DEMONSTRATION PROJECT HABITAT RESTORATION STUDY

To facilitate accomplishment of the primary goal of the land retirement demonstration project, a habitat restoration study was designed to examine various restoration techniques to determine the quickest and most cost-effective means of restoring upland habitat on retired agricultural lands. An experimental study design was developed to analyze the effects of habitat manipulation in a scientifically valid manner. Data will be collected by ESRP to assess differences between experimental treatments and for contaminants monitoring.

Study Design

Twenty study plots, each 40 acres in size, have been established on 800 acres of the western Fresno County demonstration project site (Figure 3). The central 10 acres of each 40-acre plot will be subject to one of four experimental treatments and the surrounding acres will function as a buffer. These buffer regions around each plot will help to exclude or reduce interactions between the treatments and neighboring plots. While the entire Demonstration Project area will be monitored to some extent, the focus will be on the 200 acres which are manipulated to evaluate different post-retirement land management options.

The size of the habitat restoration study was determined based on a compromise between the amount of acreage that could be reasonably manipulated and monitored with a high degree of experimental rigor, and yet had potential to show significant results in a relatively short amount of time (five years or less). Plots were arranged to create a randomized block design, which will allow for rigorous statistical analysis. A two-factor analysis of variance with equal replication will be the statistical test used for most analyses.

The four experimental treatments, which were randomly assigned to each of the five blocks, are as follows:

1) Introduction of native species, which will include seeding and/or planting of specific desired native species,

2) Microtopographic manipulations such as low mound or berm construction and scraping to create scald-like open area.

3) A combination of revegetation and microtopographic manipulation, and

4) No manipulation (control treatment)

Native Plant Reintroduction. A variety of methods will be used to restore native upland plant communities on retired lands including use of seeds and small plugs of species such as *Atriplex*, *Allenrolfe*a, *Sporobolus* and others. See Table 3 for a complete list of species currently targeted for use in restoration efforts at the demonstration site. Planting of plugs and seeding with a native mix will occur in the fall of 1999.

Maintenance of local genetic diversity should be an important concern for all restoration projects. Whenever possible, local genotypes will be collected and propagated for use on the Demonstration site, but some commercial seed will need to be purchased. Seeds of species that are expensive to purchase and easy to collect will be hand-collected, and seeds that are inexpensive will be purchased from a commercial vendor. Only seeds from sources as close as possible to the demonstration site (< 50 miles) will be obtained from vendors.

Soil imprinting is a method that will be used to the extent practicable on Demonstration Project land. Imprinting can dramatically increase native seedling survival in restoration efforts by ensuring direct contact of seeds with the soil surface and by protecting seeds from desiccation and foragers (Ted St. John, pers comm.). An imprinter is a fairly heavy piece of equipment pulled behind a tractor which seeds a site while simultaneously creating small impressions in the soil, or "safe sites" for seeds. Imprinters can be rented from qualified contractors, or built to suit a particular restoration project. Given the amount of acreage to be retired under the land retirement program, building an imprinter for the project is recommended.

Microtopographic Manipulation. Microtopographic contouring may be an important factor in the long-term success of restoration efforts on retired land. Microclimates, slope exposures, soil conditions, heterogeniety and diversity of plant habitats result from this contouring. Topography can provide protection to burrowing animals from natural disasters such as flooding. A leveled agricultural field may completely flood and cause high mortality among the resident small mammals and reptiles. A field with varying relief provides refugia to residents during catastrophic events.

A general scheme for the microtopographic work has been developed which takes into account a such factors as water flow and cost effectiveness (Figure 4). An important consideration in creating mounded areas or long berms is the flow of water over the property. The Demonstration site is located on low ground, and hence water will tend to flow from upslope areas and pond during heavy rainfall events. To discourage ponding on the experimental area, the berms will only be established along north/south and east/west orientations, which will allow water to move over the parcels relatively easily.

The expense of earth-moving equipment and operator time is also a consideration. Specifications for the berms must be clear and easy for equipment operators to reproduce in order for the method to be cost-effective on large acreages. Microtopographic work conducted at Allensworth Ecological Reserve, which involved creating large earthen berms for kit fox use, cost over $300 per acre (M. Potter, pers. comm.) This expense would be cost-prohibitive for the land retirement program.

An arrangement of long berms separated by gaps could be easily created with an angled blade pulled behind a tractor. Periodically lifting the blade off the ground will create gaps between berms. If gaps for north/south and east/west berms are lined up, the pattern that is formed allows water movement and animal movement and dispersal (Figure 4). Researchers also will be able to use the pattern for orientation and location of survey points within the 10-acre plots. Large open areas will exist between manipulated areas.

Animal Introduction. Phased reintroductions of some selected vertebrate and invertebrate species are planned in the third year of the study in treatments I and III. With the lack of adjacent native habitat, it will be difficult for some species to colonize the property. To obtain significant results within a five year period, reintroductions may be a necessary step.

Irrigation Needs. Irrigation of retired lands will not occur on a long-term basis, although some water may be applied during the initial restoration period to increase native seedling survival or to water a cover crop. No more than 0.6 acre-feet of water will be applied to retired land (R. May, pers. comm.). Due to sparse spring rainfall, irrigation of the barley crop was initiated in March, 1999. Approximately 300 acre-feet will be applied to the 1220 acres of barley on the demonstration site.

Perimeter Planting Scheme. Barley was the selected cover crop for the first year of the Demonstration Project. The grain requires relatively little water and without tillage it is unable to reseed, essentially rendering it sterile. By taking advantage of this feature of barley, incursion of the plant into plots or nearby agricultural fields is eliminated. The cover crop serves as a buffer to decrease interactive effects between plots within the experimental area and also as weed and dust control on areas outside the study plots until appropriate restoration steps can be determined based on results from the habitat restoration study. Approximately 1,220 acres of Demonstration Project lands were planted in barley in December 1999.

Cultivation of barley on the Demonstration Project lands required various levels of ground preparation, depending on the most recent crop grown and length of time fallowed. Most fields received a pre-planting soil conditioning treatment which included cultipak and bed rolling, and stubble discing and finish discing. Fields with dense vegetation or fields that had been chiseled but not disced required multiple stubble discings to achieve the same level of soil readiness as other fields.

Disposition of Lands Not Subject to Treatments

Barley Production. In addition to planting barley around test plots on the experimental areas, the remaining demonstration project land purchased by the LRT in the vicinity was planted in the same cover crop. This measure is important to prevent the establishment of weedy communities on the remaining demonstration project land while the manipulated acres are monitored for results. The presence of barley will also help control dust and loss of topsoil, both of which can be problems on tilled land that is not planted with a crop. Additionally, bare-soil evaporation (Zawislanski et al. 1992), a process that could potentially lead to wildlife contamination problems, will be hindered by the presence of a cover crop. Other cover crops besides barley may be explored on plots of land outside the eight hundred acre study area, particularly if results from monitoring indicate that barley does not adequately stabilize soils or control undesirable plant species.

Additional Restoration Studies. In addition to the experimentation on the 800 acre habitat restoration study, other smaller-scale research will be conducted as deemed necessary by the LRT and ESRP to test restoration techniques that may be useful in restoration, but cannot be included in the larger study because they would be confounding variables and too costly to implement on such a large scale.

A small trial (1.2 acres) was initiated in April 1999 to test the effectiveness of adding mycorrhizal inoculum to soil along with seed mix. Mycorrhizal fungi form symbiotic relationships with plant roots and can inhibit the growth of weedy species through nutrient cycling processes which render the soil unsuitable for those species. Mycorrhiza also increase the availability of moisture and nutrients to plant roots, and decrease the susceptibility of host plants to disease. Inoculation of the soil with mycorrhizal inoculum can be conducted at the same time as imprinting and seeding with some imprinters. Inoculum can also be added to container-grown plants which are planted as plugs. If economically feasible, mycorrhizal inoculation may be used on the demonstration site to enhance survivability of native plants and discourage ruderal species.

Hunting. Some acreage on retired lands will be set aside for hunting, education, or other purposes that directly benefit the public. In 1997, 60 acres in the NW ¼ of Section 10 were planted in safflower by DFG and used for a dove hunt in the spring of 1998 (D. Bowman, pers. comm.). Such activities could be expanded to larger areas in the future. In fact, activities such as hunting and birdwatching allows the public to benefit directly from the presence of wildlife habitat on retired land.