CALFED Quarterly Progress Report

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Period ending: March, 2003

Task 1 - Restoration Success Criteria (J. Quinn)

Initiation of Task 1 did not begin until 2003. As such, only preliminary activities took place during the first quarter of 2003 and these activities were largely restricted to initial data gathering and project conceptualization. Care was taken to preserve data, findings, and recommendations from researchers in the CRG I project, as this Task will likely build on their successes. Initial data gathering included field data files, research findings and summaries, and restoration locations from the project site. We continued by formalizing an analytical structure that emphasizes a spatially nested hierarchy of methods that can be used at varying spatial scales and can be modified to meet existing data holdings or project design goals.

The development of criteria for the evaluation of restoration success necessitates a broad assessment of existing protocols and programs; however, we feel that outcomes will need to bridge the gap between intensive field survey methods, which are time consuming and spatially limited in application, and coarser methods, which rely on remotely sensed data collected on spatial and temporal scales that are perhaps unresponsive to manager needs. It is our opinion that the Cosumnes River continues to provide an unparalleled opportunity to examine restoration from a variety of spatial scales and to not only provide insight as to how to define restoration success, but also as to how best to measure it. Continuation of Task 1 will both build on pre-existing information and on the incorporation of new project data as they become available.

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

Subtask 2a: Hydrologic Analysis (G. Fogg)

On the Cosumnes River, thin stands of new and existing valley oak, cottonwood, and willow trees are present along banks and within a sand splay created by a breach in the river levee. The presence of young trees in some areas suggests that despite the disconnection between the Cosumnes River and its aquifer, water remains available within the stream banks long enough to support tree regeneration. Water may be available for the riparian vegetation from perched groundwater zones. Perched groundwater zones are created when river water seeps into the streambed and banks and is intercepted by clay layers that impede the water from flowing vertically down to the main aquifer below. We have been performing preliminary groundwater modeling to investigate the relationships between stream flow, streambed seepage and the role of perched groundwater zones in supporting riparian vegetation.

We are using the multiphase non-isothermal flow model TOUGH2 to determine the relations between sediment heterogeneity and tendencies for groundwater perching. Sediment heterogeneity is represented in the flow model using geostatistical simulations that honor measured spatial distributions of sediment types at the Cosumnes River. In order to determine the persistence of groundwater perching after stream flow has ceased, we run the model beginning with saturated conditions and allow the streambed water to drain to the water table. According to these preliminary simulations, perched groundwater zones are still present within a 200 m vicinity of the riverbanks months after flow ceases in the river (Figure 1). These results may help explain tree regeneration along the river where the water table is well below the land surface.

Meanwhile, sediment temperature, water content and matric potential are being continuously collected using data loggers. These data are providing quantitative information regarding streambed seepage rates and directions. Measured streambed temperatures show high variability in seepage along the streambed. By plotting the difference in the maximum and minimum temperatures over a period of several months areas of focused streambed seepage can be identified, Figure 2.

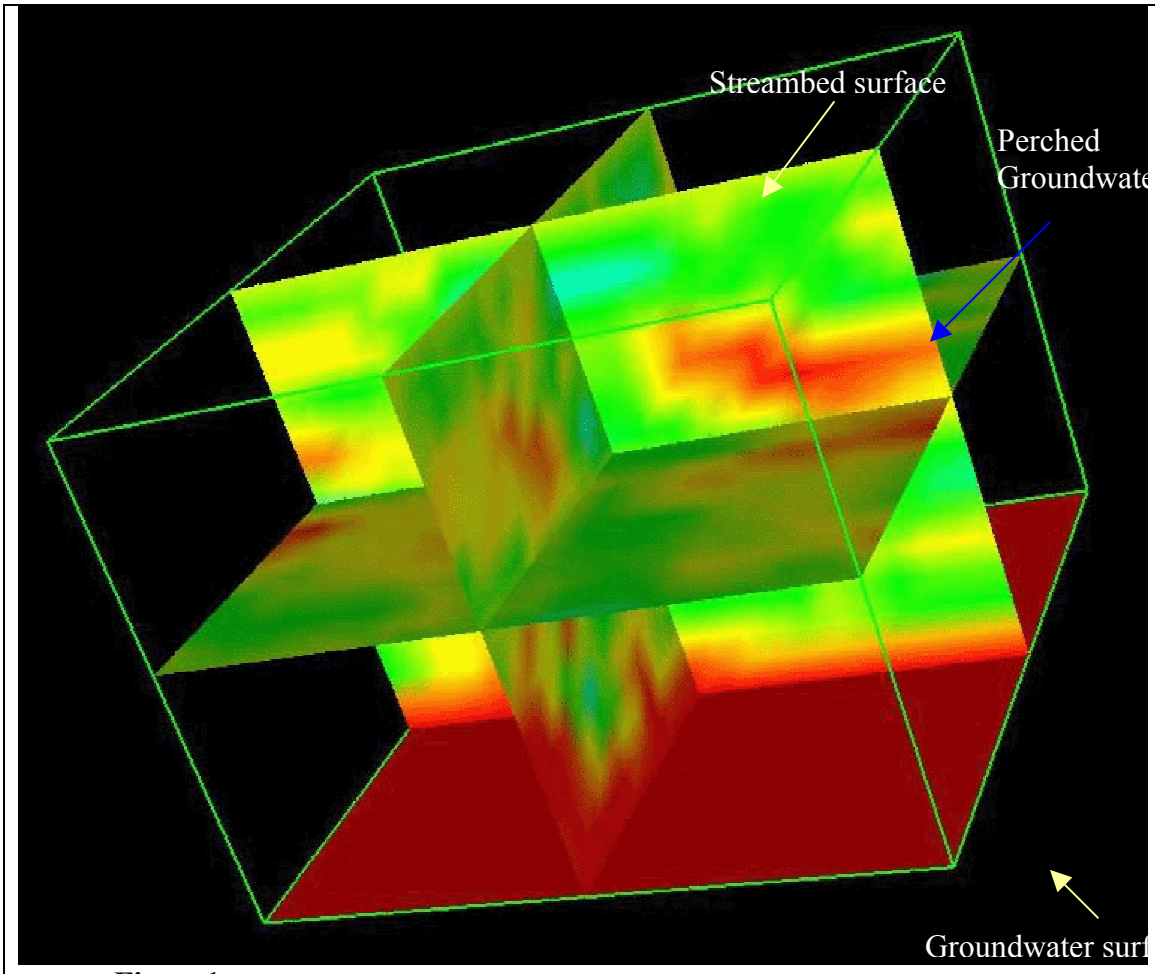

Figure1: Contour plot of sediment water content at the Cosumnes River three months after flow ceased. Red color represents saturated sediments and blue being dry. The horizontal plane spans 100 m in both directions and the vertical distance is 15 m, showing a 5:1 vertical exaggeration.

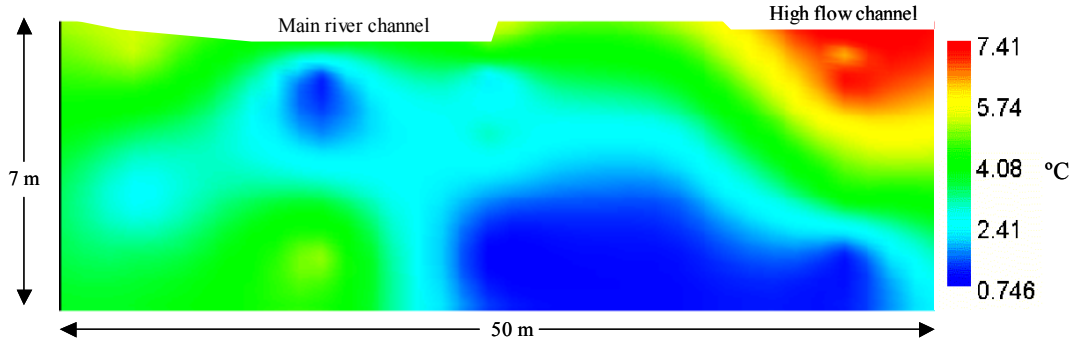

Figure 2: Contour plot of measured temperature amplitude over the period from October 2002 to March 2003, Cosumnes River near Hwy 99. Higher amplitudes (red color) represent areas of focused streambed seepage and lower amplitudes (blue color) represent areas with less seepage. Substantial seepage occurs in the high flow channel due to the presence of courser sediment material.

Subtask 2b: Evapotranspiration Analysis (K. T. Paw U)

Efforts continued to obtain land owner permission for potential siting of a tower on the windward side of Deer Creek in support of the on-going CALFED funded hydrological work there. However, multiple efforts were unsuccessful. The previously planned eddy-covariance and advective methods will not be as feasible without this tower site, so a different method was proposed (for this site only). In this method, the ecosystem surface temperature, as deduced by an infrared thermometer, would be used in conjunction with measurements of the ambient micrometeorological variables such as wind speed, air temperature, humidity, and net radiation. We still plan to install eddy-covariance equipment at the other Cosumnes River site, for which equipment is presently being chosen for ordering.

A feasibility study for the alternative method described above was carried out via an experiment to validate the use of energy balance methods to analyze evapotranspiration from a canopy, which, like the narrow riparian zone, has very little fetch. The UC Davis Lysimeter (one of the world's largest) was used to test our technique, as an independent measure of evapotranspiration. An artificial plant canopy was built on the lysimeter, and micrometeorological data were taken for a period of three weeks. Initial analysis of the data has been encouraging. It appears that our technique will enable us to measure aerodynamic resistance to water vapor exchange under varying meteorological conditions, with wind speed being a major determinant as expected (see the Figure 3. below). This should enable us to measure evapotranspiration at the Deer Creek site.

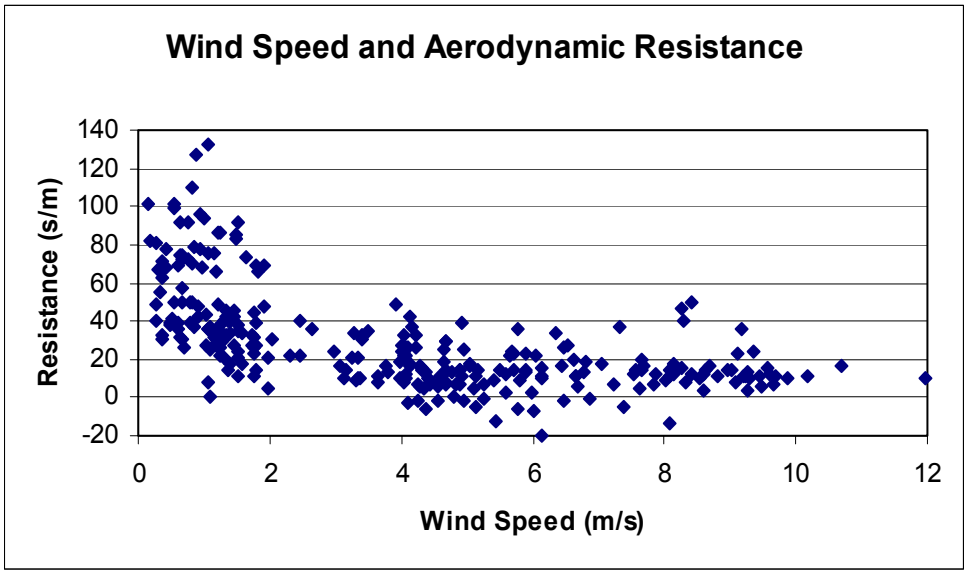

Figure 3. Relationship of wind speed (m/s) to measured resistance (s/m).

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

Subtask 3a: (M. Power, UC Berkeley): Trophic Pathways in Floodplain and River Sites

Our work complements ongoing work on flood plain primary and secondary production (Subtask 3b). The primary goal of this research is to evaluate aquatic insect emergence through several flood cycles. Emergence is measured by collecting adult insects caught in lightweight floating ($0.25m^2$) mesh dome traps over a 24-hour period. Traps (n=45) are placed to sample different habitats that range from permanently inundated to briefly flooded (and depths within those habitats with some replication) approximately every 3 weeks. To capture a range of hydrologic conditions, sampling frequency often varies with changes in flood plain inundation. A secondary goal is to examine how habitat structure (e.g., Accidental Forest, Tall Forest) on the flood plain shapes aerial insect availability and how aerial insectivore (bat) activity corresponds to those patterns. Insectivore activity is measured with bat detectors over the same 24-hour period the emergence traps are on the flood plain. Longer-term patterns of bat activity will be measured with passive acoustic monitoring with solar powered detector systems that are permanently placed in different flood plain habitats. Dr. Bill Rainey (UC-Berkeley) has been coordinating field work for this project and is helped by volunteers of students associated with my laboratory. Joe Sapp, a UC-Berkeley undergraduate, has been hired to process samples and maintains the data files.

Our pilot collection in early February yielded promising results. We deployed a total of 24 traps in 4 permanent water sites (channel, triangular flood plain pond, lower pond, Wood Duck Slough) along with a bat detector at each site. Initial sample analysis indicated that the dominant emerging insects were dipterans (true flies); however, some plecopterans (stoneflies), coleopterans (beetles), and collembolans (springtails) were also

present. In terms of total abundance, Wood Duck Slough < Permanent Pond 2 (PP2) < Main Channel < Permanent Pond 1 (PP1). Initial bat data analysis indicated the presence of Tadarida *brasiliensis* (Mexican free-tailed bat) and *Myotis sp*., especially in Wood Duck Slough. Bat activity was the inverse of insect emergence abundance. Activity at Wood Duck Slough started later than at the open sites; however, there was a continuous bat presence throughout the evening until air temperatures dropped below 5^{o}C. This initial emergence and bat study helped us to refine our trap design and placement. We will continue collecting samples throughout the year and following flooding (when it occurs).

Sandra Clinton, a postdoctoral researcher, has begun a second project investigating the role of aquatic production in floodplain soils. The overall goal of this project is to understand how the aquatic food web (mainly benthic green algae and diatoms) is transferred to the soil food web via microbial action and the importance of this process in maintaining floodplain soil fertility.

Sandra has collected pre- and post-flood samples of algae and soil from the meadow of the triangular floodplain and is in the process of analyzing these samples. She has also started a field experiment where the amount of algae on floodplains soils is either augmented or decreased and soil properties within these plots are monitored. Future studies this spring and summer include mapping the triangular floodplain and Accidental Forest soils for soil fertility and quality parameters. This summer Sandra will also begin studies investigating how variability in organic matter decomposition changes with floodplain geomorphology and vegetation.

Subtask 3b: Aquatic and Terrestrial Linkages (T. Grosholz): Flood Plain Primary and Secondary Production.

During this past quarter, there was no flooding (since early December) on the focal floodplain. In the interim, we have begun preliminary experiments involving the use of tracer N-15 to determine the contributions of periphyton and phytoplankton to secondary production in experimental mesocosms established *in situ* in ponded water that remains on the floodplain from late fall flooding events. We have been conducting preliminary investigations of uptake rates of both primary producers ; we also experimented with mesocosm enclosures in expectation of starting this experiment in late April. We monitored the abundance of periphyton on a weekly basis using experimental collectors. Samples have been analyzed for total biomass, organic content and chlorophyll a. We collected periodic samples to follow changes in species composition. Parallel measures have been made on regular samples of phytoplankton in the same ponded areas to follow changes in species composition, total abundance via chlorophyll a, and changes in relative abundances of edible vs. grazer-resistant macroinvertebrate species. We alsoinstrumented additional sites on the floodplain with temperature loggers to increase spatial coverage of existing data collection sited to better document flooding patterns and water temperatures.

Task 4 - PRBO Bird Surveys

PRBO Conservation Science completed the hiring process early in the first quarter by selecting two qualified intern biologists for the 2003 field season from a large pool of applicants. Prior to March 15th 2003, PRBO worked on pre-season preparation including project design, site selection, and purchase of operating supplies. Beginning March 15th PRBO began intensive training and fieldwork at six nest monitoring sites on the Cosumnes River Preserve.

During this quarter, PRBO designed a study to address the specific question of bird use of emergent aquatic insects within the floodplain. Insect sampling will occur within the territories of selected song sparrow pairs using sticky traps and a vacuum device during the nestling phase of the breeding cycle. In addition to song sparrows, tree swallows that feed their young almost exclusively winged insects are also being monitored using nest boxes. Nest boxes allow the observer to easily monitor and measure the contents of the nest during all stages of reproduction. The growth rates of nestling tree swallows, clutch size, and other factors of tree swallow breeding biology will be recorded in order to indirectly measure their insect prey base. To date, 53 tree swallow nest boxes will be studied throughout the Preserve during the breeding season.

PRBO is conducting intensive nest searching and monitoring at six sites (Tall Forest South, Orr Forest, Tall Forest West, Cottonwood Grove (Accidental Forest), Middle Breach and Triangle Plot). Each of these plots is visited every two to three days until mid-July. The focus is on finding and monitoring the nests of open cup nesting species but all riparian songbird species nesting within a site will be recorded. In addition to nest monitoring, songbird territories are being mapped in order to estimate abundance of breeding pairs for selected open cup nesting species. As of April 15, over 30 nests of song sparrow had been located. Other nests found and monitored include western scrub-jay, Hutton's vireo, wrentit, spotted towhee and common yellowthroat.

A new nest monitoring site in the Orr Forest (east of the Cosumnes River in the vicinity of Triangle Plot and Cottonwood Grove) was established this season. This late-successional riparian site was chosen as a replicate for the Tall Forest because of its similarity in terms of plant species composition and structure as well as bird community. Unlike Tall Forest, no monitoring by PRBO has been conducted in Orr Forest due to its relative inaccessibility.

Early in the first quarter, Julian Wood conducted project administration and planning. During the breeding season, starting March 15, fieldwork was conducted by staff biologists Julian Wood and Jeanne Hammond and by interns Andrea Pfeffer and Laura Pitsch. Principal Investigators, Nadav Nur and Geoff Geupel participated in study design and oversight.

Task 5 - Data Management (J. Quinn)

Data Management activities for the first quarter of 2003 focused on two distinct aspects of the project in regards to information collection, organization, and storage. These activities were coupled with analysis, in varying regards, as needed. The primary activity during this time was to establish and operate a standardized framework for project data incorporation. This framework consists of both geospatial, as per the ESRI and FGDC data storage format, and tabular standards, as per the National Biological Information Infrastructure format. This standardization process will allow for integration of project level data with other national and international environmental information catalogs.

The secondary activity and as per established protocols, data requests were met and technical support was provided for other project collaborators. This activity is deemed to be one that will continue for the duration of the grant; however, we are identifying opportunities for better data integration across all Tasks. One such example included GIS analyses we conducted of the invertebrate sampling sites in relation to other existing project activities. We determined that the development of a generalized graphic display of the "sphere of influence" for each Task will help minimize cross-contamination of projects or damage ongoing field trials. We continued these activities by collecting, correcting, and incorporating x-y coordinates for new floodplain sensors and sampling locations into our GIS . Other essential data, to build a more complete and useful GIS, were incorporated into the data holdings; these data included a series of high-resolution aerial photographs, in which each image needed to be registered and orthorectified. Lastly, we continued discussions with principals on the development and expansion of the CRG website and the inclusion of web-based tools for analysis. These discussions proved fruitful and we are looking forward to implementing these insightful ideas so that other researchers can make timely use of these endeavors.

Task 6 - Science Support

This quarter the Field Coordinator installed a network of permanent benchmarks to provide control points that will be used in surveying changes in the topography of the floodplain and in linking past surveys to coordinates with geodetic control. The Field Coordinator has also installed and maintained hydrological sensing equipment throughout the project site; data collected by the sensors were used to determine the volume of the floodplain by implementing AutoCAD™ analytical software. Additionally, the Field Coordinator provided support to a variety of researchers on the project, including assisting with installation of insect emergence traps and bat sensors. He met with the Preserve Manager to update him on new and continuing research installations, and worked with him to coordinate location and storage of UC vehicles, boats and related research support equipment.