRBO).

Our secondary objective is to use these monitoring data and other datasets to develop an integrated, interdisciplinary decision support tool for adaptive management of riparian forest and floodplain habitat along the lower Cosumnes River. This tool will allow managers to adaptively manage and optimize habitat benefits for multiple priority species such as Sacramento splittail, fall−run chinook salmon, Swainson’s hawk, greater sandhill crane, and giant garter snake.

This 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. We will monitor ecosystems and assess project performance within a high priority area, the Cosumnes River, for several priority species that depend on floodplain and riparian habitat. The decision support tool will inform adaptive management decisions for the multi−institutional Preserve partnership by relating existing land use and habitat condition to their ecological consequences for multiple species and communities. This process and the tools we develop will be exportable for use by other land management agencies at other CALFED priority sites. The collaborative, multidisciplinary project will also leverage CALFED’s investments in research by the UC Davis.

COSUMNES RIVER PRESERVE RESTORATION MONITORING DATA INTEGRATION FOR ADAPTIVE MANAGEMENT

A. Project Description

A.1 Introduction: Problem, Goals and Objectives.

California's riparian and floodplain ecosystems have been greatly modified and impaired since the mid-1800s. Historically, rivers would overtop their banks in the winter and spring to create expansive flooded plains that were extensively used by native fishes such as chinook salmon and Sacramento splittail. Riparian forests, once the predominant floodplain vegetation in the Sacramento Valley (Hunter et al. 1999), depended on this flooding process for regeneration and recruitment. Currently on most California rivers, however, the natural hydrologic regime has been altered by dams and levees that impound runoff, constrain stream channels, and alter the timing and magnitude of flows (Mount 1995). Floodwaters cannot spread overland to deposit sediment, distribute seeds and cuttings, or recharge groundwater. Forests and wetlands have been drained and cleared for agriculture (Reiner 1996).

Protection and restoration of floodplain and riparian habitat is a high priority for the CALFED ERP (CALFED 2001). CALFED and CVPIA recognized the potential of the lower Cosumnes River because of two unique characteristics: 1) retention of, or potential to restore, the original hydrologic drivers necessary to sustain floodplain and tidal marsh ecosystems, and 2) multi-institution partnerships committed to restoration over a large geographic area. The Cosumnes River is the only unregulated river in the Central Valley and retains much of its natural hydrology, although it is extensively leveed (Figure 1.1). Substantial tracts of riparian forest also remain. Where hydrologic connectivity has been restored between the river and floodplain by levee breaching, either via flood damage (1985, 1997) or planned restoration (1995), it has created valuable seasonal habitat for native fishes and stimulated forest recruitment (Tu 2000, Swenson et al. 2001, Trowbridge 2002, Moyle et al. 2004).

Consequently, CALFED has made substantial investments to protect existing habitat, secure restorable lands, conduct baseline monitoring and start-up stewardship, restore habitat and ecological processes, and monitor status and response of biota and processes to support adaptive management (Tables 1.1 and 1.2). CALFED has funded acquisition of 18,600 acres at the Preserve, including approximately 7,800 acres in the Cosumnes River corridor (existing habitat and restorable lands) and 10,827 acres in the northeast Delta (Staten Island, McCormack-Williamson Tract). These grants have also supported baseline biological studies (e.g. habitat mapping, riparian forest mapping, surveys for sensitive species) and restoration (e.g. wildlife-friendly levee improvements on McCormack-Williamson) on some acquisitions, but not in a coordinated or comprehensive fashion across the lower watershed. In addition to land acquisition, CALFED and others have funded numerous studies in the watershed by UC Davis and others (e.g. Cosumnes Research Group, www.watershed.ucdavis.edu/crg). The CALFED Watershed Program also recently funded the Bureau of Land Management to develop a comprehensive management plan for the Preserve.

As stated in several past grants, the goals of the Preserve's restoration activities include:

- Protect existing riparian, wetland, and aquatic habitats and associated species.
- Increase floodplain storage 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.
- Increase local populations of fall-run chinook salmon, Sacramento splittail, giant garter snake, greater sandhill crane, neotropical migrant bird species and waterfowl.
- Protect the habitat values on existing farmland through conservation easements that promote wildlife-friendly farming practices.

These general goals have been translated into tangible and measurable objectives, using TNC's "Measures of Success" framework and ecological scorecard (Table 1.3 and discussed in Section A.2). Key ecological attributes (e.g. habitat size) and indicators (e.g. acres of existing and potential riparian forest and floodplain) were defined, and current status determined in 2001 (TNC 2002). Management objectives were defined for each attribute, based on our estimate of what would ensure viability (e.g. 18,300 acres in protected status). In several cases, these objectives and ratings have not been verified as to their functionality, feasibility, or cumulative effects and interactions. The monitoring and evaluation framework we are proposing is designed to provide the data and tools necessary to accomplish this objective. Furthermore, we intend to refine the framework, which could provide an indicator and success-assessment framework exportable to many other CALFED projects and partners.

Previous funding has largely supported the early phases of restoration, namely land acquisition, some baseline monitoring and limited planning. The Cosumnes River Preserve has relatively long-term data sets on riparian bird species, floodplain hydrology, native fish, and vegetation community composition and structure. We have learned a great deal about the factors affecting these species and communities (Tu 2000, Trowbridge 2002, Keller 2003, Cosumnes Research Group 2003, Florsheim and Mount 2003). As we move into our next phase of planning for restoration and management of the Preserve, we need a means of integrating the monitoring data from past restoration actions in order to forecast how future restoration actions will affect the suite of target species and communities. We propose to develop a prioritization tool, using geospatial data and priority weighting algorithms, to support adaptive management of previous restoration actions that can be used to improve planning for future restoration in the watershed. Ultimately, we plan to simulate different restoration strategies and use the output to guide restoration and management planning as well as our continued monitoring program into the future. The development of a decision support tool such as the one proposed is a critical component of this evaluation process; both the development process and application results will help ensure robust restoration and management decisions and help accomplish Preserve goals and objectives, which are comparable to those of the CALFED ERP.

Additionally this decision support tool will provide the added feature of maximizing benefits for multiple species and communities through development of compatible restoration strategies. The challenge of managing lands for multiple species and communities is common to every land management agency and organization in the world. It is a relatively simple exercise to develop conceptual models for individual species and target restoration actions that will improve certain aspects of their life cycle. It is a much greater challenge to assess an ecosystem's cumulative response to multiple restoration actions and find restoration strategies that maximize benefits for

all species and communities. In riparian and floodplain restoration, success is determined not only by how well trees grow or water remains on the floodplain, but by how target species are affected by variations in ecosystem properties.

Restoration and management actions on the Cosumnes River Preserve have cycled through the adaptive management process numerous times as the Preserve has grown from a single acquisition of 500 acres to over 40,000 acres. Preserve management has evolved and expanded from opportunistic acquisition of intact habitat (riparian forest, wetlands, vernal pool grasslands), to active restoration via hand-planting of trees and creation of managed wetlands, and finally to include restoration of ecosystem processes that sustain natural floodplain function and forest regeneration (Reiner 1996, Swenson et al. 2001). At each step the Preserve staff and partners have reevaluated the objectives and methods, given new scientific data and additional threats and opportunities, to manage the Preserve in an adaptive management framework.

The purpose of this project is to monitor past restoration actions and evaluate that information to determine what adjustments are needed to better achieve restoration objectives within the Preserve. The secondary objective is to use the monitoring data to produce an integrated, interdisciplinary decision support tool for restoration and management of riparian forest and floodplain habitat along the lower reaches of the Cosumnes River (Figure 1.1). This tool will help assess cumulative response to multiple restoration actions and thus allow managers to adaptively manage and optimize habitat benefits for multiple priority species and communities.

This project will:

- Collect key community-level and utilize process-level data fundamental to the assessment of the system (mapping of remote imagery, field monitoring, and data mining of other Cosumnes datasets in coordination with other studies by the Cosumnes Research Group);
- Refine and validate existing conceptual models by using previously collected and on-going monitoring data on relevant targets (birds, vegetation community, fish, hydrology);
- Create a tool that will relate existing land use and habitat condition to its ecological consequences for multiple species and communities important to the Preserve and CALFED;
- Support land management and restoration decision-making on the Preserve by providing a framework in which innovative alternative restoration designs can be examined for their ecological outcomes;
- Export this process and the tools developed for use by other land management agencies

The Cosumnes River Preserve is uniquely suited to answer several of CALFED's questions about restoration performance. The Preserve has two multi-institutional initiatives with durable partnerships that have proven records of attracting funding and producing results: the Preserve partners that have owned and cooperatively managed the lands since 1994[1], and the Cosumnes

[1] The Cosumnes River Preserve consists of lands and easement rights owned by the Bureau of Land Management (BLM), The Nature Conservancy (TNC), California Department of Fish and Game (CDFG), Sacramento County Parks, Recreation and Open Space (Sacramento County), California Department of Water Resources (DWR), Ducks Unlimited, Inc. (DU), California State Land Commission, Sacramento Valley Conservancy (SVC), and Natural Resource and Conservation Service (NRCS). These agencies and organizations have been cooperatively managing the Preserve since 1994 through a Cooperative Management Agreement (CMA 1994).

Research Group of UC Davis (CRG) that has conducted interdisciplinary studies since 2000[2]. This particular proposal brings together the expertise of TNC (riparian restoration, indicators, vegetation monitoring, adaptive management), UCD's Information Center for the Environment (ICE) (mapping and modeling), and PRBO Conservation Science (birds). Results of this joint fact-finding project will be shared and coordinated with Preserve stakeholders and with other monitoring efforts through CRG, UCD's Information Center for the Environment, and BDAT (through ICE and UCD Watershed Science Center).

A.2 Justification

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) (Figure 2.1). Research at the Cosumnes River indicates that floodplain inundation provides major benefits to aquatic species including increased spawning and rearing habitat, increased native fish production, enhanced food web within the floodplain, and food web support downstream (Sommer et al. 2001a, 2001b, Mueller-Solger et al. 2002, Harrel and Sommer 2003, Schemel et al. 2004, Moyle et al. 2004). Sacramento splittail exemplify the importance of seasonal flooding of the floodplain (Figure 2.2) (Moyle et al. 2004). Adults move onto flooded floodplain habitat in March and April to spawn on submerged vegetation. Larvae rear on the floodplain in April and May, and then return to the river channel in response to cues from the draining floodplain. Aquatic invertebrate production, which provides food for rearing Sacramento splittail and juvenile fall-run chinook salmon, is maximized by periodic (approximately monthly) small flood pulses on the Cosumnes floodplain and increased residence time of water (Grosholz et al. 2004).

Riparian forest communities also benefit from floodplain inundation (Figure 2.3). Floodwaters stimulate forest regeneration by depositing fresh sediment and plant propagules (Tu 2000, Swenson et al. 2001, Trowbridge 2002, Florsheim and Mount 2003). Flooding also helps suppress many upland weeds (Trowbridge 2002). Topographic heterogeneity is increased (Florsheim and Mount 2003), which results in a mosaic of vegetation (Trowbridge 2002). Forest communities (existing, restored, or potentially restorable) at the Cosumnes River Preserve vary in site characteristics (soils, flooding or moisture), type (dense riparian forest or open oak savannah, Keller and Quinn 2002), age or successional stage (early willow-cottonwood, mixed, or mature valley oak, Tu 2000), and recruitment (less recruitment observed in forests further upstream).

Neotropical bird populations and nesting habitat are one of the best ecological measures of riparian habitat diversity and function (RHJV 2004) (Figure 2.4). PRBO Conservation Science

[2] The Cosumnes Research Group is a collaborative research group at UC Davis affiliated with the John Muir Institute of the Environment, Center for Integrated Watershed Science, and the Information Center for the Environment. Principally, CRG provides an academic forum for multidisciplinary endeavors in the Cosumnes River watershed. CRG consists of faculty, students, and professional researchers pursuing science related research in geomorphology, hydrology, meteorology, fisheries, ecology, and geography, among many disciplines. Data repositories, publications, and contact information can be found at their website (http://watershed.ucdavis.edu/crg/). Furthermore, in 1999 TNC and UCD signed an MOU creating the Cosumnes Science Consortium to: 1) conduct baseline scientific studies, 2) design and implement monitoring programs, 3) increase understanding of basic riparian ecosystem processes, and 4) design and implement studies to measure the success or failure of conservation programs and adaptive management strategies implemented in the watershed.

has systematically monitored riparian birds at the Cosumnes River Preserve for nine years (1995 - 2004), with additional occurrence records extending years earlier. The objectives of this program are to (1) document habitat usage and breeding success by bird species, (2) evaluate bird response to different restored habitats, (3) track long-term relative abundance trends, (4) assess seasonal effects on bird abundance, and (5) provide land management recommendations.

Lowland floodplain systems are impacted by a number of stressors, including construction of levees that prevent floodplain inundation, filling in channels, draining wetlands, clearing riparian forests, leveling of floodplain topography, and land conversion to agriculture (TNC 2001, Florsheim and Mount 2003). The loss of habitat and the dynamic processes that transported water and sediments to the floodplain led to efforts at the Cosumnes River Preserve to (1) protect existing habitat by land acquisition and (2) restore flooplain and riparian habitats by breaching levees, planting vegetation, and controlling weeds (Swenson et al. 2001).

We hypothesize that restoration actions such as levee alteration (breaches and setbacks) will reestablish natural tidal and floodplain processes (ERP Strategic Goal 2), thereby enabling wetland and floodplain restoration (Goal 4) and benefiting floodplain-dependent species (Goal 1). Species that should benefit include MSCS "R" species (fall-run chinook salmon, Sacramento splittail, and "r" species (Swainson's hawk, giant garter snake, greater sandhill crane). We further hypothesize that restoration and management actions designed to have maximal benefit for a single target species and/or community may negatively impact other target species communities (e.g. conversion of open floodplain to forest may decrease habitat for native fish).

Ecosystem Restoration Indicators and Performance Measures

The CALFED ERP has not developed ecosystem indicators and performance measures for lowland floodplain systems. 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 developed using TNC's "Measures of Success" framework for assessing conservation impact (TNC 2000, 2003) (Table 2.1). This framework has four core components: (1) selecting a limited number of focal conservation targets, (2) identifying "key ecological attributes" for these targets based on conceptual models, (3) defining an "acceptable range of variation" for each attribute as measured by properly selected indicators; and (4) rating target status based on whether or not its key attributes are within their acceptable ranges of variation (Parrish et al. 2003).

This framework was applied at the Cosumnes River Preserve in 2001 to identify several prospective indicators and to generate a range of "best-guess" viability ratings for each key attribute (species, community, process) (Table 1.3, TNC 2002). However, these ratings have not been verified as to their functionality, feasibility, or compatibility. It is critical that we assess whether reaching a given rating for an indicator actually achieves long-term viability of the target. Additionally, we must know if the rating is achievable given environmental, economic and other constraints. Finally and most importantly, we must determine how optimizing benefits for one species or community affects the rest of the system. This project will give us the data and tools needed to make these critical assessments for many of our key targets.

A.3. Previously Funded Monitoring

The Cosumnes River has been the focus of intense research and monitoring, much of it funded by CALFED and conducted by the Cosumnes Research Group. For example, Table 3.1 describes the sampling frequency, period of record and major variables that have been collected at each location. Specific methods and analyses are summarized in numerous peer-reviewed publications (Table 3.1). Analyses of these data have yielded new insight into a variety of complex topics including hydrological modeling, geomorphology, water quality trends, food web relationships and fish life history. In addition, these ongoing monitoring efforts form the basis for the conceptual models and performance indicators described in the previous section. While a substantial amount of data has been collected on various species, hydrologic and biotic processes and plant and animal communities in the restored areas of the Preserve, we lack a tool for integrating this information. The integration of this data is critical to understanding how the ecosystem responds to not only the restoration and management actions we implement on lands within the Preserve but also to interannual variability in rainfall and temperature.

A.4. Approach and Scope of Work

The proposed project will refine and measure indicators for selected key ecological attributes and targets, as identified in our conceptual models (Figures 2.1-2.4). We will focus on mapping habitat distribution (Task 2, indicator 1), vegetation typing for habitat structure (Task 3, indicator 2), and riparian birds as indicators of ecosystem function (Task 4, indicator 3). Other indicators will be monitored under a complimentary effort being proposed by UC Davis and relevant data incorporated into development of the adaptive management tool (Task 5).

TASK 1: Project management (TNC)

TNC will provide oversight of all phases of the project, including submittal of progress reports, public participation and outreach, communication and contracts for professional services. TNC staff and collaborators will present the project results annually at either the State of the Estuary or the CALFED Science conference and at least one statewide scientific conference.

TASK 2: Map and characterize terrestrial land cover (Quinn and Viers)

Subtask 2.1: Land cover mapping: We will use the Manual of California Vegetation (Sawyer and Keeler-Wolf, 1995, Thorne et al. 2004) methodology to map 2005 land cover and vegetation to the alliance level (or better) for at least the classes of particular importance to TNC management processes within the study area (e.g., riparian forests, wetlands, and active habitat restoration sites). This task complements CDFG plans to develop comparable maps throughout the Delta in 2005-6, and should support TNC management both by 1) quantifying the extent, condition, degree of fragmentation locally and regionally of vegetation types under consideration for acquisition or restoration, and 2) providing a predictive map layer for modeling expected occurrences of indicator species or markers to provide a basis for estimating success of management measures (see Task 5).

Subtask 2.2:High-resolution plant community mapping: We will process and analyze hyperspectral remote imagery (HyMap from the summer of 2004, likely to be re-flown in 2005 and perhaps 2006 – provided by CalSpace with Boating and Waterways funding) and augmented by a number of other imagery sources in our data library[3]. We will characterize dominant and subdominant native and non-native plant species using hyperspectral imagery and object segmentation software (eCognition[4], see Dobrowski in prep.). We will then apply statistical algorithms for vegetation community mapping that identify unique spectral reflectance signatures for target species, which can be cross-referenced to field plots or known stands of particular species or habitat types for calibration and validation (DiPietro et al. 2002, Underwood et al. 2002, Viers et al. 2002). These methods have been demonstrated to successfully identify riparian communities (Viers et al. 2002) and selected invasive species (see DiPietro et al. 2002 for *Arundo donax*; Underwood et al. 2002 for *Carpobrotus edulis*.). Spectral signatures for a number of additional species of management interest to TNC are currently under development for the Delta region (Underwood, Ustin, unpublished). Profiles will first be tested using known locations of target species and communities at the Preserve, then applied to identify and monitor targets across the Preserve. Results will assist managers with implementation of the Preserve's Adaptive Weed Management Plan, which includes monitoring of desirable target species and communities as well as weed species that threaten the survival of these desired conservation targets (CRP 2000).

TASK 3: Monitor riparian and floodplain vegetation in restored and reference sites (Marty)

Subtask 3.1: Establish long-term, permanent vegetation plots throughout floodplain and riparian habitat: Vegetation monitoring at the Cosumnes Preserve will take place at the scale of site-restoration (10^{-1} - 10^{2} m^2) to track trends in restored habitat over time using a standardized protocol, which we will develop. This vegetation monitoring effort will inform adaptive management by providing the information necessary for TNC managers to assess and model changes in their conservation targets over time in a scientific manner (Stohlgren et al. 1997, Chong et al. 2001, Busch and Trexler 2003).

Various vegetation monitoring protocols have been used throughout the Cosumnes River Preserve floodplain and riparian habitat over the last 15 years (Griggs 1991, Tu 2000, Trowbridge 2002, May and Associates 2000, Keller 2003). The goals and methodologies of these efforts have varied widely, and their duration has been relatively sporadic (~1-5 years). We will establish standardized protocols and fixed locations for field monitoring of vegetation in our target habitats: floodplain, restored riparian, and natural riparian forests. Monitoring activities will be located at sites on the lower Preserve, middle Preserve and Valensin Ranch to reflect management priorities and to provide a spatially stratified approach to our long-term monitoring effort. Standardization of monitoring methods and establishment of fixed monitoring locations will allow long-term comparative analyses to promote sound implementation of adaptive management. These methods are also proposed for adoption in a complimentary proposal by DWR, CDFG, UCD, and others for paired monitoring in the Yolo Bypass and

[3] http://watershed.ucdavis.edu/crg/
[4] http://ww.definiens-imaging.com/

Liberty Island areas. Standardization of methods among various monitoring sites will facilitate use of mature successional areas on the Cosumnes River floodplain as control sites against which to evaluate the success of early restoration efforts in other locations. Thus, the paired monitoring, treated as an explicit before-after-control-impact experimental design (BACI, see Underwood 1991, Stewart-Oaten and Bence 2002), will allow both projects to better separate the effects of management actions from natural variability, and will help establish an empirical basis for conducting regional-scale assessments of broadly applied environmental change, such as that expected from long-term climate shifts.

To detect compositional changes over time, we will establish permanently marked gradsects (Sawyer and Keeler-Wolf 1995) in all targeted habitats and collect species composition data along transects, including records of absolute percent cover values for all native and exotic plant species in randomly placed quadrats along these gradsects. In forested and forest restoration sites, we will establish permanently marked plots and record demographic data for each tree species within these plots, including diameter-at-breast-height, absolute tree height, mean canopy radius, tree survival and recruitment. Plots will be monitored using Stohlgren's Modified-Whittaker plot method (Falkner et al. 1995), with transect location stratified to insure inclusion of riparian vegetation at varying successional stages. Where feasible, transects will be located to continue past vegetation monitoring efforts of Tu (2000), Trowbridge (2002), Keller (2003) and CRP staff and volunteers (see Subtask 3.2).

Subtask 3.2: Develop a volunteer habitat monitoring team: Volunteer workforces are an integral part of the operation of the Cosumnes River Preserve. Volunteers are used to staff the Visitor's Center, lead guided nature walks, conduct bird monitoring, eradicate weed infestations, and perform maintenance on CRP infrastructure. We have also successfully used volunteers for vegetation sampling on a large vernal pool study on the Preserve (Marty in press). In several cases, volunteer tenure pre-dates many Preserve staff, thus providing critical continuity to operations, institutional knowledge, and management history.

We plan to establish a volunteer-based vegetation monitoring team to assist with the vegetation monitoring outlined in Task 3.1. Preserve ecologists and trained interns will train and lead this team to ensure that high quality data collection occurs.

TASK 4: Determine the contribution of these habitats to restoring bird populations (Wood, Nur and Geupel)

PRBO has collected site-specific data since 1995 on avian populations at the Cosumnes River Preserve providing a unique opportunity for large-scale evaluation of restored (natural-process-based and horticultural restoration) riparian habitat, over a meaningful ecological time scale. Thus, an excellent opportunity exists for the ERP to not only evaluate riparian restoration but also to understand riparian system function and how specific management actions affect environmental systems. PRBO is in a unique position to implement a predictive monitoring program whose goal will be to identify factors that cause responses (desirable or undesirable) in various parameters of the avian community. For example, we can address how different flow regimes or restoration techniques ultimately affect avian diversity or abundance. Documenting avian use of process-based and horticultural restoration areas over time will not only allow

evaluation but can also provide information on the viability of different restoration and management techniques. PRBO uses nationally standardized protocols allowing direct comparison with other CALFED ERP-funded restoration monitoring studies, including studies carried out by PRBO scientists. Furthermore, PRBO's monitoring program, in place since 1995, yields information not only on the distribution and abundance of riparian birds, but also information on the demographic processes (survival and reproductive success) that underlie the observed patterns of abundance and diversity.

PRBO has conducted ten years (1995 to 2004, inclusive) of intensive surveys on populations of riparian birds at the Cosumnes River Preserve. Much of this work has focused on baseline monitoring and subsequently, on evaluating riparian regeneration at cultivated and process-based restoration sites. We propose to continue intensive and extensive avian monitoring and evaluation at established CALFED-funded restoration sites, as well as adjacent restoration sites not funded by ERP. For comparison purposes we will continue monitoring in remnant riparian habitat at key reference sites. This comparison is necessary to assess temporal and spatial variability of ecological processes and avian population process and evaluate success of conservation actions. Bird population characteristics from CALFED restoration sites (process-based and cultivated) will be compared to one another and to conserved reference sites.

Subtask 4.1 Monitor and evaluate CALFED-funded restoration and reference sites using bird species richness, species diversity, abundance of focal species, and distribution: We will assess species diversity at several CALFED-funded sites on the Cosumnes River Preserve and adjacent to it. This will be done over a large spatial scale using standard point count surveys (Ralph et al. 1993), a technique that PRBO has used in the Central Valley since 1993, including sites on the Sacramento River, the San Joaquin River, and their tributaries. In addition, point count surveys will be used to assess relative abundance of a suite of riparian species and to determine their distributions throughout the Preserve, within and between patches of habitat. An example of analysis of abundance data of 21 riparian species is provided in Nur et al. (2004).

The proposed work will build on a time-series of data on abundance and species diversity, collected by PRBO at the Cosumnes Preserve since 1995. Thus, we propose to continue monitoring through the 2008 breeding season. Results obtained from point count surveys will be compared with other sites in the Central Valley, as well. We will establish the extent of variation across years over the entire time series of data collection (1995 to 2008) and will also identify the magnitude and nature of variation across sites (both restoration and reference), as well as the degree of covariation among sites with respect to temporal variation.

For this subtask and the following (4.2), point count surveys will be conducted according to nationally standardized protocols (Ralph et al. 1993). All stations will be surveyed twice during the breeding season (April though June), identifying all birds seen and/or heard at each point for five minutes within a 50 m radius. Point count stations will be located a minimum distance of 200 m apart. At each point count station, vegetation assessment will be conducted using the relevé method described by Ralph et al. (1993; Nur et al. 2004), using the same center point and radius as the bird surveys. The relevé method is designed to quickly characterize habitat in terms of species composition and vegetation structure.

Subtask 4.2 Relate patterns in abundance, distribution, and species diversity to hydrological, and vegetation characteristics: We will examine the extent to which variation in diversity and abundance, among and within sites, is due to variation in vegetation features, and that which may be associated with physical processes themselves (e.g., flooding). Comparisons will be drawn between restoration and reference sites. We will test the hypothesis that vegetation characteristics (composition and structure), which will be quantified as part of subtask 4.1, can by themselves account for the observed differences in abundance and diversity of songbirds at restoration vs. reference sites. If this hypothesis is supported, we will identify the vegetative or habitat features that can, statistically, explain the observed variation in abundance and diversity. If the hypothesis is not supported, we will examine alternative explanations (e.g., availability of stream banks for foraging birds).

Subtask 4.3 Assess primary demographic parameters at selected CALFED and reference sites, specifically adult survival and reproduction and identify the factors (local and at a landscape-level) that influence these two parameters: We will examine two important demographic processes: adult survival and reproductive success. Although bird density (assessed in subtask 4.1) is often positively related to reproductive success (Bock and Jones 2004), we stress the importance of measuring reproductive success directly to determine the value of restoration sites for riparian bird populations. We will use nest monitoring (Martin and Geupel 1993) to determine reproductive success and its components (statistical methods are described in Nur et al. 1999). An example of analysis of once component of reproductive success, clutch size, is presented by Nur et al. (2003). We will analyze adult survival based on resighting of color-banded individuals, making use of state-of-the-art capture/recapture analyses (Cooch et al. 1996). For this task we will draw on data collected since 1995 at the Cosumnes Preserve, for these analyses. We will determine variation in these parameters among years and among sites. We will address questions such as: Has reproductive success at restoration sites increased over time as these sites have matured? Are birds as successful at older restoration sites as in remnant forest sites?

Subtask 4.4 Synthesize information on demography so as to evaluate source/sink status at restoration and remnant riparian sites and project future population trajectory: We will synthesize information on life history characteristics and demographic parameters into simple population-dynamic models. The objective is to estimate deterministic population growth rate at restoration and reference sites and compare the two. Temporal variation in demographic parameters will need to be incorporated and more complex models may be required (Nur and Sydeman 1999).

Subtask 4.5 Estimate frequency of recolonization of restoration sites and identify factors promoting or inhibiting recolonization: We will compile information, based on point count surveys, nest-monitoring, and constant effort-mist netting (Ralph et al. 1993), regarding the first appearance and first breeding of riparian songbird species at restoration sites. We will examine these data with respect to age of the restoration plot, vegetation characteristics, and landscape influences (e.g., proximity to a remnant forest site). Information on recolonization, and factors that may influence this process, will be helpful to managers in designing and evaluating restoration projects. This information will then be incorporated into metapopulation models to be developed in a future grant.

Subtask 4.6 Assess reproductive success for Swainson's Hawk and identify local and landscape level factors that affect nest site selection: We will search for and monitor Swainson's Hawk nests within the Lower Cosumnes Preserve to determine nest success. Vegetation assessment will be conducted at the nest to assess the role of local factors. These data will be incorporated into the habitat maps produced in Task 2 to identify landscape level factors that may influence nest site selection. The Swainson's hawk demonstrates the need to preserve and properly manange necessary foraging areas adjacent to the riparian habitat where they typically nest (RHJV 2004). The objective is to assess the role of riparian habitat and the adjacent upland habitat in nest site selection on the Preserve.

TASK 5: Develop spatial decision support tool for biodiversity and indicator species (Quinn and Viers)

Subtask 5.1: GIS development and support: UC Davis (watershed.ucdavis.edu/crg) has developed extensive GIS resources widely used by both researchers and TNC resource managers and volunteers to locate resources, facilities, monitoring and research plots and transects, invasive species locations and control activities, and other geospatial attributes of the Preserve and surrounding landscape. UC Davis will continue those activities, incorporating new GIS datasets as needed, processing, differentially correcting and loading GPS data, and providing general QA/QC and digital cartography. It will also make core data publicly available by operating an ArcIMS server, dataset download site, and metadata library.

Subtask 5.2 Modeling spatial distributions and risk profiles for environmental indicators: As discussed section A.2, TNC has developed a success-measure framework, including candidate indicator suite for the Cosumnes (Table 2.1) that is part of a wider effort to deploy an indicator effort in support of adaptive management across multiple landholdings. A central goal of the proposed project is to sequentially test and map candidate indicators, as needs are identified by Preserve managers. Since most indicators have only been assessed in small subsets of the Preserve's 40,000+ acres, the first step in this effort will be to map predicted locations of indicator elements, given known distributions and GIS data on underlying predictors (e.g., vegetation/habitat type, land management class, soil, elevation, flood inundation pattern, land use, grazing, and fire history, etc.)

A variety of statistical models exist that attempt to define an environmental envelope encompassing point occurrences, and then to look for similar environmental profiles elsewhere on the landscape and use those to calculate and map a probabilistic surface predicting the occurrence of the species or indicator elsewhere on the landscape -- particularly in areas that have not been sampled. Scott et. al. (2002) provide an extensive review of available methods, but to our knowledge, none has been tested in California floodplain environments. We will adapt and code the algorithms, to work with the CRG GIS system, for at least four methods reported as usefully predictive in similar environments elsewhere (logistic regression, CART, GARP, and neural net analysis). These model runs will produce maps of indicator species or biological elements chosen by TNC managers. Specifically, we intend to use a suite of environmental predictor and response variables to develop a multi-metric set of surfaces that can be used for management and prioritization. The response variables (Table 4.1) are adapted from

TNC's "Measures of Success" indicator suite and reflect targeted species and ecological processes, which TNC managers have identified as both priorities in management action and meaningful measures of restoration success; these data are generally stored as point occurrences from specific observation. The environmental predictors (Table 4.2) reflect some of the available spatial information to be used in the modeling effort. These datasets, while still far from complete, are nevertheless much richer than the low resolution data usually used to derive "environmental envelopes" (typically DEMs, some climate attributes, potential vegetation, and often productivity indicators derived from Landsat -- see Scott et al, 2002) These spatial data are available in both vector (categorical) and raster (continuous) formats, which will aid in a variety of statistical tests.

The resulting probabilistic spatial profiles (e.g., yellowthroat nesting habitat suitability) will be overlaid with parcels of particular management importance (potential acquisitions or easements, development threats, restoration choices, etc.) to identify sites representing unusual opportunities or risks in protecting/managing the chosen indicator elements. Typically, field crews will perform site assessments to assure general qualitative assumptions and also perform subsequent model validation. The results should both test the relative value of competing models (e.g., logistic regression vs. neural net) and help make management assessment more rapid, focused, and science-driven. These analyses are expected to be particularly useful in cases where TNC managers need to choose between competing restoration priorities (e.g., restoring crane vs. riparian passerine habitat), as it should identify opportunities to simultaneously address multiple indicator/endpoints and to run scenarios on post-restoration conditions implied by different management choices.

Subtask 5.3 -- Priority-setting tool: One of the major goals for TNC, both locally in the Cosumnes floodplain and North Delta and regionally is to develop a “conservation blueprint” for land protection and restoration. To do so, managers and planners at TNC and partner agencies in the CRP need a simple tool that permits them to simultaneously weight a range of competing values and threats, calculate combined priority scores, and use the results to evaluate a variety of complex scenarios on possible acquisition, management, and restoration portfolios, balancing such factors as trade-offs between riparian, water bird, and rare plant habitat, degree of threat from development or invasive species, access for outdoor recreation, and predicted effects of climate change, changes in hydrological regime, or potential fragmentation. To do so, users need to be able to choose particular values and indicators for analysis from a wider suite, weight and combine them in easy and intuitive ways, and be able to visualize a map of the combined values in a computationally efficient way so that multiple scenarios can be run, including in workshop settings.

We envision the specific goals as follows:

- Users should be able to choose their own GIS layers without too much help from software developers, weight their relative importance, and generate their own maps showing their (additive) combined values.
- Users also need to be able to specify, at least in a gross way, the relationship between the resource state (e.g., land use) and relative priority. For example, presence of T&E species might be high value for a conservation easement scenario, but a discouragement factor for a scenario envisioning restoration using heavy equipment.

- Users should be able to screen out irrelevant real estate (i.e., only do analyses for protected lands)
- Users should be able to group datasets into themes (species and habitats, water and wetlands, infrastructure...), which can be visualized individually or in combination
- There should be one or more automated normalizing procedures so that users can compare un-alike value measures (bird diversity and fire frequency) on the same numerical scale (e.g., 0 to 100)
- Users should be able to save and modify scenarios (user-chosen sets of parameters and weights) for later analysis or re-use
- Ideally, users should be able to look at the priority (hotspot) maps generated by their choices, then drill into them to examine the sources of patterns.
- The process should be intuitive.

Conceptually, the process is:

1. Choose the datasets and the fields within each to be used.
2. For each dataset, specify whether it is an environmental value (habitat rarity, fire risk) or mask (e.g., restoration is only possible on some Preserve lands)
3. If the dataset is a value dataset, specify the relationship between the raw value (for example, the percentage of native fish in a water body) and the normalized value (for example min = 0, max = 100, linear in-between). This could have a semi-automated default procedure for most layers.
4. If it is a mask dataset, specify which locations are included (Preserve land, or below 1000 ft. elevation, or in Placer County – value = 1 for each) and which are excluded (public land, above 1000 ft., any other county -- value = 0 for each)
5. Specify the relative weight of each dataset within the theme
6. Specify the relative weights of the themes
7. Generate the output map. For each location, the local value is a (scaled) sum of the value layer entries if all mask elements are 1, and zero if any mask element is 0.
8. (evaluate and return to an earlier stage to refine)

Software to conduct these analyses will be developed as an ArcGIS 9 application using the Cosumnes GIS environment, as expanded in subtask 5.1. Specific layers used in the analysis may be raw data (e.g., flood frequency), or calculated probabilistic maps (e.g., riparian bird diversity) from subtask 5.1. Specific choices will be developed according to the adaptive management needs of the Cosumnes Preserve partners. Software will first be tested at UC Davis in a controlled computer lab environment, but will deployable at the Preserve and by partner agencies, and further tested in a planning workgroup setting.

If feasible, all code will be open source or in the public domain so that the application can be widely distributed in the Bay-Delta community.

A.5. Feasibility

The assembled team has extensive experience working on multi-disciplinary collaborative research projects. The principal investigators are experts in their fields. All have conducted

important research in this study system, and have past experience applying the described methodologies. The work we propose can be completed in the time allotted, as many analyses will draw on existing data and most proposed methodologies have been tested in this system. We have access to all sampling sites, which are located on the Preserve, either as the landowning entity (TNC) or through our arrangements under the Preserve Cooperative Management Agreement. TNC will continue to work with the Cosumnes Research Group at UC Davis coordinating and communicating activities and results as specified in the 1999 MOU between TNC and UCD. This monitoring and adaptive management effort will be closely coordinated with the development of the CBDA- Watershed Program Cosumnes Watershed Management Plan in order to support adaptive management of the Preserve.

A.6. Expected Outcomes and Products

The monitoring and assessment program developed by this multi-institutional collaboration will yield a range of products and deliverables. TNC will be 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 three general categories:

Reports. TNC in coordination with the UC Davis 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.

Website and Databases. In order to support the diverse stakeholder groups and decision-makers in the region, information about this project will be readily available at the Cosumnes Research Group website[5]. This website will display quarterly and annual reports, publications by the project collaborators, and foundation documents or related links. Additionally, an interactive version of the decision support tool will be available for download on the CRG website. PRBO will develop a database with bird abundance, diversity, reproductive success, and adult survival estimates for all sites studied since 1995, through 2007.

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. The project collaborators 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 partner has budgeted in this proposal to present their results at one statewide and one national conference annually.

A.7. Data Handling, Storage, and Dissemination

Information systems supporting this project will be managed by the Information Center for the Environment (ICE) at UC Davis, using campus computing facilities in both ICE and the

[5] http://watershed.ucdavis.edu/crg/

Watershed Center. ICE currently manages the data for Cosumnes River floodplain projects (*watershed.ucdavis.edu/crg*). Eventually, we expect that the project's data infrastructure will become part of a planned interagency IT facility planned for the proposed Bay-Delta Science Consortium building at UC Davis.

Databases. Riparian and wetland bird data are coordinated with Partners in Flight and the Riparian Habitat Joint Venture (for whom ICE already operates a website funded by USGS), and complies with national standards under development by the National Biological Information Infrastructure (NBII, see *cain.nbii.gov*). Metadata comply, and will continue to comply, with FGDC metadata standards, making them available through other FGDC clearinghouse sites including CERES, NBII, and FGDC itself. As controlled vocabularies for the metadata become standardized, it will require some effort to convert the metadata to the standardized usages, which in principal should make them searchable through CERES, BDAT, NBII and other portals as well as through the project's data systems.

Many of the underlying biological and hydrological databases, both existing and planned, will use architectures that reflect particular project goals and analyses. Many will be kept primarily as custom GIS/geodatabase datasets, and exported to BDAT and SWAMP using XML, RDF, and emerging Web Services technologies (e.g., SOAP). ICE (through CalEPA) has received an USEPA National Environmental Information Exchange Network (NEIEN) grant to develop the technology for interoperability through web services.

GIS. We intend to develop a geodatabase to house all relevant spatial data using ESRI ArcGIS (Environmental Research Systems Institute, Inc., Version 9.0, Redlands, CA). Geodatabases are an emerging standard for housing geospatial data in that they are a singular object with inherent properties that allow importation and exportation through a variety of mechanisms, such as Structured Query Language (SQL); they house metadata in accordance with Federal Geospatial Data Committee (FGDC) standards; spatial feature classes can be nested within feature datasets, providing a much needed structural framework; and geodatabases can also house a variety of tabular, non-spatial data. We will use the personal geodatabase version, which uses Microsoft Access (Redmond, WA) as its database engine, because it is portable, configurable, affordable, and more easily implemented by team members and cooperators than the Oracle (Redwood Shores, CA) based enterprise geodatabase. It is worth noting, however, that personal geodatabases can be uploaded into enterprise versions; thus, state and federal agencies that implement the enterprise version can easily assimilate the results of this proposed scientific study.

Currently, our GIS data holdings include specific place-based information for the Cosumnes study area that is not limited to digital orthophotographs, digital raster graphics of USGS topographic maps (1:24000), digital elevation models (10m or better) digital line graphs of hydrography, transportation networks, land use, and parcel boundaries, among many. ICE houses over 1 Terabyte of spatial data depicting the environment of California; many of these data are inclusive of the study area. Specialized data include global positioning system located biological monitoring sites, telemetric micro-meteorological sites, and permanent vegetation transects. Our ability to leverage these data for scientific enterprise is unprecedented. We are also coordinated with a variety of other consortia, such as Riparian Habitat Joint Venture, Vegetation MOU

Working Group, and Wetlands Regional Monitoring Program in regards to GIS standards and protocols.

In addition to assisting site selection and team coordination, we intend to use our GIS facilities to help anticipate spatial and temporal trends to assist the opportunistic targeting of habitats or populations of interest to long-term monitoring in the Cosumnes study area. For example, we are currently leveraging environmental spatial data, such as elevation and distance from road, against monitored populations of an invasive weed to anticipate future control activities. We anticipate that similar opportunities will arise to examine expected locations of breeding passerine birds, hot spots of primary productivity in the aquatic environment, and zones of seedling establishment by riparian plant species.

Remote Sensing. Our remote sensing activities will use a combination of software, hardware, and imagery sources to help depict land use – land cover, land use – land cover change, vegetation type, phenology and structure. We intend to use ENVI (Environment for Visualizing Images, Research Systems Inc., Boulder, CO), ERDAS Imagine (Leica Geosystems, Atlanta, GA), and Image Analyst (ESRI, Redlands, CA) as our primary remote sensing software. Our remote sensing activities will also be coordinate with CalSpace and the Center for Spatial Technologies and Remote Sensing, whom are currently working with Boating and Waterways to identify selected invasive plant species in the Delta; we will also maintain a presence within UC Division of Agriculture and Natural Resources Monitoring Landscape Change Workgroup; and also maintain coordination with the Remote Sensing Lab of the US Forest Service, Region 5, particularly in regards to their change detection program.

Our imagery sources will include high-spatial resolution, multi-spectral images from QuickBird or equivalent. These data will be classified using a combination of supervised and unsupervised techniques. Aside from general land use – land cover classification and change detection, we anticipate that textural measures, such as lag variance and entropy, from these data will also correlate to ground measurements in regards to canopy closure and other structural elements of canopied forests. We intend to use of HyMap hyperspectral imagery, provided by CalSpace, where available to extract spectral end-member profiles for targeted entities. These entities include focal habitats, such as late-seral riparian forests (i.e., valley oak – *Quercus lobata*) or early successional riparian forests (i.e., cottonwoods – *Populus spp.* – and willows – *Salix spp.*), as well as undesirable plant species (e.g., *Arundo donax*). Lastly, we intend to use coarse resolution multi-spectral imagery, such as ASTER (Advanced Spaceborne Thermal Emission and Reflection Radiometer) or TM (Landsat 5 Thematic Mapper), to augment all levels of activity.

A.8. Public Involvement and Outreach

The principal forum for outreach among landowners will be through the Cosumnes River Preserve partnership (TNC, Bureau of Land Management, California Department of Fish and Game, Sacramento County Parks, Recreation and Open Space, California Department of Water Resources, Ducks Unlimited, Inc., California State Land Commission, Sacramento Valley Conservancy, and Natural Resource and Conservation Service). TNC will continue coordinating with the agencies and organizations that manage the Preserve through a Cooperative

Management Agreement (1994). Public outreach will be accomplished through the Preserve's multi-partner education and outreach program, which includes environmental education programs for local schools, facilities for public use, volunteer opportunities, participation in watershed forums with agencies and local stakeholders (e.g. North Delta Improvements Group, the Mokelumne Cosumnes Watershed Alliance, and the Cosumnes River Task Force), and scientific presentations. TNC will continue coordinating activities with the multidisciplinary Cosumnes Research Group (1999 MOU between TNC and UCD) to further adaptive management of the Preserve. Outreach to resource managers will occur at regional and national meetings, and through publication. Additional information will be distributed at regional meetings, through publication, and through the UC Davis Information Center for the Environment.

A.9. Work Schedule

The work schedule for the implementation of the monitoring program is presented in Table 4.1. 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.

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

This 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. Progress toward several ERP strategic goals (CALFED 2000) is being made at the Cosumnes River Preserve. Restoration actions such as levee alteration (breaches and setbacks) will reestablish natural tidal and floodplain processes (ERP Strategic Goal 2), thereby enabling wetland and floodplain restoration (Goal 4) and benefiting floodplain-dependent species (Goal 1). 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 a high priority area identified in Chapter 2 of the PSP, the Cosumnes River. 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
Giant Garter Snake
Sacramento Splittail
Valley Elderberry Longhorn Beetle
Greater Sandhill Crane
Swainson's Hawk

B.2. Relationship to Other Ecosystem Restoration Actions, Monitoring Programs, or System-wide Ecosystem Benefits

TNC's Cosumnes River Preserve is part of a public-private partnership. This partnership is formalized under a Memorandum of Agreement with project activities coordinated through the CRP non-profit organization. Public and private partners include the local governments, stakeholders, U. S. Fish and Wildlife Service, California Department of Fish and Game, California Department of Parks and Recreation, California Department of Water Resources, U.S. Army Corps of Engineers, Riparian Habitat Joint Venture, Sacramento River Preservation Trust, Sacramento River Partners, Northern California Water Association, and the Farm Bureau, among others.

The proposed 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 riparian restoration projects within the North Delta and tributaries. Additional linkages are discussed in sections A.7 and A.8.

Indicators will be developed and refined in cooperation between the Cosumnes Research Group and the Preserve partners. Management goals for indicators (i.e. desired states for key processes, species, and ecosystem structure) will be identified by the Preserve partners in the course of the upcoming development of a comprehensive management plan (2003 Watershed Program grant).

C. Qualifications.

Dr. Marty will serve as overall coordinator of this project. She will be assisted by TNC staff including Ramona Swenson, Ecoregional Ecologist, Lisbeth Jakobsen, Grants Specialist, Dianna McDonell, Associate Director of Operations and Cathy Morris, Attorney.

Biographical Sketches:

Geoffrey R. Geupel has a degree from Lewis and Clark College (BS Biology 1978) and has been employed as a biologist at PRBO for 24 years. He is currently Director of the PRBO's Terrestrial Ecology Division Program with a $1.7 million annual budget and 40 field biologists Mr. Geupel with over 25 years experience in ornithological monitoring and research, has

authored over 30 refereed publications including *Field Methods for Monitoring Landbirds* published in 1993 buy the USFS and has helped define bird-monitoring protocols now used throughout North America. Current areas of interest include population biology, bird response to habitat restoration, and conservation planning. He is currently: Co-Chair of California Partners in Flight, Chair of the Riparian Habitat Joint Venture's Science Committee, Board member of the Central Valley Joint Venture and Sonoran Joint Venture, and member of both the National Cowbird Advisory Council and Important Bird Area (IBA) National Technical Committee.

Jaymee T. Marty received her Ph.D. from UC Davis in Restoration Ecology in 2002. She graduated with a BS in Management from Embry-Riddle Aeronautical University in 1989. From 2000 to the present Jaymee has worked as uplands ecologist and now the lead ecologist at the Cosumnes River Preserve for TNC. She has over 9 years of experience monitoring vegetation and invertebrates in riparian, grassland and vernal pool habitats. Dr. Marty's current research focuses on the multi-trophic effects of management and restoration techniques including grazing, fire, and herbicide treatment on vegetation and aquatic invertebrates. Her work has received extensive national press and has been accepted for publication in *Conservation Biology*.

Nadav Nur has degrees from Duke University (Ph.D. in Zoology 1981) and an MS in Biostatistics from the University of Washington in 1991. He was Alexander von Humboldt Research Fellow, at the University of Tübingen from 1986-1987. From 1989 to the present Dr. Nur has served as the quantitative and population ecologist for the PRBO Conservation Science and is currently the Directory of Population Ecology and a adjunct professor at San Francisco State University since 1998. Dr. Nur's research interests focus on population modeling, quantitative ecology and statistical analysis of landbirds, seabirds, shorebirds and marine mammals. He has been a PI on over 20 grants from federal, state and private funding sources (including NSF, EPA, USGS NBS, USFWS, CDFG, and CALFED). Dr. Nur is author or co-author of over 50 scientific publications, including *A Statistical Guide to Data Analysis of Avian Monitoring Programs*, published in 1999 by the USFWS. He has served on two working groups of the CMARP arm of CALFED.

Jim Quinn is Professor of Environmental Science and Policy at the University of California, Davis, co-Director of the Information Center for the Environment (ICE), and leader of the California Information Node (CAIN) of the National Biological Information Infrastructure. Current research interests include environmental applications of Semantic Web technologies, the use of geospatial information systems to assess biodiversity, land use, and water quality, international databases and information sharing on invasive species and species in protected areas, watershed and floodplain analysis, and the dynamics and restoration of the San Francisco Bay – Sacramento Delta ecosystem. Past research programs also include work on marine intertidal communities, Pacific Coast marine fisheries, marine protected areas, and conservation biology as applied to parks and nature preserves. He has degrees from Harvard (1973) and the University of Washington (1979), and was on the faculty of the University of Pennsylvania before joining the Davis faculty in 1981.

Ramona Swenson holds a Ph.D. from UC Berkeley (Integrative Biology 1995) and B.A. from Swarthmore College (Biology 1986). She has worked with TNC since 1999, first as Senior Ecologist at the Cosumnes River Preserve and currently as the Ecoregional Ecologist for the Central Valley. Dr. Swenson brings her expertise in aquatic biology, riparian ecology, fisheries and conservation planning to the development of conservation priorities, restoration strategies

and management plans for the Central Valley, Cosumnes River, and other California sites. In 2001 she worked with other scientists to pioneer methods for developing indicators and performance measures, as pilot-tested at the Cosumnes River Preserve. She collaborates with scientists and research institutes (such as UC Davis' Cosumnes Research Group) on multidisciplinary research to inform land management and monitoring. Dr. Swenson's awards include an NSF Pre-Doctoral Fellowship and outstanding female graduate from Swarthmore College.

Julian K. Wood has a degree from Earlham College (B.A. Biology 1995). In 1996 he joined PRBO Conservation Science as an intern and in 2001 as a staff biologist. He has been supervising riparian bird monitoring projects in the Central Valley since 2000. As the San Joaquin Valley Program Director he has supervised and trained over 50 seasonal biologists, interns and volunteers in various bird monitoring methods. Current areas of interest include bird response to habitat restoration, and impacts of human land use to riparian bird communities.

D. Cost.

D.1 Budget

We are requesting $885,419 to complete the proposed project. The budget for this proposal has been completed on the PSP website including information on the overall budget and justification.

D.2. Cost sharing. None.

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 Cosumnes River Preserve will continue to be the focus of restoration activity into the indefinite future, requiring continuity of monitoring programs and funding sources.

A separate and complimentary funding proposal also involving monitoring on the Cosumnes River Preserve (The COYOTE Project) is following the current design of NSF Long Term Ecological Research (LTER) 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. The on-going monitoring components of the current proposal would be covered by funding from any or all of these sources.

E. Compliance with Standard Terms and Conditions.

A list of TNC's comments and exceptions to the standard terms and conditions is provided in Table 6.1.

F/G. Literature Cited

Ahearn, D.S., Sheibley, R.W., Dahlgren, R.A. and Keller, K.E. 2004a. Temporal dynamics of stream water chemistry in the last free-flowing river draining the western Sierra Nevada, California. J. Hydrology. 295:47-63.

Ahearn, D.S., R.W. Sheibley, R.A. Dahlgren. 2004b. Effects of river regulation on water quality in the Mokelumne Watershed, California. River Research and Applications, in press.

Amoros, C. and G. Bornette. 2002. Connectivity and biocomplexity in waterbodies of riverine floodplains: Freshwater biology, v. 47, p. 761-776.

Anderson, Michael L, Z.Q. Chen, and M.L. Kavvas. In Press. Modeling Low Flows on the Cosumnes River. Journal of Hydrologic Engineering, v. 9. p. 126-134.

Bock, C. E., and Z. F. Jones. 2004. Avian habitat evaluations: should counting birds count? Frontiers in Ecology and the Environment. 2:403-410.

Busch, D. E. and J. C. Trexler, Eds. 2003. Monitoring ecosystems: interdisciplinary approaches for evaluating ecoregional initiatives. Washington, Island Press.

CALFED (California Bay-Delta Program). 2001. Ecosystem Restoration Program, Draft Stage 1 Implementation Plan, Sacramento, 113 p.

Chong, G. W., R. M. Reich, et al. 2001. "New approaches for sampling and modeling native and exotic plant species richness." Western North American Naturalist 61(3): 328-335.

Cooch, E., R. Pradel, and N. Nur. 1996. A practical guide to capture/recapture analysis using SURGE. Centre d'Ecologie Fonctionelle et Evolutive CNRS, Montpellier, France.

Cosumnes Research Group. 2003. Cosumnes-Mokelumne Paired Basin Project: Coupled Hydrogeomorphic-Ecosystem Models to Support Adaptive Management, Final Reports (http://watershed.ucdavis.edu/crg/projects_final.html)

Cosumnes River Preserve. 2000. Cosumnes River Preserve Adaptive Weed Management Plan.

Crain, P. K., K. Whitener, and P. B. Moyle. 2003. 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, Symposium 39, Bethesda, Maryland.

DiPietro, D., S. L. Ustin, and E. C. Underwood. 2002. Mapping the invasive riparian weed Arundo donax and associated riparian vegetation using AVIRIS. *in* R. O. Green, editor. Eleventh JPL Airborne Earth Science Workshop. National Aeronautics and Space

Administration; Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California.

Dobrowski, S.Z., Greenberg, J.A., Ramirez, C.M., and Ustin, S.L. (in preparation) Existing Vegetation Map of the Lake Tahoe Basin. Center for Spatial Technologies and Remote Sensing. University of California, Davis.

Fleckenstein, J.H., M. Anderson, G. Fogg, and J. Mount. 2004. Managing Surface water-groundwater to restore fall flows in the Cosumnes River, Journal of Water Resources Management and Planning. July/August: 301-310.

Florsheim, J.L., and Mount, J.F. 2002. Restoration of floodplain topography by sandsplay complex formation in response to intentional levee breaches, lower Cosumnes River, California. Geomorphology 44(1-2): 67-94.

Florsheim, J. L. and J. F. Mount. 2003. Changes in lowland floodplain sedimentation processes: pre-disturbance to post-rehabilitation, Cosumnes River, California. Geomorphology 56: 305-323.

Gallo, E.L., and R.A. Dahlgren, 2004, Floodplain hydrobiogeochemistry as revealed by high resolution spatiotemporal sampling, 3rd Biennial CALFED Bay-Delta Program Science Conference Abstracts, p. 85.

Griggs, F. T. 1991. History of the Riparian Forest Restoration Project. Galt, CA, Cosumnes River Preserve.

Grosholz, E.D., E. Gallo, A. Müeller-Solger, A. Welch, C. Jannusch, and S. Kwok. 2004. Restoring the Cosumnes River Floodplain: How often should it flood and what constitutes success?, 3rd Biennial CALFED Bay-Delta Program Science Conference Abstracts, p. 96.

Hammersmark, C.T., W.E. Fleenor and S. G. Schladow. In Revision. Simulation of Flood Impact and Habitat Potential for a Tidal Freshwater Marsh Restoration: Ecological Engineering

Harrell, W.C. and T.R. Sommer. 2003. Patterns of Adult Fish Use on California's Yolo Bypass Floodplain. Pages 88-93 in P.M. Faber, editor. California riparian systems: Processes and floodplain management, ecology, and restoration. 2001 Riparian Habitat and Floodplains Conference Proceedings, Riparian Habitat Joint Venture, Sacramento, California.

Hunter, J. C., K.B. Willett, M.C. McCoy, J.F. Quinn, and K.E. Keller. 1999. Prospects for preservation and restoration of riparian forests in the Sacramento Valley, California, USA. Environmental Management 24 (1):65-75.

Ivey, G.L. and C. P. Herziger. 2003. Sandhill crane monitoring at Staten Island, San Joaquin County, California 2002-03. Prepared for The Nature Conservancy, August 2003. 55 pages.

Ivey, G.L. and C. P. Herziger. 2003. Farming for wildlife: An overview of agricultural operations at Staten Island, San Joaquin County, California. Prepared for The Nature Conservancy, August 2003. 25 pages.

Keller, K.E. and J.F. Quinn. 2002. Identification of Landscape Scale Characteristics that Impact Valley Oak (*Quercus lobata*) Growth: Cosumnes River Preserve Restoration Sites, a Case Study. Manuscript.

Keller, K.E. 2003. Landscape scale analysis of riparian restoration, site selection and adaptive management in California's Cosumnes River Floodplain. Doctoral Dissertation in Ecology. UC Davis, 88 pages

Littlefield, C. D. and G. L. Ivey. 2000. Conservation assessment for greater sandhill cranes wintering on the Cosumnes River floodplain and Delta regions of California. February 2000. Report prepared for The Nature Conservancy, Cosumnes River Preserve. 27 pp.

Martin, T. E. 1992. Breeding productivity considerations. What are the appropriate habitat features for management? *In* J.M. Hagan and D.W. Johnston (editors) Ecology and Conservation of Neotropical Migrant Birds. Smithson. Inst. Press. Washington, D.C.

Martin, T.E., and G.R. Geupel. 1993. Nest monitoring plots: Methods for locating nests and monitoring success. J. Field. Ornithol. 64:507-519.

Martin, T. E., C. Paine, C. Conway, W.M. Hochachka, P. Allen, and W. Jenkins. 1997. The Breeding Biology Research and Monitoring Database (BBIRD) Field Protocol. Univ of Montana Cooperative Wildlife Research Unit. Unpublished manual.

Marty, J. T. In Press. Effects of cattle grazing on diversity in ephemeral wetlands. Conservation Biology.

May Consulting Services. 2000. Baseline Riparian Monitoring for the Cosumnes River Preserve: Shaw and Castello Riparian Forests. Prepared for The Nature Conservancy. October 2000.

Mount, J.F. 1995. California Rivers and Streams: The Conflict Between fluvial Process and Land Use. University of California Press, Berkeley, California. 359 pp.

Mount, J.F., Florsheim, J.L., and Trowbridge, W.B. 2002. Restoration of Dynamic Floodplain Topography and Riparian Vegetation Establishment through Engineered Levee Breaching. Proceedings: The Structure, Function and Management Implications of Fluvial Sedimentary Systems. IAHS Publ., no. 276, pp. 85 91.

Moyle, Peter 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, U.S.A. Environmental Biology of Fish.

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. http://repositories.cdlib.org/jmie/sfews/vol2/iss2/art3

Mueller-Solger AB, Jassby AD, Mueller-Navarra DC. 2002. Nutritional quality for zooplankton (Daphnia) in a tidal freshwater system (Sacramento-San Joaquin River Delta, USA). *Limnology and Oceanography* **47(5)**: 1468-1476.

Noujdina, Nina. 2003. Extracting land cover change classes in the Consumnes River watershed from Landsat TM/ETM+ images using spectral indices: A methodology for long-term land cover monitoring Masters Thesis, Uninversity of California Davis.

Nur, N., G. Ballard, and G.R. Geupel. 2004. The response of riparian bird species to vegetation and local habitat features in the Central Valley, California: a multi-species approach across spatial scales. *In* Gardali T., S.L. Small, N. Nur, G.R. Geupel, G. Ballard, and A.L. Holmes. 2004. Monitoring landbirds in the Sacramento Valley. PRBO report to The Nature Conservancy.

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

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

Nur, N., J. Wood, H. Spautz, J. Hammond, and G.R. Geupel. 20003. Temporal trends and spatial heterogeneity in reproductive success of Song Sparrows in San Francisco Bay and the Central Valley: Assessing the role of local vs. global influences. Paper presented at the 2003 CALFED Science Conference, January 2003, Sacramento, CA.

Parrish, J.D., D. P. Braun and R.S. Unnasch (2003). Are we conserving what we say we are? Measuring ecological integrity in protected areas. *Bioscience* September 2003 53(9):851-860.

Power, M.E. G. Parker, W.E. Dietrich, and A. Sun. 1995. How does floodplain width affect floodplain river ecology? A preliminary exploration using simulations. Geomorphology 13: 301-317.

Ralph, C.J., G.R. Geupel, P. Pyle, T.E. Martin, and D.F. DeSante. 1993. Field methods for monitoring landbirds. USDA Forest Service Publication, PSW-GTR 144, Albany, CA.

Reiner, R.J. 1996. The Cosumnes River Preserve: 1987-95 fertile ground for new conservation ideas. Fremontia 24(1):16-19.

Ribeiro, F. M., P. K. Crain, and P. B. Moyle. In Press. Variation in condition factor and growth of young of year fishes in floodplain and riverine habitats of the Cosumnes River, California. Hydrobiologia.

Rogan, J. and Miller, J. and Stow, D. and Franklin, J. and Levien, L. and Fischer, C., 2003. Land-Cover Change Monitoring with Classification Trees Using Landsat TM and Ancillary Data, Ph. Eng. RS 69:793-804

RHJV (Riparian Habitat Joint Venture). 2004. Version 2.0. The riparian bird conservation plan: a strategy for reversing the decline of riparian associated birds in California. California Partners in Flight. http://www.prbo.org/calpif/pdfs/riparian.v-2.pdf.

Sawyer J.O. and T. Keeler-Wolf. 1995. A Manual of California Vegetation. California Native Plant Society, Sacramento, CA.

Schemel LE, Sommer TR, Mueller-Solger, Harrell WC. 2004. Hydrologic variability, water chemistry and phytoplankton biomass in a large floodplain of the Sacramento River, CA, USA. Hydrobiologia 513: 129-139.

Scott, J. M., P. J. Heglund, M. Morrison, M. Raphael, J. Haufler, B. Wall, editors, 2002. Predicting Species Occurrences: Issues of Scale and Accuracy, Island Press.

Sommer TR, Harrell WC, Nobriga ML, Brown R, Moyle PB, Kimmerer WJ, Schemel L. 2001a. California's Yolo Bypass: Evidence that flood control can be compatible with fisheries, wetlands, wildlife, and agriculture. Fisheries 26: 6-16.

Sommer TR, Nobriga ML, Harrell WC, Batham W, Kimmerer WJ. 2001b. Floodplain rearing of juvenile Chinook salmon: evidence of enhanced growth and survival. Canadian Journal of Fisheries and Aquatic Sciences 58: 325-333.

Sommer, TR, R. Mager, J. Mount, P. Moyle, E. Soderstrom. 2002. Report of the Floodplain Group, CALFED ISB Adaptive Management Workshop.19-20 March, 2002. Report. 12 pp.

Sommer, T.R., W.C. Harrell, R. Kurth, F. Feyrer, S.C. Zeug, and G. O'Leary. 2004. Ecological patterns of early life stages of fishes in a river-floodplain of the San Francisco Estuary. Pages 111-123 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, Symposium 39, Bethesda, Maryland.

Sommer TR, Harrell WC, Mueller Solger A, Tom B, Kimmerer W. 2004. Effects of flow variation on channel and floodplain biota and habitats of the Sacramento River, California, USA. *Aquatic Conservation* 14: 247-261.

Stewart-Oaten, A., and JR Bence. 2002. Temporal and spatial variation in environmental impact assessment. Ecological Monographs 71:303-339.

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.

The Nature Conservancy. 2000. 5-S Framework for Site Conservation: A Practitioner's Handbook for Site Conservation Planning and Measuring Conservation Success. Available at www.conserveonline.org.

The Nature Conservancy. 2002. Auditing Progress on Conservation by Design: Cosumnes River Project (Central Valley Ecoregion, California). draft Report. February 22, 2002.

The Nature Conservancy. 2003. The Enhanced 5-S Project Management Process: An Overview of Proposed Standards for Developing Strategies, Taking Action, and Measuring Effectiveness and Status at Any Scale. Report, July 28, 2003. 25 pp.

Thorne, J.A., J. A. Kennedy, J. F. Quinn, and M. McCoy. 2004 Submitted. A Vegetation Map Of Napa County Using The Manual Of California Vegetation Classification And Its Comparison To Other Digital Vegetation Maps. Madroño.

Tockner, K. F. Malard, and J.V. Ward. 2000. An extension of the flood pulse concept: Hydrological Processes, v. 14., p. 2861-2883.

Trowbridge, W. B. 2002. The influence of restored flooding on floodplain plant distributions. Doctoral Dissertation. University of California at Davis. 66 pp.

Tu, I. M. 2000. Vegetation patterns and processes of natural regeneration in periodically flooded riparian forests in the Central Valley of California. Doctoral Dissertation. University of California at Davis. 181 pp.

Underwood, A. J. 1991. Beyond BACI: experimental designs for detecting human environmental impacts on temporal variations in natural populations. Australian Journal of Marine and Freshwater Research 42:569-587

Underwood, E. C., S. L. Ustin, and D. DiPietro. 2002. Mapping Non-Native Plants (Iceplant) Using Hyperspectral Imagery. *in* R. O. Green, editor. Eleventh JPL Airborne Earth Science Workshop. National Aeronautics and Space Administration; Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California.

Viers, J.H., C.T. Sailer, C.M. Ramirez, J.F. Quinn, and M.L. Johnson. 2002. An Integrated Approach to the Discrimination of Riparian Vegetation in the Navarro River Watershed, Mendocino County, California, USA. Eleventh JPL Airborne Earth Science Workshop. National Aeronautics and Space Administration; Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California.

Viers, J.H., I.B. Hogle, J.F. Quinn, M. Schwartz. In preparation. Spatial predictors of a floodplain invader (*Lepidium latifolium*).

Ward, J.V., Tockner, K, Arscott, D.B., and C. Claret, 2002. Riverine landscapte diversity. Freshwater Biology, v. 47, p. 517-539.

H. Nonprofit Verification.

A letter verifying the non-profit status of is available for viewing and download at the following url: http://tncweeds.ucdavis.edu/temp/taxexmptltr.pdf.

List of Figures and Tables

Table 1.1 – Funded restoration actions on the lower Cosumnes River that will be monitored under this proposal.

Project Title	Source	Term	Project Type	Progress and Accomplishments	Status	CALFED Milestones supported
Cosumnes River Preserve (Valensin Ranch Acquisition) (96-M06)	FED (USFWS)	9/96-9/97	Acquisition	Acquired Valensin Ranch to protect 270 acres valley oak forest, 500 acres wetlands, and 60 acres of vernal pools. Better management practices implemented on rangeland. Some grassland restoration attempts failed	Completed	Milestones 5, 12, 14
Cosumnes Floodplain Acquisition and Restoration (98-B17)	FED (BOR)	7/98-12/98	Acquisition	Acquired 2,245 acres, including valley oak forest (~870 acres), cropland and rangeland. Conducted baseline habitat mapping and initial planning for Laguna Creek restoration.	Complete	Milestones 5, 12, 14
Cosumnes River Acquisition, Restoration, Planning and Demonstration (98-F19)	FED (USFWS)	7/99-9/01	Acquisition and Stewardship	Acquired 475 acres on lower Cosumnes floodplain. Further restoration depends on acquisition of upstream property and hydrologic assessment of potential for levee breaching to restore hydrologic connectivity of the floodplain	Complete	Milestones 5, 12, 14
Cosumnes Start-up stewardship and restoration (97-N14a)	CA Prop 204	1/98-9/03	Acquisition and Stewardship	Acquired 628 acres and retired 53 acres of farmland to allow natural restoration. Completed baseline habitat mapping and startup stewardship. Further restoration depends on acquisition of adjacent properties.	Complete	Milestones 5, 12, 14
Cosumnes/ Mokelumne Corridor Floodplain Acquisitions, Management and Restoration Planning (01-N10)	CA Prop 204	4/01-3/06	Acquisition, Stewardship	Acquired 122 acres of vineyard that is being restored with other funding to native grassland and wetlands. Acquired easements on 649 acres in wildlife-friendly agriculture. Other acquisitions to be pursued as opportunities arise.	In progress	Milestones 5, 6, 7, 12, 14, 15

Table 1.2 –Restoration actions funded by CALFED grants to TNC that will NOT be monitored under this proposal.

Project Title	Source	Term	Project Type	Progress and Accomplishments	Status	CALFED Milestones supported
McCormack-Williamson Tract Acquisition and Wildlife-Friendly Management Project (99-F04)	FED. (USFWS)	4/98-3/00	Acquisition	Acquired McCormack-Williamson Tract (1512 acres) as Phase I for restoration of tidal freshwater wetlands and riparian forest by restoring hydrologic connectivity.	Complete	Milestones 8, 9, 13, 14, 16, 22
McCormack-Williamson Tract Restoration - Wildlife Friendly Levee Management (USFWS 114200J039)	FED. (USFWS)	9/99-1/04	Stewardship	Resloped interior slope of levee (1 mile) to improve levee integrity, and planted with native grasses. This is a necessary precursor for restoring wetlands. Restoration scenarios being evaluated by North Delta Planning process.	Complete	Milestones 13, 14
Staten Island Acquisition (01-N23)	CA Prop 204	1/01-1/04	Acquisition, Stewardship, Monitoring	Acquired 9,200 acres in the northeast Delta to maintain in wildlife-friendly agriculture that supports wintering greater and lesser sandhill cranes, and waterfowl. Conducted baseline monitoring of biological resources, T&E species. Studied sandhill crane habitat use on Staten and surrounding areas. Future management and restoration will depend on North Delta Planning Process.	Completed	Milestones 6, 8, 13
McCormack-Williamson Tract Restoration - Wildlife Friendly Levee Management (ERP-02-P25)	CA Prop 204	12/03-11/06	Stewardship	Will reslope approx. 4 miles of interior levees slope to support restoration of wetlands via restoration of hydrologic connectivity. Restoration scenarios being evaluated by North Delta Planning Process.	In planning	Milestone 9

Table 1.3. Ecological scorecard of key ecological attributes, indicators and estimated ratings for the lower floodplain at the Cosumnes River Preserve (TNC 2002), as developed under the "Measures of Success" framework (TNC 2003). "Desired rating" is the quantifiable management objective for each attribute. This table serves as a starting point for indicators in the proposed project, which will refine key attributes and indicators, test assumptions for indicator rating thresholds, and update status of indicator ratings with current monitoring data in collaboration with other monitoring efforts in the area. (TNC indicator categories also show corresponding CALFED categories).

Entry assistance ON					**Bold = 2001 rating**	Indicator Ratings		*Italics = Desired rating*		
Conservation Target Enter # of Target		Category	Key Attribute	Indicator	Poor	Fair	Good	Very Good	2001-02 Rating	Desired Rating (object-ive)
2	Lower Floodplain	Landscape Context Ecosystem Structure indicator	Connectivity: River-Floodplain (lateral)	Average number of days and timing of floodplain inundation	less than 25 or more that 150 days average over 5 yrs. with fewer than 3 winter and spring pulses	less that 50 or more that 120 days average over 5 years with fewer than 3 winter and spring pulses	***50-120 days of inundation average over 5 years with at least 3 winter and 3 spring pulses***	60-70 days inundation, average over 5 years with at least 3 winter pulses and 3 spring pulses	Good	Good
2	Lower Floodplain	Landscape Context Ecosystem Structure indicator	Ground-water availability (shallow)	Amount of riparian floodplain habitat with ground water levels within 10 feet of surface.	4,575 acres of riparian floodplain lands (25% of core area)	**9,150 acres of riparian floodplain lands (50% of core area)**	13,725 acres of riparian floodplain lands (75% of core area)	*16,740 acres of riparian floodplain lands (90% of core area)*	Fair	Very good
2	Lower Floodplain	Landscape Context Process indicator	Hydrologic Regime: Flooding	Timing, magnitude, and duration of flood flows	Flow patterns strongly altered, flood peaks impaired by dams or flood control	Flow patterns moderately altered with moderate impairment of flood flows	Flow patterns slightly altered with some impairment of flood flows	***Flood flows are within natural range of variability***	Very Good	Very good
2	Lower Floodplain	Condition Species-based indicator	Riparian Bird Community	Successful breeding by resident and neotropical migratory birds (songbirds, Swainson's hawk)	Breeding by <4 of 14 priority riparian spp. No Pacific slope flycatcher or Hutton's vireo breeding.	**Breeding by 5-7 of 14 priority riparian spp, and sometimes Pacific slope flycatcher & Hutton's vireo**	*Breeding by 7-10 of 14 priority riparian spp breeding, as well as Pacific slope flycatcher & Hutton's vireo*	Breeding by by 10 of 14 priority riparian spp., as well as Pacific slope flycatcher & Hutton's vireo	Fair	Good

		Entry assistance ON			**Bold = 2001 rating**	Indicator Ratings		*Italics = Desired rating*		
Conservation Target Enter # of Target		Category	Key Attribute	Indicator	Poor	Fair	Good	Very Good	2001-02 Rating	Desired Rating (object-ive)
2	Lower Floodplain	Condition Ecosystem structure indicator	Riparian Vegetation: Community Composition (lagging indicator)	Composition and structure of riparian forest communities	Only willow scrub present	Mostly willow scrub and willow/cotton-wood, with some valley oak.	**Willow scrub, willow/cotton-wood, mixed riparian, and mature valley oak present**	*Mature valley oak & mixed riparian dominate, with willow scrub and willow/cotton-wood also present*	Good	Very Good
2	Lower Floodplain	Condition Ecosystem structure indicator	Riparian Vegetation: Recruitment (leading indicator)	Seedlings and saplings of willow and cottonwood (on fresh sediment deposits), oak and Oregon ash (in existing forests and uplands) in the entire lower floodplain region	No recruitment of willow, cottonwood or oak	Limited recruitment of willow and cottonwood, no oak recruitment	*Good recruitment of willow & cottonwood, limited recruitment of oak*	**Good recruit-ment of willow, cottonwood and oak species.**	Very Good	Good
2	Lower Floodplain	Size Ecosystem structure indicator	Area of riparian floodplain habitat	Acres of existing and potential riparian floodplain habitat protected	4,575 acres (25% of total core area)	9,150 acres (50% of total core area)	**13,725 acres (75% of total core area)**	*18,300 acres (entire Core area)*	Good	Very Good
2	Lower Floodplain	Size Ecosystem structure indicator	Buffer area of surrounding upland habitat (also provides foraging habitat for cranes and Swainson's hawk)	Acres of buffer around core riparian area that are protected (conservation easement, county planning regulations,),in compatible agriculture	No buffer area protected	**100-8,000 acres buffer (up to 25% of total buffer area)**	8,000-16,000 acres buffer (50% of total buffer area)	*16,000-24,000 acres buffer (75% of total buffer area)*	Fair	Very Good

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	"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)
	Nonnative Invasive species	Abundance and diversity of non-native fish and macroinvertebrates in relation to native species.

Table 3.1: Elements, methods and products of previous Cosumnes floodplain monitoring work
(Dates in parentheses indicate when sampling was initiated.)

Activity	Task	Season and Frequency	Methods and products
Hydrology and Geomorph-ology	Flow gages	Daily (1990s)	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	Secchi	Variable (1999)	Moyle et al. (2003); Crain et al. (2004); Ahearn et al. (in press a,b); CRG (2003)[1]
	Turbidity, Conductivity	Daily-weekly (2000) Feb-May	
	Temperature and pH	Continuous (2000) Feb-May	
	Nutrients	Variable (2000)	
Aquatic Resources	Chlorophyll a	Continuous (2000) Feb-May	Grosholz et al (2004), Gallo and Dahlgren (2004); CRG[1] (2003)
	Zooplankton, Drift and Benthic invertebrates	1-2x/week (2000) Feb-May	
	Larval fishes	1-2x/week (2000) Feb-May	Crain et al. (2004); CRG[1] (2003), Ribiero et al (2004)
	Fish - Beach seine and electrofishing	Variable (1999)	Moyle et al. (2003), CRG[1] (2003)
Terrestrial Resources	Aerial photos	Variable (1998)	
	Vegetation *relevé* *gradsect* *transect* *areal field survey* *point center quarter* *aerial survey*	 annual (1995) annual (2000) annual (1999) various, annual (1987) one time (2000) sporadic (2001)	Moyle et al. (2003), Keller (2003), Trowbridge (2002), Tu (2000), Noujdina (2003), CRG[1] (2003)
	Wetlands		Kalman et al. (2004)
	Invasives	Opportunistic (1997)	Underwood et al. (2002); DiPietro et al. (2002)
	Riparian Birds	PRBO (1993) (~6 mo./year)	Ralph et al. (1993); Nur et al. (1999)
	Sandhill Cranes	Sporadic winter (1999)	Littlefield and Ivey (2000), Ivey and Herziger (2003 a,b)
	Giant Garter Snake	Daily weekly (2001-02) May-Sep	Hansen (2001, 2002, 2004)
	Bats		Power et al. (2004)
Data Manage-ment	***Geographic data***		
	Field Plots	Custom databases (2000)	http://watershed.ucdavis.edu/crg
	Framework Datasets	Farmlands (2000)	http://casil.ucdavis.edu
	Elevation	Airborne1 via DWR (2002)	http://watershed.ucdavis.edu/crg
	Land Use Land Cover	NLCD 2000; Vernal Pools (1997); NWI (ongoing)	http://ice.ucdavis.edu/
	Change Detection	See Noujdina (2004)	Noujdina (2003); Rogan et al. (2003)
	Imagery		
	Aerial Photos	Opportunistic -- typically every few years	Moyle et al. (2003), CRG[1] (2003), Florsheim and Mount (2003)
	Multispectral	Landsat, MODIS, others, better than annual (1992)	Rogan et al. (2003)
	Hyperspectral	HyMap (2004, possible annual updates)	Underwood et al. (2002); DiPietro et al. (2002)
	LiDAR	Airborne1 via DWR (2002)	Roering et al. (2002)

Table 4.1 List of indicator response variables available and sources of data.

Indicator Response Variables	Source
Avian Community	
targeted avian species (presence/absence)	PRBO 1995 - 2004
nest success, rate	PRBO 1995 - 2004
avian community diversity (number of species, Jaccard, Shannon-Wiener or equivalent)	PRBO 1995 - 2004
sandhill crane, roosting (presence/absence)	PRBO 1995 - 2004
sandhill crane, foraging (presence/absence)	PRBO 1995 - 2004
Swainson's hawk, nesting (presence/absence)	PRBO 1995 - 2004
Swainson's hawk, foraging (presence/absence)	PRBO 1995 - 2004
Fishes	
splittail (presence/absence)	Moyle et al. 2003
chinook salmon, reproduction	Moyle et al. 2003
chinook salmon, migration	Moyle et al. 2003
chinook salmon, rearing	Moyle et al. 2003
Mammals	
Bats, abundance	Rainey in prep.
Bats, diversity	Rainey in prep.
Rats, wood (presence/absence)	Whisson unpublished
Rats, black (presence/absence)	Whisson unpublished

Table 4.2 List of environmental predictor variables and sources of data.

Environmental Predictor Variables	Datum
Riparian Forest Patch Dynamics	
Patch Size	from ground-based mapping effort (Task 2), m^2
Patch Age	age class determined by restoration date or historical record, yr 10^1
Patch Complexity (shape index, etc.)	from ground-based mapping effort (Task 2)
Patch Isolation	from ground-based mapping effort (Task 2)
Patch Composition (presence/absence of target restoration tree species)	from ground-based mapping effort (Task 2)
Patch Structure (dimensionality)	from ground-based mapping effort (Task 2), mean height m; percent canopy cover; number of canopy layers
Land Cover Typography	
Broad Vegetation Class	from Land Cover mapping effort (Task 2)
Land Use History (e.g., former agricultural field, native remnant forest)	from archival records
Anthropogenic Factors	
Distance to Road (Interstate/Highway; primary road; secondary road; management road; trail)	existing and ongoing GIS survey data, m Log
Distance to Levee	existing and ongoing GIS survey data, m Log
Distance to Levee Breach	existing and ongoing GIS survey data, m Log
Distance to Canal	existing and ongoing GIS survey data, m Log
Management Scheme (active, passive, intensive)	from archival records
Management Frequency & Human Visitation (frequent, infrequent)	from archival records
Environmental Factors	
Elevation	existing LIDAR, cm
Aspect	existing LIDAR, cm
Slope	existing LIDAR, cm
Soil Type & Constituent (clay, loam, sand, pH)	SSURGO data, augmented with NRCS County Soils
Distance to Flowing Water	existing and ongoing GIS survey data, m Log
Distance to Flood Water	existing and ongoing GIS survey data, m Log
Distance to Ponded Water	existing and ongoing GIS survey data, m Log

Table 5.1 Project work schedule. (Task numbers may not correlate directly with task numbers as written in the proposal).

Task #	Task Descriptions	Scheduled Deadlines	Year 1 Jan 06-07		Year 2 Jan 07-08		Year 3 Jan 08-09	
Task 1	**Project Management**							
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	Final Project Report	1-Jan-09						
Milestone	Quarterly and Final Reports Completed							
Milestone	Outreach Conducted and Final Products Disseminated							
Milestone	Completion of Indicators and Performance Measures							
Task 2	**Map and Characterize Terrestrial Land Cover**							
2.1	Land Cover Mapping	on-going						
2.2	High-Resolution Plant Community Mapping	on-going						
2.3	Data entry into GIS, provide on-line access	on-going						
2.4	Prepare Quarterly Progress Reports	31-Mar, 30-Jun, 30-Sept, 31-Dec						
Deliverable	GIS, with on-line access, to existing vegetation data	30-Jul-06						
Deliverable	CVM - compliant vegetation map of study region	30-Jul-07						
Deliverable	Manuscript - analysis of restored floodplain	30-Jul-07 on						
Deliverable	Final Report: CRP adaptive management	1-Jan-09						
Milestone	Acquisition and processing of remote sensing data							
Milestone	Classification and mapping of land cover							
Milestone	Statistical field validation of landcover interpretation							
Milestone	Field application for CRP managers							
Task 3	**Vegetation Monitoring**							
3.1	Finalize design and layout for vegetation monitoring	31-Jul-06						
3.2	Vegetation field monitoring	31-Jul-06 on						
3.3	Field data entry and QA/QC	31-Jul-06 on						

Task #	Task Descriptions	Scheduled deadlines	Year 1 Jan 06-07		Year 2 Jan 07-08		Year 3 Jan 08-09	
3.4	Prepare Quarterly Progress Reports	31-Mar, 30-Jun, 30-Sept, 31-Dec						
Deliverable	Manuscript - analysis of vegetation data	30-Jan-08 on						
Deliverable	Final Report: Vegetation monitoring	1-Jan-09						
Milestone	Integration of data protocols and handling							
Task 4	**Bird Monitoring**							
4.1	Finalize design and layout for bird monitoring	31-Jul-06						
4.2	Bird field monitoring	31-Jul-06 on						
4.3	Field data entry and QA/QC	31-Jul-06 on						
4.4	Prepare Quarterly Progress Reports	31-Mar, 30-Jun, 30-Sept, 31-Dec						
Deliverable	Manuscript - analysis of bird data	30-Jan-08 on						
Deliverable	Final Report: CRP bird monitoring	1-Jan-09						
Deliverable	Bird database for CRP	1-Jan-09						
Milestone	Integration of data protocols and handling							
Task 5	**Develop Spatial Decision Support Tool and Indicator Species**							
5.1	GIS development and support	ongoing						
5.2	Modeling spatial distributions and risk profiles for environmental indicators	ongoing						
5.3	Priority-setting tool	30-Jul-07 on						
Deliverable	Integrated geodatabase environment for CRP	01-Jan-07 on						
Deliverable	Software -- Spatial distribution models for select indicators							
Deliverable	Decision Support software	1-Jan-07						
Deliverable	Final Report: Decision support tool	1-Jul-09						
Milestone	Final specification of user needs for modeling and decision support software							
Milestone	Working geodatabase software							
Milestone	Working on-line access to GIS data and mapped model outputs							
Milestone	Working modeling tool							
Milestone	Testing and field application of modeling tool							

Table 5.1 Comments and Exceptions to Sample ERP Grant Agreement, the General Terms & Conditions and the Special Terms and Conditions as contained in Attachment 3 to PSP

NOTE: The Nature Conservancy (TNC) reserves the right to make additional comments and exceptions as new forms are provided for review or forms already reviewed are revised.

Exhibit Section Paragraph	**Comment/Exception**
Exhibit A, Section III, Paragraph 2	1) TNC's Project Directors do not have unlimited authority to act on behalf of the organization. Replace "[Project Director] shall have the full authority to act on behalf of the Grantee." with "[Project Director] shall act on behalf of the Grantee." 2) It is unclear what is meant by the word "binding." Propose to replace "All communications submitted to the Project Director shall be as binding as if given to the Grantee." with "All communications to Grantee shall be submitted to the Project Director."
Exhibit B, Section 1	Section 5 of this Exhibit indicates that Grantee will be paid based on actual expenses. Given this, replace "The Grantee shall invoice no more frequently than monthly based upon percent complete by task and deliverables." with "The Grantee shall invoice no more frequently than monthly based upon permitted expenses incurred towards the completion of the Project."
Exhibit B, Section 2, Paragraph 1	It is unclear why Grantee cannot invoice until agency receives a notice of satisfactory completion from ERP Grant Manager. Work progress is communicated in Progress Reports. Propose to delete "upon receipt of notice of satisfactory completion of acceptance of work by ERP's Grant Manager." and change the next sentence stating "The State will not accept an invoice for which work has not been approved and will return the invoice as a disputed invoice to the Grantee." to "The State will not accept an invoice for which adequate progress towards the Project Deliverables has not been made. The progress must be detailed in the Progress Reports."
Exhibit B, Section 2, Paragraph 3	TNC exempt employees are not paid hourly, but are paid on a salaried basis bi-weekly. If we were to attempt to calculate an hourly rate for each position, the hourly rate would be different each pay period since the number of hours worked usually varies each pay period. As has been accepted by CBDA in the past, TNC requests that hourly rates for exempt employees not be required on invoices submitted, and that staff be listed by category, not by name, to keep information confidential.
Exhibit B, Section 2, Paragraph 5	Invoices are requested to be mailed to one location only. Delete "whichever date occurs later."
Exhibit B, Section 3	Add additional paragraph stating "Full credit shall be allowed for Grantee's expenses necessarily incurred under this Grant Agreement up to the date of written cancellation."
Exhibit B, Section 4.A	Replace Section 4.A with "Line item and task adjustment(s). Grantee shall expend funds in the manner described in the approved Budget. As long as the total contract amount does not increase, the Grantee may: (1) decrease the Budget for any individual tasks by no more then 10% of the total task amount, on a cumulative basis, and increase the Budget for one or more tasks by an equal amount; and (2) adjust the Budget between individual line items within a task by no more then 10% of the total task amount for such task. Any other variances in the budgeted amount among tasks, or between line items within a task, require approval in writing by CDFG or CBDA. All cumulative variances to the approved Budget must be reported with each invoice submitted to CDFG or CBDA for payment. The total amount to be funded under this Agreement may not be increased except by amendment of this Grant Agreement. Any increase in the funding for any particular Budget item shall mean a decrease in the funding for one or more other Budget items unless there is a written amendment to this Grant Agreement pursuant to the ERP Grant/Contract Amendment Workshop process (see Exhibit A - Attachment 3 - ERP Amendment Guidelines)."
Exhibit B, Section 5.A	Need to add some mechanism to allow for rollover of unused funds from one fiscal year to the next within the term of the agreement.

Exhibit B, Section 5.E	As allowed previously by CBDA, allow TNC to enter into fixed-price subcontracts in which instance subcontractor detailed personnel costs would not be required in the Budget Summary nor in each invoice submitted to the State. Additionally, in the case of a fixed-price subcontract, back up documentation would not be required of subcontractors with each invoice. Fixed-price subcontracts would be competitively bid (or sole sourced) unless subcontractor was named in the proposal, per Agreement requirements. Special provisions would need to be allowed when subcontracting with universities.
Exhibit B, Section 5.F	It is stated that travel reimbursement guidelines are in accordance with the current State of CA guidelines. Per established TNC policies and procedures, TNC reimburses its employees for actual travel costs incurred; we do not pay employees a per diem for travel. Additionally, TNC follows the IRS rules for mileage reimbursement. Therefore, we propose that travel costs for TNC employees be reimbursed based on actual costs, that mileage for a personal vehicle be reimbursed at the current federal rate, and that State Travel and Per Diem Expense Guidelines are not attached as an Exhibit to the Agreement (this has been accepted by CBDA in the past).
Exhibit B, Section 6	Delete third paragraph relating to Grantee retaining 10% of subcontractor's earnings. TNC pays subcontractors at their own risk. Also, Section 8(c) of Exhibit D absolves the State of any responsibilities, including payment obligations, for subcontractors.
Exhibit B, Budget Summary and Detailed Breakdown - Equipment Detail	It is unclear from Exhibit B – Budget Summary and Detailed Breakdown – Equipment Detail, what constitutes equipment. As defined in the Sample, equipment has a normal life expectancy of one year or more and an approximate cost of $5,000 or more, yet items in the Sample's table cost $2,000 and $3,000. TNC's capitalization threshold is $50K. Anything under that amount would be booked as supplies, not equipment to our General Ledger, but we can provide reports on anything meeting the State's equipment description once this description is confirmed.
Exhibit C, Section 5	Add at the end of section "provided that Grantee shall have no indemnification obligations under this paragraph to the extent that any claim or loss is caused by the gross negligence or willful misconduct of the party seeking indemnification."
Exhibit C, Section 7	Because there may be work done and deliverables submitted that have already been approved, replace "In the event of such termination, the Grantee agrees, upon demand, to immediately repay to the CDFG or CBDA an amount equal to the amount of grant funds disbursed to the Grantee prior to such termination." with "All costs to CDFG or CBDA shall be deducted from any sum due to Grantee under this Grant Agreement and the balance, if any, shall be paid to the Grantee upon demand." Additionally, add the following paragraph "CDFG/CBDA or Grantee may terminate this Grant Agreement, without cause upon 30 days advance written notice. The Grantee shall be reimbursed for all work performed and reasonable expenses incurred up to the date of termination."
Exhibit C, Section 15, Paragraph 1	Replace the phrase "and will provide a drug-free workplace by taking the following actions" to "and will, or continue to, provide a drug-free workplace by taking, or continuing, the following actions"
Exhibit D, Section 1	Before we can agree to comply with "the adopted environmental mitigation plan," we need to know what it is.
Exhibit D, Section 3	To the following sentence "The Grantee shall notify the CDFG or CBDA at least ten (10) working days prior to any public or media event publicizing the accomplishments and/or results of this Grant Agreement and provide opportunity for attendance and participation by CDFG or CBDA representatives" add "or as soon as the event has been scheduled if it is not scheduled ten or more working days in advance."
Exhibit D, Section 4	To the following sentence "The Grantee assumes all operations and maintenance costs of the facilities and structures; the CDFG or CBDA shall not be liable for any cost of such maintenance, management or operation" add "which is not expressly set forth in the Scope of Work and/or the Budget attached to this Agreement, as amended from time to time in accordance with this Grant Agreement."
Exhibit D, Section 7	Delete "If the State and Grantee are unable to resolve the dispute, the decision of the ERP Program Manager or Designee shall be final."
Exhibit D, Section 8	Please provide a reference for "basic State Requirements" since this is not specified.

Exhibit D, Section 10	Replace the first sentence with "Grantee shall have the right to disclose, disseminate, and use, in whole or in part, all data, plans, drawings, specifications, reports, computer programs, operating manuals, notes, and other written or graphic work produced in the performance of this Grant, and Grantee agrees that such rights are subject to the rights of the State as set forth in this section." Additionally, we reserve the right to amend the language in this section if necessary when dealing with universities as subcontractors, subject to State approval.
Exhibit D, Section 14	Delete this section since the State is already protected by other default and termination clauses that are in conflict with this Section 14.
Exhibit D, Section 15, Paragraph 1	Replace the first sentence with "Grantee shall cooperate with the CDFG or CBDA staff, working on behalf of the Resources Agency, to ensure compliance with all applicable permitting and environmental review requirements that may be required to accomplish the project described in the Scope of Work."

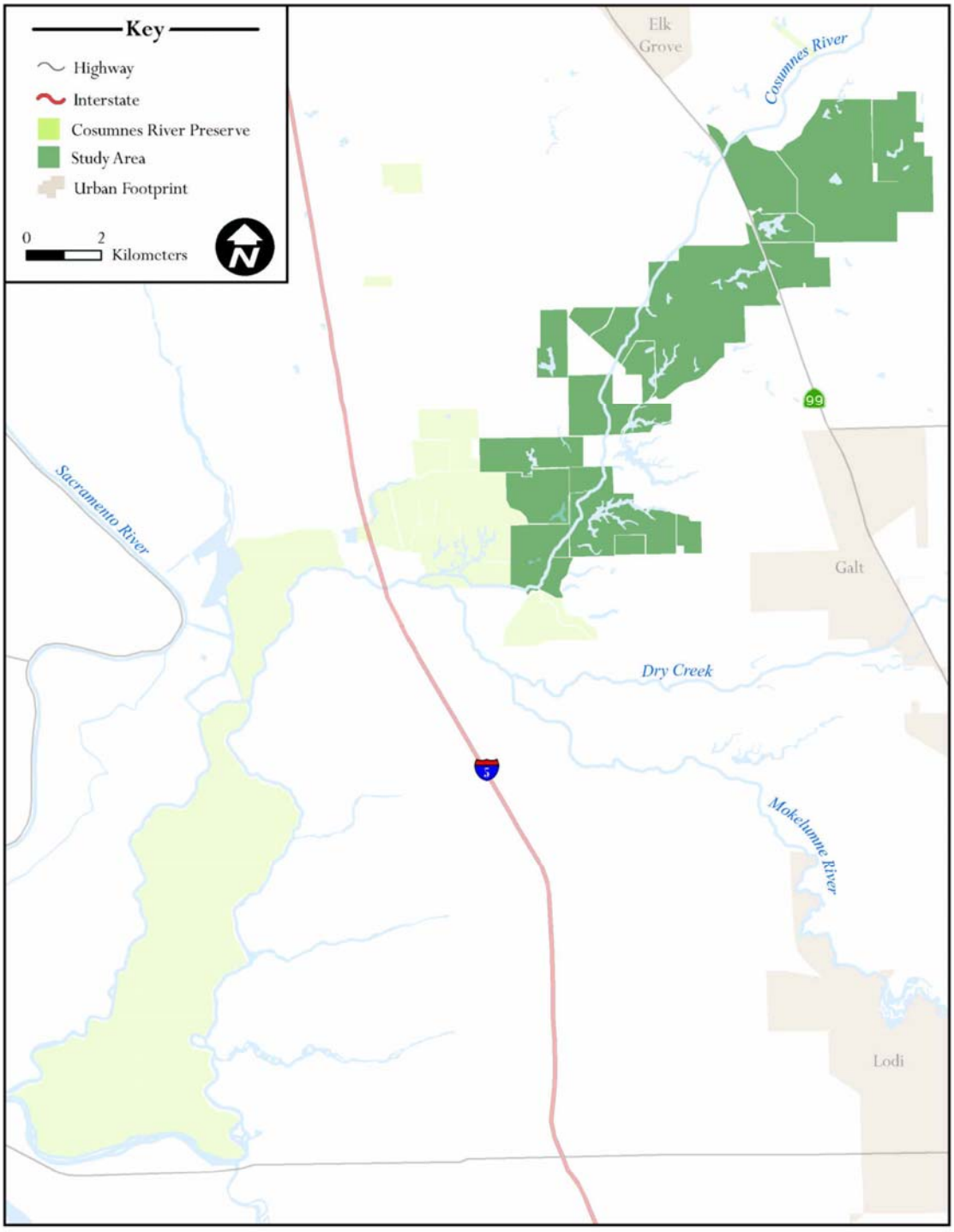

Figure 1.1: Cosumnes River Preserve Study Area

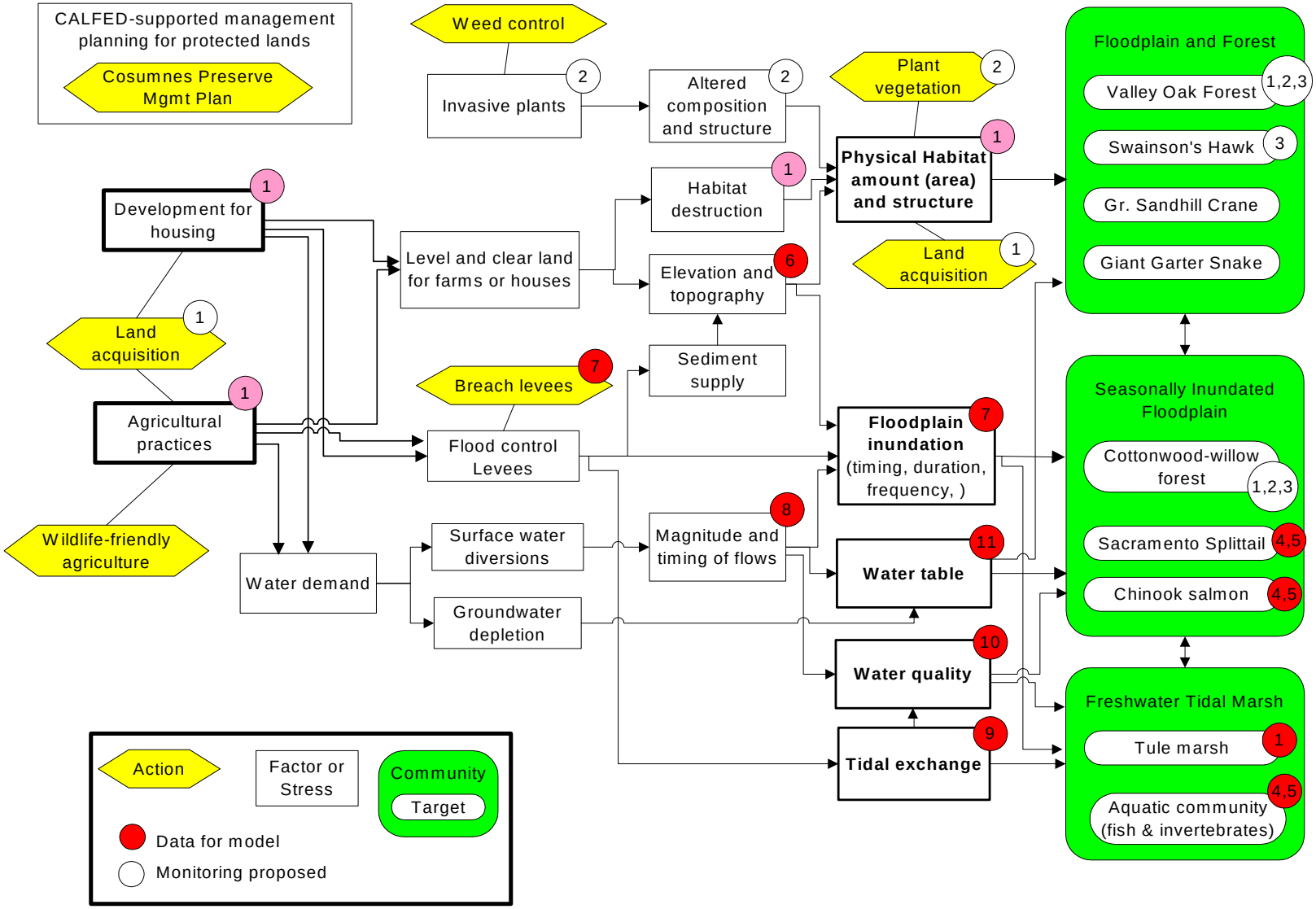
CALFED-supported management planning for protected lands
Cosumnes Preserve Mgmt Plan
Weed control
Invasive plants
2
Altered composition and structure
2
Plant vegetation
2
Floodplain and Forest
Valley Oak Forest
1,2,3
Swainson's Hawk
3
Gr. Sandhill Crane
Giant Garter Snake
Development for housing
1
Habitat destruction
1
Physical Habitat amount (area) and structure
1
Land acquisition
1
Land acquisition
1
Level and clear land for farms or houses
Elevation and topography
6
Sediment supply
Breach levees
7
Agricultural practices
1
Flood control Levees
Floodplain inundation (timing, duration, frequency,)
7
Seasonally Inundated Floodplain
Cottonwood-willow forest
1,2,3
Sacramento Splittail
4,5
Chinook salmon
4,5
Wildlife-friendly agriculture
Water demand
Surface water diversions
Groundwater depletion
Magnitude and timing of flows
8
Water table
11
Water quality
10
Tidal exchange
9
Freshwater Tidal Marsh
Tule marsh
1
Aquatic community (fish & invertebrates)
4,5
Action
Factor or Stress
Community
Target
Data for model
Monitoring proposed

Figure 2.1 (continued) - Hydrologic processes of floodplain inundation and tidal exchange are the driving forces that shape and sustain floodplain and wetland 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 – Data to be used in adaptive management model
Open circles – Indicators to be monitored by this grant

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

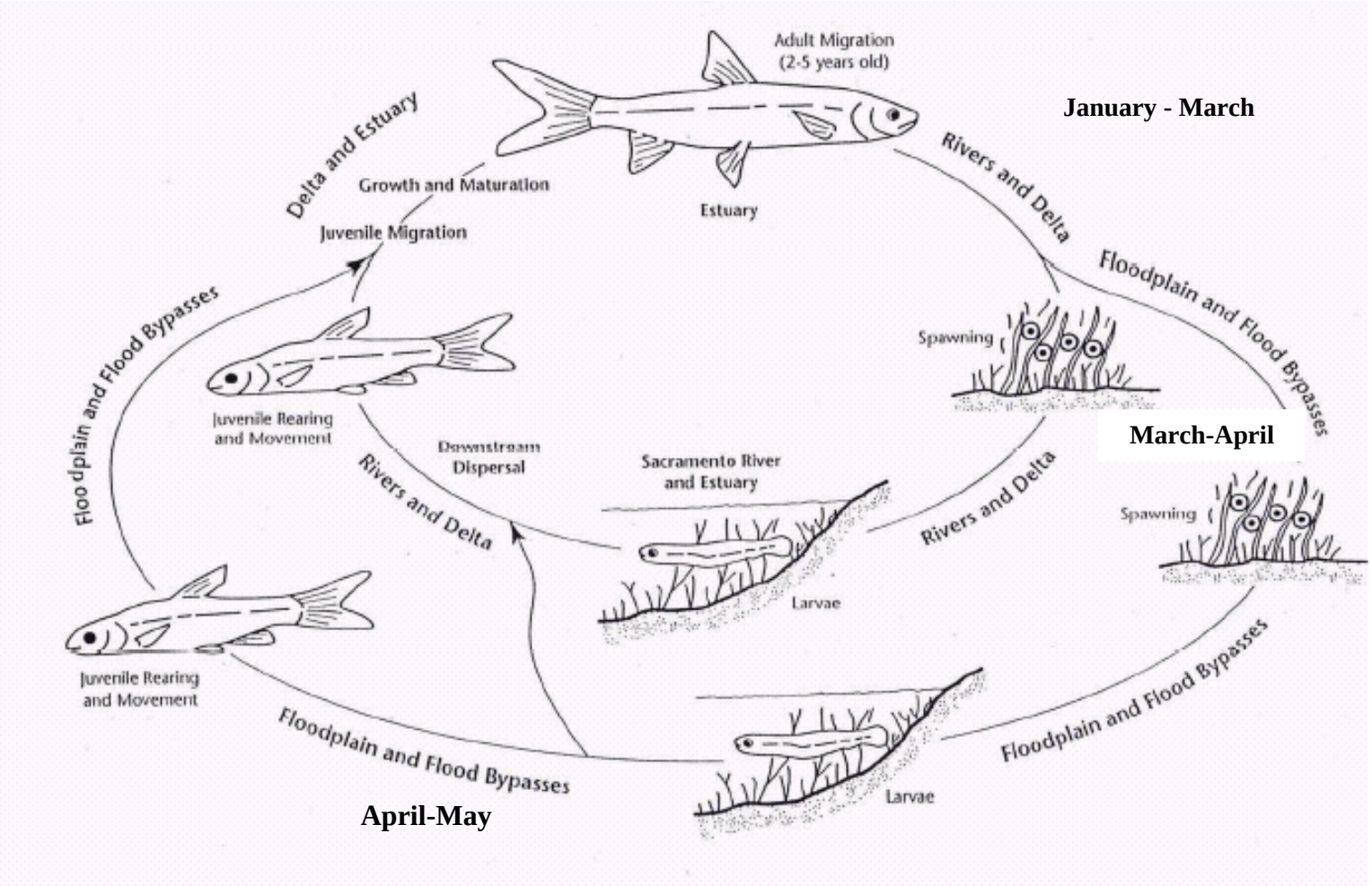

Figure 2.2 - Sacramento splittail conceptual model (from NHI et al. 2002. "Habitat Improvement for Native Fish in the Yolo Bypass"). As documented by Moyle et al. (2004), adults move onto flooded floodplain habitat in March and April to spawn on submerged vegetation. Larvae rear on the floodplain in April and May, and then return to the river channel in response to cues from the draining floodplain. Aquatic invertebrate production, which provides food for rearing Sacramento splittail and juvenile fall-run chinook salmon, is maximized by periodic (approximately monthly) small flood pulses on the Cosumnes floodplain and increased residence time of water (Grosholz et al. 2004).

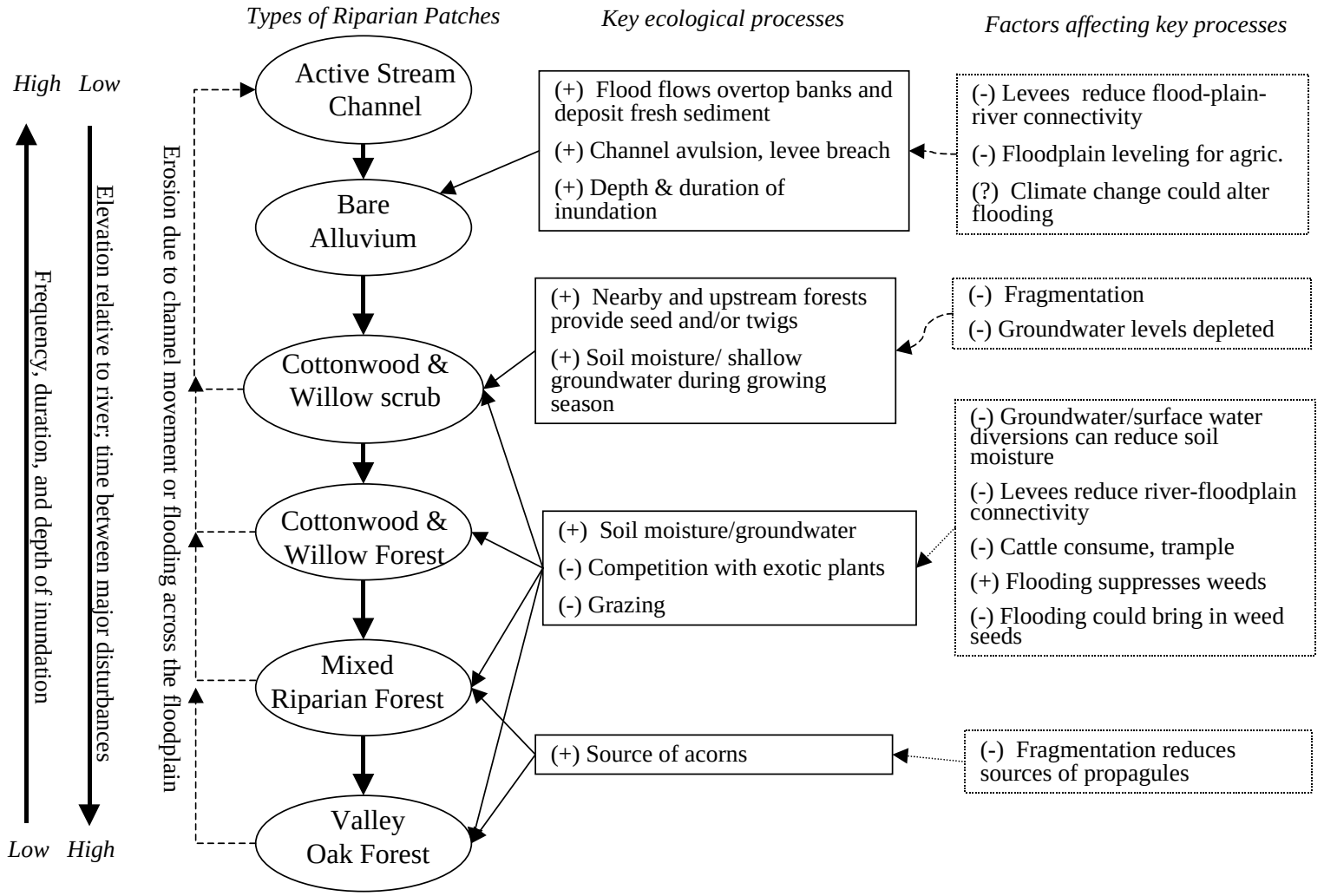

Figure 2.3 – Riparian forest succession on the Cosumnes River floodplain. (based on Florshiem & Mount 2003, Richter & Richter 2000, SRAC 2000, Tu 2000, Trowbridge 2002, and UC Davis Cosumnes Research Group pers. comms.). The Cosumnes is a multiple-channel, anastomosing river system rather than a meandering river with point bars (Florsheim and Mount 2003).

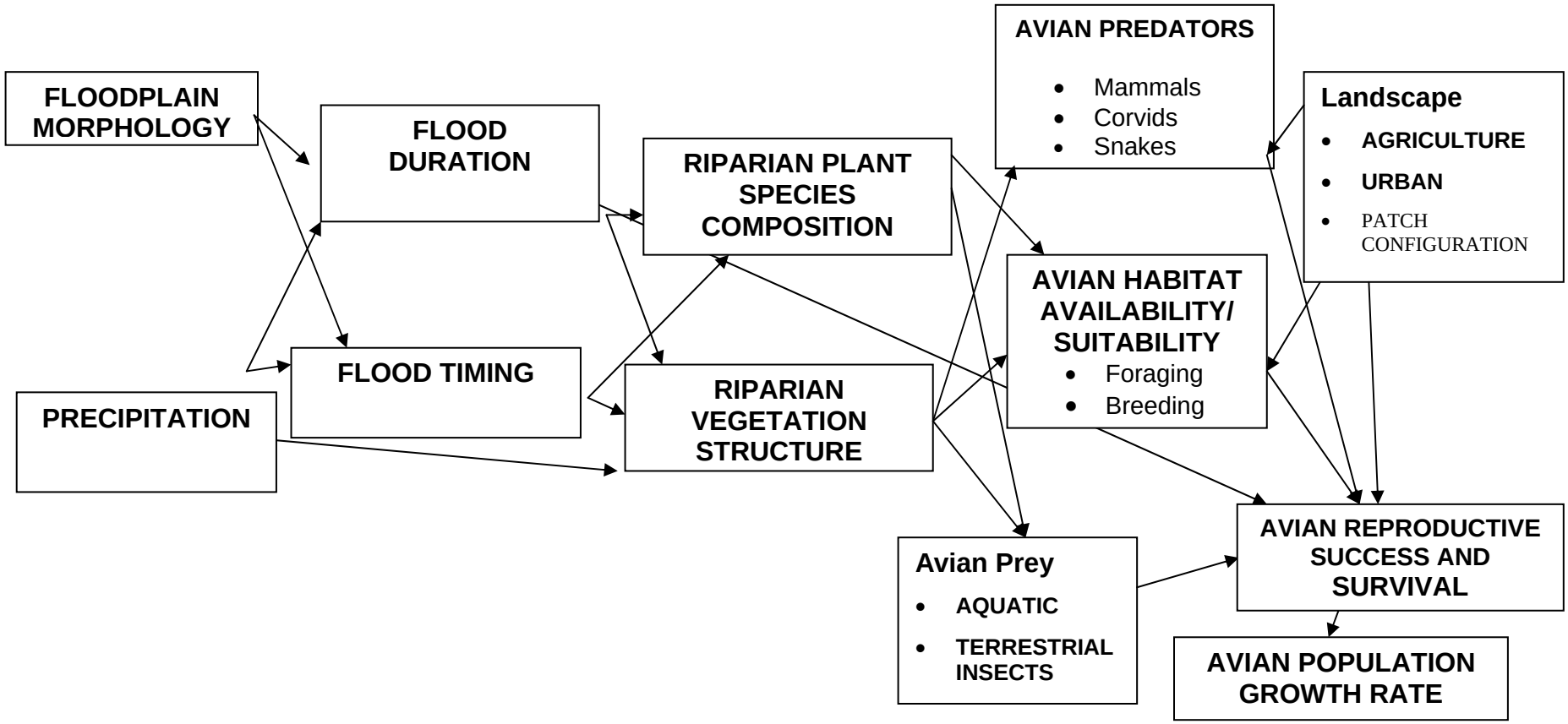

Figure 2.4. Riparian bird conceptual model for Cosumnes River Preserve (November 2004).

Tasks And Deliverables

Cosumnes River Preserve restoration monitoring data integration for adaptive management

Task ID	Task Name	Start Month	End Month	Deliverables
1	Project Management	1	36	Quarterly and final reports. Periodic invoices
2	Vegetation Mapping	1	36	Detailed habitat maps Spatial data points for previous and curent monitoring data
3	Vegetation monitoring	1	36	Manuscripts Poster or oral presentation at scientific nmeeting
4	Bird Monitoring	1	36	Manuscripts Poster or oral presentation at scientific meeting
5	Model	1	36	Web-accessible decision support tool

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
$129,485	$38,094	$4,000	$10,000	$521,757	$5,000	$0	$0	$708,336	$177,084	$885,420

Do you have cost share partners already identified?
No.

If yes, list partners and amount contributed by each:

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.

Cosumnes River Preserve restoration monitoring data integration for adaptive management

Cosumnes River Preserve restoration monitoring data integration for adaptive management

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)	**4309**	**1723**	**0**	**0**	**0**	**0**	**0**	**0**	$6,032	**1508**	$7,540
2: Vegetation Mapping (12 months)	**341**	**136**	**0**	**0**	**66686**	**0**	**0**	**0**	$67,163	**16791**	$83,954
3: Vegetation monitoring (12 months)	**38137**	**10845**	**0**	**5000**	**0**	**5000**	**0**	**0**	$58,982	**14745**	$73,727
4: Bird Monitoring (12 months)	**341**	**136**	**0**	**0**	**68606**	**0**	**0**	**0**	$69,083	**17271**	$86,354
5: Model (12 months)	**341**	**136**	**0**	**0**	**55711**	**0**	**0**	**0**	$56,188	**14047**	$70,235
Totals	**$43,469**	**$12,976**	**$0**	**$5,000**	**$191,003**	**$5,000**	**$0**	**$0**	**$257,448**	**$64,362**	**$321,810**

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)	**4459**	**1784**	**1000**	**1000**	**0**	**0**	**0**	**0**	$8,243	**2061**	$10,304
2: Vegetation Mapping (12 months)	**353**	**141**	**0**	**0**	**61486**	**0**	**0**	**0**	$61,980	**15495**	$77,475
3: Vegetation monitoring (12 months)	**34535**	**9250**	**0**	**2000**	**0**	**0**	**0**	**0**	$45,785	**11446**	$57,231

4: Bird Monitoring (12 months)	**353**	**141**	**0**	**0**	**69798**	**0**	**0**	**0**	$70,292	**17573**	$87,865
5: Model (12 months)	**353**	**141**	**0**	**0**	**52111**	**0**	**0**	**0**	$52,605	**13151**	$65,756
Totals	**$40,053**	**$11,457**	**$1,000**	**$3,000**	**$183,395**	**$0**	**$0**	**$0**	**$238,905**	**$59,726**	**$298,631**

Year 3 (Months 25 To 36)

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)	**4015**	**1606**	**3000**	**0**	**0**	**0**	**0**	**0**	$8,621	**2155**	$10,776
2: Vegetation Mapping (12 months)	**365**	**146**	**0**	**0**	**29022**	**0**	**0**	**0**	$29,533	**7383**	$36,916
3: Vegetation monitoring (12 months)	**40853**	**11617**	**0**	**2000**	**0**	**0**	**0**	**0**	$54,470	**13618**	$68,088
4: Bird Monitoring (12 months)	**365**	**146**	**0**	**0**	**79442**	**0**	**0**	**0**	$79,953	**19988**	$99,941
5: Model (12 months)	**365**	**146**	**0**	**0**	**38895**	**0**	**0**	**0**	$39,406	**9852**	$49,258
Totals	**$45,963**	**$13,661**	**$3,000**	**$2,000**	**$147,359**	**$0**	**$0**	**$0**	**$211,983**	**$52,996**	**$264,979**

Budget Justification

Cosumnes River Preserve restoration monitoring data integration for adaptive management

Labor

Compensation shown represents annual average salaries for the position (weighted for the particular region) over 3 years (adjusted for expected increases in year's 2 and 3), not any employee's actual salary. Hours are estimates per year.

Science Specialist II (Exempt) Hours: 420/280/460 – Annual Salary: 62,000/64,170/66,416 Associated Director of Operations(Exempt) Hours: 70/70/0 – Annual Salary: 50,000/51,750/53,561 Science Specialist I (Exempt) Hours: 560/560/560 – Annual Salary: 43,000/44,505/46,063 Lead Intern Hours Hours: 560/560/560 – Hourly Salary: 15/15.53/16.07 Intern Hours: 560/560/560 – Hourly Salary: 10/10.35/10.71

Benefits

40% for all exempt employees 8.5% for interns

Travel

Task 3: A TNC scientist will attend 1 conference in Year 2 of the project to present results of vegetation monitoring ($1000). Two staff members will attend 1 conference in year 3 of the project to present vegetation monitoring results and one staff member will attend 2 conferences ($3000).

Supplies And Expendables

Year 1 – Field supplies ($2000), computer supplies ($3000) Year 2 – Field supplies ($2000) Year 3 – Field supplies ($2000)

Services And Consultants

Proposed fixed−price contract to UC Davis for $303,910 to perform: Task 2: Map and characterize terrestrial land cover (Land cover mapping, High−resolution plant community mapping) Task 5: Develop spatial decision support tool (GIS development and support, Modeling spatial distributions and risk profiles for environmental indicators, Priority setting tool) The amount of the fixed price contract is based on the following estimates: $24,540 for travel, $16,260 for supplies and expendables, and $38,100 in equipment. Proposed fixed−price contract to PRBO for $217,846 for: Task 4: Determine contribution of these habitats to restoring bird populations (Monitor bird populations at restoration sites, relate patterns to environmental characteristics, assess demographic parameters, synthesize information, and estimate nest site colonization frequency and factors affecting recolonization) The amount of the fixed price contract is based on the following estimates: $7700 for travel and $4000 for supplies and expendables.

Equipment

Trimble handheld GPS unit $5000

Lands And Rights Of Way

none

Other Direct Costs

none

Indirect Costs/Overhead

The Nature Conservancy (TNC) has a Provisional Negotiated Indirect Cost Rate (NICRA) of 25% which was negotiated with and approved by TNC's cognizant agency, U.S. Department of Interior, and calculated in compliance with the requirements

of OMB Circular A−122, and bound into TNC's annual OMB Circular A−133 audit reports. TNC's indirect cost per the NICRA includes salaries, fringe benefits, fees and charges, supplies and communication, travel, occupancy, and equipment for general and administrative regional and home office staff. These costs are reflected in the Indirect Costs category of this proposal and are not reflected anywhere else in the proposal budget. Direct staff costs are reflected in the salary and benefits categories of the proposal budget.

Comments

Environmental Compliance

Cosumnes River Preserve restoration monitoring data integration for adaptive management

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 Sacramento County	X	X	
permission To Access State Land Agency Name DFG, State Lands Commission, DWR	X	X	
permission To Access Federal Land Agency Name BLM, BOR	X	X	
permission To Access Private Land Landowner Name	–	–	

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

Land Use

Cosumnes River Preserve restoration monitoring data integration for adaptive management

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?
X No.
– Yes.

Describe briefly the provisions made to secure this access.

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	**4410**	**X**
Farmland Of Statewide Importance	**4989**	**X**
Unique Farmland	**0**	**–**
Farmland Of Local Importance	**0**	**–**

Is the land affected by the project currently in an agricultural preserve established under the Williamson Act?
– No.
X Yes.

Is the land affected by the project currently under a Williamson Act contract?
– No.
X Yes.

Why is the land use proposed consistent with the contract's terms?

Open space is an allowable land use under the contract. Additionally, land use changes will not occur as part of this project since we only propose to monitor restored and natural habitats.

Describe any additional comments you have about the projects land use.

The majority of the land in this study is not in active production.