LAND RETIREMENT DEMONSTRATION PROJECT
YEAR THREE
2001 ANNUAL REPORT

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EXECUTIVE SUMMARY

Introduction

Vast tracts of land on the west side of the San Joaquin Valley are characterized by a high groundwater level and high selenium content. The application of irrigation water to these lands results in an accumulation of poor-quality drain-water. The elimination of drain water is a chronic problem on these lands. One way to reduce the accumulation of drain water and to lessen problems associated with its disposal is to retire the land from agricultural production. The Central Valley Project Improvement Act (CVPIA) of 1992[1] authorized a land retirement program as recommended in the San Joaquin Valley Drainage Program Final Report[2]. An interagency team consisting of representatives from the United States Bureau of Reclamation (USBR), the United States Fish and Wildlife Service (USFWS), and the United States Bureau of Land Management (USBLM) has been assembled to accomplish the goals of the CVPIA Land Retirement Program[3]. This program may purchase land, water, and other property interests from willing sellers who receive Central Valley Project water allocations. Although land retirement may provide solutions to some problems associated with agricultural drainwater, land retirement comes with its own set of challenges including: land acquisition, redistribution of the acquired water, and habitat restoration to reduce the potential for agricultural weeds and pests that would adversely impact neighboring farming interests.

Prior to initiating land retirement on a greater scale, a 15,000-acre demonstration project has been designed to test various methods of habitat restoration. The objectives are to assess the effects of land retirement on drain water and groundwater levels, evaluate its potential to decrease bio-available selenium and other toxic compounds, and to determine relative costs and success of different restoration treatments in re-establishing native biota on the sites. Two study sites, one in western Fresno County (Tranquillity site) and the other in Tulare and Kings counties (Atwell Island site), have been established. The California State University Stanislaus, Endangered Species Recovery Program (ESRP) is leading the biological studies at both sites, conducting restoration efforts, and managing the Tranquillity site. The physical impacts of land restoration are being examined by the USBR at both sites. The USBLM is conducting restoration efforts and managing the Atwell Island site.

This annual report summarizes information collected in 2001 from both the Tranquillity and Atwell Island study sites, and also results through 2001 of the Habitat Restoration Studies, site-wide biological surveys, restoration trials and efforts at both sites, and impacts of land retirement on physical properties (groundwater, soils, geology, etc). Data

[1] Federal Register: March 9, 1998. Vol. 63, No. 45. p11453.

[2] San Joaquin Valley Drainage Program. 1990. Fish and wildlife resources and agricultural drainage in the San Joaquin Valley, California. Vols I and II. 707pp+appendices.

[3] U.S. Department of Interior. 1997. Central Valley Project Improvement Act Section 3408(h): Land Retirement Program Guidelines. Unpubl. report, Interagency Land Retirement Team, Fresno, CA, 19 pp.

collected for the Habitat Restoration Studies include plant cover and survivorship, invertebrate richness and abundance, amphibian and reptile richness and abundance, avian richness and abundance, and small mammal richness and abundance. Site-wide data collection includes night spotlighting surveys, track station surveys, winter raptor surveys, contaminants monitoring, and plant cover and survivorship on various test plots. Physical impact data that are being collected include soil type and soil chemistry, groundwater levels, and groundwater contaminants.

Tranquillity Habitat Restoration Study

Although imprinting of native seeds in 1999 was successful in establishing native plants on our study plots in 2000, by 2001 frequency, cover, and abundance of native plants had diminished and exotic and native weedy species predominated. While conditions in the southern San Joaquin Valley region in 2000 and 2001 have not been favorable for production of desirable native plants, it is becoming clear that improved weed control is necessary for restoration of retired agricultural lands.

Invertebrate richness did not vary by treatment in any year, nor did richness vary among any given year across treatments. Abundance of invertebrates did not vary by treatment, except in 2001 where the contoured but non-restored plots had the fewest invertebrates. For most treatments, there was a trend of increasing invertebrate abundance from 1999 to 2000, then decreasing abundance in 2001. The most notable differences in richness were that block 1 had greater richness than any other block during all years and that block 3 had a relative low richness in 2000. Abundance among the blocks were most similar in 1999 and most variable in 2001, indicating that blocking effect is increasing. Invertebrate composition exhibited temporal changes. Thysanoptera dominated the invertebrate population in 1999 whereas Hemiptera and, secondarily, Thysanoptera dominated in 2000. In 2001 Orthoptera was dominant.

No amphibians or reptiles were captured on the plots, indicating that they remain scarce. Incidental sightings on the plots included a California king snake and a western fence lizard. Also, numerous western toads and a California king snake were observed in the vicinity of the study plots during site-wide survey efforts.

Richness and abundance of birds were highly variable among seasons in 2001. We expected this because of the numerous seasonal migrants that visit the study site. There were no observable differences in richness or abundance between treatments. Spring abundance increased each year from 1999 to 2001 and winter abundance increased from 2000 to 2001. Most species using the plots were grassland obligates or facultative grassland species. With the exception of horned larks, avian species of special concern were more abundant on the plots than in previous years. Two very desirable species, northern harriers and short-eared owls, were observed nesting on the plots.

Deer mice were the most abundant small mammal captured, although house mice, ornate shrews, California voles, and a single harvest mouse also were captured. The abundance of small mammals, particularly deer mice, has increased each year since 1999. The abundance of deer mice tended to be greater on plots that had a combination of restoration and contouring. Although treatment type appeared to have no effect on house

mouse abundance, shrews were most abundant on restored plots and voles were most abundant on contoured plots.

Atwell Island Habitat Restoration Study

In 2001, baseline data were collected on the Atwell Island study plots while they were still covered with a barely crop. The barley crop was harvested in the fall and treatments were applied. The Atwell Island HRS site seemed to possess few floristic similarities to the Tranquillity HRS site during its baseline year. In particular, a number of aggressively weedy species that were abundant at the Tranquillity HRS site were much less abundant at the Atwell Island HRS site. The absence of these species suggests that the Atwell Island site may not be plagued by weeds to the same degree as the Tranquillity site. Nevertheless, the noxious weed fivehook bassia was fairly abundant in the Atwell Island HRS plots, which may prove to be a significant problem in future years.

Invertebrate richness among the three study blocks was relatively constant, however, species composition varied. Block 1 was dominated by 4 orders (Acari, Thysanoptera, Isopoda, and Araneae), Block 2 was dominated by 2 orders (Acari and Thysanoptera) and Block 3 was dominated by a single order (Coleoptera). Sweep samples were collected, but are not yet completely identified and analyzed.

Neither amphibians nor reptiles were observed on the study plots. Incidental sightings at the HRS site included western toads, gopher snakes, and horned lizards.

Blocks 1 (10 species) and 2 (11 species) had relatively high avian richness as compared to Block 3 (5 species). Red-winged blackbirds, horned larks, western meadowlarks, and savannah sparrows were the most common birds observed.

No small mammals were captured on the study plots. Nevertheless, one San Joaquin pocket mouse (a federal Species of Special Concern) was captured by hand near one of the plots on Block 3.

Restoration Studies at Tranquillity

Results from a trial of two seeding methods (imprinting and drilling) of native seeds, while not statistically significant, suggested that the response of individual species to these methods is highly variable. These results suggest the need for more rigorous trials to determine the most appropriate method for seeding various species.

An investigation of seeding barley by imprinting and drilling suggested that either approach is acceptable. Likewise, a trial of these two seeding methods using a seed mix of barley and native grasses yielded no statistically significant differences. Nevertheless, a greater number of introduced weedy species was noted on plots seeded with the mixture containing native grasses than on the plots seeded solely with barley. This suggests that some of the weedy species on the HRS plots may have been introduced through the inclusion of their seeds in commercially purchased native seed mixes.

Biological Monitoring at Tranquillity

As in 1999 and 2000, there was seasonal variability in species richness during spotlighting surveys in 2001. There was a trend of increasing richness from 1999 to 2001. No single species was observed during every season; however, barn owls, black-tailed hares, desert cottontails, and short-eared owls were present most seasons. Generally, barn owls, black-tailed hares, desert cottontails, and red-tailed hawks were the most abundant species.

Species richness was highest on the track stations in the summer of 2000 and spring 2001 and the lowest in fall and winter 1999. Abundance of tracks was greatest in summer of 2001 and lowest in fall and winter of 1999. The greatest frequency of visitation and the greatest rate of visitation were of small mammals, except in the summer and winter of 2000. The high variability observed in the richness, abundance, frequency and rate of tracks may be indicative of the high variability in climactic conditions of the San Joaquin Valley, rather than being indicative of responses to restoration efforts at the site.

American kestrels and northern harriers were the most common raptors seen during the raptor surveys, but red-tailed hawks, loggerhead shrikes, and white-tailed kites were also frequently observed. Northern harriers and red-tailed hawks increased in rate of occurrence each year. A peregrine falcon and a ferruginous hawk, both species of special concern, were first observed on the site in 2001. Individuals of both species were observed foraging over the study plots.

Bio-accumulation of selenium does not appear to be a concern at the Tranquillity site. Selenium levels of all biota sampled (vegetation, invertebrates, and small mammals) did not increase from 1999 to 2001. In fact, there is a trend of decreasing selenium levels in most groups sampled. Selenium levels of most biotic groups fall within typical background levels. These levels are 0.01 to 0.6 mg/kg for terrestrial vegetation, 0,1 to 2.5 mg/kg for terrestrial invertebrates, <1.0 to 4.0 mg/kg for whole bodies of small mammals, and 1.0 to 10.0 mg/kg for small mammal livers. The only plant that exceeded the vegetation background levels was *Brassica nigra*, a known selenium accumulator. The levels of selenium observed in *B. nigra* (about 1.0 mg/kg) collected from the Tranquillity site are very low considering the levels that selenium that can be accumulated (500 to 1,000 mg/kg). Selenium levels in spiders and isopods slightly exceeded typical background levels for terrestrial invertebrates. However, spiders are predators and isopods are detritivores, so selenium bio-accumulation in these taxa are expected to be higher than in beetles, crickets, and other typical terrestrial invertebrates. The levels of selenium accumulation in bodies and livers of both deer mice and shrews are at the low end of the range typical for selenium accumulation in small mammals.

Restoration Studies at Atwell Island

During the fall of 2001 the Bureau of Land Management established a series of 456 small plots (1/1000 acre) to test the effectiveness of differing soil preparations and seeding rates on germination success and survival of native shrubs, forbs, and grasses. Seed from 29 species were planted at rates of 40, 80, and 160 pounds per acre. Four methods of site preparation were used: scraping the surface, disking to 8 inches, harrowing to 4 inches,

and no preparation. Supplemental nitrogen and phosphorus were added to some plots. Results of these trials will be available after the growing season in spring 2002.

Approximately 1.5 miles of hedgerows were planted with a seed mix (of *Atriplex lentiformis*, *Leymus triticoides*, *Vulpia microstachys*, *Amsinkia menziesii*, *Helianthus annus*, *Frankenia salina*, *Eremocarpus setigerus*), *Dichelostemma capitatum*, and *Hemizonia pungens*) using a range drill. A seed mix (of *Eremocarpus setigerus*, *Sporobolus airoides*., *Frankenia salina*, *Hemizonia pungens*, *Lasthenia* sp., *Atriplex polycarpa*, *A. spinifera*, *Vulpia* sp., *Gilia* sp., *Suaeda moquinii*, *Isocoma acradenia*) was also planted on approximately 240 acres using both a range drill and an imprinter. Three small areas (approximately 30 ft. x 90 ft.) that were seeded were burned immediately prior to planting.

Approximately 150 native trees and shrubs (that were rooted in supercells—10 in deep plastic containers) were planted along the Alpaugh canal and drip irrigation was installed. Drip irrigation also was installed in an 80-acre area that was planted with the range drill to supply supplemental water to shrubs during their first growing season.

A restoration effort also was conducted at an abandoned evaporation pond. Several species of salt-tolerant plants were planted as seedlings or seeds.

Biological Monitoring at Atwell Island

The most commonly observed species during spotlighting surveys, in order of decreasing abundance, were: barn owls, kangaroo rats, western toads, desert cottontails, black-crowned night herons, and great egrets. Species richness was higher in September than in December.

The greatest abundance and variety of tracks were observed during the September track station survey. In September, the most abundant tracks were of mice, insects, kangaroo rats, and western toads, whereas in December the most abundant tracks were of mice, birds, and dogs. The frequency and rate of visitation of invertebrates, amphibians, and reptiles, birds, and small mammals were greatest in the fall.

Eight species of raptors and loggerhead shrikes were observed during the winter raptor survey. The most commonly seen raptors were red-tailed hawks and northern harriers. Prairie falcons and ferruginous hawks also were intermittently observed. A total of 71 species of birds were observed during a mid-winter bird count. The most commonly observed birds were red-winged blackbirds, house finch, white-crowned sparrows, savannah sparrows, horned larks, and European starlings. Additionally, incidental sightings of 102 species of birds, 5 species of mammals, 2 species of reptiles, and 5 species of butterflies were recorded.

Bio-accumulation of selenium does not appear to be a concern at the Atwell Island site. Selenium levels of all taxa (vegetation, invertebrates, and small mammal) sampled were within typical background levels. These levels are 0.01 to 0.6 mg/kg for terrestrial vegetation, 0,1 to 2.5 mg/kg for terrestrial invertebrates, <1.0 to 4.0 mg/kg for whole bodies of small mammals, and 1.0 to 10.0 mg/kg for small mammal livers. Selenium

levels of all taxa did not increase from 2000 to 2001. In fact, there is a slight trend of decreasing selenium levels.

Physical Impacts at Tranquillity

The Tranquillity Land Retirement Demonstration Project site is underlain by flood basin deposits consisting of moderately to densely compacted clays that range in thickness from 5 to 35 ft. The flood basin clays have low permeability and provide poor drainage conditions for irrigated agricultural production. The U.S. Department of Agriculture soil types found at the site in order of abundance include the Tranquillity clay (80%), the Lillis clay (10%) and the Lethent silt loam (10%). Data on baseline soil chemistry, collected during 1999, indicate that the site soils are highly to moderately saline, and contain elevated concentrations of selenium and boron when compared to other soils in the San Joaquin Valley. The baseline data on soil chemistry collected during 1999 are adequate for establishing project baseline soil concentrations of selenium, boron, and salinity.

Groundwater monitoring data collected to date support the conceptual model of a declining, shallow water table in response to land retirement. The average decline in water level observed in 10 monitoring wells for the period between August 1999 and October 2001 was 4 feet. The area of the site underlain by a shallow water table within 7 feet of the land surface decreased from 600 acres (30% of the site) to 34 acres (less than 2% of the site) during the time period from October 1999 to October 2001. Large vertical groundwater gradients measured at the site indicate perched water-table conditions in the shallow groundwater system.

Baseline groundwater quality data taken during 1999 indicate that the shallow groundwater is a highly saline, sodium sulfate type of water that contains high concentrations of selenium and boron (median electrical conductivity = 43,260 micro-siemens/cm, median selenium concentration = 1280 μg/l, median boron concentration = 46 mg/liter). Stable isotope data indicate that the shallow groundwater has undergone evaporation resulting in high salinity and trace element concentrations. Selenium concentrations observed in deep wells completed in the underlying Sierra Nevada deposits at the site are below the analytical detection limit for this study (less than 0.4 μg/l). Reducing geochemical conditions in the Sierran deposits underlying the northern portion of the site may account for this observation. Tritium data from the shallow monitoring wells indicate that the shallow groundwater consists of a mixture of water recharged before and after 1952. Tritium data from the deep wells completed in the Coastal Range deposits at the site indicate that the groundwater was recharged before 1952. Data on groundwater quality collected during 1999 are adequate for establishing baseline project conditions. No surface water ponding was observed at the site during 2001.

Physical Impacts at Atwell Island

The Atwell Island demonstration site lies on the southwestern margin of the Tulare Lake bed. The site is underlain by lakebed and marsh deposits consisting primarily of clay and silt with some sand. Soils in the Atwell Island study area consist of silt and sand loams

that are formed from alluvium derived from igneous and sedimentary rocks. The U.S. Department of Agriculture soil mapping units found at the site in order of abundance include the Posochanet silt loam, Nahrumb silt loam, Westcamp silt loam, Excelsior fine sandy loam, and Lethent fine sandy loam. Baseline data on soil chemistry will be collected at the site during 2002 to establish project baseline soil concentrations of selenium, boron, and salinity within the study research blocks. Monitoring wells were installed at the site in the fall of 2001 to establish baseline groundwater conditions. Initial groundwater level measurements indicate the presence of a perched water table beneath much of the site. The year 2002 will be the baseline for groundwater levels and groundwater quality. Surface water monitoring will also commence in 2002.

Tours, Presentations, Conferences, and Workshops

One site tour of the Tranquillity site was given in 2001. Information obtained during our studies was presented at conferences sponsored by the western section of The Wildlife Society and The Society for Ecological Restoration, California Chapter. Additionally, presentations were given to The Westlands Resource Conservation District and to students at California State University Stanislaus. Land Retirement Team members attended a workshop on restoration sponsored by the USBLM, a workshop on field ornithological techniques sponsored by Point Reyes Bird Observatory, and attended a national conference sponsored by The Wildlife Society.

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