CALFED Quarterly Progress Report

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CALFED Project #: ERP-01-NO1

Period ending: July 2005

Task 1 -- Restoration (J.Quinn)

We are presently analyzing monitoring data from restoration and riparian forest areas. Spatial reference information for these restoration data are being correlated with landscape variables within a GIS and within community matrices, representing local riparian diversity, turnover, and natural expectation of riparian floodplain communities in an river system with an unaltered hydrograph. These data are also being nested within the larger regional framework of restoration in the CBDA area, in which the Natural Resources Project Inventory has cataloged a number of restoration projects (n=54). Of these projects, there are 154 vascular plant taxa that have been used in restoration actions. Comparatively, this is represents a small portion of the total riparian taxa naturally found. For example, the CRP lists over 400 plant taxa on the preserve proper. More over, 50% of the total project/taxa information pool is represented by just 16 taxa, led by Valley Oak (*Quercus lobata*) (Figure 1). Although Valley Oak are charismatic and are not regenerating to levels of expectation, it would be short sighted to not account for the breadth of natural diversity found in less altered locations when planning restoration. We will continue to analyze this disconnect to make future recommendations.

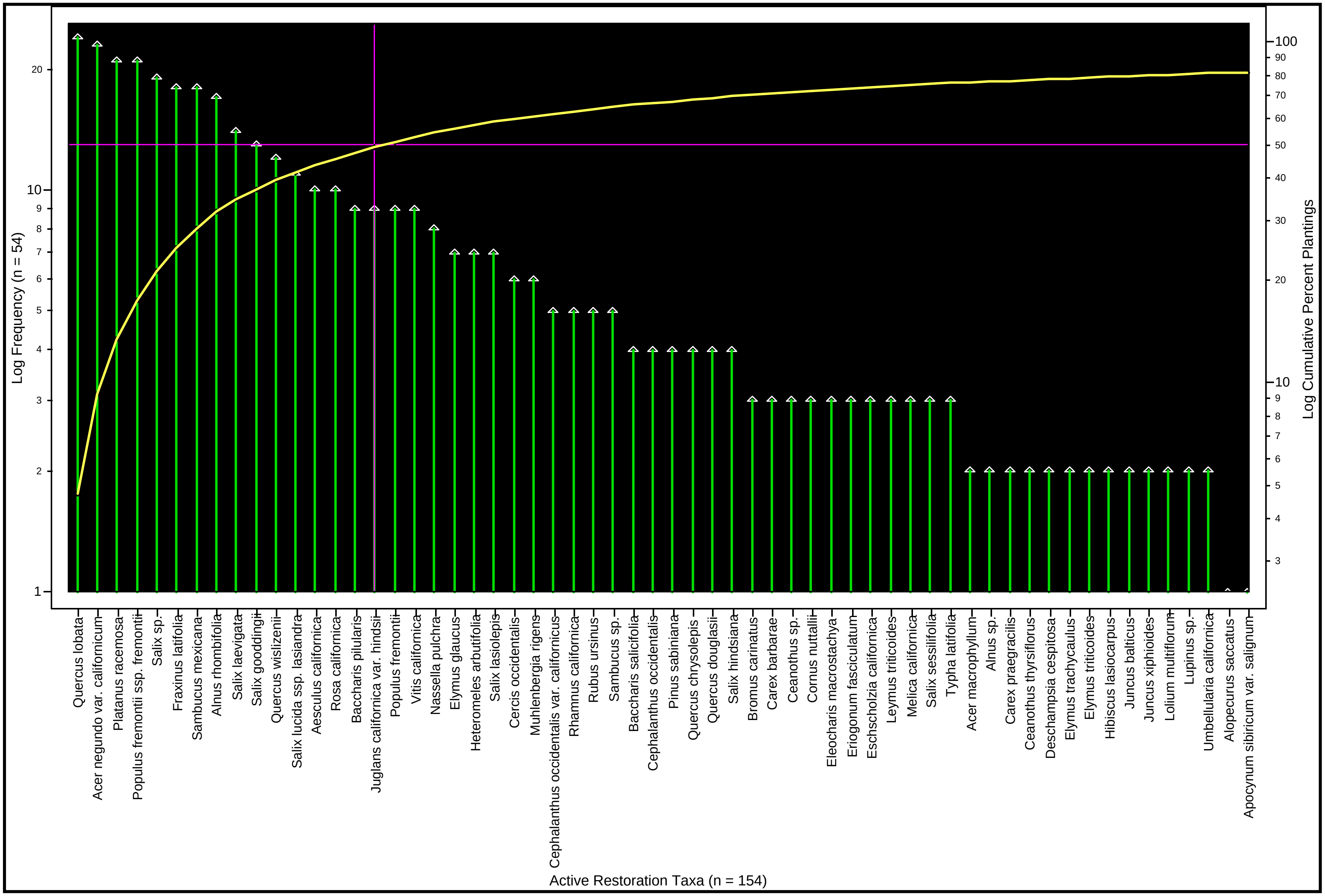
Log Frequency (n = 54)
Log Cumulative Percent Plantings
Active Restoration Taxa (n = 154)
Quercus lobata
Acer negundo var. californicum
Platanus racemosa
Populus fremontii ssp. fremontii
Salix sp.
Fraxinus latifolia
Sambucus mexicana
Alnus rhombifolia
Salix laevigata
Salix gooddingii
Quercus wislizenii
Salix lucida ssp. lasiandra
Aesculus californica
Rosa californica
Baccharis pilularis
Juglans californica var. hindsii
Populus fremontii
Vitis californica
Nassella pulchra
Elymus glaucus
Heteromeles arbutifolia
Salix lasiolepis
Cercis occidentalis
Muhlenbergia rigens
Cephalanthus occidentalis var. californicus
Rhamnus californica
Rubus ursinus
Sambucus sp.
Baccharis salicifolia
Cephalanthus occidentalis
Pinus sabiniana
Quercus chrysolepis
Quercus douglasii
Salix hindsiana
Bromus carinatus
Carex barbarae
Ceanothus sp.
Cornus nuttallii
Eleocharis macrostachya
Eriogonum fasciculatum
Eschscholzia californica
Leymus triticoides
Melica californica
Salix sessilifolia
Typha latifolia
Acer macrophyllum
Alnus sp.
Carex praegracilis
Ceanothus thyrsiflorus
Deschampsia cespitosa
Elymus trachycaulus
Elymus triticoides
Hibiscus lasiocarpus
Juncus balticus
Juncus xiphioides
Lolium multiflorum
Lupinus sp.
Umbellularia californica
Alopecurus saccatus
Apocynum sibiricum var. salignum

Figure 1

Task 2 - Groundwater - Vegetation Interactions (G. Fogg and K.T. Paw U)

Subtask 2a: Hydrologic Analysis (G. Fogg)

During this period work was focused on running numerical models to simulate groundwater surface water interaction. The model represents a 125 m reach of the river and extends 175 m southwest of the river. The model is being used to determine if heterogeneous alluvial deposits surrounding the river can store enough water seeping from the river to support riparian vegetation. Simulations suggest that 26 to 49 % of the modeled area can support evapotranspiration (ET) at the demand rate throughout the season. The figure below shows the areas where there is enough water to support the ET rate at various times during the spring and summer. The predicted area that can support phreatophyte vegetation is well correlated to the actual area covered with vegetation at the Cosumnes. The simulations also show ET becoming increasingly supply dependent in late July when storage in the root zone becomes depleted (see figure below). These results indicate that in areas where groundwater levels are well below the river, focused recharge to perched groundwater surrounding the river in late July could significantly enhance water availability to riparian vegetation during the driest part of the season, and thus have a significant positive effect on the riparian ecosystems surrounding the river. Subtask 2a is approximately 90% finished.

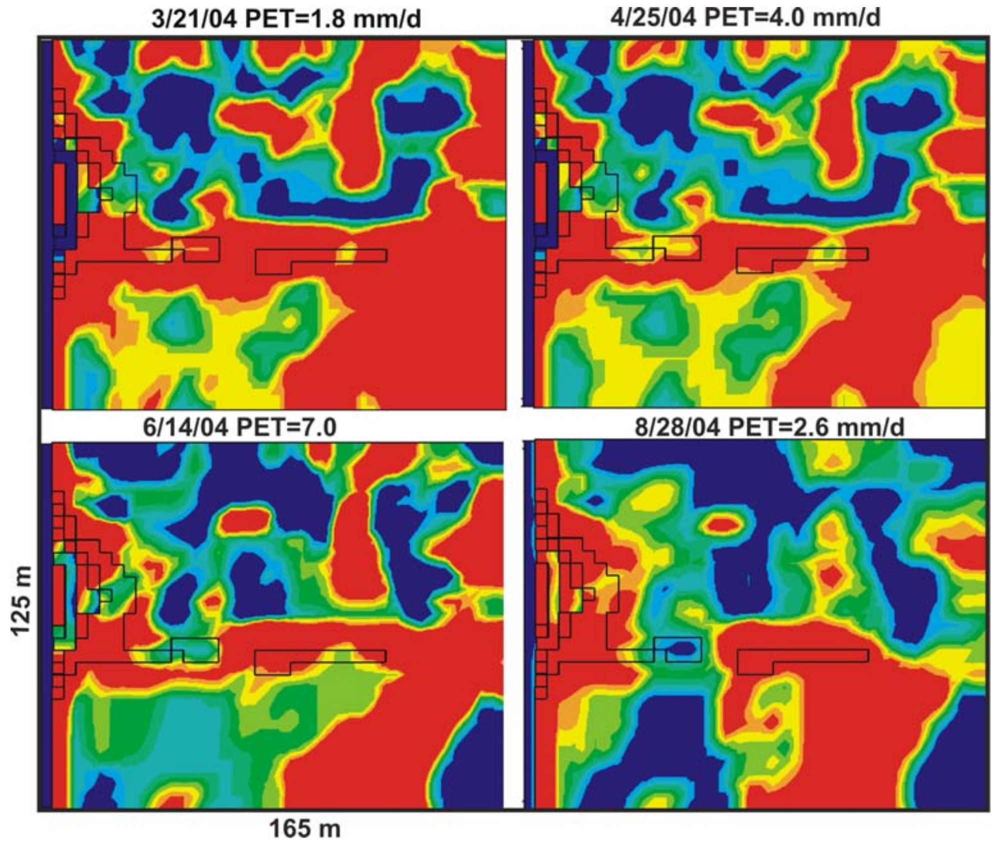

Figure 2: Contour plots showing areas where the simulated ET is equal to the demand (red) and areas where ET is supply dependent (other colors). Root-water uptake is simulated as being dependent on capillary pressure.

Subtask 2b: Evapotranspiration Analysis (P.I. K. T. Paw U & graduate student John Kochendorfer)

This quarter we continued recording micrometeorological data from the two evapotranspiration towers. Initial analysis of the data has also been performed. The towers did not need to be lowered this quarter as all the sensors have been working well, however some of the signal cables and guy wires had to be temporarily disconnected in order to disentangle them from the encroaching Cottonwood canopy. The continuing work includes not only evapotranspiration, but other meteorological variables.

We have begun a field experiment under carefully controlled conditions at the Campbell Tract to assist with this research. This involves examining the effects of advection into edges of vegetation, such as the vegetation in riparian zones. Sensors for measurements of turbulence and mean advection have been purchases, and calibration activities have begun. In addition, the field site has been prepared for the experiments.

Budgetary and Logistic Situation

Substantial progress has been made in the past quarter; we estimate that the project's accomplishments are approximately 80% towards achieving the project's final objectives. We have purchased some equipment to help with analyzing data taken during 'advective' situations, typical of riparian regions. We are on the verge of gathering data for this data for this intensive experiment, while simultaneously gathering data at both of our sites. Labor costs may be incurred for additional personnel being recruited to assist with both the field experiments and data analysis.

Task 3 - Aquatic and Terrestrial Linkages (M. Power and T. Grosholz)

Subtask 3a: (W.E. Rainey, M. E. Power, UC Berkeley)

Field activities during both the seasonally extended flooding and subsequent drying of the site included approximately biweekly insect emergence sampling and continued monitoring of bat acoustic activity. During some intervals, high flows precluded emergence sampling at a subset of the normal array of sampling sites. Similarly, unusual water depths on the floodplain either deactivated or forced temporary removal of several acoustic monitoring stations, but some stations remained active throughout the flooding season.

The extensive open water on the floodplain persisted into warmer months when bat activity and diversity is undergoing seasonal increase throughout lowland California. Acoustic activity levels (indicative of foraging) at flooded sites somewhat sheltered from prevailing winds (e.g., the forest edge of the lower floodplain pond) were very high for extended intervals, relative to prior study years.

An extended flooded season generates more insect emergence samples. Initial laboratory processing and identification of collections continued, along with replacement and training of new student assistants for this time consuming activity. Data entry, validation and graphical evaluation of emergence trapping results were an important parallel task this quarter and will continue into the next. Acoustic detector removal, refit, and reinstallation shaped by flooding events were extensive this quarter. Data downloads, backup, and processing to extract activity estimates by species, night, and site continued.

Subtask 3b: (Grosholz, UC Davis)

During the past quarter, we continued to sample the residence time-vegetation transect that investigators are collaboratively following. Unfortunately, the floodplain was flooded continuously from March through early June making delineating flood and following post-flood events nearly impossible. Also, manipulative experiments including mesocosm stable isotope tracer studies were not possible. We were able to establish and monitor the abundance and distribution of periphyton in limited areas in order to quantify benthic primary production to compare with our ongoing estimates of water column primary production (see below for photosynthesis estimates). We also quantified the abundance and distribution of large aquatic macrophytes including *Ludwigia* and *Polypogon* which are fast becoming a dominant feature of the ponded areas and threatens to occlude remaining open water habitats. Also during this quarter, we continued flood season monitoring activities and completed a series of assays designed to measure primary productivity and microbial activity in different floodplain areas and under different flow regimes. The assays included field incubations using C^{13}-incorporation and oxygen production or consumption as endpoints and laboratory incubations using C^{14}-incoporation under different light levels simulated in a photosynthetron. Preliminary results indicate that the C^{13}-incorporation method is well suited for *in situ* primary productivity measurements in flood plains. In addition to these field and laboratory activities, we also completed enumeration of phytoplankton in most 2004 samples. Several new genera of phytoplankton taxa have been identified. Also, a new species of invasive shrimp (genus *Palaemonetes*) has been tentatively identified pending taxanomic analysis.

Task 4 - Avian Studies component (N. Nur, G.R. Geupel, J Wood PRBO)

During this quarter, PRBO biologists and interns collected data on bird abundance, distribution, diversity, productivity and survival. Our crew of two onsite interns, and one onsite field supervisor collected data from five nest plots: Accidental Forest, Tall Forest West, Tall Forest, Middle Breach, and Triangle Plot (see project map in second quarter report 2003). We found, monitored and geo-referenced over 374 nests of more than 22 species (Table 1). Orr Forest nest plot, conducted during 2003-2004, was dropped in 2005 due to a lack of funding. Two PRBO staff biologists (Kirstin

Lindquist and Julian Wood) conducted point count surveys at 15 sites throughout the Preserve for a total of 118 points. Each site was visited twice from April to July. Mist netting was conducted at two sites, Wendel's Levee and Tall Forest (Wilson's Section) but access was sporadic due to high water until the end of June. Vegetation assessments were conducted at all nests (over 374), at 150 randomly chosen non-use sites (30 within each nest searching area), and at all point counts. Approximately 50 active tree swallow (*Tachycineta bicolor*) nest boxes were monitored to determine nest success and nestling weight gain. Some adults and all nestlings were banded as part of a long-term attempt to measure fecundity and adult and juvenile survival and recruitment. All methods used are outlined in the second quarterly report 2003. All data collected were entered and proofed throughout the season.

The high water events caused nest failure among ground and low-shrub nesting species such as song sparrow (*Melospiza melodia*), spotted towhee (*Pipilo maculatus*), Wrentit (*Chamaea fasciata*), Common Yellowthroat (*Geothlypis trichas*), and others. Conversely, tree swallow productivity was very high during the spring and but waned as the season progressed and the floodplain dried up.

Common name	Scientific name	Total nests found
Pied-billed Grebe	*Podilymbus podiceps*	2
Mallard	*Anas platyrhynchos*	4
Virginia Rail	*Rallus limicola*	1
Common Moorhen	*Gallinula chloropus*	3
Mourning Dove	*Zenaida macroura*	9
Black-chinned Hummingbird	*Archilocus alexandri*	7

Allen's Hummingbird	*Selasphorus sasin*	1
Western Wood-Pewee	*Contopus sordidulus*	10
Pacific-slope Flycatcher	*Empidonax difficilis*	1
Hutton's Vireo	*Vireo huttoni*	3
Tree Swallow	*Tachycineta bicolor*	86
Bushtit	*Psaltriparus minimus*	5
American Robin	*Turdus migratorius*	14
Wrentit	*Chamaea fasciata*	8
Common Yellowthroat	*Geothlypis trichas*	3
Spotted Towhee	*Pipilo maculatus*	30
Song Sparrow	*Melospiza melodia*	138
Black-headed Grosbeak	*Pheucticus melanocephalus*	28
Blue Grosbeak	*Passerina caerulea*	1
Red-winged Blackbird	*Agelaius phoeniceus*	5
Lesser Goldfinch	*Carduelis psaltria*	2
American Goldfinch	*Carduelis tristis*	13
		Total 374

Table 1. Number of nests found on all plots in 2005.

Task 5 -- Data Management (J. Quinn)

We have concentrated on three activities, calculating leaf-area-index through obtaining digital images of semi-hemispherical canopy cover of the Accidental Forest, assisting Task 7 with the creation of high spatial resolution raster surfaces depicting interpolated water quality data, and analyzing watershed data for the Cosumnes and the greater CBDA region. The use of a Nikon digital camera fitted with a semi-hemispherical lens was used to capture canopy cover at several locations (n=20) within the Accidental

Forest, a targeted successional cottonwood forest created by an accidental levee breach. These images will then be segmented in image processing software to calculate a leaf-area-index, which can then be correlated to evapotranspiration calculations in Task 2b.

We conducted our GIS analysis using assembled field collected water quality data (Task 7) into a personal geodatabase and generated a number of spatial descriptors from independent spatial data layers. These descriptors included depth, determined as an inverse correlate to a high resolution digital elevation model and distance to primary flow path. An analysis mask was created by segmenting the digital elevation model at the 3.9m (MSL) contour, which best approximated the high water mark of the seasonal flood regime. We employed inverse-distance weighting (IDW) as an interpolation technique to spatially infer water quality at unsampled locations within the floodplain. IDW is a simple, exact surface interpolator taking into account the distance the between fixed and interpolated point evaluated in the neighborhood. IDW, as employed in ArcGIS Spatial Analyst Extension (see Watson and Philip 1985 for specific implementation notes), takes advantage of spatial boundaries, such as our analysis mask of the triangle floodplain, by using a variable neighborhood.

Watershed base data were collated to show the strategic importance of the Cosumnes River watershed in a network of biologically important watersheds identified in the Sierra Nevada Ecosystem Report and the Northwest Forest Plan (Figure 3). These data will help conservation and restoration planners identify other watershed targets for future funded activity.

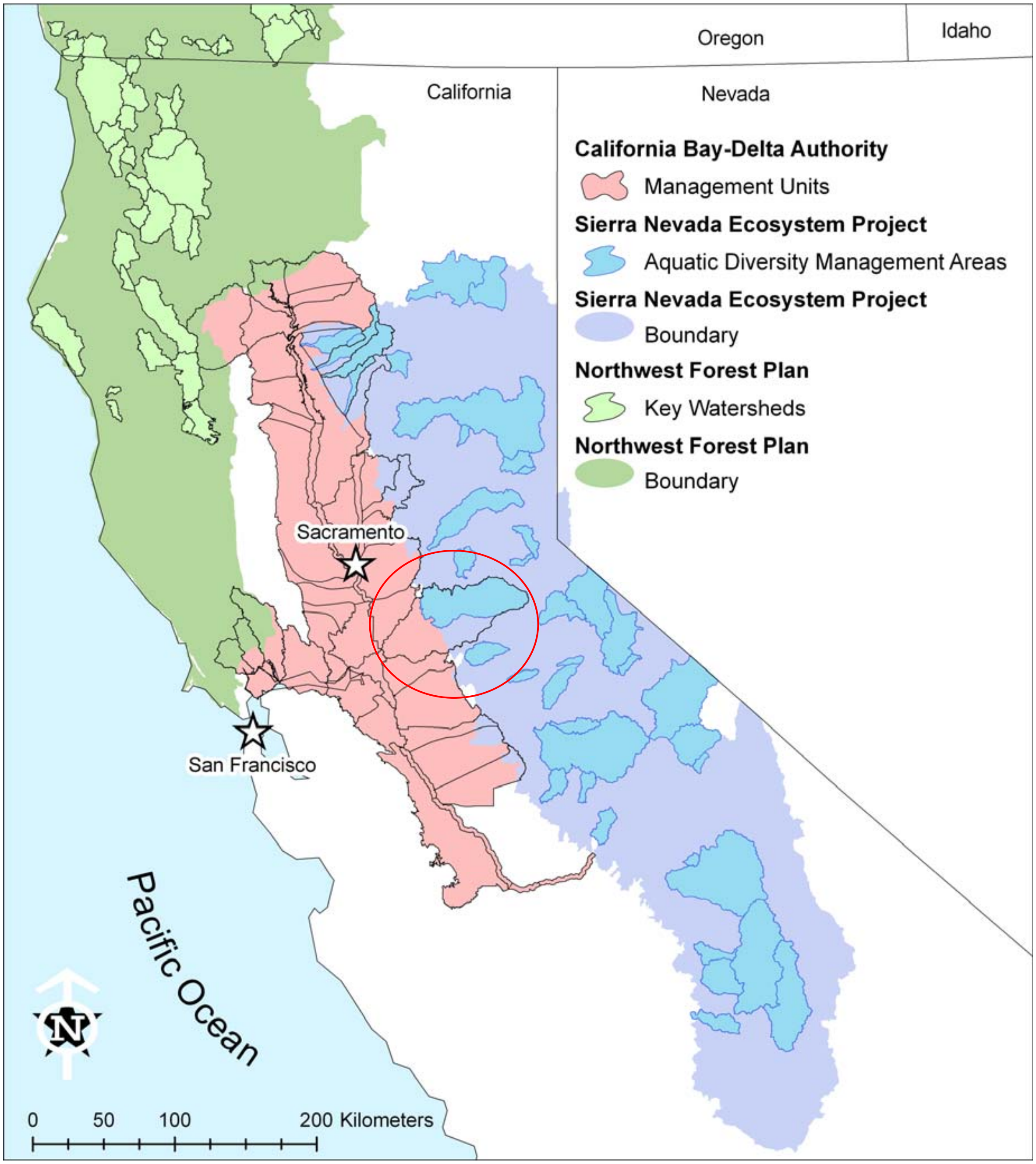

Figure 3. Cosumnes River watershed, circled in red, is a strategically placed and integral piece of a network of key aquatic diversity areas in northern California, connecting elements of the Sierra Nevada Ecosystem Project and the Northwest Forest Plan.

Task 6 – Coordination/Science Support (J. Mount)

As flooding continued into June, hydrologic data was continually sampled throughout the quarter. As the flooding finished, all of the final hydrologic data was collected and processed for future use by the researchers. The temperature sensors that had been placed throughout the floodplain before the flood season were collected and the data was downloaded. Preparations were made for a summer surveying effort which will help to measure the changes in topography and sediment deposition on the floodplain. Continued support was provided to maintain fish sampling on the floodplain. Support was also provided to help sample for a new species of shrimp that was found on the floodplain for the first time.

Task 7 – Continued Floodplain Monitoring (J. Mount)

Suspended algal biomass distribution across a restored floodplain (Cosumnes River, CA) was analyzed throughout the hydrograph from January – June 2005. High temporal-resolution Chlorophyll-a measurements were made *in situ* with field fluorometers in the channel and floodplain. At various stages of flooding we sampled the surface of the floodplain with a field fluorometer and created chlorophyll-a distribution maps within a GIS. The resultant data indicate that periodic connection and disconnection of the floodplain with the channel is vital to the functioning of the floodplain, as a temporally available resource rich habitat and as a subsequent source of concentrated suspended algal biomass for downstream environments. Peak chlorophyll-a levels on the floodplain occurred during disconnection, reaching levels as high as 25 $\mu g\ l^{-}$

[1]. Chlorophyll-a distribution across the floodplain was controlled by water age and local physical/biological conditions, the latter of which was a function of water depth. As such, zones of maximum chlorophyll-a concentration varied between deep and shallow zones, depicting low to high residence time respectively. During connection, the deeper pond zone exhibited low chlorophyll-a (mean = 3.61 $\mu g\ l^{-1}$) and the shallow littoral zone had elevated concentrations (mean = 5.18 $\mu g\ l^{-1}$); during disconnection, the shallow zone chlorophyll-a increased (mean = 11.18 $\mu g\ l^{-1}$), but the pond experienced the greatest algal growth (mean = 14.15 $\mu g\ l^{-1}$). Storm induced floodwaters entering the floodplain not only pushed antecedent floodplain waters off the floodplain, but also redistributed floodplain resources, creating areas of hypoxia in non-flushed areas. Floodplains, and their inherent spatial and temporal complexity, are a critical linkage zone between aquatic and terrestrial resources, differentiating riparian from channel habitat. Our findings suggest that high-resolution spatial and temporal studies are necessary to fully understand floodplain complexity.