

CALFED Quarterly Progress Report

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Period ending: October 2004

Task 1 -- Restoration (J.Quinn)

During summer 2004 we conducted field surveys of invasive perennial pepperweed in riparian restoration areas, incorporated field data into our geodatabase, developed a linked, relational database for tracking weed monitoring efforts, incorporated three years of monitoring data into this new database, and refined the experimental design of an adaptive management scheme to control perennial pepperweed in riparian areas.

Our monitoring results are informing management of perennial pepperweed on this and similar restored floodplains by identifying environmental characteristics and restoration actions which influence weed population dynamics. This summer completed our third year of field mapping and monitoring of perennial pepperweed (*Lepidium latifolium*) populations on a restored floodplain at the Cosumnes River Preserve. Data analysis from this observational study suggests that perennial pepperweed growth is not inhibited by shade. Neither shade level nor shade presence/absence shows any correlation with rate of stem, area or density increase over three years. These results contradict our original hypothesis that as riparian forest restoration progressed, the increase in shade cover would prevent further spread of perennial pepperweed. Instead, we find that forested areas provide elevated habitat where pepperweed populations can thrive. These and other results of preliminary data analyses were presented with a poster at the California Invasive Plant Council (CALIPC) annual meeting in Ventura, October 7-8, 2004.

We presented a poster at the 2004 CALFED Science Symposium which detailed our application of experimental design to adaptive weed management at the Cosumnes River Preserve: "Experimental Design Applied to Adaptive Management of Invasive Species", Hogle, Viers, Quinn, & Schwartz.

Abstract: We have developed an adaptive management framework for control of perennial pepperweed (*Lepidium latifolium*) at the Cosumnes River Preserve that closely follows the recommendations of the July 2003 CALFED workshop on Adaptive Management of Non-native Invasive Species (NIS). Our project inventories and monitors existing pepperweed populations at the Cosumnes River Preserve to provide background data of the baseline condition from which to statistically analyze population change. Targeted research on control of pepperweed will use a scientific hypothesis-testing approach to refine our conceptual model and guide future adaptive management actions. This ongoing research is explicitly designed to add to existing knowledge about relationships between management techniques and ecosystem processes by testing hypotheses on weed control and restoration success.

We have modeled pepperweed population expansion trajectories and the effects of extrinsic factors on these trajectories in unmanaged populations, allowing us to block our sampling sites for experimental treatments by significant extrinsic factors that affect pepperweed population dynamics. Performance of management techniques will be measured not only by changes in pepperweed density, abundance and rate of spread, but also by tracking changes in native species population dynamics at treated versus untreated sites. This information will aid in quantifying impacts of pepperweed in relation to ongoing restoration projects at the Preserve. The results of this adaptive management methodology can be used to model future management scenarios, and thus identify best management practices for pepperweed based on site-specific characteristics of areas targeted for restoration and management. The project and methodology support CALFED initiatives on adaptive management by examining baseline conditions and management interventions in a scientific framework. This approach also meets the goals of CALFED NIS management by using replicable methods which can limit future expansion of pepperweed and improve restoration success of riparian vegetation.

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

Subtask 2a: Hydrologic Analysis (G. Fogg)

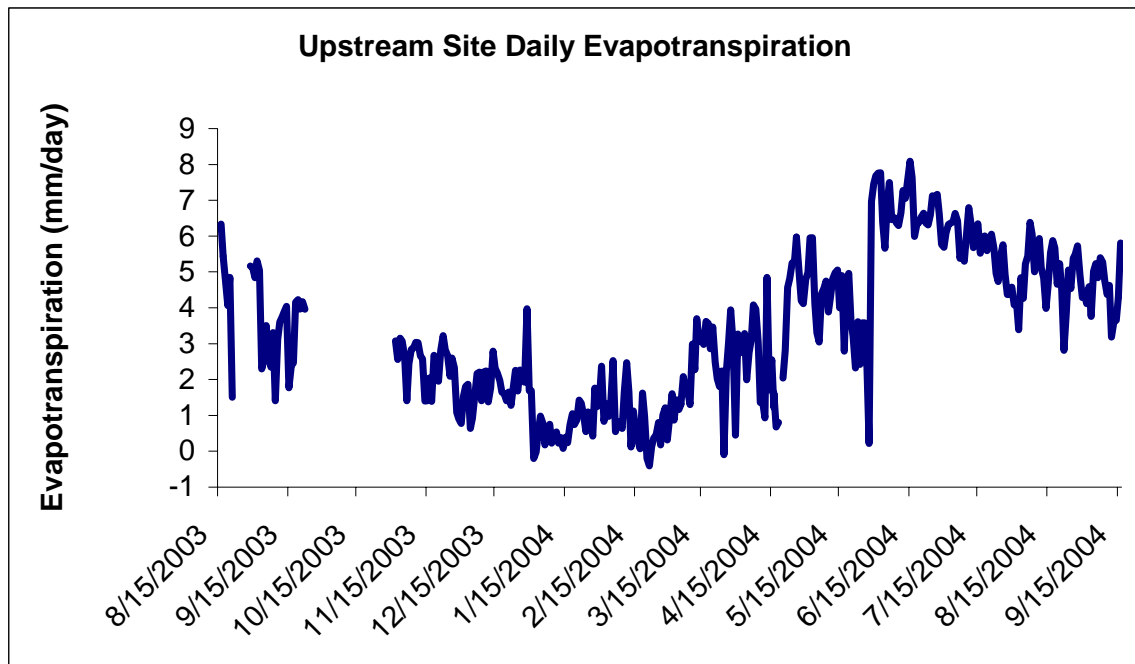
Field activities during this period consisted of installing temperature probes along the channel between the discharge gage at Michigan Bar and the lower preserve. These temperature probes were installed at fifteen locations spaced about one mile apart. Temperature probes are being used to indirectly determine if flow is present in the channel where the temperature probes are located. This information will be useful for determining the location of the stream terminus after the first precipitation event when flow is intermittent.

We have continued to analyze data collected from the reach scale study. These data are being used to refine our conceptual model of surface/groundwater interaction and perched aquifer conditions. Hypothetical simulations were run to quantify the amount of base-flow that could be contributed by perched aquifers for various hydrogeologic conditions. We found that for hydrogeologic conditions at the Cosumnes, 1.5 cubic feet per second (CFS) of base-flow can be contributed for two months after streamflow ceases by a perched aquifer that extends 3000 ft along the channel. The amount of baseflow contributed over the entire length of the Cosumnes may be much greater than 1.5 CFS depending on the occurrence of clay sediment layers greater than 10 feet below the channel surface.

We are continuing to develop and calibrate a numerical model of the Cosumnes that will be used to perform a water budget over the study reach that includes transpiration by riparian vegetation. This modeling will be used to analyze the effects of climate and groundwater pumping on the water budget, as well as, for testing the effectiveness of management practices.

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

We continued to take quasi-continuous data at two hydrological field locations, the Deer Creek Costello site, and the downstream Accidental Forest eddy-covariance (EC) tower. An infrared thermometer was added to the suite of instrumentation at the Accidental Forest allowing us to estimate energy storage in the cottonwood canopy. We processed all of the data collected to date. We presented our methods and results in a talk given at the American Meteorological Society 25th Conference on Agricultural and Forest Meteorology in Vancouver, BC and in a poster at the CALFED Science Conference in Sacramento. Some plots linking canopy conductance taken from the upstream eddy-covariance tower appear to link canopy conductance to groundwater availability measured by the UC Davis Hydrology group led by Prof. Graham Fogg. Below is a plot of total daily evapotranspiration measured at the upstream tower.



Budgetary and Logistic Situation

Substantial progress has been made in the past quarter; we estimate that the project's accomplishments are approximately 55% towards achieving the project's final objectives. As before, continued enhancements to the instrumentation are expected in the near future, which should entail equipment expenditures. We plan to gather data for the next year at both of our sites, and perhaps beyond until the end of the project, with concentration on analyzing the data by the end of this calendar year. Labor costs (within the budget) are being used for additional personnel being recruited to assist with both the field experiments and data analysis. Travel costs to the aforementioned conferences were within this budget, and further travel expenditures to a conference in November 2004 will be incurred.

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

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

During this quarter, the study site undergoes seasonal drying, with a varied time course from year to year. Water levels and wetted area in the river channel and Wood Duck Slough generally fall, although the Slough was subject to very rapid level changes (up and down) from irrigation water management. With higher surface to volume, the wetted area and depth of the Triangular and Lower Pond decline more rapidly than the channels. Under warm conditions, rooted and floating macrophytes and benthic algae grow rapidly, followed for some species (e.g., *Ruppia*) by senescence and replacement as water temperature and other parameters continue to change. The wetted surface covered by plants in the river was very patchy, but occupied nearly all of the Lower Pond. This additional plant biomass offers both forage and refuge structure for aquatic and terrestrial insects, but markedly alters local aquatic foraging opportunities for bats in that it further reduces the area available for skimming emergent insects from open water. Skimming is a favored foraging mode for two bat species acoustically common at the site.

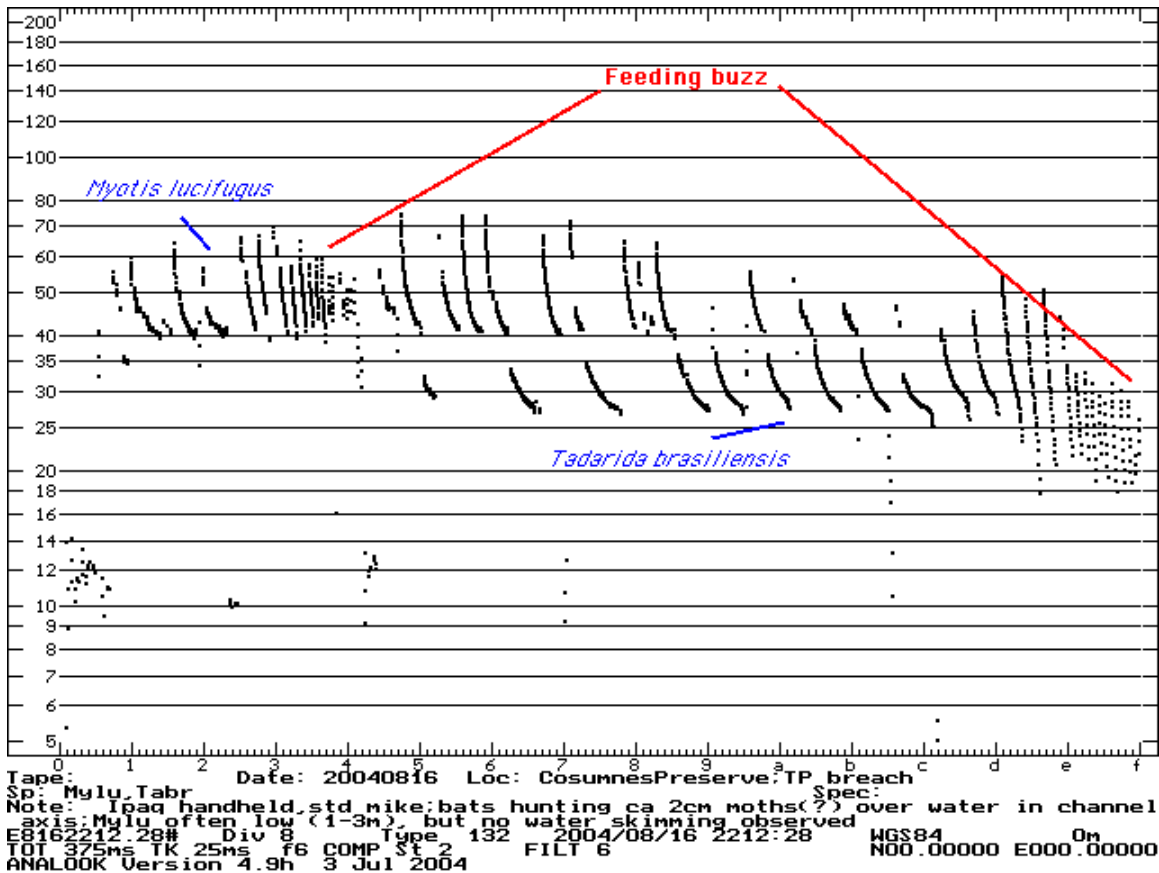
We continued periodic sampling of flying insects with overnight deployments of aquatic emergence traps, but stopped sampling the ponds as they dried. As in past quarters, solar or storage battery-powered monitors at water body shoreline positions and other floodplain stations continuously sampled bat acoustic activity. Project time was employed as before in operating the acoustic monitoring systems (field downloading; component testing and maintenance; data transfer, backup and analysis).

While monitoring devices with fixed map position and height above the ground layer vegetation yield excellent information on seasonal and shorter term point activity, water level declines on the low gradient floodplain mean that pond shorelines retreat out of the detection volume of the monitor and thus no direct data are available on activity in the smaller remaining wetted area. To address this, design and construction of trial floating monitor systems for installation in the deeper portions of the (now dried) ponds continued. In these relatively buffered locations, the systems need to function and be accessible for download through several meter changes in water level during flood events, but, in most years, will not encounter the large floating debris and geomorphic alterations found at the more dynamic breach sites.

In mid-August, we set multiple mist nets one night near the two acoustic sampling sites on Wood Duck Slough, primarily to capture and identify a sample of the 40 kHz *Myotis* which are the source of a significant proportion of total acoustic activity there. Unfortunately, activity near ground level along the Slough was low, so that only two juvenile Mexican freetail bats (*Tadarida brasiliensis*), a 25 kHz species acoustically common on the floodplain, were netted.

Few bats were observed hunting below the canopy height in active acoustic monitoring (with a spotlight and detection system) while walking tracks in or adjacent to the Tall

Forest. Similar reconnaissance sampling by vehicle or walking elsewhere within the floodplain study area on the same night showed generally low activity. However, several species, including Mexican freetails, red bats (*Lasiurus blossevillii*, a species proposed for DFG special concern status) and the little brown bat (*Myotis lucifugus*) were readily observable over the remaining water along the vegetated river channel at the Triangular Pond levee breach, hunting what appeared to be 1- 2 cm TL moths. The figure shows a 15 second acoustic sample with pulse trains (including more rapid ‘feeding buzzes’ as they approached prey items) from both the little brown bat and Mexican freetail.



The little brown bat is a generalist with several foraging modes, frequently including skimming the water surface to capture emerging aquatic insects, but no insect emergence or skimming behavior were seen at this time. As noted previously, this species is not represented by museum records for the Central Valley floor, but visual and acoustic observations at Cosumnes and elsewhere indicate it is present at least in some larger riparian forest remnants.

Subtask 3b: (Grosholz, UC Davis)

This quarter, we completed most chemical analyses for samples collected during the 2004 floodplain sampling season and a series of organic matter bioavailability assays. Some phytoplankton and microzooplankton counts were also completed and revealed very high ciliate biomass in the flood plain during the drain period in lower residence time sites

with low mesozooplankton biomass. Low mesozooplankton biomass coincided with higher abundance of fish larvae, possibly implying a trophic cascade from fish to mesozooplankton to ciliates. Bioavailability assays showed that concentrations and bioavailability of DOC and POC in the Cosumnes floodplain are similar and often greater than in Delta habitats. Similar to results from comparable experiments conducted in Delta habitats, bioavailable DOC in the Cosumnes floodplain is associated with detritus and bioavailable POC is associated with phytoplankton. However, somewhat differently from Delta results, phytoplankton-detritus appears to be more readily available for microbial consumption than fresh phytoplankton. Phytoplankton counts will be conducted next quarter to test this hypothesis. Analysis of monitoring data revealed further interesting connections between DOC, particulate phosphorus, and cyclopoid abundance and fatty acid content. These results were presented in a talk and a poster during the CALFED Science Conference. Anke Mueller-Solger also served as Program Co-Chair for this conference.

We continued to analyze samples of macrozooplankton, insect and plant biomass samples collected during the 2004 flood season with a strong emphasis on collections from the high temporal resolution. These samples were taken at sites that differed in the residence time of the water mass and the presence of vegetation. Our data show that residence time strongly affected organismal abundance. Higher residence time areas had higher overall density of zooplankton as well as the most variable levels among flood periods. Relative abundance of cyclopoid copepods was greatest at low residence time sites. Insects were highest in the river and mollusks were highest during flood stages. Chl a and DOC levels were highest in high residence time sites. We also analyzed water quality samples in collaboration with Dahlgren's lab. Our data indicate that there are strong daily cycles in chl a that suggest a diurnal shift in the balance between grazing and primary production.

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

In July, PRBO staff biologists and interns completed data collection on the Cosumnes River Preserve. During this month we ran mist nets, monitored nests, collected vegetation information at nest sites, randomly generated sites and point count stations, and entered and proofed data. Mist nets were operated every ten days at two sites, Wendel's Levee near Accidental Forest and Wilson's Section of Tall Forest until July 31st. Although most pairs were no longer nesting by July, PRBO continued to find and monitor active nests until July 31. Nest vegetation measurements were conducted throughout the season but especially in June and July as nest searching and monitoring activities slowed. Nest vegetation measurements were taken at all confirmed nests and at 20 randomly generated points within each nest monitoring plot. Vegetation at selected point count transects was measured in the upper and lower floodplain areas. All data were entered, proofed, and backed up at PRBO Terrestrial Ecology Division Headquarters.

A total of 67 tree swallow (*Tachycineta bicolor*) nests in artificial nest boxes were monitored from three different sites on the Preserve. Some of these nests were from the same box and may have been the result of double brooding. Although 65 nests were

successful in fledging at least one young a total of 22 individual nestlings did not fledge and died in the nest indicating conditions in 2004 were not as favorable as 2003.

During the period from July to September, 2004 PRBO managed and analyzed data collected during the field season. Nadav Nur and Julian Wood attended Cosumnes Research Group meetings and Julian Wood presented results from Cosumnes and other Central Valley projects at the 3rd Biennial CALFED Bay-Delta Program Science Conference. Title and abstract for this talk are given below.

Title: Using birds to evaluate riparian restoration at sites in the San Joaquin Valley/Delta region

Abstract: Recently, land managers have come to place high value on wildlife monitoring in evaluating completed restoration projects, advising current management, and guiding future restoration projects in an adaptive management framework. The methods used and the temporal and spatial scale of monitoring are important considerations when designing a project. We present preliminary results from several avian monitoring studies that use multi-tiered methods and a multi-species approach to evaluate riparian condition. Point Reyes Bird Observatory has been monitoring songbird populations as indicators of healthy riparian systems in restored and remnant riparian habitat at sites along the San Joaquin, Mokelumne, and Cosumnes Rivers. All projects focus on evaluating riparian habitat pre- and post-restoration by relating the structure of songbird communities, their distribution, abundance and primary demographic parameters to vegetation characteristics. A long-term monitoring program, established in 1995 on the Cosumnes River Preserve, has been documenting the response of songbirds to natural process-based riparian restoration areas. Although the highest species diversity was found in mature forest, several riparian focal species such as Common Yellowthroat (*Geothlypis trichas*), Song Sparrow (*Melospiza melodia*) and Blue Grosbeak (*Guiraca caerulea*) are more abundant and in some cases have higher nest success in early successional restoration sites. Thus, riparian birds benefit from restoration projects that are staggered in time and thus at different stages of development, corresponding to the naturally dynamic landscape of riparian floodplain. At the San Joaquin River NWR, monitoring was initiated in 2000 to evaluate a large-scale cultivated restoration project that began in 2002. Preliminary data show several species breeding in restored sites during the first year of restoration. At mature sites, nest substrate selection for Song Sparrow, Spotted Towhee (*Pipilo maculatus*) and American Goldfinch (*Carduelis tristis*) was positively correlated with forb cover underlining the importance of planting and managing for understory species.

Task 5 -- Data Management (J. Quinn)

We are now utilizing Open Source code to support the data management needs of the Cosumnes Research Group. We have completed the implementation of our server cut-over to a Linux/Apache configuration, which supports a variety of Open Source software.

Obtaining project images and maps, sharing critical information among collaborators, and providing consistent attribution of data are necessary elements in supporting ecosystem science. Our Open Source data archive, which integrates photographic images, spatial location, and core metadata, serves as a relevant and timely framework from which to capture restorative science in the Cosumnes River floodplain.

We heavily modified Coppermine Photo Gallery (SourceForge.net) to permit the collection, manipulation and selective display of data elements related to sets of photographic images and maps. Coppermine is an Open Source script, written in the PHP web scripting language, using the GD image creation library (Boutell.com). Our modifications permit the collection and storage of images and image metadata, consistent with standards of the National Biological Information Infrastructure (NBII). These collected data include and extend the Dublin (Darwin) Core metadata framework for published document description, which is essentially descriptive data about the resource of interest, cataloging such attributes as authorship, location, affiliation, time frame, and other details. Coppermine requires a MySQL database, which we manage with the phpMyAdmin user interface (SourceForge.net). Spatial references are linked to a custom mapping application utilizing the University of Minnesota's MapServer software. The catalogue is currently hosted on a machine running the Linux operating system and the web pages are served by Apache HTTP Server.

We reported on our use of this Open Source data archive via a poster titled “An Open Source Solution to Scientific Archiving: Cosumnes Research Group Online Image Catalogue”, at the 2004 CALFED Science Symposium. This poster described our applied research program to create this online catalogue of the Cosumnes Research Group's photographs and maps, displayed with spatial reference and resource metadata. This online photo gallery and information archive is accessible to all on a public web site, serving as a data repository from which to support present activities and to gauge future restoration successes.

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

This quarter the Field Coordinator has continued to work on the radio telemetry systems necessary to display floodplain data collection in real-time on the internet. This entailed erecting a 60 foot tower on the preserve and adjusting all of the sensors so that they could communicate with the tower. From that location tests were run to determine the feasibility of installing a repeater tower for the data. The Coordinator has also continued installing and maintaining hydrological sensing equipment. New locations have been identified for the installation of sensors that may help build a better hydrologic model of the floodplain. Sensors were also installed in the lagunitas to help understand the hydrology of that floodplain system. The Coordinator has also been working with The Nature Conservancy to install equipment in the farm center that will be used by the Cosumnes Research Group (CRG). The coordinator also helped prepare data used by the CRG presenters at the CALFED Science Conference

Task 7 – Continued Floodplain Monitoring (J. Mount)

A contract amendment in the Spring of 2004 added funds to this project (“Cosumnes II”) for a new Task 7 -- to maintain the collection of hydrologic and aquatic data initiated under an earlier and related CALFED-funded project (“Cosumnes I”). Under this new Task, hydrologic data collection was continued through the spring and summer. In addition, for part of the Spring and for all of this quarter, this Task provided a portion of the Field Coordinator’s salary in support of the hydrologic and radio telemetry equipment installation activities outlined in Task 6, above.

Aquatic monitoring activities were conducted during the late spring and summer. During the spring, seining took place at 6 sites at prescribed times in the hydrological cycle timed to coincide with the water and invertebrate sampling. Fish caught were euthanized and then preserved in a 5% buffered formalin solution and brought back to UC Davis for later identification. During the initial floodplain filling and draining cycle only non-native resident fish from surrounding sloughs were found in very low numbers. During the summer months samples were processed and identified. Each species of fish was identified, standard length was taken and fish were transferred into alcohol. Splittail and carp were found in the juvenile stages from early April through May samples. Samples of splittail were sent to a lab for genetic analysis.