CALFED Quarterly Progress Report

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Period ending: December 2002

Special note: This report summarizes not just activities for the last quarter of 2002, but rather, all work conducted on this project during calendar 2002. Because there was a significant delay between announcement of the award by CALFED and finalization of a contract between CALFED and UCD, work did not begin on all project tasks at the same time. Some principal investigators chose to start work even in the absence of a final contract; others were unable to take that risk. The summaries below reflect work conducted over varying time periods during the calendar year of 2002. Future reports will adhere to the more typical quarterly format.

Task 1 - Restoration Success Criteria (J. Quinn)

Although no monies from Task 1 were spent during 2002, significant efforts were made in pre-planning for initiation of this task. Namely, we made an effort to solidify our data holdings that pertain to the identification and cataloging restoration and monitoring activities throughout the project area. This entailed coordinating and attending meetings with project principals, resource managers, and affiliated researchers. This task level pre-planning, in coordination with Task 5, will provide the foundation for future collaborative processes and for significant advancement of project and task goals.

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

Subtask 2a: Hydrologic Analysis (G. Fogg)

The reach scale hydrologic analysis is focused on a six hundred foot reach of the Cosumnes River located just upstream from the intersection between Dillard Road and Highway 99, South of Sacramento. Data collection includes measurements of: shallow groundwater levels, channel sediment temperature, soil moisture content and soil water potential. Additionally, we surveyed water surface profiles over the study reach before the flow in the Cosumnes River ceased in late May. We also installed monitoring equipment into the channel sediments, creating a total of twenty-five sediment cores at a depth of twenty feet below the channel bottom. We subsequently analyzed these sediments based on texture and color.

A total of seven piezometers were installed to measure the head seven feet below the channel and, using the piezometers, water level measurements were made on a weekly basis. Although, the regional water table elevation is located approximately thirty feet below the streambed at this site, four of the seven piezometers were measuring positive head and were completed in a perched aquifer located near the upstream end of the study reach. In general, the four piezometers completed in the perched aquifer show slowly declining water levels, corresponding to the decline in river stage (Figure 1). The

channel bottom at the upstream end of the study reach is made up of sand and clay loam material. The other three piezometers located at the lower end of the study reach, where the channel bottom is made up hardpan material, went dry after three days. It is believed that these piezometers went dry because they were screened in unsaturated sediments.

Presently, sixteen thermocouple nests for measuring sediment temperature have been installed into the river channel. Each thermocouple nest consists of six thermocouples located at incremental depths to twenty feet below the channel. Thermocouple nests were installed in three cross-sections that are located two hundred feet downstream from each other (Figure 2). Temperature measurements are made on an hourly basis. Streambed temperatures at the upper section of the study reach referred to as TCN section 1, suggest that the streambed permeability is relatively high as compared to the lower part of the study reach where TCN sections 2 and 3 are located. Temperature measurements suggest that vertical seepage is occurring at site 2 to a lesser extent than site 1. Temperature measurements also indicate that lateral flow underneath the channel is significant. At the lower section of the study reach, stream water is reaching the temperature probes 15 feet below the channel surface due to lateral seepage. Vertical seepage at the lower section of the study reach is very low and temperature probes 3 feet blow the channel do not indicate that the stream water is reaching this depth.

Two boreholes (TDR1 and TDR2) were drilled on the bank of the Cosumnes River and were instrumented with Time Domain Reflectometer (TDR) probes and thermocouples (see Figure 2 for a diagram of field instrumentation). The TDR and thermocouple probes were installed at incremental depths down to thirty-one feet below the top of the stream bank in order to measure soil moisture and temperature. During the drilling of these boreholes, sediments were analyzed based on texture and recorded. A thin (approx. 2 ft thick) perched aquifer was encountered at a depth corresponding to the elevation of the perched aquifer located below the channel bottom. Soil moisture content and temperature are recorded on a half hour basis. Soil moisture has remained relatively constant for both boreholes (see Figure 2) except at a depth of 27.4 feet below land surface at TDR2 where a significant change in the soil moisture was measured, corresponding to a large flow event in the Cosumnes River. In general, the variations in volumetric water content are greater at TDR1 as compared to TDR2. This observed difference may be due to variations in soil texture and/or shading from trees at TDR2.

Heat dissipation probes were installed into the center of the channel at sites 2 and 3 to measure soil water potential (see Figure 2 for a diagram of field instrumentation). At site 2, subtle changes in soil water potential measured at 9, 15, and 20 feet were recorded between November 20 and December 26, 2002. However, no changes in soil water potential were measured at 12 feet. These changes in soil water potential correspond to changes in temperature at these depths due to influence of thermal energy stored in the stream water as it seeps through the stream sediments. Heat dissipation probes installed below the channel at site 3 do not indicate any changes in soil water potential except at a depth of 20 feet, where the soil water potential increased by 200 cmH_20, suggesting that water originating upstream from site 3 is seeping laterally along permeable layers. Soil water potential measurements at depth shallower than 20 feet suggest that very little water is seeping vertically at site 3.

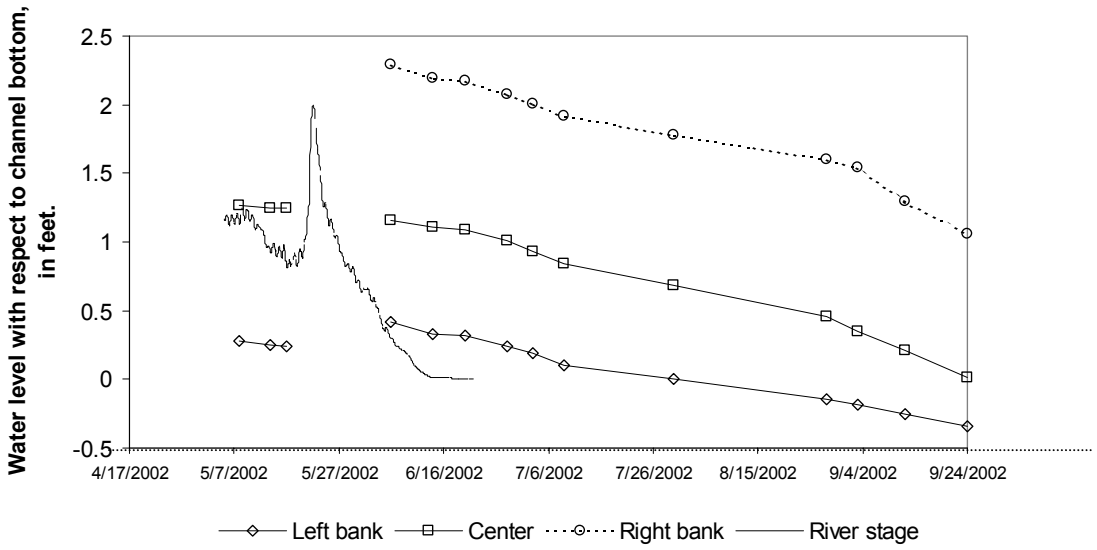

Figure 1. Water levels measured in piezometers (P1-3) and in the stream. Piezometers were completed in a perched aquifer located at upper end of study reach at site 1.

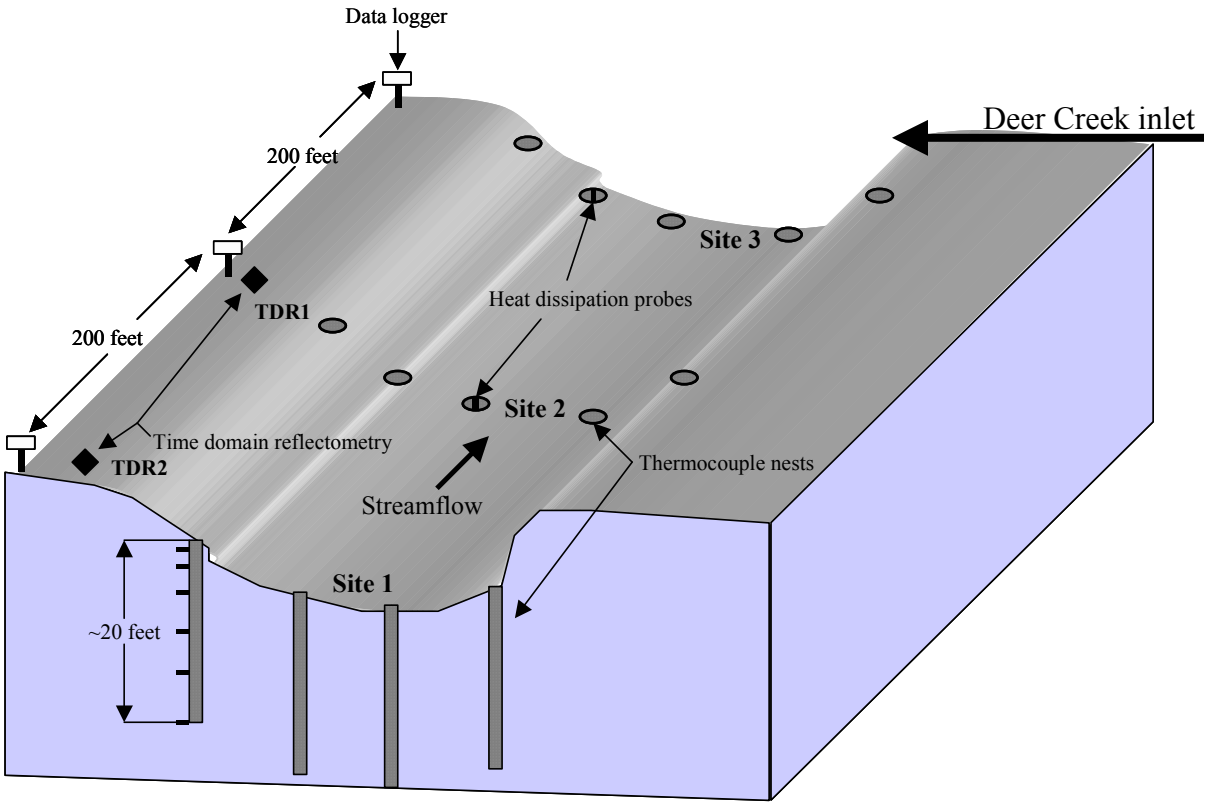

Figure 2: Diagram showing locations of field equipment on the Cosumnes River just upstream from the confluence of Deer Creek into the Cosumnes.

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

The main objective of this section of the project is to assess evapotranspiration from regions targeted for detailed hydrological studies under the supervision of Prof. Graham Fogg.

First Quarter & Second Quarter, 1/02-6/02. Except for scheduled meetings with investigators, no major work was carried out, as funding was not present. A preliminary site visit took place along the Cosumnes River. Additionally, we made preliminary plans regarding power and micrometeorological equipment options and placement; we also investigated and engaged in administrative issues regarding the erection of a micrometeorological sensor tower.

Third quarter, 7/02-9/02. One graduate student was hired. A detailed site visit to one of the already-established hydrological sites took place. A survey of tree heights and geomorphology of the region was done to determine feasible locations for the micrometeorological equipment. Security issues were discussed with members of the hydrological science team. Attempts were made to identify the owners of the lands on which some equipment could be placed. Continued administrative issues were investigated regarding the erection of towers on land controlled by The Nature Conservancy. Preliminary plans were made to erect a tower on one side of the river channel, with a grid of sensors upwind and within the riparian vegetation. Various types of wind velocity, temperature, and humidity sensors and equipment were examined to see if procurement was suitable for this project.

Fourth Quarter 9/02-12/02. Administrative issues continued, with further investigations into gaining permissions to put up towers on the property of the first hydrology site. Identification of the actual owners of one parcel was especially challenging, as was attempting to reach the owner.

Several meetings of most of the P.I.'s took place for coordination of the overall "Influence of flood regimes..." project. It was decided that two hydrology sites should be operated, the first one, already with many hydrological sensors, would be first fully instrumented, and then the second site further down river would be established. Possible locations of the second site include the Accidental Forest. The first site, which would be most easily characterized scientifically, is some distance away from the main site.

A climatic data survey commenced for the first hydrology site. Of several possible stations that were identified, only one yielded usable data. These data showed a wind rose with a predominant wind direction almost parallel to the river channel, which would make some of the methods (advection-mass balance) proposed for this first site very challenging. Changes to the plans regarding what types of instruments are most appropriate, are currently being made.

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

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

Trophic Pathways in Floodplain and River Sites

During Fall 2002, CALFED funding was spent on salary support for Bill Rainey, Sandra Clinton, and Collin Bode. Dr. Rainey is a Research Associate at UC-Berkeley and oversees the primary collection of aerial insectivore data and general project management. Sandra Clinton is a Postdoctoral Researcher who is assisting in the collection of field data and beginning a project investigating aquatic-soil linkages at the preserve (see below). Collin Bode is a Staff Programmer/Analyst who helps with collection of field data, data management and storage, and provides GIS expertise. At this time, we began project planning, decided upon field methods for the study, and assembled the necessary field supplies for the anticipated 2002-2003 winter floods.

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

This project sub-task began in January 2002 to capture dynamics of primary and secondary production during 2002 flooding events. Our objective for 2002 was to develop a better understanding of the link between primary and secondary production by characterizing temporal and spatial variability in abundance, community composition, and importantly food quality of flood plain versus river channel primary producers and the potential to fuel secondary production. Postdoctoral researcher Anke Mueller-Solger (PGR VI -10%) and technician Su-Fei Kuok (PGR I -100%) closely coordinated field work for this project component with the primary consumer project component led by P.I. Ted Grosholz. During the flooding period in winter and spring 2002, we conducted near-weekly sampling at fixed flood plain sites, each with varying geomorphic and hydrological characteristics. We monitored total suspended sediments, dissolved and particulate phosphorus and nitrogen, particulate carbon, seston carbon and nitrogen stable isotope signatures, seston fatty acid composition, chlorophyll a, and phytoplankton abundance and community composition. We also conducted pilot work for periphyton sampling and analyses. In addition, we conducted a feeding assay with *Daphnia magna* to examine growth responses to flood plain food sources.

The summer of 2002 was devoted to sampling and data analyses, as well as method development. In particular, we experimented with the use of the stable carbon isotope C-13 rather than the traditional radioactive carbon isotope C-14 for *in situ* algal primary productivity measurements in the flood plain. All sediment, nutrient, chlorophyll a, and carbon sample analyses were completed and the adaptation of the C-13 method for use in the flood plain was nearly completed.

During the most recent quarter, we completed analysis of last season's seston fatty acid samples. We analyzed these data as well as the sediment, nutrient, chlorophyll a, and carbon data collected during the 2002 flooded season. We will present these results at the upcoming 2003 CALFED Science conference and Anke Mueller Solger will serve as chair for the Flood Plain Restoration session at this conference and as co-convener of the poster session. During this time, we drafted a work plan in collaboration with other

project team members, UC Berkeley (M. Power *et al.*) in particular; we also ordered supplies and calibrated equipment in preparation for the winter field season.

We continued testing new instrumentation for continuous *in situ* measurement of algal pigments. We tested the "bbe Fluoroprobe" during an all-day cruise in the Delta and simultaneously collected discrete chlorophyll a and phytoplankton samples as well as continuous chlorophyll fluorescence and turbidity data using Turner instruments. Preliminary data analyses are quite promising. . In an effort to assure data comparability and eliminate redundant lab analyses, we compared results from different laboratories that processed measured data from the Cosumnes flood plain, such as chlorophyll.

The Cosumnes River flood plain began flooding in early December 2002. During this first event, we collected seston and nutrient samples at sites around the floodplain as well as drift net samples at the spillover sites by the levee breach. We also collected preliminary samples of various materials in the flooded forest area (including the area known as Accidental Forest) for stable isotope analysis as part of program to determine if carbon and nitrogen inputs from the forested floodplain can be detected in the open, unforested floodplain.

Task 4 - PRBO Bird Surveys (J. Wood, N. Nur, J. Hammond, and G. Geupel)

Overview

PRBO Conservation Science collected songbird abundance, distribution and demographic data from different habitat types within the Cosumnes River Preserve from March to August 2002. We collected data from two new nest monitoring sites in early successional floodplain habitat to coincide with CALFED-funded research sites. These sites are: 1) Triangle Plot (located north and west of Wendel's levee and west of Cosumnes River), and 2) Middle Breach (located just south of Accidental Forest). See Figure 3.for a map of our study sites and point count locations in the Tall Forest and adjacent floodplain area of the Preserve. Using the methods described below, other sites have been monitored by PRBO since 1995 (see Table 1). A total of 99 point count stations representing 13 transects were sampled using "variable circular plot" point counts to assess relative abundance and species richness and diversity. At six of the 13 sites, nest monitoring was conducted to measure productivity and predation levels in mature riparian forest, mid-successional and early-successional riparian areas. A total of 339 nests from 27 different species were found in 2002 (Table 2). In addition, Modesto Song Sparrow (*Melospiza melodia mailliardi*) nestlings from each nest at all sites (and many adults) were color banded to determine juvenile and adult survival and dispersal and to assist with identification in the field. Song Sparrow nestling fecal samples, when made available, were collected from all sites during banding to indirectly sample their prey base. Song Sparrows, because of their abundance and occurrence at all sites, were chosen as a focal species for this project. During the 2002 breeding season fieldwork was conducted by Julian Wood, Jeanne Hammond, Andy Pfeffer, Jill Coumoutso, and Kim Maute. Principal Investigators, Nadav Nur and Geoff Geupel participated in study design and oversight.

Figure 3. Map of PRBO study sites in Tall Forest and floodplain section of Cosumnes River Preserve, 2002. All nest plots are outlined and associated point count stations are shown as points (see Table 1 for site names). Some point count locations and Greenfield site are not pictured.

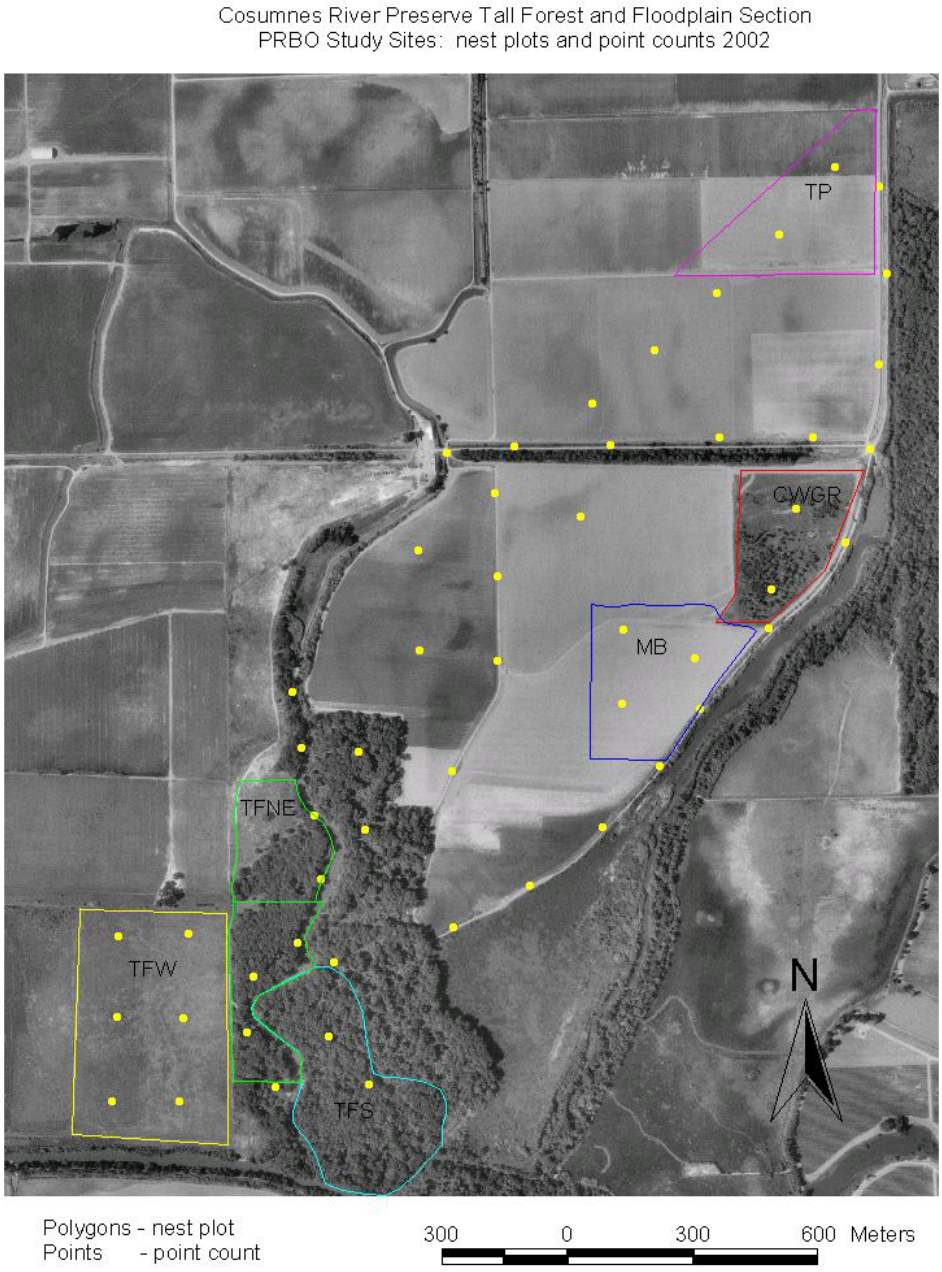

Table 1. Cosumnes 2002 Study Locations.

Nest Plots

Name	Acronym	Size	Years conducted
Tall Forest West (planted restoration)	TFW	19.6 hectares	96-02
Tall Forest South	TFS	15 hectares	95-02 (plot area covered changed over yrs)
Tall Forest Northwest	TFNW	5.7 hectares	95-02
Cottonwood Grove/Accidental Forest	CWGR	8 hectares	95-00, 02
Middle Breach	MB	10.3 hectares	2002
Triangle Plot	TP	10.3 hectares	2002

Spot-mapping Plots (same as above plus Green Field)

Name	Size
TFW	19.6 hectares
TFS	15 hectares
TFNW	5.7 hectares
CWGR	8 hectares
MB	10.3 hectares
TP	10.3 hectares
Green Field –GF	7.8 hectares

Point Count Transects

Name/Acronym	Years conducted	Number of Points
TFS/TFNW/TFNE=TAFO	95-02	13
Tall Forest West=TFW	2002	6
Wendel's Road=WERO	95-02	9
Fallow Field=FAFI	95-02	7
Grizzly Slough/DWR=DWRE	95-02	12
Valensin Ranch=VALE	95-01	17
Willow Slough=WISL	95-02	15
Wendel's Levee=WELE	95-02	8
MIBR=MB	2002	3
TRPL=TP	2002	5
Cottonwood Grove=CWGR	2002	2
Green Field=GRFI	2002	2

Mist-netting Sites

Name	Location	Number of Nets	Years run
Wendel's Levee – WL	Levee/accidental forest	10	95-02
Tall Forest - TF	Wilson's section	10	95-00,02 (98 only part of the season due to high water)

Table 2. Number of nests found for each species on the preserve with all sites combined, 2002.

Species	**Number of nests found**
Mourning Dove	3
Downy Woodpecker	8
Nuttall's Woodpecker	1
Northern Flicker	1

Black-chinned Hummingbird	5
Allen's Hummingbird	1
Ash-throated Flycatcher	1
Western Wood-Pewee	5
Western Scrub-Jay	2
Red-winged Blackbird	14
Western Meadowlark	1
Bullock's Oriole	6
American Goldfinch	17
Lesser Goldfinch	1
Song Sparrow	158
Spotted Towhee	34
Black-headed Grosbeak	11
Blue Grosbeak	1
Tree Swallow	5*
Hutton's Vireo	3
Common Yellowthroat	22
House Wren	12
White-breasted Nuthatch	1
Oak Titmouse	1
Wrentit	9
Bushtit	10
American Robin	6
* Excludes Tree Swallow nest boxes monitored	

Methods

Variable circular plot point counts

To measure species diversity, abundance and distribution throughout the preserve we used variable circular plot point counts in which the distance from the observer to the species detected is estimated. Five concentric rings, centered on the observer and each 10 m wide, extend outward to 50 m. Two larger bands extend from 50 to 100 m and 100 to 200 m. The type of detection is recorded (i.e., song, call, and visual) and birds flying over the station are recorded separately. Any evidence of breeding is also recorded (e.g., material carry, food carry, and copulation). Point counts were conducted from April 26 to June 28 and each point was visited three times throughout the season.

Constant Effort Mist netting

Mist netting was conducted from 1995 to 2002 at Wendel's Levee, adjacent to Accidental Forest and at Tall Forest (not conducted in 2001) in Wilson's Section. Netting procedures conformed to guidelines described in Ralph *et al.* (1993). In summary, 10 mist nets were operated once every ten days during the breeding season (May 1 to Aug 10). Nets were operated from 15 minutes after local sunrise, checked every 20 to 45 minutes (depending on conditions) and were operated for five hours. Birds captured were removed from the net and processed near the capture site. Each bird captured (except hummingbirds and game birds) received a USFWS band for permanent identification and to allow estimates of survival from subsequent captures rates. All individuals of Song Sparrow were given a unique combination of three colorbands in addition to the USFWS

band to facilitate identification in the field. Age, sex and other morphometric measurements were recorded as described by Pyle (1997) prior to releasing each bird.

Nest monitoring

To calculate reproductive success and the factors that affect success, the nests of songbirds were located and monitored as described in Martin and Geupel (1993). Nests were located by observing revealing behaviors, flushing females from nests and searching in appropriate habitat. The nest contents are recorded every two to four days until fledging or failure can be determined. Any Brown-headed Cowbird activity is noted without manipulations by the observer. Nest success is calculated using the Mayfield method (Mayfield 1975), which takes into account the number of days a nest was observed thereby correcting for possible overestimation of nest success probability. This overestimation is caused by the greater likelihood of a nest found late in the nesting period succeeding compared with a nest found early in the nesting period

Spot Mapping

All nest plots, plus the Green Field site, were spot mapped to determine the number and size of breeding songbird territories. Each nest plot was spot mapped at least twice per week by the same observer. Green Field, not a nest plot, was spot mapped less frequently.

Vegetation Sampling

Soon after a nesting attempt terminated we measured the vegetation associated with the nest within a 5 m radius following BBIRD protocol (Martin *et al*. 1997). In summary, we identified the main nest substrate and measured shrub density, shrub and forb cover and ground cover. Tree diversity and density were sampled in an 11 m radius. The percent canopy cover was also measured. We similarly measured vegetation at point counts but used the relevé method as outlined in Ralph *et al.* (1993). General habitat characteristics of the site were recorded within a 50 m radius of the point count station.

Fourth quarter activities

PRBO Conservation Science worked on data entry, management and analysis of breeding season data collected on the Cosumnes River Preserve from March through July 2002. Several color-band re-sighting surveys were conducted for wintering Song Sparrow on the Tall Forest West Re-veg plot, Middle Breach, and Triangle Plot. Color-band combinations were recorded and locations of color-banded birds were geo-referenced. Preparation for the 2003 field season included attendance at meetings and science conferences and literature review for input into study design. The hiring of field crew for the breeding season also commenced during this time period. In addition, a volunteer was advised in the construction of about 50 Tree Swallow nest boxes to be erected on the edge of the flood plain adjacent to the Tall Forest. Monitoring nest boxes located near the visitor center for the nests of Tree swallow was started in 2002. Tree swallow nest

monitoring and banding of adults and nestlings will continue in 2003. David Winkler, co-coordinator of the Golondrinas de las Americas Program, is assisting with the Tree swallow study design.

During the 2002 non-breeding season project, Julian Wood conducted planning and data analysis. Principal Investigators, Nadav Nur and Geoff Geupel participated in study design and oversight.

Task 5 - Data Management (J. Quinn)

We initiated the development of a robust data integration and management strategy to complement the ongoing and future research activities of the Cosumnes Research Group (CRG) throughout the Cosumnes River watershed proper. Although some elements of this strategy build on existing infrastructure and institutional capacity, it became apparent that technical innovation and investment were required to fully meet the needs of the project. This need has been met through a combination of structural assessment, prioritization, and implementation within our computing environment. Namely, we made significant upgrades to our existing computational hardware to more fully realize gains in data integration and software improvement. We also made substantial upgrades to the networking environment, which was considered the bottleneck in our ability to disseminate project information in a timely and coordinated fashion. Lastly, we upgraded existing spatial analysis software to leverage newer modules that allow for the real-time mapping of project information. We also trained the principal programmer in use of the new analytical software package. Results of these activities are currently served from the CRG website (http://watershed.ucdavis.edu/crg). As it stands, these initial steps will help form the foundation for future project data integration and, importantly, transfer of research findings to the general public.

Several staff worked in varying capacities on this Task, either from a computing administration position, as above, or from a directed programming and analysis position, as will be most future activities. For example, we have handled individual data requests and technical support from project collaborators through the development of data delivery packets, consisting of necessary tabular and spatial data in either digital or hardcopy format. Future directed analyses will build on these relationships and on our improved infrastructure. As is expected, we also disseminated general project information to interested parties and assisted with ascertaining project details when needed. These experiences are essential for building and maintaining institutional capacity, which will allow for further collaboration, integration, and project success.

Task 6 - Science Support

During the organizational phase of this grant, the Watershed Center Director and Coordinator worked with the staff of the Cosumnes River Preserve to familiarize all

parties with the objectives of this project and its relationship to prior UCD/CALFED research at the Preserve. This included attending meetings with agency partners and stakeholders interested in working with the program, multiple site visits and a formal presentation describing results of the current research program to the Cosumnes River Preserve Cooperator's meeting.

In addition to outreach activity, the Watershed Center hired a new field coordinator in October. This field coordinator's duties include organizing and assisting the field work of researchers on the grant, being a point of first-contact with staff of The Nature Conservancy and the Preserve, servicing and maintaining field equipment and sensors, installing new sensors where needed, regularly downloading dataloggers and distributing data to researchers.

During the fall, most of the time of the field coordinator was devoted to installing, maintaining and repairing a network of depth and velocity sensors that are being used to characterize the hydrology of the floodplain on the lower Cosumnes River. Additionally, the field coordinator installed 40 new temperature recorders on the floodplain in order to monitor water temperatures during flood events.