

**BASELINE ASSESSMENT
FOR
RIPARIAN RESTORATION
AT THE
STEGEMAN RESTORATION AREA**

Prepared by:

**Jean G. Hubbell, M.S.
Catherine Little
Katie C. Price
John W. Hunt, M.S.
Dr. David M. Wood
Department of Biological Sciences
California State University, Chico**

January 2006

Prepared for:

**The Nature Conservancy
Sacramento River Project, Chico, California**

TABLE OF CONTENTS

	Page
SECTION 1: RESTORATION PLANTING RECOMMENDATIONS	2
Introduction	3
Adjacent Landcover	3
Methods	3
Restoration Type Recommendations	5
Restoration Planting Recommendations	5
References	15
SECTION 2: REMNANT RIPARIAN VEGETATION SURVEY	16
Introduction	17
Methods	17
River Channel History	18
Remnant Riparian Vegetation Community Descriptions	19
References	27
SECTION 3: SOIL SURVEY	28
Introduction	29
Methods	29
Soils Description	30
References	39
SECTION 4: SPECIAL STATUS ANIMAL SPECIES, BIRD COUNTS, AND NON-NATIVE MAMMALS	40
Introduction	41
Methods	41
Special Status Animal Species	41
Threatened and Endangered Wildlife Species	43
Non-Native Mammal Species	43
Bird Counts	44
References	48

SECTION ONE

STEGEMAN

RESTORATION PLANTING RECOMMENDATIONS

Prepared by:

Jean G. Hubbell, M.S.
Catherine Little
Katie C. Price
Dr. David M. Wood
Department of Biological Sciences
California State University, Chico

Introduction

The Stegeman tract is located approximately 2.75 miles south of Princeton in Colusa County on the west side of the Sacramento River at river mile 160 and is owned by the Wildlife Conservation Board and managed by the California Department of Fish and Game as the northern parcel of the Stegeman Unit of their Sacramento River Wildlife Area. The entire tract is 69 acres in area. The Stegeman Restoration Area (hereafter “Restoration Area”) is 10 acres of the tract inside the levees and is currently a fallow walnut orchard surrounded by riparian habitat. East of the Restoration Area is a sparse cottonwood riparian forest on the banks of the Sacramento River along with herbland, all within the Stegeman tract. South of the Restoration Area is herbland and then mixed riparian forest, which wraps around and bounds the west and north sides of the Restoration Area. This vegetation is also within the Stegeman tract and extends southward into the adjacent property. Significant colonization of the walnut orchard by adjacent riparian species has occurred along the western edge. Unfortunately this colonization is predominantly from California black walnut (*Juglans californica*), a controversial species that many ecologists do not consider native to the Sacramento Valley.

Field surveys of nearby remnant riparian vegetation, site soils and birds were conducted during May, June and July, 2005, at the Restoration Area. Information on special status animals and non-native mammals for the site was also compiled during that time.

Five natural plant communities were found to occur close to the Restoration Area: Great Valley mixed riparian forest, Great Valley cottonwood riparian forest, Great Valley willow scrub, elderberry savanna, and herbland (Holland 1986; Figure 1). With the exception of herbland, all of these communities in some form (i.e. may differ in nomenclature) are on the list of California Terrestrial Natural Communities recognized by The California Natural Diversity Database (CA DFG 2003). Four of these plant communities (excluding herbland) comprise the estimated 45 acres of native riparian vegetation within the Stegeman Tract. A detailed discussion of nearby remnant riparian vegetation is in Section Two.

The restoration planting recommendations are presented below with supporting vegetation and soil surveys in Sections Two and Three. The special status animal and non-native mammal information is in Section Four.

Adjacent Landcover

The Stegeman tract is adjacent to two properties; however the Green Valley Corporation property is included here as a third adjacent landowner due to its proximity to the Stegeman tract. To the east is the Sacramento River. To the south is the 76-acre Yerxa property with remnant riparian vegetation bounding the Stegeman tract. The Yerxa walnut orchard is at the southwestern corner of the tract. There is approximately 700 m of remnant riparian vegetation located on the Stegeman tract between the Restoration Area and the Yerxa walnut orchard. To the west and north of the Stegeman tract is the 60-acre 1000-acre Ranch tract owned by The Nature Conservancy. Remnant riparian vegetation separates the Restoration Area from the 1000-acre Ranch tract to the west, by approximately 280 m. To the north is the levee on the 1000-acre Ranch tract and to the north of that is 196 acres owned by Green Valley Corporation with a fruit drying facility and mature plum orchards. This property is approximately 80 m from the Restoration Area separated by the levee (~ 40 m) and by remnant riparian forest and herbland (~ 40 m).

Methods

The 10-acre Restoration Area was stratified into sections based on soils, topography and geomorphology. The sections were determined from aerial photographs and soil maps, and

refined as needed upon site review. Potential plant communities were chosen for the Restoration Area utilizing the remnant riparian vegetation community descriptions and Restoration Area soil descriptions and estimated elevations (not shown), including the influence of historic channels and estimated flood frequency (Figures 1-5; Sections Two and Three). In the figures, the information on flood frequency comes from Department of Water Resources (DWR) 1997 data whereas the aerial photographs are from 1999. Thus on occasion the two do not coincide due to changes in landform and river location between the two time periods. Furthermore the DWR estimated flood frequencies do not account for local topography and thus the estimated flood frequencies may not represent actual flooding patterns (CA DWR 2002, US ACOE 1997). Although only the flood frequencies are shown here, restoration recommendations take into account the topography data from the U.S. Army Corps of Engineers 1997 digital elevation model (DEM) with 2 foot contours. Since the error on these data is +/- 2 feet, only differences greater than 4 feet are considered real. The potential plant communities are based on Holland's riparian communities (1986). Since biodiversity enhancement is an important restoration goal, species composition of the Holland community is adjusted to reflect nearby remnant riparian plant communities and local differences in that plant community (Hubbell and Euseff 1998).

Recommended frequencies for woody species are based on species frequency in the remnant riparian vegetation, visual dominance and biodiversity concerns (Tables 1 and 2; Peterson et al. 2003, Wood 2003). For communities where no nearby remnant vegetation data exist, data from other baseline assessments with that community were used (e.g. Hubbell et al. 1998, 1999a-d, 2003a-d) or estimates were made based on expected frequency of a species for that community. Remnant riparian woody species frequency was calculated in two ways to provide information on both species composition and distribution for recommended woody species. (1) Calculating remnant riparian woody species frequency across quadrants provides data on species composition and thus is referred to as composition frequency in this document. Within a remnant riparian community type composition frequency was calculated as: number of quadrants a species occurred in divided by total number of quadrants sampled times 100 (Table 4). Since remnant riparian vegetation composition frequencies for woody species are by one of three physiognomic classes, and recommended composition frequencies are for all woody species lumped together, then recommended composition frequencies will be 1/3 of those found in the remnant vegetation and then possibly adjusted as noted above (Table 1). For species that occurred in multiple physiognomic classes the composition frequency was totaled and then divided by three. (2) Calculating remnant riparian woody species frequency across sampling points provides data on species distribution within the community (e.g. is it clumped or ubiquitous) and thus is called distribution frequency in this document (Table 2). These data can be utilized in the details of the planting design. Within a remnant riparian community type distribution frequency was calculated as: number of points a species occurred at divided by total number of points sampled times 100 (Table 4). For recommendations of species that occurred in multiple physiognomic classes, distribution frequency was calculated across these physiognomic classes. Thus remnant vegetation distribution frequencies are more similar to recommendations.

The species composition and abundance recommendations for herbaceous species are predominantly based on local visual dominance in remnant riparian areas, ecologically-based substitutions of natives for those non-natives common in remnant areas, and biodiversity enhancement (Table 3; Peterson et al. 2003, Wood 2003). Recommendations for herbaceous species are not as precise as are those for woody species due to low occurrence of native herbs in remnant riparian vegetation as well as to the paucity of general information regarding composition and abundance of the herbaceous layer of riparian communities. Holl and Crone's (2004) study of herbaceous communities along a 150 km reach of the middle Sacramento River

found no relationship between understory herbaceous communities and overstory dominance. Still, we were able to use Holl and Crone's data as a basis for some of the recommended herbaceous species. If there were data from both remnant riparian vegetation surveys and from Holl and Crone (2004) we used a mean of the two for the basis of our recommendations. Abundance of remnant riparian herbaceous species within a community type was calculated as mean percent cover: percent cover for a species summed over all points divided by the total number of sampling points (Table 5). Direct seeded grass species are listed without abundances. Only abundance for recommended herbaceous species composition is included here due to the limited data for distribution frequency of remnant riparian herbaceous species (Table 3).

For communities with *Salix* species (cottonwood riparian forest, mixed riparian forest, willow scrub, mule fat scrub, buttonbush scrub) the total recommended herbaceous species coverage is less than 100 % because this value was calculated as 100% minus the sum of mean percent cover for all the *Salix* species in that community.

Restoration Type Recommendations

Active horticultural restoration is recommended to derive the greatest habitat benefit for this Restoration Area in the short term. Direct loss of habitat is one of the primary reasons that many native species and communities of the Sacramento River ecosystem are in such critical conditions. To improve the situation more habitat must be created in the short term. While restoration by natural processes provides one means of creating new terrestrial habitats, the approach has its limitations. Natural process restoration only works in a timely manner on the lowest lying areas of the floodplain where appropriate hydrogeomorphologic conditions exist. Sites where natural process restoration is appropriate are limited on the Sacramento River, as most areas are not subject to the erosional and depositional forces that foster natural recruitment events. Although the Restoration Area is directly adjacent to the main channel of the Sacramento River, and mainly lies in the estimated 1-2 year floodplain, elevation data (U.S. ACOE 1997) clearly shows that the entire Restoration Area is higher by at least several feet than the large area of remnant vegetation to the west and south. This suggests that the Restoration Area itself will probably not flood to the degree required for natural process restoration to be successful. In addition, a comparison of air photos from 1999 to 2004 shows that the Restoration Area remained essentially unchanged, without significant colonization by native species during that period.

If active horticultural restoration is not undertaken, then at a minimum orchard trees and unwanted natives (e.g. California black walnut) should be removed and weed control measures should be taken. This could provide a jumpstart for natural process restoration. Should colonization of native species not happen in a timely manner then at least the Restoration Area is prepared for horticultural restoration. Natural process restoration without any intervention (i.e. orchard removal and weed control) is not recommended as the Restoration Area will continue to be infested with non-native invasive species (e.g., yellow-starthistle, Johnson grass, Bermuda grass) that will inhibit the colonization and proliferation of desirable native vegetation for the foreseeable future. Previous research along the Sacramento River has shown even when sites are artificially flooded coincident with the dispersal of native propagules, exotic species will come to dominate (Peterson 2002).

Restoration Planting Recommendations

Figure 5 depicts the potential plant communities with flood frequency and soil sampling locations. Composition and distribution frequencies for the recommended species within a potential plant community are in Tables 1-3. Communities are placed in arcuate bands as much

as possible to simulate the natural vegetation pattern. Mixed riparian forest is suggested for the western portion and a northern patch of the Restoration Area to expand the existing adjacent mixed riparian forest into the approximate 2-year floodplain, where the 1999 aerial photo shows the soils can support tree growth. The soils here have a finer texture than elsewhere in the Restoration Area. Willow scrub is recommended for the sandiest areas where orchard growth appears to be poor or lacking in the 1999 aerial photo and regular flooding, approximately every 1-2 years, would occur. For example, there are sand lenses several feet thick in the subsurface of the willow scrub B area (Figure 5, Table 11). Cottonwood riparian forest is suggested for the eastern portion of the Restoration Area to extend the present band of cottonwood riparian forest throughout the approximate 1 year floodplain, where the 1999 aerial photo indicates soils will support tree growth. Soils here are coarser textured and thus better drained than those where mixed riparian forest is recommended.

Stegeman Restoration Area: Remnant Riparian Plant Communities

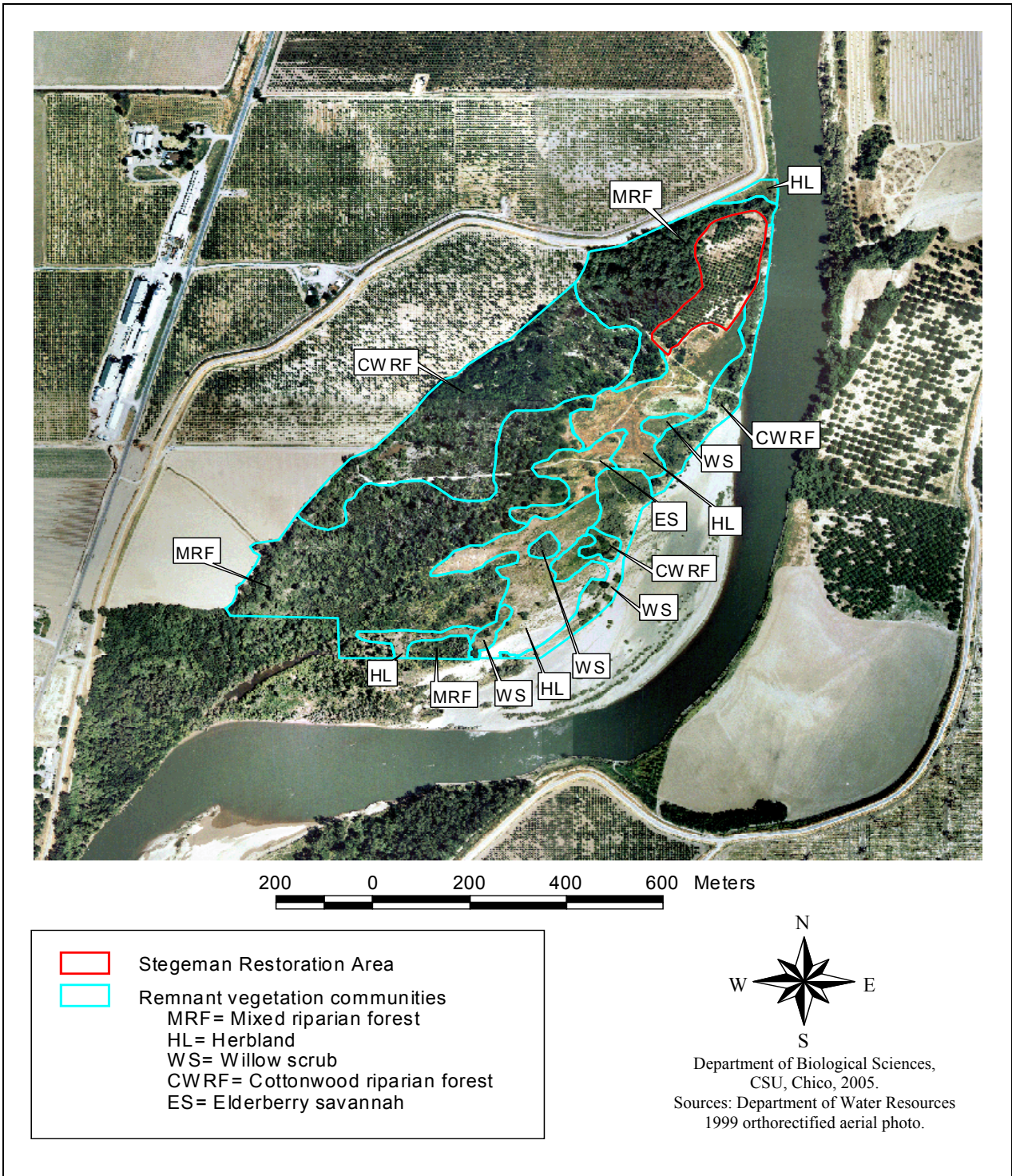


Figure 1. Remnant riparian plant communities nearby the Stegeman and 1000-acre Ranch Restoration Areas, Colusa County, California.

Stegeman Restoration Area: Estimated Flood Frequency and Soil Sampling Locations

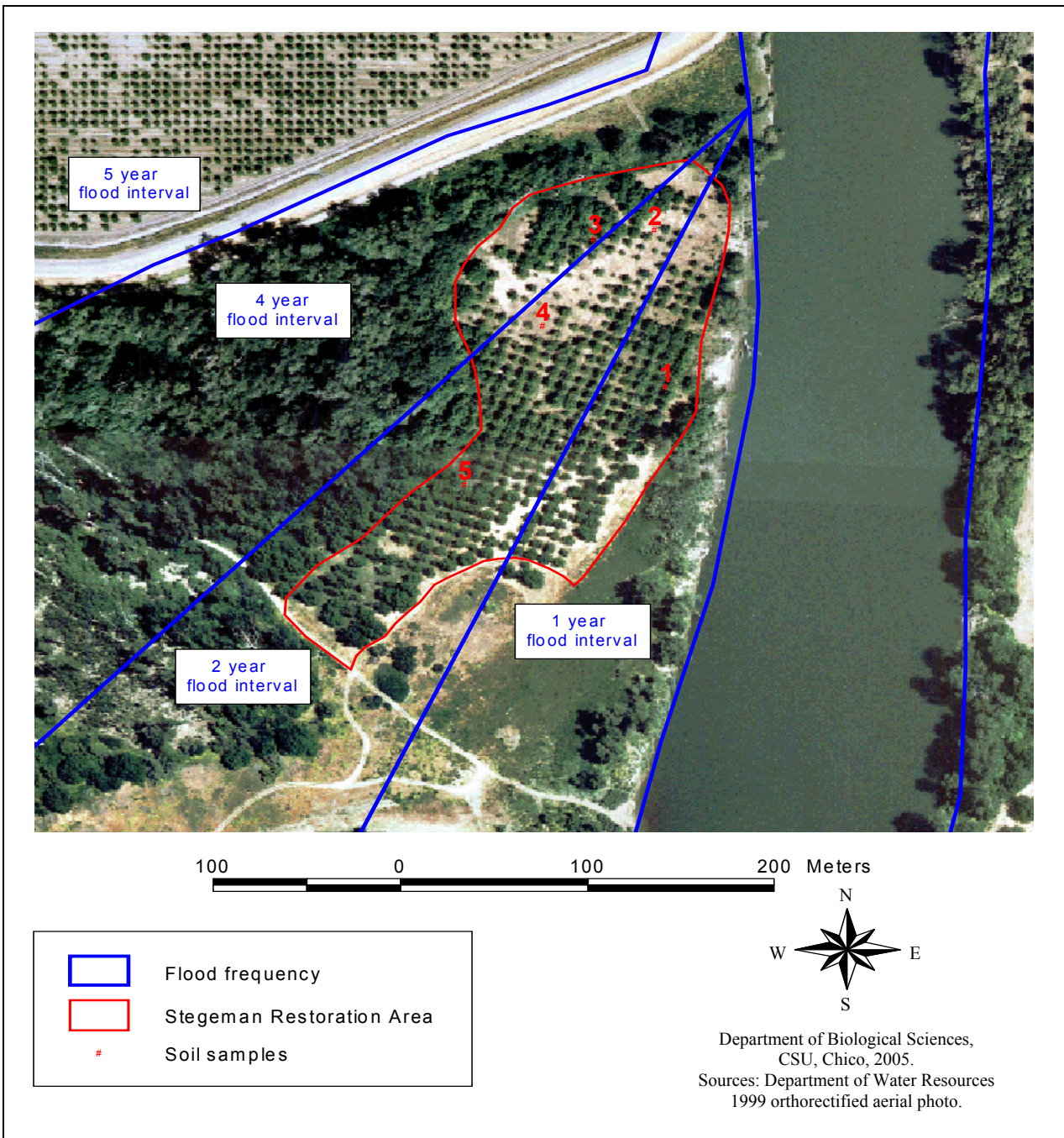


Figure 2. Estimated flood frequency and soil sampling locations at the Stegeman Restoration Area, Colusa County, California. Flood frequencies are from Department of Water Resources 1997 data; air photos are from 1999.

Stegeman Restoration Area: Soil Sampling Locations and Historic River Channels

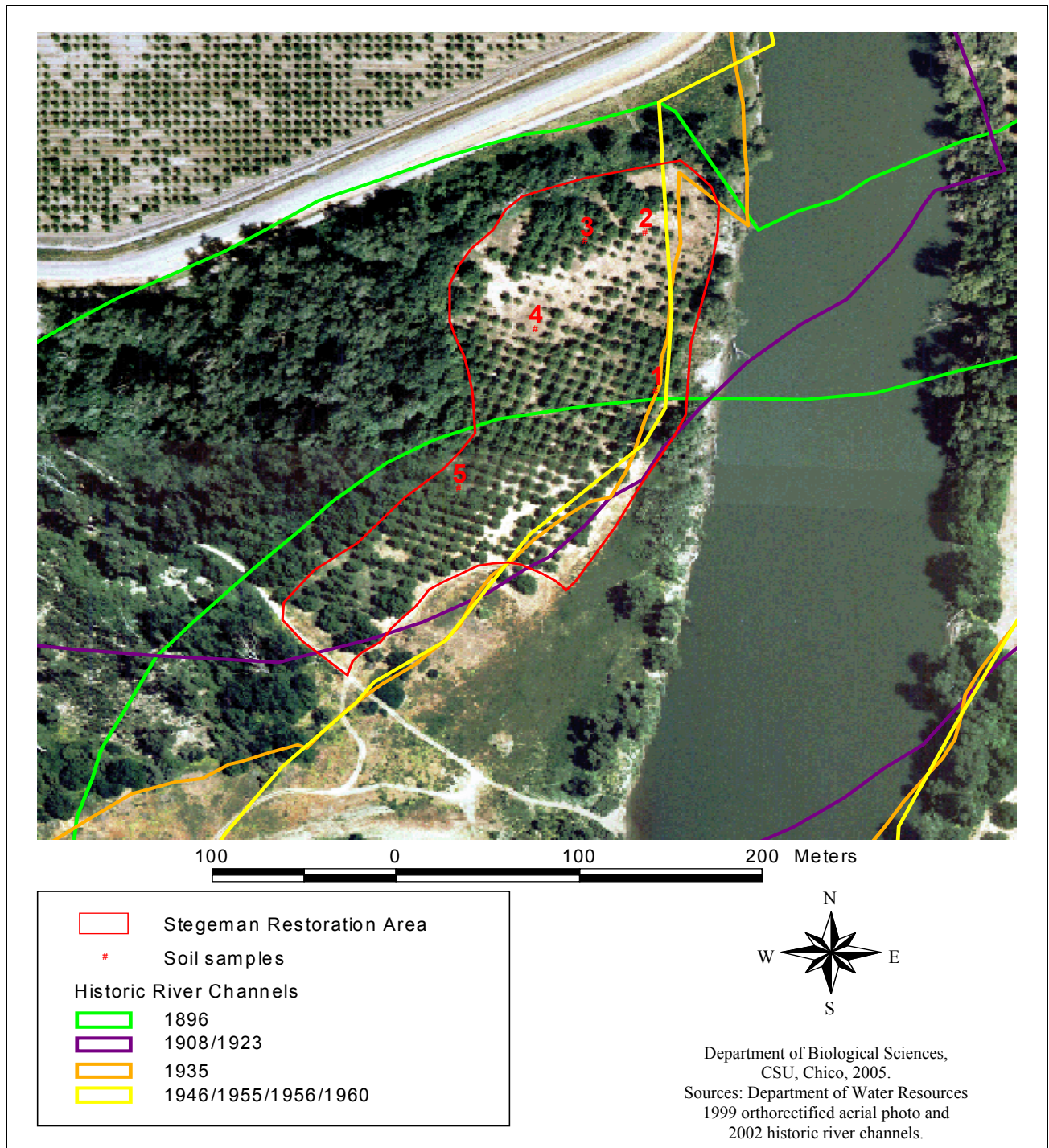


Figure 3. Soil sampling locations and historic river channels from 1896, 1908, 1923, 1935, and 1960 at the Stegeman Restoration Area, Colusa County, California. The 1923 river channel is the same as 1908 and the 1960 river channel is the same as 1946, 1955, and 1956 for this stretch of the river.

Stegeman Restoration Area: Potential Plant Communities

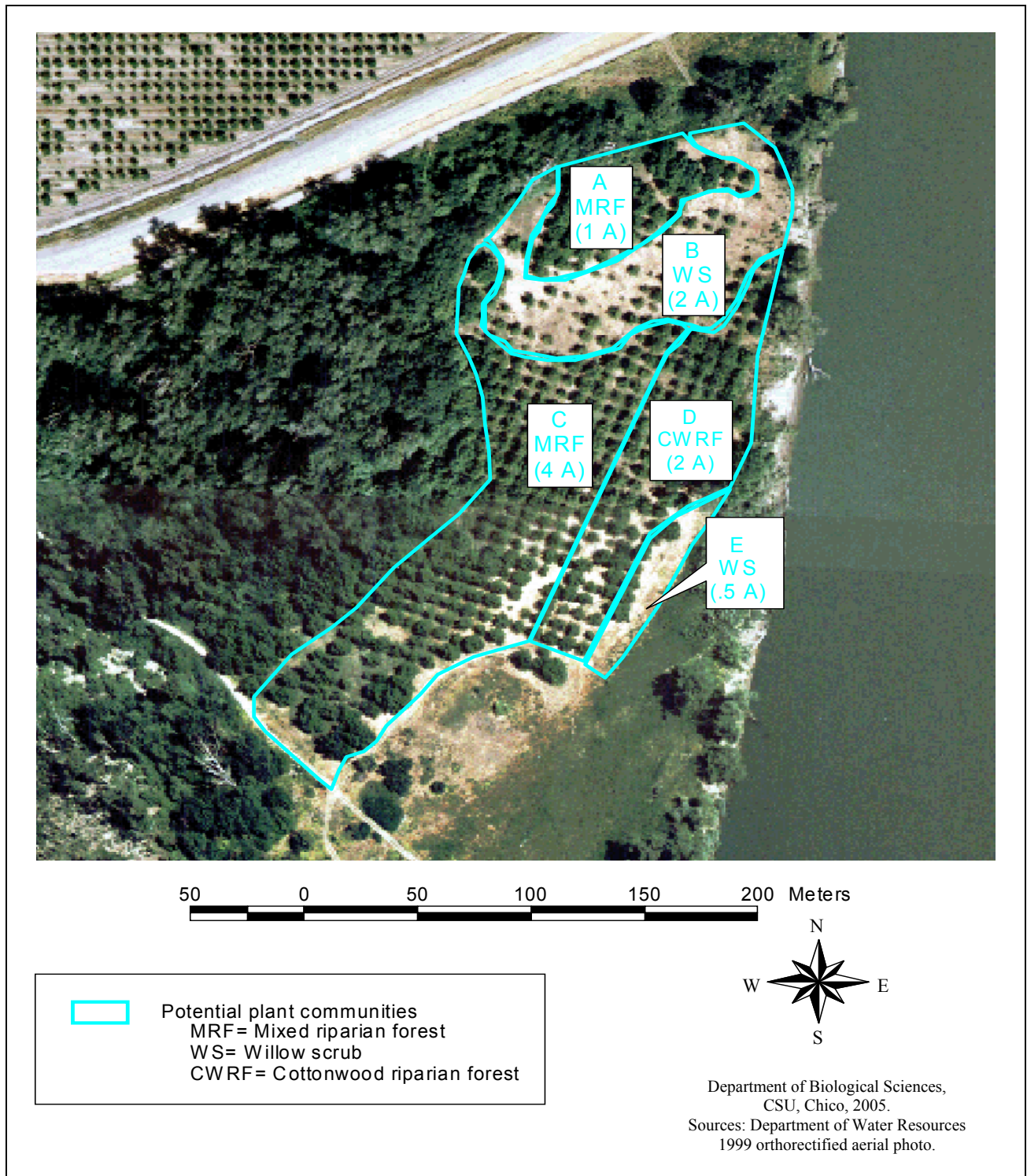


Figure 4. Potential plant communities for the Stegeman Restoration Area, Colusa County, California.

Stegeman Restoration Area: Estimated Flood Frequency, Soil Sampling Locations, and Potential Plant Communities

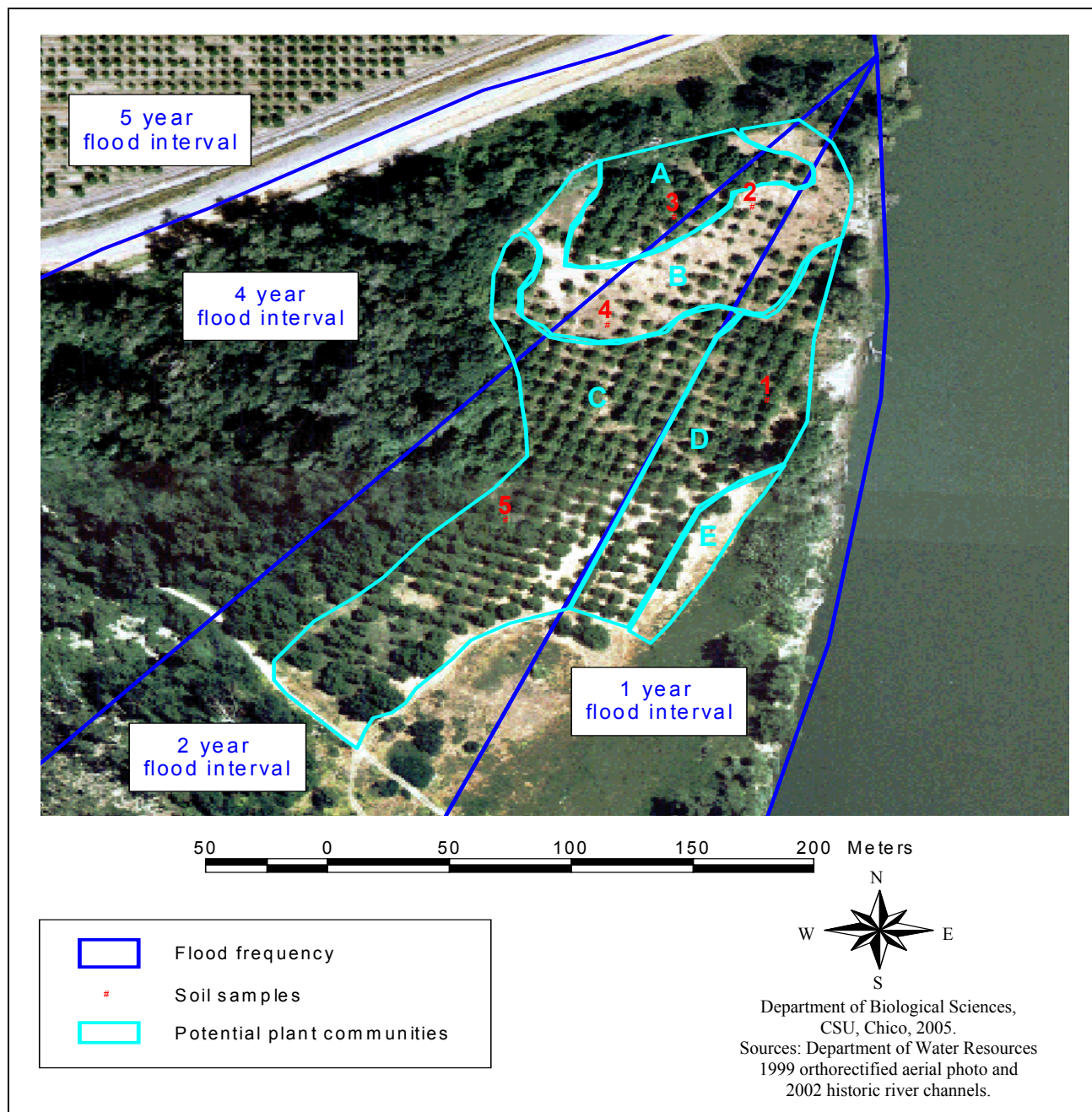


Figure 5. Estimated flood frequency, soil sampling locations, and potential plant communities at the Stegeman Restoration Area, Colusa County, California. A is mixed riparian forest (1 acre), B is willow scrub (2 acres), C is mixed riparian forest (4 acres), D is cottonwood riparian forest (2 acres), and E is willow scrub (.5 acre). Flood frequencies are from Department of Water Resources 1997 data; air photos are from 1999.

Table 1. Composition frequency by community type for potential woody overstory restoration species for the Stegeman Restoration Area, Colusa County, California. Remnant vegetation frequency is given by community type for those species recorded during quantitative sampling. Abbreviations are: MRF=Mixed Riparian Forest; CWRF=Cottonwood Riparian Forest; WS=Willow Scrub. A “+” indicates observed but not sampled for that community; a blank indicates not observed. An “H” indicates a species added since listed by Holland. Nomenclature follows The Jepson Manual (Hickman 1993).

Common Name	Scientific Name	Composition Frequency (%)					
		Remnant Vegetation			Stegeman Recommendations		
		Stegeman/1000-acre Ranch					
Woody Species		MRF (n=56)	CWRF (n=56)	WS (n=16)	MRF	CWRF	WS
box elder	<i>Acer negundo</i>	50	85		17	18	
western sycamore	<i>Platanus racemosa</i>	2	2		5	1	
Fremont cottonwood	<i>Populus fremontii</i>	14	46	H	5	30	10
valley oak	<i>Quercus lobata</i>		+		5		
narrow-leaved willow	<i>Salix exigua</i>	6	16	106	3	15	35
Goodding's black willow	<i>Salix gooddingii</i>	H	4		3	5	10
arroyo willow	<i>Salix lasiolepis</i>	23	4	19	8	5	11
Oregon ash	<i>Fraxinus latifolia</i>	H	H		5	2	
mule fat	<i>Baccharis salicifolia</i>		5			2	
California button willow	<i>Cephalanthus occidentalis</i> var. <i>californicus</i>	H	4		3	1	
California rose	<i>Rosa californica</i>	5		H	5		5
California blackberry	<i>Rubus ursinus</i>	43	11		14	2	
blue elderberry	<i>Sambucus mexicana</i>			6			2
western poison oak	<i>Toxicodendron diversilobum</i>	14	2		5		
red willow	<i>Salix laevigata</i>	H	H		3	2	5
shining willow	<i>Salix lucida</i> ssp. <i>lasiandra</i>	H	H	H	3	2	5
California pipevine	<i>Aristolochia californica</i>	9		6	3		2
California man-root	<i>Marah fabaceus</i>	5	4	44	2	1	10
California wild grape	<i>Vitis californica</i>	23	68	H	10	13	5
virgin's bower	<i>Clematis ligusticifolia</i>	H			3		
Total Coverage					100	100	100

Table 2. Distribution frequency by community type for potential woody overstory restoration species for the Stegeman Restoration Area, Colusa County, California. Frequency is given by community type for those species recorded during quantitative sampling. Abbreviations are: MRF=Mixed Riparian Forest; CWRP=Cottonwood Riparian Forest; WS=Willow Scrub. A blank indicates not observed. An “*” indicates estimated frequency for species that were recommended but not sampled within a remnant community. Nomenclature follows *The Jepson Manual* (Hickman 1993).

Common Name	Scientific Name	Stegeman Recommendations		
		Distribution Frequency (%)		
Woody Species		MRF	CWRF	WS
box elder	<i>Acer negundo</i>	64	79	
western sycamore	<i>Platanus racemosa</i>	7	7	
Fremont cottonwood	<i>Populus fremontii</i>	43	79	75*
valley oak	<i>Quercus lobata</i>	10*		
narrow-leaved willow	<i>Salix exigua</i>	7	29	100
Goodding's black willow	<i>Salix gooddingii</i>	10*	14	75*
arroyo willow	<i>Salix lasiolepis</i>	29	10*	50
Oregon ash	<i>Fraxinus latifolia</i>	10*	10*	
mule fat	<i>Baccharis salicifolia</i>		14	
California button willow	<i>Cephalanthus occidentalis</i> var. <i>californicus</i>	10*	14	
California rose	<i>Rosa californica</i>	14		10*
California blackberry	<i>Rubus ursinus</i>	50	21	
blue elderberry	<i>Sambucus mexicana</i>			25
western poison oak	<i>Toxicodendron diversilobum</i>	21		
red willow	<i>Salix laevigata</i>	10*	10*	10*
shining willow	<i>Salix lucida</i> ssp. <i>lasiandra</i>	10*	10*	10*
California pipevine	<i>Aristolochia californica</i>	14		25
California man-root	<i>Marah fabaceus</i>	7	7	50
California wild grape	<i>Vitis californica</i>	29	79	75*
virgin's bower	<i>Clematis ligusticifolia</i>	10*		

Table 3. Mean percent cover by community type for potential herbaceous understory restoration species at the Stegeman Restoration Area, Colusa County, California. Abbreviations are: MRF=Mixed Riparian Forest; CWRF=Cottonwood Riparian Forest; WS=Willow Scrub. Abundances in italics are from Holl and Crone (2004). A blank indicates not observed. An “E” indicates species to be planted on the edge. The “*” indicates that the source data are for this genus and one or more appropriate species were selected to represent the genus. A “DS” indicates that these species will be direct seeded and thus not planted as plugs. Note that the herbaceous component is less than 100 % in communities with *Salix* species (see Methods). Nomenclature follows *The Jepson Manual* (Hickman 1993).

Common Name	Scientific Name	Mean Percent Cover					
		Remnant Vegetation			Stegeman Recommendations		
		Stegeman/1000-acre Ranch					
Herbaceous Species		MRF (n=14)	CWRF (n=14)	WS (n=4)	MRF	CWRF	WS
mugwort	<i>Artemisia douglasiana</i>	6.00	8.00	23	5	16	13
Indian hemp	<i>Apocynum cannabinum</i> var. <i>glaberrimum</i>		1.00			2	
horseweed	<i>Conyza canadensis</i>	0.05			3		
fireweed	<i>Epilobium ciliatum</i>	0.05	1.00*		3	2	
goose grass	<i>Galium aparine</i>	10.00	2.00	17	9	7	
lotus	<i>Lotus purshianus</i>	0.05			3		
bugleweed	<i>Lycopus americanus</i>	0.09	0.10		3	2	
nettle	<i>Urtica dioica</i>	2.00			5	4	
western goldenrod	<i>Euthamia occidentalis</i>				10	5	
California goldenrod	<i>Solidago californica</i>				10	5	
hairy evening-primrose (E)	<i>Oenothera elata</i>				5	5	
Santa Barbara sedge	<i>Carex barbarae</i>	3.00*	0.36*		15	11	10
clustered field sedge	<i>Carex praegracilis</i>	3.00*	0.36*		8	10	10
blue wildrye	<i>Elymus glaucus</i> ssp. <i>glaucus</i>	1.00	0.40	3	DS	DS	DS
creeping wildrye	<i>Leymus triticoides</i>		H		DS	DS	DS
Total Coverage					80	70	33

References

- California Department of Fish and Game. 2003. California Natural Diversity Database, List of California Terrestrial Natural Communities. Wildlife and Habitat Data Analysis Branch, Sacramento CA. Retrieved from: <http://www.dfg.ca.gov/whdab/pdfs/natcomlist.pdf>.
- California, Department of Water Resources. 2002. GIS of the middle Sacramento River, California. Northern District, Red Bluff, California.
- Hickman, J., Ed. 1993. The Jepson Manual: Higher Plants of California. University of California Press, Berkeley, California.
- Holl, K. D. and E. L. Crone. 2004. Applicability of landscape and island biogeography theory to restoration of riparian understorey plants. *Journal of Applied Ecology* 41:922-933.
- Holland, R. F. 1986. Preliminary Descriptions of the Terrestrial Natural Communities of California. California Department of Fish and Game, Non-game Heritage Program, Sacramento, California.
- Hubbell, J.G. and D.S. Efseaff. 1998. Vegetation Assessment of Five 1998/1999 Sacramento River Project Restoration Sites for The Nature Conservancy. Unpublished report to The Nature Conservancy.
- Hubbell, J.G., D.L. Brown, J. Rotnem, J. Schwenkler, G. Magda, C. Wilder, and S. Ellberg. 1999a. Kaiser 1999 Site Assessment for the Nature Conservancy. Unpublished report to The Nature Conservancy.
- . 1999b. River Vista 1999 Site Assessment for the Nature Conservancy. Unpublished report to The Nature Conservancy.
- Hubbell, J.G., D.L. Brown, J. Rotnem, J. Schwenkler, G. Magda, and C. Wilder. 1999c. Ryan 1999 Site Assessment for the Nature Conservancy. Unpublished report to The Nature Conservancy.
- . 1999d. Stone 1999 Site Assessment for the Nature Conservancy. Unpublished report to The Nature Conservancy.
- Hubbell, J.G., J.W. Hunt, M. Quinn, and D.M. Wood. 2003a. Site Assessment for Riparian Restoration at the RX Ranch Unit. Unpublished report to The Nature Conservancy.
- . 2003b. Site Assessment for Riparian Restoration at the Deadman's Reach Unit of U.S. Fish and Wildlife Service's Sacramento River National Wildlife Refuge. Unpublished report to The Nature Conservancy.
- . 2003c. Site Assessment for 2003 Restoration at the Haleakala Unit of U.S. Fish and Wildlife Service's Sacramento River National Wildlife Refuge. Unpublished report to The Nature Conservancy.
- . 2003d. Site Assessment for Riparian Restoration at the Sunset Ranch Unit. Unpublished report to The Nature Conservancy.
- National Agriculture Imagery Program. 2004. Orthorectified aerial photos of Glenn and Colusa Counties, California.
- The Nature Conservancy. 2005. Draft Colusa Subreach Background Report. Northern Central Valley Office, Chico, California.
- Peterson, D.R. 2002. The development of an alternative restoration strategy for Sacramento River riparian forests. Master's Thesis, California State University, Chico.
- Peterson D.R., G.H. Golet, R. Luster, M. Roberts, and D. Jukkola. 2003. Modeling plant community types as a function of physical site characteristics. Report to CALFED. Available at: <http://www.sacramentoriverportal.org>.
- U.S. Army Corps of Engineers. 1997. Digital elevation model. Received from The Nature Conservancy.
- Wood, D.M. 2003. An analysis of vegetation on restoration sites. Report to The Nature Conservancy. Available at: <http://www.sacramentoriverportal.org>.

SECTION TWO

STEGEMAN

REMNANT RIPARIAN VEGETATION SURVEY

**Catherine Little
Jean G. Hubbell, M.S.
Gay Ann Silman
Katie C. Price
Dr. David M. Wood**

Introduction

Remnant riparian vegetation surveys of nearby stands are used as a reference for potential vegetation communities and for determining planting recommendations in the Restoration Area. Vegetation surveys were conducted in May 2005.

East of the Restoration Area is a sparse cottonwood riparian forest on the banks of the Sacramento River along with herbland, all within the Stegeman tract. South of the Restoration Area is herbland and then mixed riparian forest, which wraps around and bounds the west and north sides of the Restoration Area. This vegetation is also within the Stegeman tract and extends southward into the adjacent property. Significant colonization of the Restoration Area (a fallow walnut orchard) by adjacent riparian species has occurred along the western edge. Unfortunately this colonization is predominantly from California black walnut (*Juglans californica*), a controversial species that many ecologists do not consider native to the Sacramento Valley. Existing remnant riparian vegetation surveyed occurs on land owned by the Wildlife Conservation Board and managed by California Department of Fish and Game as the Stegeman Unit of their Sacramento River Wildlife Area (including the Stegeman Tract) and the Yerxa private property. Details of adjacent landcover can be found in Section One. The same remnant vegetation was sampled for both the Stegeman and 1000-acre Ranch Restoration Area Baseline Assessments.

Five natural communities were found to occur close to the Restoration Area: Great Valley mixed riparian forest, Great Valley cottonwood riparian forest, Great Valley willow scrub, elderberry savanna, and herbland (Figure 6). Qualitative community descriptions follow Holland (1986). With the exception of herbland, all of these communities in some form (i.e. nomenclature may differ) are on the list of California Terrestrial Natural Communities recognized by The California Natural Diversity Database (CA DFG 2003). Four of these plant communities compose the estimated 45 acres of native riparian vegetation within the Stegeman Tract.

Methods

The vegetation survey maps community types and lists the most obvious plant species for nearby remnant riparian vegetation. Community typing here is qualitative and is based on visually dominant species, overall species list and frequency data rather than complete quantified sampling for community composition. Intergradations occur for most community types in the riparian vegetation. Listing of the visually common plant species was performed during point-quarter sampling and site reconnaissance. Nomenclature follows *The Jepson Manual* (Hickman 1993). If no common name is listed in *The Jepson Manual* then Oswald and Ahart's (1994) common name was used.

Vegetation sampling was conducted in the remnant riparian vegetation surrounding the Restoration Area (Figures 1 and 6). Point-quarter sampling was used to quantify frequency of woody species and abundance of herbaceous species (Barbour et al. 1999). Remnant vegetation was stratified into approximate community types using aerial photograph interpretation and GIS vegetation coverage (CA DWR 2002; not shown). Each community type was then sampled to provide enough data to confirm the community type, adjust boundaries, and describe species composition. The amount of sampling for each community is proportional to its area. In each community type within the remnant riparian vegetation at least four sampling points were established (if possible). Forty sampling points, each with four quadrants, were established along several transects running roughly perpendicular to the bands of vegetation. For frequency of woody species, each quadrant was sampled for three types of woody species: trees, shrubs and vines. For each type of woody species, the first species encountered within each quadrant of a sampling point was recorded. Since a number of riparian woody species occur as both trees and

shrubs, physiognomic criteria were used (e.g. multiple stems for shrub and diameter at breast height greater than 8 cm for trees). Thus some woody species can be listed in two categories. For abundance of herbaceous species, the percent cover of the three most visually abundant species within a 3m radius of each sampling point was recorded.

Within each remnant riparian community type and woody species category, frequency was calculated in two ways to provide information on both woody species composition and distribution. (1) Calculating woody species frequency across quadrants provides data on species composition and thus is referred to as composition frequency in this document. Within a community type composition frequency was calculated as: number of quadrants a species occurred in divided by total number of quadrants sampled times 100 (Tables 4 and 6). These data are the basis for determining frequency of recommended species for restoration. (2) Calculating woody species frequency across sampling points provides data on species distribution within the community (e.g. is it clumped or ubiquitous) and thus is called distribution frequency in this document. These data can be utilized in the details of the planting design. Within a community type distribution frequency was calculated as: number of points a species occurred at divided by total number of points sampled times 100 (Tables 4 and 6). Abundance of herbaceous species within a community type was calculated as mean percent cover: percent cover for a species summed over all points divided by the total number of sampling points (Tables 5 and 7). Total percent herbaceous cover for a given point may sum to above or below 100% as a result of overlapping herb layers or patches of bare ground, respectively.

Species observed in the remnant riparian vegetation were divided into potential woody and herbaceous restoration species (Tables 4 and 5) and woody and herbaceous species not recommended for restoration (Tables 6 and 7). Composition and distribution frequency by community type are given for species that occurred at the sampling points. Species observed, but not quantitatively sampled, in a community type are noted by a “+” in the tables.

A search of the literature and the California Natural Diversity Database (CNDDB; CA DFG 2005) records was performed to determine potential and known occurrences of threatened and endangered plant species occurring within 1.0 mile of the Restoration Area. A separate CNDDB search was done by USGS quadrangles (7.5’ series) to determine additional species with potential to occur on site. Four quadrangles were searched including Princeton, Butte City, Moulton Weir, and Sanborn Slough. An electronic copy of the CNDDB records is included on the Baseline Assessment CD.

River Channel History

The main channel of the Sacramento River scrolled across the remnant riparian vegetation area from at least 1896 through 1964 (CA DWR 2002; Figures 3, 11-12). By 1935 the main channel had moved to the eastern edge of the present day forests, making these forests between 75 and 100 years old (Figures 3 and 11). The herbland, elderberry and willow scrub communities have developed since the channel migrated from this area in roughly 1964 making them as much as 41 years old (Figures 11-13). The point bar area to the east (open area with only a few tiny bands of vegetation) was the main channel from at least 1964 to at least 1976 (Figure 12). The small bands of vegetation toward the edge are the 1981 main channel’s western edge (Figure 13). Thus most of the point bar developed sometime between 1976 and 1981, with the eastern edge developing between 1981 and 1999. Most of the point bar is therefore between 39 and 24 yrs old, with the eastern edge developing over the last 24 years.

Remnant Riparian Vegetation Community Descriptions

Qualitative community descriptions follow those of Holland (1986) with approximate acreage in parentheses. Remnant riparian plant communities are mapped in Figure 6. Starting in the west, the remnant riparian habitat has a large stand of cottonwood riparian forest (31 acres) bordering the 1000-acre Ranch Restoration Area. This forest is composed primarily of widely spaced large Fremont cottonwood (*Populus fremontii*) interspersed with Goodding's black willow (*Salix gooddingii*) and a few western sycamore (*Platanus racemosa*), with an understory of young box elder (*Acer negundo*). A few valley oak (*Quercus lobata*) trees are interspersed along the border of the 1000-acre Ranch Restoration Area. There are patches of open areas occupied primarily by California blackberry (*Rubus ursinus*) and California wild grape (*Vitis californica*) and dense areas with stands of medium-sized Fremont's cottonwood trees. Two large stands of mixed riparian forest (44 acres, 15 acres) occur closer to the river, adjacent to the cottonwood riparian forest. The northern stand bounds the Restoration Area on the north, west and southwest. This forest community is relatively more dense with additional dominant species such as California black walnut (*Juglans californica*), willow (*Salix exigua*, *S. lasiolepis*), and pockets of pure edible fig (*Ficus carica*). Closer to the river, there are two large areas of herbland (11 acres, 12 acres) and another small area (2 acres) within the southern portion of the mixed riparian forest. The herbland is dominated by herbaceous species, primarily non-native forbs with patches of native mugwort (*Artemisia douglasiana*). Between the herbland and mixed riparian forest communities, there is a small elderberry savannah (4 acres) with blue elderberry (*Sambucus mexicana*) shrubs widely spaced among the herbaceous layer and a few solitary California black walnut and Fremont cottonwood trees. Along the river there are two stands of cottonwood riparian forest (7 acres, 1 acres) dominated by large Fremont cottonwood trees. The northern stand bounds the Restoration Area on the east. Willow scrub patches occur along the river and intergrade with the surrounding herbland and cottonwood riparian forest communities. The willow scrub communities consist of dense patches of medium-sized narrow-leaved willow (*Salix exigua*) interspersed with pockets of herbaceous species, usually occurring closer to the edge of the community.

Stegeman Restoration Area: Remnant Riparian Vegetation Sampling Locations

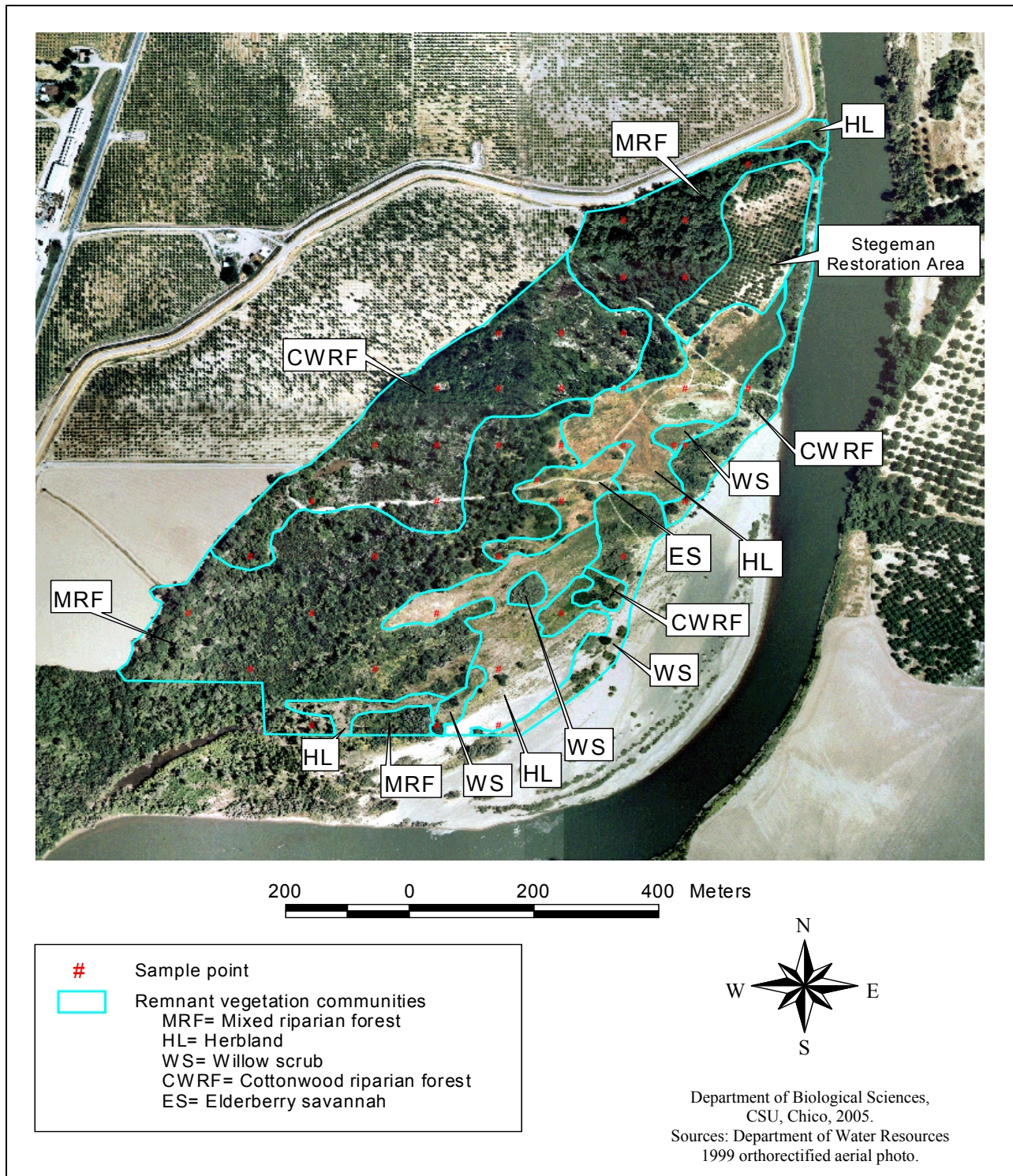


Figure 6. Remnant riparian plant communities and vegetation sampling locations within riparian plant communities close to the Stegeman and 1000-acre Ranch Restoration Areas, Colusa County, California.

Table 4. Composition and distribution frequencies by community type for potential native woody restoration species found in remnant riparian vegetation close to the Stegeman Restoration Area, Colusa County, California. Frequency is given by community type for those species recorded during quantitative sampling. The sample size (n) for composition frequency represents the number of quadrants sampled. The sample size (n) for distribution frequency represents the number of points sampled. Abbreviations are: MRF=Mixed Riparian Forest; CWRP=Cottonwood Riparian Forest; ES=Elderberry Savannah; WS=Willow Scrub; HL=Herbland. A “+” indicates observed but not sampled for that community; a blank indicates not observed. Nomenclature follows *The Jepson Manual* (Hickman 1993).

Common Name	Scientific Name	Family	Composition Frequency (%)					Distribution Frequency (%)				
Trees			MRF (n=56)	CWRP (n=56)	ES (n=16)	WS (n=16)	HL (n=16)	MRF (n=14)	CWRP (n=14)	ES (n=4)	WS (n=4)	HL (n=4)
box elder	<i>Acer negundo</i>	Aceraceae	23	39				50	64			
western sycamore	<i>Platanus racemosa</i>	Platanaceae	2	2				7	7			
Fremont cottonwood	<i>Populus fremontii</i>	Salicaceae	14	46	6		6	43	79	25		25
valley oak	<i>Quercus lobata</i>	Fagaceae		+								
narrow-leaved willow	<i>Salix exigua</i>	Salicaceae	2	2		31		7	7		50	
Goodding's black willow	<i>Salix gooddingii</i>	Salicaceae		4					14			
arroyo willow	<i>Salix lasiolepis</i>	Salicaceae	9			6		14			25	
Shrubs												
box elder	<i>Acer negundo</i>	Aceraceae	27	46				50	71			
mule fat	<i>Baccharis salicifolia</i>	Asteraceae		5					14			
California button willow	<i>Cephalanthus occidentalis</i> var. <i>californicus</i>	Rubiaceae		4					14			
California rose	<i>Rosa californica</i>	Rosaceae	5					14				
narrow-leaved willow	<i>Salix exigua</i>	Salicaceae	4	14		75		7	21		100	
arroyo willow	<i>Salix lasiolepis</i>	Salicaceae	14	4		13	13	21	14		50	25
blue elderberry	<i>Sambucus mexicana</i>	Caprifoliaceae			69	6	6			100	25	25
western poison oak	<i>Toxicodendron diversilobum</i>	Anacardiaceae	5	2	6			14	7	25		

Table 4 continued.

Common Name	Scientific Name	Family	Composition Frequency (%)					Distribution Frequency (%)				
Vines			MRF (n=56)	CWRF (n=56)	ES (n=16)	WS (n=16)	HL (n=16)	MRF (n=14)	CWRF (n=14)	ES (n=4)	WS (n=4)	HL (n=4)
California pipevine	<i>Aristolochia californica</i>	Aristolochiaceae	9			6		14			25	
virgin's bower	<i>Clematis ligusticifolia</i>	Ranunculaceae			6					25		
California man-root	<i>Marah fabaceus</i>	Cucurbitaceae	5	4	31	44		7	7	50	50	
California blackberry	<i>Rubus ursinus</i>	Rosaceae	43	11	31			50	21	50		
western poison oak	<i>Toxicodendron diversilobum</i>	Anacardiaceae	9					14				
California wild grape	<i>Vitis californica</i>	Vitaceae	23	68				29	79			

Table 5. Mean percent cover and distribution frequency by community type of potential native herbaceous restoration species found in remnant riparian vegetation close to the Stegeman Restoration Area, Colusa County, California. The sample size (n) for mean percent cover and for distribution frequency is the same and represents the number of points sampled. Abbreviations are: MRF=Mixed Riparian Forest; CWRF=Cottonwood Riparian Forest; ES=Elderberry Savannah; WS=Willow Scrub; HL=Herbland. A blank indicates not observed. Nomenclature follows *The Jepson Manual* (Hickman 1993).

Common Name	Scientific Name	Family	Mean Cover (%)					Distribution Frequency (%)				
Herbs			MRF (n=14)	CWRF (n=14)	ES (n=4)	WS (n=4)	HL (n=4)	MRF (n=14)	CWRF (n=14)	ES (n=4)	WS (n=4)	HL (n=4)
Indian hemp	<i>Apocynum cannabinum</i> var. <i>glaberrimum</i>	Apocynaceae		1.00					7			
mugwort	<i>Artemisia douglasiana</i>	Asteraceae	6	8.00	50	23		7	14	75	75	
sedge	<i>Carex</i> sp.	Cyperaceae	3	0.36			1	21	7			25
blue wildrye	<i>Elymus glaucus</i> ssp. <i>glaucus</i>	Poaceae	1			3		7			25	
willow herb	<i>Epilobium</i> sp.	Onagraceae		1.00			3		7			25
goose grass	<i>Galium aparine</i>	Rubiaceae	10	2.00	4			50	14	25		
nettle	<i>Urtica dioica</i>	Urticaceae	2					21				

Table 6. Composition and distribution frequencies by community type for woody plant species not recommended, but found in remnant riparian vegetation close to the Stegeman Restoration Area, Colusa County, California. Frequency is given by community type for those species recorded during quantitative sampling. The sample size (n) for composition frequency represents the number of quadrants sampled. The sample size (n) for distribution frequency represents the number of points sampled. Abbreviations are: MRF=Mixed Riparian Forest; CWRF=Cottonwood Riparian Forest; ES=Elderberry Savannah; WS=Willow Scrub; HL=Herbland. A “+” indicates observed but not sampled for that community; a blank indicates not observed. Nomenclature follows *The Jepson Manual* (Hickman 1993).

Common Name	Scientific Name	Family	Composition Frequency (%)					Distribution Frequency (%)				
Trees			MRF (n=56)	CWRF (n=56)	ES (n=16)	WS (n=16)	HL (n=16)	MRF (n=14)	CWRF (n=14)	ES (n=4)	WS (n=4)	HL (n=4)
California black walnut	<i>Juglans californica</i>	Juglandaceae	38		31			71		75		
Mediterranean hackberry	<i>Celtis australis</i>	Ulmaceae		+								
Shrubs												
edible fig	<i>Ficus carica</i>	Moraceae	27	5				36	14			
California black walnut	<i>Juglans californica</i>	Juglandaceae	18	2				36	7			

Table 7. Mean percent cover and distribution frequency by community type for herbaceous plant species not recommended, but found in remnant riparian vegetation close to the Stegeman Restoration Area, Colusa County, California. Frequency is given by community type for those species recorded during quantitative sampling. The sample size (n) for mean percent cover and for distribution frequency is the same and represents the number of points sampled. Abbreviations are: MRF=Mixed Riparian Forest; CWRP=Cottonwood Riparian Forest; ES=Elderberry Savannah; WS=Willow Scrub; HL=Herbland. A “+” indicates observed but not sampled for that community; a blank indicates not observed. Nomenclature follows *The Jepson Manual* (Hickman 1993).

Common Name	Scientific Name	Family	Mean Cover (%)					Distribution Frequency (%)				
Herbs			MRF (n=14)	CWRP (n=14)	ES (n=4)	WS (n=4)	HL (n=4)	MRF (n=14)	CWRP (n=14)	ES (n=4)	WS (n=4)	HL (n=4)
bent grass	<i>Agrostis avenacea</i>	Poaceae				8	4				25	25
bur-chervil	<i>Anthriscus caucalis</i>	Apiaceae	1.00		25	16		7		75	50	
giant reed	<i>Arundo donax</i>	Poaceae				+						
ripgut grass	<i>Bromus diandrus</i>	Poaceae	4.00		20	15	16	7		25	25	25
black mustard	<i>Brassica nigra</i>	Brassicaceae	5.00	2	15			21	14	75		
soft chess	<i>Bromus hordeaceus</i>	Poaceae	1.00	1		13	26	7	7		25	50
yellow star-thistle	<i>Centaurea solstitialis</i>	Asteraceae		4	16	10	8		14	25	25	25
red-stemmed filaree	<i>Erodium cicutarium</i>	Geraniaceae					7					50
grass	Grass sp.	Poaceae		2		9	1		7		50	25
Klamathweed	<i>Hypericum perforatum</i>	Hypericaceae			+		+					
smooth cat's-ear	<i>Hypochoeris glabra</i>	Asteraceae					1					25
Italian ryegrass	<i>Lolium multiflorum</i>	Poaceae		4			1		7			25
annual beard grass	<i>Polypogon monspeliensis</i>	Poaceae		4					7			
curly dock	<i>Rumex crispus</i>	Polygonaceae	0.21					7				

Special-status Plant Species

Information about known and potential occurrences of special-status plant species was obtained from the California Natural Diversity Database (CNDDDB; CA DFG 2005). Based on the quadrangle search of the CNDDDB, five species were initially identified to potentially occur within 1 mile of the Restoration Area. Based on distribution, elevation, and habitat requirements, one of these species was determined to be unlikely to occur. Of the four species with potential to occur, no known occurrences were found within 1.0 mile of the Restoration Area.

Table 8. Special-status plant species potentially occurring within 1.0 mile of the Stegeman Restoration Area, Colusa County, California. FE = federally listed as endangered; FT = federally listed as threatened; CE = California state listed as endangered; CNPS = California Native Plant Society, 1B = rare, threatened or endangered in California and elsewhere, 2 = rare in California but more common elsewhere, 3 = need more information, 4 = plants of limited distribution; a watch list. Habitat descriptions were adapted from CNPS (2004).

Scientific Name	Common Name	Habitat	Status	Potential to Occur
<i>Astragalus tener</i> var. <i>ferrisiae</i>	Ferris's milk-fetch	Meadows and seeps (vernally mesic), valley and foothill grassland (subalkaline flats); elevation 5-75 meters.	CNPS 1B	May occur. No known occurrences within 1 mile of the Restoration Area.
<i>Atriplex depressa</i>	brittlescale	Chenopod scrub, meadows and seeps, playas, valley and foothill grassland, vernal pools/alkaline, clay; elevation 1-320 meters.	CNPS 1B	May occur. No known occurrences within 1 mile of the Restoration Area.
<i>Cordylanthus palmatus</i>	palmate-bracted bird's-beak	Chenopod scrub, valley and foothill grassland (alkaline); elevation 5-155 meters.	FE, CE, CNPS 1B	May occur. No known occurrences within 1 mile of the Restoration Area. Known from only nine occurrences.
<i>Hibiscus lasiocarpus</i>	Rose-mallow	Marshes and swamps (freshwater); elevation 0-120 meters.	CNPS 2	May occur. No known occurrences within 1 mile of the Restoration Area.
<i>Neostapfia colusana</i>	Colusa grass	Vernal pools (adobe); elevation 5-200 meters.	FT, CE, CNPS 1B	Unlikely to occur due to the lack of suitable habitat. No known occurrences within 1 mile of the Restoration Area.

References

- Barbour, M.G., J.H. Burk, W.D. Pitts, F.S. Gilliam and M.W. Schwartz. 1999. *Terrestrial Plant Ecology* 3rd Edition. Addison Wesley Longman, Menlo Park, CA.
- California Department of Fish and Game. 2003. California Natural Diversity Database. List of California Terrestrial Natural Communities. Wildlife and Habitat Data Analysis Branch, Sacramento, CA. Retrieved from: <http://www.dfg.ca.gov/whdab/pdfs/natcomlist.pdf>
- California Department of Fish and Game. 2005. California Natural Diversity Database. RareFind 3. Updated May 27, 2005. Wildlife and Habitat Data Analysis Branch, Sacramento, CA.
- California Department of Water Resources. 2002. GIS of the middle Sacramento River, California. Northern District, Red Bluff, California.
- California Native Plant Society (CNPS). 2004. *Inventory of Rare and Endangered Vascular Plants of California* (sixth edition). Rare Plant Scientific Advisory Committee, David P. Tibor, Convening Editor. California Native Plant Society. Sacramento, CA.
- Hickman, J.C. 1993. *The Jepson Manual*. University of California Press, Berkeley, California.
- Holland, R.F. 1986. Preliminary descriptions of the terrestrial natural communities of California. California Department of Fish and Game, Sacramento, California.
- Oswald, V. and L. Ahart. 1994. *Manual of the Vascular Plants of Butte County, California*. CNPS Press, Sacramento, California.
- The Nature Conservancy. 2005. Draft Colusa Subreach Background Report. Northern Central Valley Office, Chico, California.

SECTION THREE

STEGEMAN

SOIL SURVEY

**Jean G. Hubbell, M.S.
Catherine Little
Katie C. Price
Dr. David M. Wood**

Introduction

A survey of Restoration Area soils is used to document existing conditions for plant growth and thus guide the restoration planting recommendations. Information on soil texture and depth to water table gathered from auger holes across the Restoration Area is used to match specific locations with appropriate plant community types.

The Stegeman tract is located approximately 2.75 miles south of Princeton in Colusa County. The Restoration Area, encompassing approximately 10 acres, lies inside the levees on the west side of the Sacramento River at river mile 160. Currently the Restoration Area is a fallow walnut orchard.

Methods

Soil data were gathered from augering 5 holes by hand across the Restoration Area during June and July of 2005. These 5 holes were located on a grid at approximately 50-125 meter intervals (Figures 2 and 10). Initially a grid with holes 200m apart was laid out on the Restoration Area, resulting in only 1 hole. Four additional holes were added to meet the minimum of 5 holes per/Restoration Area, or 1 hole/10 acres in order to give an accurate representation of soils across the Restoration Area. Textural analysis was done following the Natural Resource Conservation Service's (NRCS) texture-by-feel method at one-foot increments (Table 9; Schoeneberger et al. 2002). In addition, depth to refusal (gravel, water table or unconsolidated sand) was noted for each sample location along with any unique characteristics. Soil locations were classified into deep and shallow based on NRCS soil survey standards (Table 10; Schoeneberger et al. 2002).

Table 9. Natural Resource Conservation Service's soil texture classification.

<u>Texture</u>	<u>% Sand</u>
Silt	0-20
Silt loam	20-35
Sandy silt loam	35-50
Sandy loam	50-70
Loamy sand	70-85
Sand	85-100

Table 10. Natural Resource Conservation Service's soil depth classification.

<u>Depth class</u>	<u>Depth (inches)</u>
Very Shallow	0-10
Shallow	10-20
Moderately Deep	20-40
Deep	40-60
Very Deep	>60

Soils Description

The Restoration Area soils are dominated by sandy soils interspersed with both finer and coarser layers throughout the profile. The sandy loam/loamy sand dominated profile mostly concurs with the historic soil surveys of Colusa County from 1907, 1948 and 1967 and the current 1998 soil survey (Figures 7-10). When placed on the 1907 Colusa County Soil Survey, the Restoration Area was in the Sacramento River channel (Figure 10) and thus sandy soils would be expected. In the 1948 and 1967 historic surveys, the soils are described as Columbia Soils undifferentiated (Harradine 1948), and Columbia Association with fine sandy loam textures (USDA 1967). The 1998 soil survey describes the soils as Tujunga Loam and Vina Loam. The auger hole textures are somewhat coarser than a typical Tujunga Loam or Vina Loam profile with sandy loams over sands instead of loams over fine sand or sandy loams. Table 11 gives the auger hole data, and Table 12 lists comments (if any) for each hole. Surface textures across the site vary, consisting of sandy loam to clay loam, with coarser textured surface materials being found closer to the river (Table 11). These surface loams overlay a heterogeneous profile composed mainly of sandy loam/loamy sand overlaying and interspersing with both finer and coarser textured soils ranging from clay loam to sand (Table 11). The heterogeneity of these soils reflects the historic channel meanders across this site at least over the last 109 years (Figures 3, 11-13). Most of this Restoration Area has very deep soils with refusal from 12 to 20 feet.

The Restoration Area soils are typical of active floodplain soils where stratification from various flooding events is still quite evident but a uniform fining upward sequence (where coarser material is found at depth and finer textures make up the upper layers of the profile) has yet to occur. A uniform fining upward sequence is more typical of alluvial soils further from the active channel (Andrew Conlin Pers. Comm. 2003). All the soil auger holes have series of fining upward sequences representative of channel deposits, reflecting the historic scrolling of the Sacramento River across the Restoration Area (Table 11, Figures 3, 11-13; CA DWR 2002, USDA 1907). Between 1896 and 1964 the main channel of the Sacramento River ran across some portion of the Restoration Area. Channel deposits are still evident as barren areas in the 1999 aerial photo (and 2004, not shown) and are characterized by auger holes 2 and 4.

The Restoration Area has very deep soils with the water table or gravel being reached between 12 and 20 feet. In one location there was no refusal after 20 feet of augering. Three auger holes reached the water table at 12, 16.5 and 20 feet (holes 2, 3 and 5 respectively, Table 11). This variation in depth to the water table may simply be a difference in the June sampling of holes 2 and 3 versus the mid-July sampling of hole 5. Certainly the significant depth to the water table in early June, even with all the late rains, is indicative of the coarse texture of these soils and their low water holding capacity. Further, 2005 was a particularly wet spring and early summer and thus the water table may be more elevated than in a typical year.

Sampling location 2 had mottling, a reduced oxygen characteristic (redox feature) at a depth of 16 feet (Tables 11, 12, Figures 2, 10). Redox features represent soil horizons influenced by saturated conditions for extended periods of time throughout the year. These conditions would be expected in soils that are adjacent to present channels, overflow channels, or sloughs, or in the annual floodplain and in historic buried channels, which may then act as a channel for the underground flow of water.

Auger holes 2 and 4 have sand lenses that occur at 6 and 5 feet below the surface, respectively (Table 11, Figures 2, 10). These sand lenses are most likely the bank of the river channel at sometime between 1896 and 1923 based on historic channel locations (Figures 2, 10, 11-13; CA DWR 2002, USDA 1907).

Table 11. Soil texture by depth across the Stegeman Restoration Area, Colusa County, California.

Date Sampled	6/2/2005	6/2/2005	6/23/2005	7/16/2005	7/16/2005
Point	1	2	3	4	5
Surface	Sandy Loam	Sandy Loam	Clay Loam	Clay Loam	Loam
1 ft	Sandy Loam	Sandy Loam	Sandy Loam	Loamy Sand	Loam
2 ft	Sandy Loam	Sandy Clay Loam	Clay Loam	Loamy Sand	Loam
3 ft	Clay Loam	Loamy Sand	Sandy Loam	Loamy Sand	Loam
4 ft	Sandy Loam	Loamy Sand	Sandy Loam	Loamy Sand	Sandy Loam
5 ft	Sand	Loamy Sand	Sandy Loam	Loamy Sand	Sandy Loam
6 ft	Sand	Sand	Sandy Loam	Loam	Loam
7 ft	Clay Loam	Sand	Sandy Loam	Sand	Silty Clay Loam
8 ft	Sandy Clay Loam	Sand	Sandy Loam	Sand	Silty Clay Loam
9 ft	Clay Loam	Sand	Loam	Sand	Loam
10 ft	Clay Loam	Sand	Loam	Sand	Clay Loam
11 ft	Sandy Clay Loam	Sand	Sandy Loam	Sand	Silty Clay Loam
12 ft	Sandy Loam	Sand		Sand	Loamy Sand
13 ft	Sandy Loam	Sand		Silty Clay Loam/Clay Loam	Clay Loam
14 ft	Sandy Loam	Loamy Sand		Clay Loam	Sandy Loam
15 ft	Sand/Gravel	Loamy Sand		Silty Clay Loam	Clay Loam
16 ft		Sandy Loam		Sand	Sand/Loamy Sand
17 ft				Sand/Loamy Sand	Sandy Loam
18 ft				Sand	Sand/Loamy Sand
19 ft				Sand/Loamy Sand	Sand/Loamy Sand
20 ft				Sand/Loamy Sand	Sand/small gravel
Total	15 ft 6 in	16 ft 6 in	12 ft	20 ft	20 ft
Refusal	Gravel	Saturation	Saturation	None	Saturation

Table 12. Soil auger hole comments for the Stegeman Restoration Area, Colusa County, California. Reduced oxygen conditions are noted as mottling. Extreme anaerobic conditions are noted as gleying or gleyed layers.

Hole #1- Gravel refusal between 15 and 16 ft.
Hole #2- Gravel between 9 and 13 ft. Mottling at 16 ft.
Hole #3- No comments.
Hole #4- Soil becomes sandier from 7-12 ft. Moisture increase at 14 ft. Sandier at 16 ft.
Hole #5- Sandier at 1 ft. Siltier at 2 & 3 ft. Moisture increase at 11 ft. Small gravel and saturation at 20 ft.

Stegeman Restoration Area: 1907 Soil Series

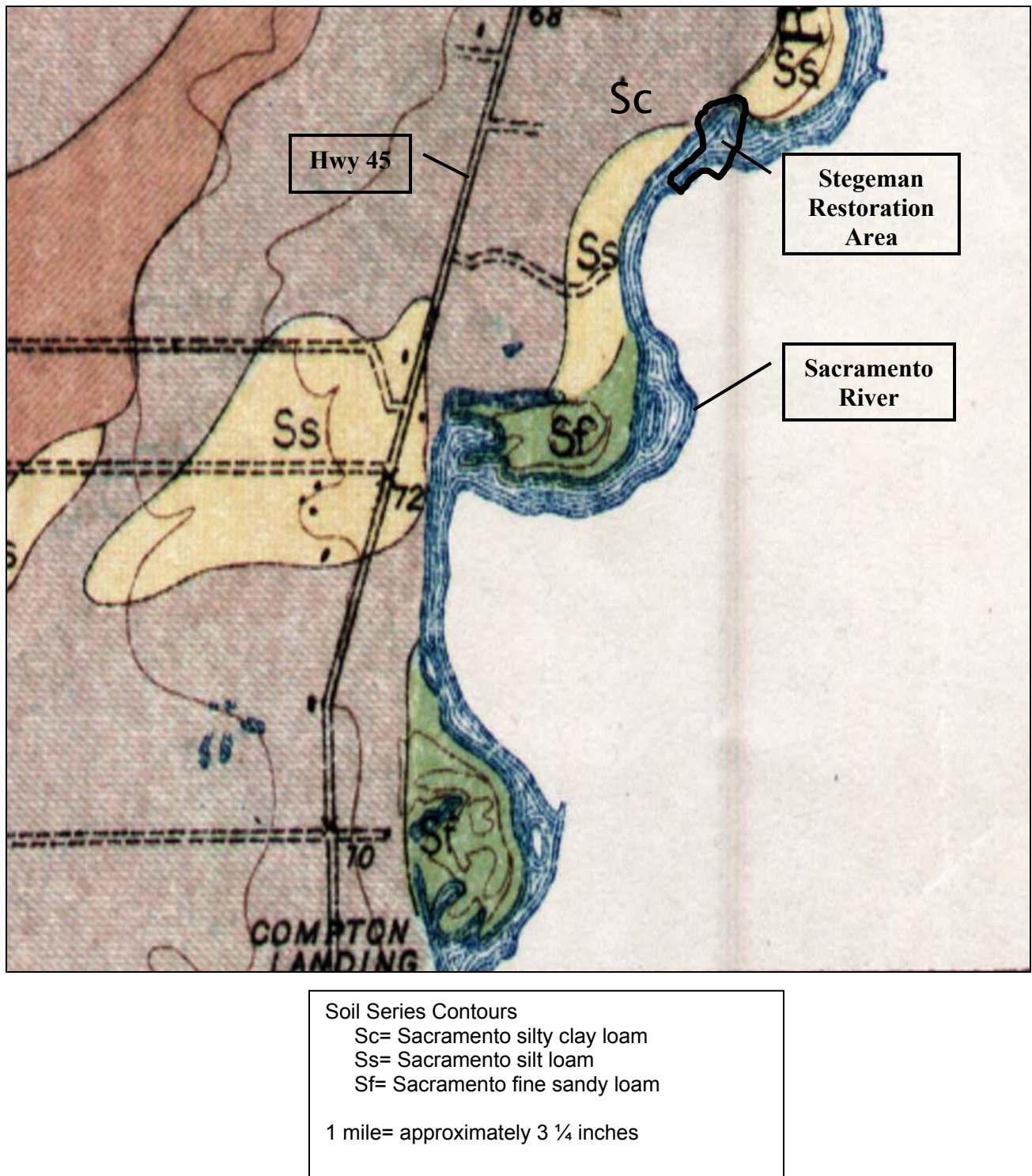
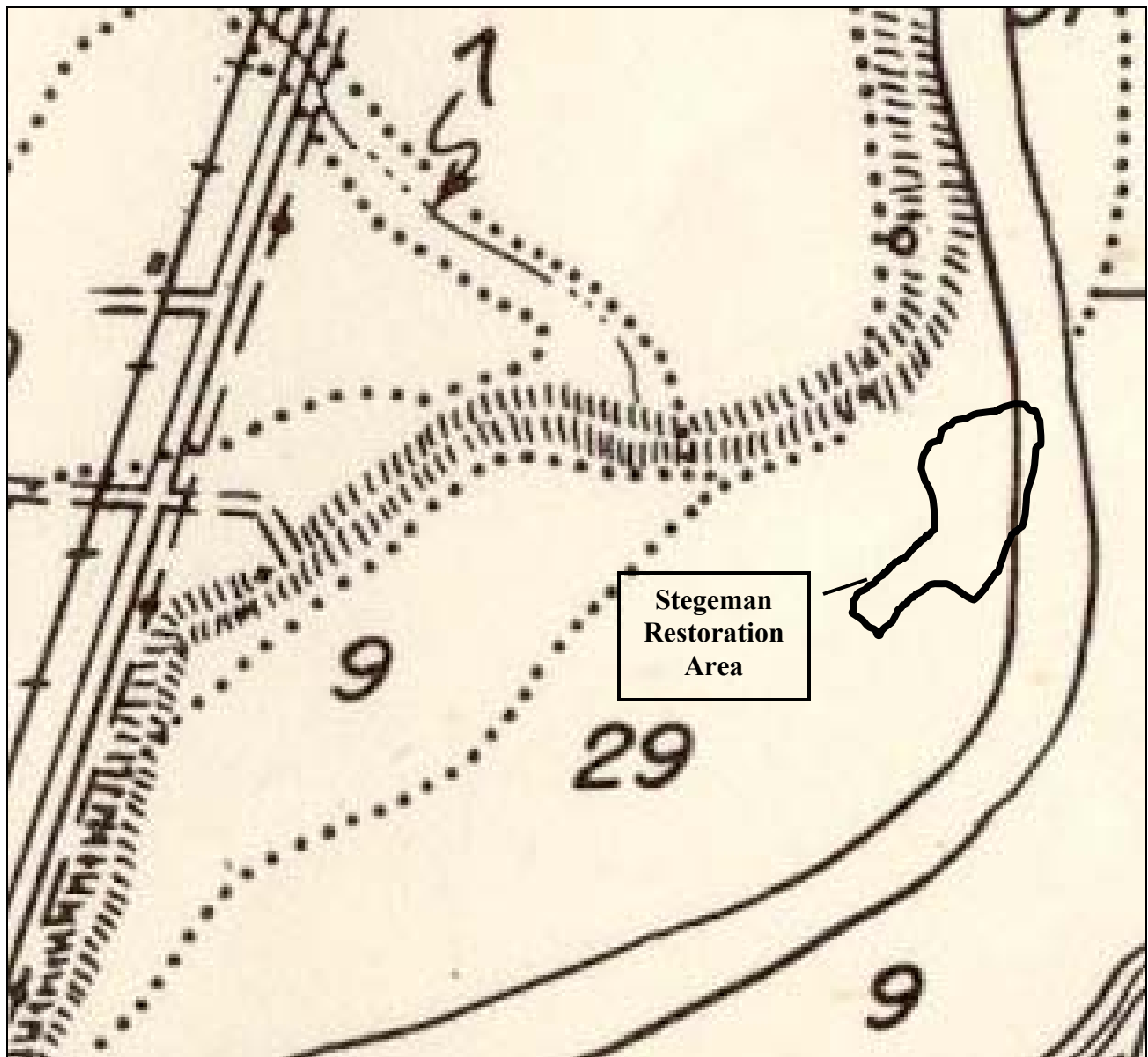


Figure 7. Approximate boundary and location of Stegeman Restoration Area on the 1907 Soil Survey map, Colusa County, California (USDA Bureau of Soils).

Stegeman Restoration Area: 1948 Soil Series



Soil Series Contours

7= Sycamore Loam, 0-2% slope, nearly level

9= Columbia Loam, 0-2% slope, gently undulating

29= Columbia soils undifferentiated, variable microrelief,
0-2% slope, gently undulating

1 mile= approximately 7 inches

Figure 8. Approximate boundary and location of Stegeman Restoration Area on the 1948 Soil Survey map, Colusa County, California (Harradine 1948).

Stegeman Restoration Area: 1967 Soil Series



Figure 9. Approximate boundary and location of Stegeman Restoration Area on the 1967 Soil Survey map, Colusa County, California (USDA Soil Conservation Service).

Stegeman Restoration Area: 1998 Soil Series

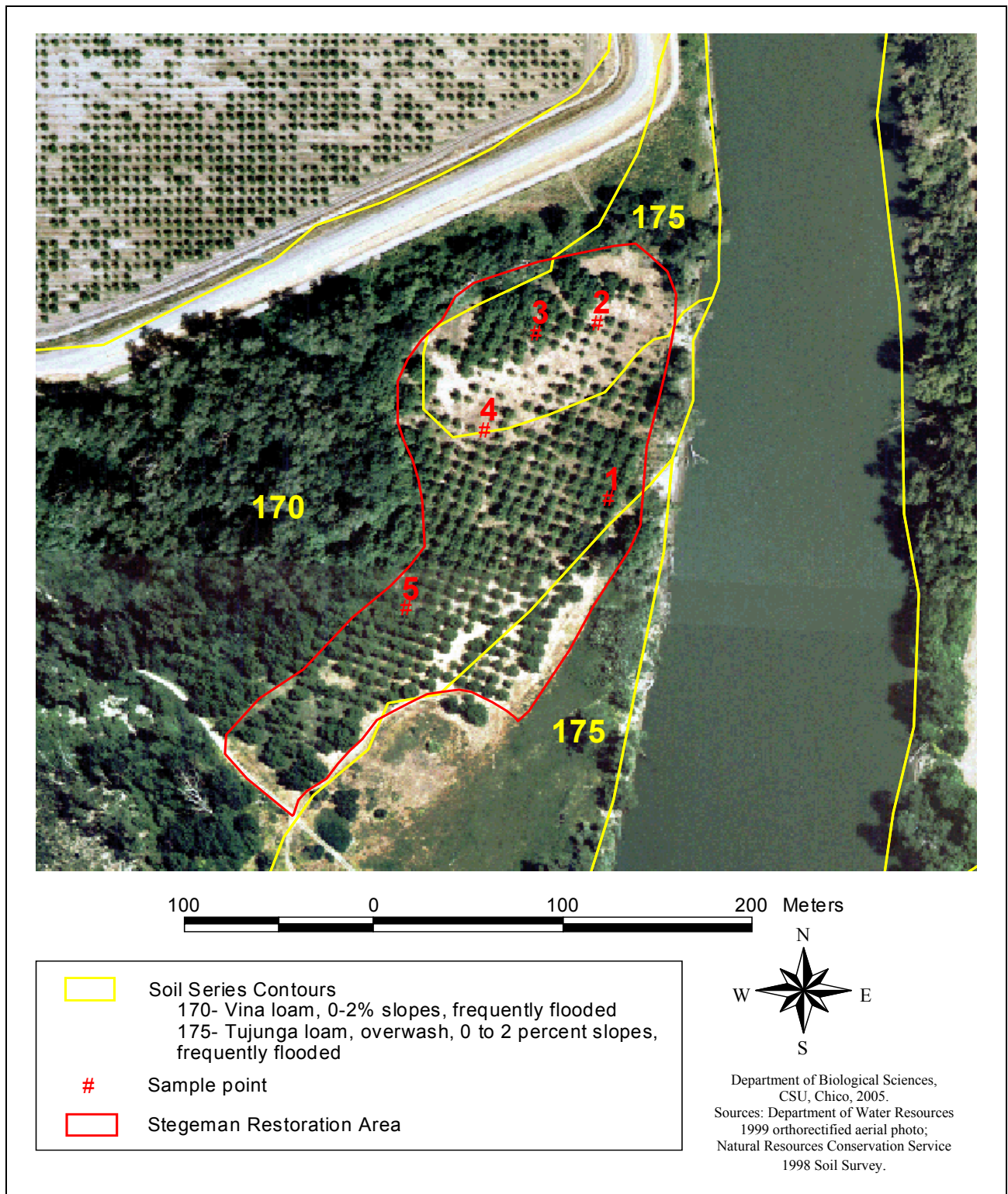


Figure 10. Soil series contours from the 1998 Colusa County Soil Survey at Stegeman Restoration Area, Colusa County, California (USDA NRCS).

Stegeman Restoration Area: Historic River Channels 1896-1923

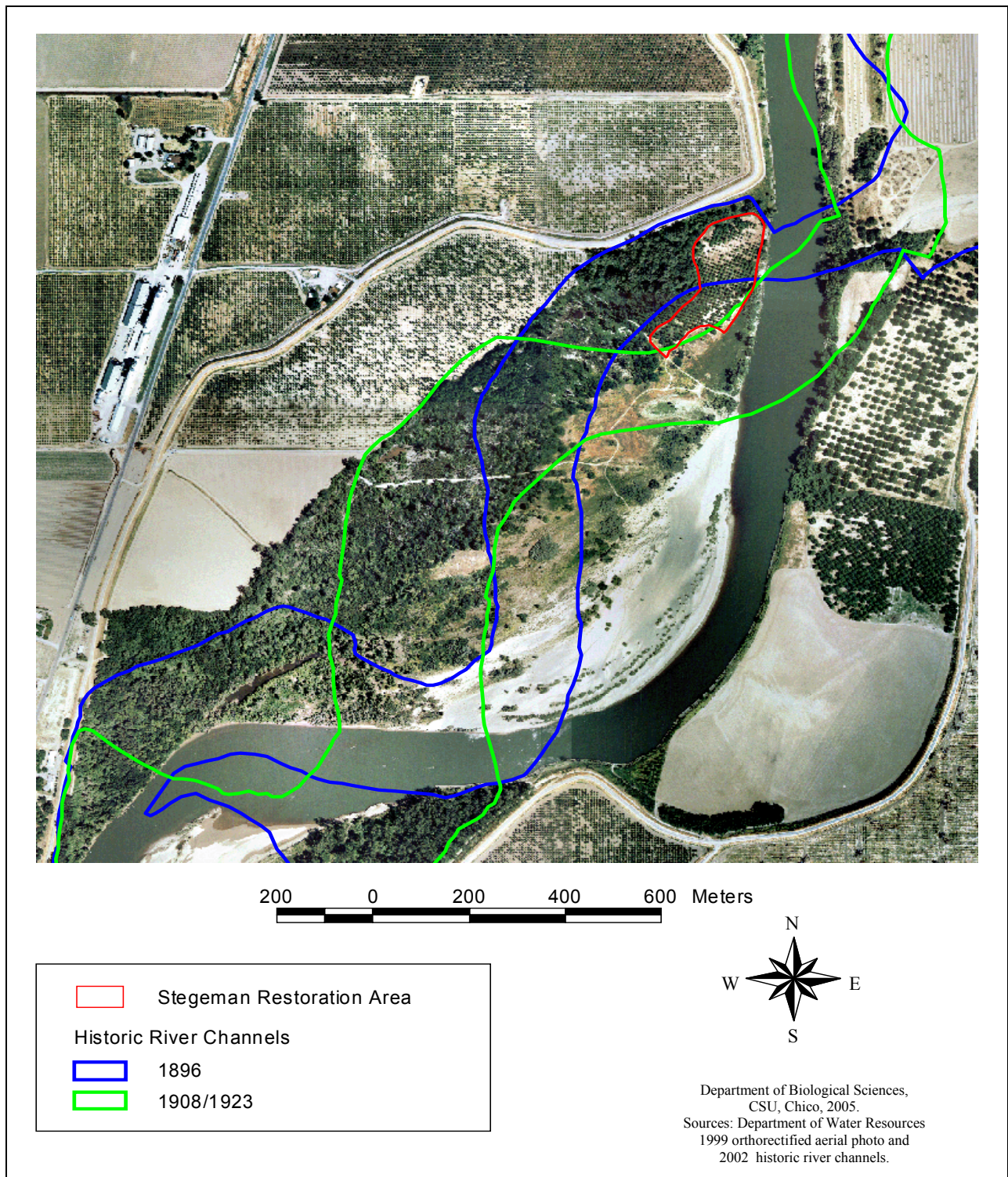


Figure 11. Historic river channels from 1896, 1908 and 1923 at Stegeman Restoration Area, Colusa County, California. The 1908 and 1923 channel is the same for this stretch of the river.

Stegeman Restoration Area: Historic River Channels 1935-1976

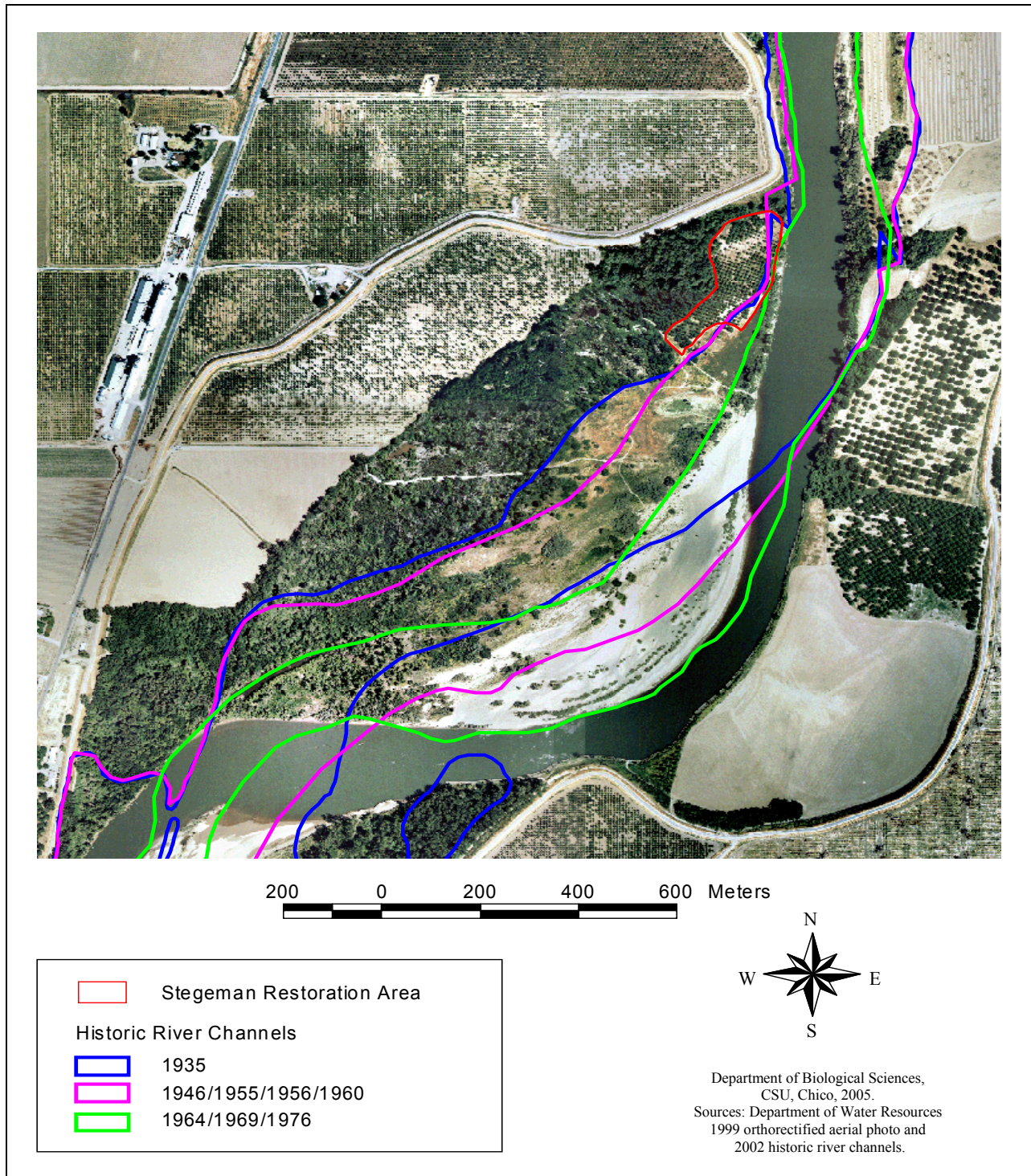


Figure 12. Historic river channels from 1935, 1960, and 1976 at Stegeman Restoration Area, Colusa County, California. The 1960 channel is the same for this stretch of the river as 1946, 1955 and 1956. The 1976 channel is the same for this stretch of the river as 1964 and 1969.

Stegeman Restoration Area: Historic River Channels 1981-1997

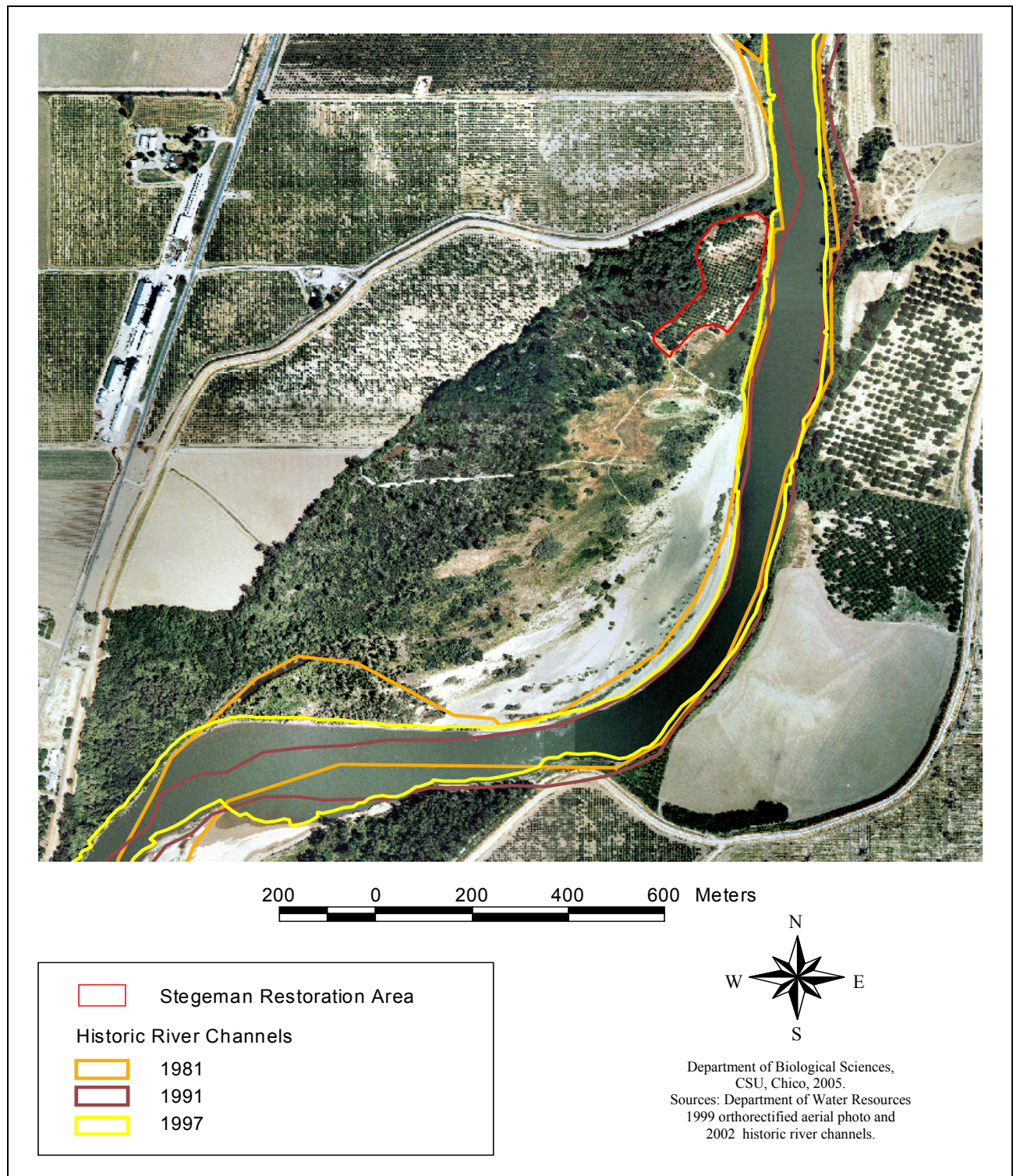


Figure 13. Historic river channels from 1981, 1991, and 1997 at Stegeman Restoration Area, Colusa County, California.

Acknowledgements

Thanks to our field assistants Gay Ann Silman, Aggie Morrow, Mark Lynch, Stacey Henderson, and Jason Glick for augering holes and data entry.

References

- California Department of Water Resources. 2002. GIS of the middle Sacramento River, California. Northern District, Red Bluff, California.
- Harradine, F. F. 1948. Soils of Colusa County, California. University of California Berkeley, College of Agriculture, Agricultural Experiment Station, Division of Soils. Berkeley, California.
- Schoeneberger, P.J., D.A. Wysocki, E.C. Benham and W.D. Broderson, (editors). 2002. Field book for describing and sampling soils, Version 2.0. Natural Resources Conservation Service, National Soil Survey Center, Lincoln, NE.
- The Nature Conservancy. 2005. Draft Colusa Subreach Background Report. Northern Central Valley Office, Chico, California.
- U.S. Department of Agriculture, Bureau of Soils. 1907. Soil map, California, Colusa Sheet. Colusa County, California.
- U.S. Department of Agriculture, Soil Conservation Service. 1967. Report and general soil map, Colusa County, California.
- U.S. Department of Agriculture, Natural Resources Conservation Service. 1998. Soil Survey of Colusa County, California.

SECTION FOUR

SPECIAL STATUS ANIMAL SPECIES, BIRD COUNTS, AND NON-NATIVE MAMMALS

**John W. Hunt, M.S.
David Koenig
Dr. David M. Wood**

Introduction

Animals such as wildlife and birds will benefit from the increased habitat created through natural process or active restoration. Information on wildlife and bird species present or known to occur near the Restoration Area can be used to better judge the value of restoration actions at a particular site. Non-native mammal species are important due to their probable negative impact on native wildlife species. Non-native mammal species can prey upon, directly compete with, and significantly disturb native wildlife.

Methods

A July 2005 computer search for known occurrences of special status animal species (federal and state threatened and endangered species and species of special concern) occurring within 1.0 mile of the Restoration Area was conducted using the California Natural Diversity Database (CA DFG 2005). An assessment of potential non-native mammals and special status animal species occurring at or within 1.0 mile of the Restoration Area was performed in June and July 2005. This assessment was based on aerial photographs, field surveys of remnant riparian vegetation and associated nearby habitat, field experience of the authors and habitat characteristics of the species involved. During the bird point count survey (see below), any occurrences or signs of special status species or non-native mammals were noted. General habitat characteristics were gathered from vegetation surveys (Section Two). Information on species status was taken from California Wildlife Habitat Relations 8.0 (CA DFG 2002) and the California Natural Diversity Database (CA DFG 2005).

Bird species were surveyed on June 22, 2005, following an adaptation of the methods proposed by Ralph et al. (1993). Nine point count stations set approximately 200 m apart were established within remnant riparian habitat close to the Stegeman tract (Figure 14). All birds observed (either seen or heard) within an eight-minute observation period were recorded. To reduce the possibility of individuals being recorded a second time at another station, only data on species encountered within 50 m of each station are presented here. To compute frequency of occurrence for a species, the total number of observations for that species was divided by the total number of observations for all species.

Special Status Animal Species

Table 13 lists California Natural Diversity Database special status species occurrences within 1.0 mile of the Restoration Area. More than one record indicates multiple sightings of a species in different years and/or locations. Table 14 is a list of special status wildlife species with potential or known to occur or reside within 1.0 mile of the Restoration Area.

Table 13. California Natural Diversity Database special status species occurrences occurring within 1.0 mile of the Stegeman Restoration Area, Colusa County, California. FE/FT= federally endangered/federally threatened; FSC=Federal species of special concern; SE/ST=state endangered/state threatened; SSC=California species of special concern.

Common Name	Scientific Name	Status	# of known occurrences
Swainson's hawk	<i>Buteo swainsonii</i>	ST	1
Western yellow-billed cuckoo	<i>Coccyzus americanus occidentalis</i>	SE	3
Bank swallow	<i>Riparia riparia</i>	ST	4
Osprey	<i>Pandion haliaetus</i>	SSC	1

Table 14. Special status animal species with potential or known to occur or reside within 1.0 mile of the Stegeman Restoration Area, Colusa County, California. FE/FT=federally endangered/federally threatened; FSC = Federal species of special concern; SE/ST=state endangered/state threatened; SSC = California species of special concern; SSC1= species that face immediate extirpation of their entire California population or their California breeding population if current trends continue (these species may qualify as state endangered or threatened, but are not yet listed); SSC2 = species on the decline in a large portion of their range in California, which require management to prevent their becoming SSC1; SSC3 = species not in any present danger of extirpation and their populations within most of their range do not appear to be declining seriously, however, due to their small populations in California they are vulnerable to extirpation should a threat materialize; ?=not enough information.

Common Name	Scientific Name	Status	Breeding
Valley elderberry longhorn beetle	<i>Desmocerus californicus dimorphus</i>	FT	
Sacramento splittail	<i>Pogonichthys macrolepidoptus</i>	SSC1	potential
Steelhead – Central Valley ESU	<i>Oncorhynchus mykiss</i>	FT	potential
Chinook salmon (fall run)	<i>Oncorhynchus tshawytscha (fall run)</i>	SSC	potential
Chinook salmon (spring run)	<i>Oncorhynchus tshawytscha (spring)</i>	FT/ST	potential
Chinook salmon (winter run)	<i>Oncorhynchus tshawytscha (winter)</i>	FE/SE	probable
Hardhead	<i>Mylopharodon conocephalus</i>	SSC3	
Western spadefoot toad	<i>Spea hammondi</i>	SSC	potential
Western pond turtle	<i>Clemmys marmorata</i>	SSC	probable
Giant garter snake**	<i>Thamnophis gigas</i>	FT/ST	potential
American white pelican	<i>Pelecanus erythrorhynchos</i>	SSC	
Double-crested cormorant*	<i>Phalacrocorax auritus</i>	SSC2	potential
White-faced ibis	<i>Plegadis chihi</i>	SSC	
Osprey*	<i>Pandion haliaetus</i>	SSC2	known
Bald eagle	<i>Haliaeetus leucocephalus</i>	FT/SE	
Northern harrier	<i>Circus cyaneus</i>	SSC2	probable
Sharp-shinned hawk	<i>Accipiter striatus</i>	SSC3	
Cooper's hawk*	<i>Accipiter cooperii</i>	SSC3	probable
Swainson's hawk	<i>Buteo swainsoni</i>	ST	known
Ferruginous hawk	<i>Buteo regalis</i>	SSC	
Golden eagle	<i>Aquila chrysaetos</i>	SSC3	
Peregrine falcon	<i>Falco peregrinus</i>	SE	
Prairie falcon	<i>Falco mexicanus</i>	SSC3	
California gull	<i>Larus californicus</i>	SSC3	
Burrowing owl	<i>Athene cunicularia</i>	SSC2	potential
Short-eared owl	<i>Asio flammeus</i>	SSC2	potential
Long-eared owl	<i>Asio otus</i>	SSC	
Greater sandhill crane	<i>Grus canadensis tabida</i>	ST	
Long-billed curlew	<i>Numenius americanus</i>	SSC	
Western yellow-billed cuckoo	<i>Coccyzus americanus occidentalis</i>	FSC/SE	known
Willow flycatcher	<i>Empidonax traillii</i>	SE	?
Loggerhead shrike	<i>Lanius ludovicianus</i>	CSC	probable
Purple martin	<i>Progne subis</i>	SSC2	
Bank swallow	<i>Riparia riparia</i>	ST	known
Yellow warbler	<i>Dendroica petechia</i>	SSC2	potential
Yellow-breasted chat	<i>Icteria virens</i>	SSC2	probable
California horned lark**	<i>Eremophila alpestris actia</i>	SSC	potential
Tricolored blackbird	<i>Agelaius tricolor</i>	SSC	potential
Townsend's big-eared bat**	<i>Corynorhinus townsendii</i>	SSC2	?
Pallid bat**	<i>Antrozous pallidus</i>	SSC	?
Western mastiff bat	<i>Eumops perotis</i>	SSC2	?

*Species observed within 1.0 miles of the Restoration Area by the authors.

** Species not known or with low probability of occurrence within area of consideration.

Threatened and Endangered Wildlife Species

Seven threatened or endangered wildlife species are of particular interest in the vicinity of the Stegeman tract. Following is a brief discussion of their status and any observations noted during fieldwork.

1. Valley elderberry longhorn beetle (*Desmocerus californicus dimorphicus*)

Valley elderberry longhorn beetle (VELB) is a federally threatened species. Potential VELB habitat occurs throughout nearby remnant vegetation wherever blue elderberry (*Sambucus mexicana*) is present. This species is not recorded in the CNDDDB as occurring within 1.0 mile of the Restoration Area and nearby remnant riparian habitat.

2. Steelhead (*Oncorhynchus mykiss*) – Central Valley Evolutionarily Significant Unit (ESU)

The Central Valley steelhead ESU is a federally threatened population. Steelhead is an anadromous fish species spawning in tributaries of the Sacramento River.

3. Chinook salmon (*Oncorhynchus tshawytscha*) – spring run

The spring run Chinook salmon is a federal and state threatened species. Spring run Chinook salmon are an anadromous species of fish that spawns in tributaries of the Sacramento River. Mill, Deer, and Butte Creek are the principle spawning grounds of this species.

4. Chinook salmon (*Oncorhynchus tshawytscha*) – winter run

Winter run Chinook salmon is a federal and state endangered species. Winter run Chinook salmon are known to spawn in cold gravels of the Sacramento River. This species is recorded as occurring throughout the lower Sacramento River below Keswick Dam.

5. Swainson's hawk (*Buteo swainsonii*)

Swainson's hawk is a state threatened species. Swainson's hawks have been observed foraging within 1.0 mile of the Restoration Area by the authors. This species is recorded in the CNDDDB as nesting within 1.0 mile of the Restoration Area.

6. Bank Swallow (*Riparia riparia*)

Bank swallows are a state threatened species. This species is known to nest in colonies in undercut banks along the Sacramento River. This species is recorded in the CNDDDB as nesting within 1.0 mile of the Restoration Area.

7. Western yellow-billed cuckoo (*Coccyzus americanus occidentalis*)

Western yellow-billed cuckoos are a state endangered species known to nest in riparian forests along the Sacramento River. This species is recorded in the CNDDDB as nesting within 1.0 mile of the Restoration Area.

Non-native mammal species

Table 15 lists the non-native mammal species known to occur or potentially occurring within 1.0 mile of the Restoration Area, and an estimate (where possible) of abundance. Small mammal sampling is currently being conducted at the Restoration Area and within nearby remnant riparian habitat, but information on non-native mammals presented here is highly qualitative and should be taken as such.

Domestic dogs were not observed on or near the Restoration Area. Because of the proximity of residences, domestic dogs potentially occur on the Restoration Area periodically.

Feral cats have not been observed at the Restoration Area, but this species is expected to occur periodically due to the proximity of residences to the Restoration Area and the fact that feral cats have been observed repeatedly at other restoration areas. Feral cats can cause significant depredation on small vertebrates as well as serving as a potential vector for disease to other mammals (e.g. feline distemper, feline leukemia, feline immune deficiency disease, and toxoplasmosis; Coleman et. al. 1997).

House mice and roof rats are known to occur, and Norway rats have potential to occur within 1.0 mile of the Restoration Area. These animals are relatively widespread in lower elevations in California, especially in association with residences and agriculture (Whitaker 1991) and have been documented in riparian areas. Roof rats have been shown to be important nest predators in remnant riparian and riparian restoration sites at Cosumnes River Preserve (Desley Whisson and Andy Engilis Jr. ongoing research). According to Whisson, because of its arboreal habits, mixed riparian forests can provide an ideal habitat for this species (Whisson unpublished). Norway rats are also a widespread invasive mammal species with a high potential of occurrence, but lacking the arboreal tendencies of roof rats.

Nutria were not observed on or near the Restoration Area, but have a high probability of occurring in freshwater marsh within nearby riparian vegetation immediately east of the Restoration Area. Potential effects of nutria on native wildlife are not well documented. Tracks of Virginia opossum were observed on and around the Restoration Area. Domestic/feral dogs, feral cats, roof rats, Norway rats and Virginia opossum are all known predators of small mammals, birds, reptiles and amphibians. All non-native mammals listed above are likely to have a widespread occurrence within riparian habitat along the Sacramento River. Information is currently being gathered on the relative abundance of non-native rodent species, but more information on the presence/absence and relative abundance of other non-native mammals (such as feral cats) needs to be collected in order to determine the relative importance of these species.

Table 15. Non-native mammal species known or potentially occurring within 1.0 miles of the Stegeman Restoration Area, Colusa County, California. Estimated abundances are based upon the experience of the authors and field observations at the Restoration Area and similar sites. A “common” indicates that the species was observed in abundance either during visual surveys or during small mammal trapping. An “unknown” indicates that either the species was never observed or that the site itself was not sampled.

Common Name	Scientific Name	Observed	Abundance
Domestic dog	<i>Canis domesticus</i>	No	Unknown
Feral Cat	<i>Felis catus</i>	No	Unknown
House Mouse	<i>Mus musculus</i>	Yes	Common
Roof Rat	<i>Rattus rattus</i>	Yes	Common
Norway Rat	<i>Rattus norvegicus</i>	No	Unknown
Nutria	<i>Myocastor coypu</i>	No	Unknown
Virginia Opossum	<i>Didelphus virginianis</i>	Sign (tracks)	Common

Bird Counts

Figure 14 shows sampling locations and Table 16 lists all bird species observed on the June 22, 2005 point counts. Figure 15 shows the frequency of occurrence for species observed more than once. Forty-two species were encountered during the survey, and species composition was fairly typical of riparian habitats along the Sacramento River. Black-headed grosbeak was the most frequently observed species (12.5%) followed by Bewick’s wren (8.9%), spotted towhee (7.1%) and western wood-pewee (5.4%).

Table 16. Bird species observed within and adjacent to remnant riparian habitat of the Stegeman Restoration Area, Colusa County, California (see table 14 for definition of status).

Common name	Scientific Name	Status
American crow	<i>Corvus brachyrhynchos</i>	
American goldfinch	<i>Carduelis tristis</i>	
American pelican	<i>Pelecanus erythrorhynchos</i>	SSC
American robin	<i>Turdus migratorius</i>	
Ash-throated flycatcher	<i>Myiarchus cinerascens</i>	
Bewick's wren	<i>Thryomanes bewickii</i>	
Black-headed grosbeak	<i>Pheucticus melanocephalus</i>	
Brewer's blackbird	<i>Euphagus cyanocephalus</i>	
Brown-headed cowbird	<i>Molothrus ater</i>	non-native
Bullock's oriole	<i>Icterus bullocki</i>	
Bushtit	<i>Psaltiriparus minimus</i>	
California quail	<i>Calipepla californica</i>	
California towhee	<i>Pipilo crissalis</i>	
Common yellowthroat	<i>Geothlypis trichas</i>	
Downy woodpecker	<i>Picoides pubescens</i>	
European starling	<i>Sturnus vulgaris</i>	non-native
Great blue heron	<i>Ardea herodias</i>	
Great egret	<i>Ardea alba</i>	
Great-horned owl	<i>Bubo virginianus</i>	
House finch	<i>Carpodacus mexicanus</i>	
House wren	<i>Troglodytes aedon</i>	
Killdeer	<i>Charadrius vociferus</i>	
Lark sparrow	<i>Chondestes grammacus</i>	
Lazuli bunting	<i>Passerina amoena</i>	
Lesser goldfinch	<i>Carduelis psaltria</i>	
Mourning dove	<i>Zenaida macroura</i>	
Northern flicker	<i>Colaptes auratus</i>	
Northern mockingbird	<i>Mimus polyglottos</i>	
Nuttall's woodpecker	<i>Picoides nuttallii</i>	
Oak titmouse	<i>Baeolophus inornatus</i>	
Red-tailed hawk	<i>Buteo jamaicensis</i>	
Rock dove	<i>Columba livia</i>	non-native
Spotted towhee	<i>Pipilo maculatus</i>	
Tree swallow	<i>Tachycineta bicolor</i>	
Turkey vulture	<i>Cathartes aura</i>	
Western bluebird	<i>Sialia mexicana</i>	
Western kingbird	<i>Tyrannus verticalis</i>	
Western scrub-jay	<i>Aphelocoma californica</i>	
Western wood-pewee	<i>Contopus sordidulus</i>	
White-breasted nuthatch	<i>Sitta carolinensis</i>	
Wood duck	<i>Aix sponsa</i>	
Yellow-billed magpie	<i>Pica nuttalli</i>	

Stegeman Restoration Area: Bird Survey Locations

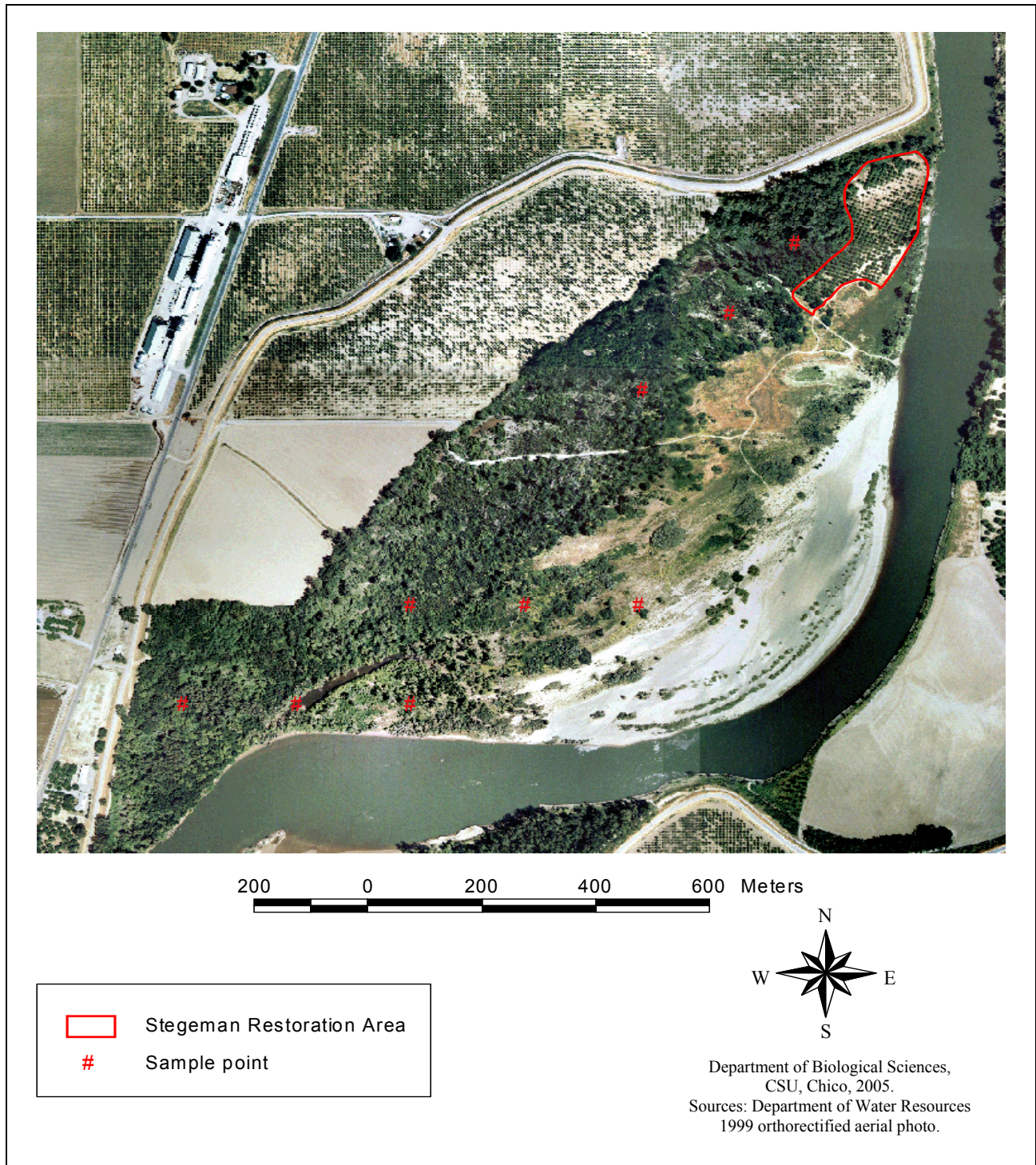


Figure 14. Bird survey station locations in riparian habitat close to the Stegeman Restoration Area, Colusa County, California.

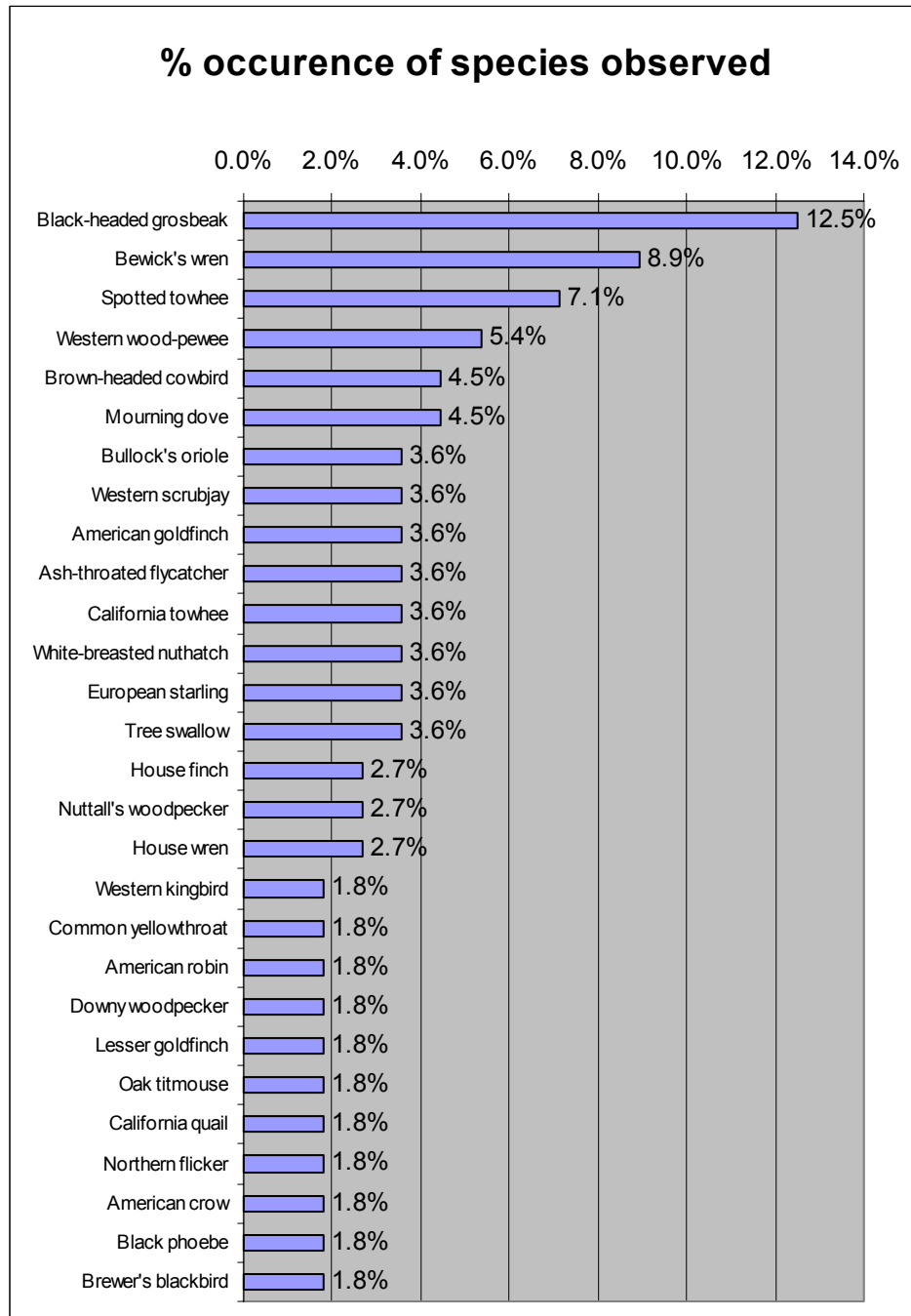


Figure 15. Frequency of bird species observed more than once within a 50 m radius of nine 8-minute observation stations within remnant riparian habitat close to the Stegeman Restoration Area, Colusa County, CA. Species observed only once are excluded for clarity.

References

- Burt, W. H., and R. P. Grossenheider. 1976. *A Field Guide to Mammals*. Houghton Mifflin Co., Boston, MA.
- California Department of Fish and Game. 2002. *California Wildlife Habitat Relationships Systems 8.0*. Wildlife and Habitat Data Analysis Branch, Sacramento, CA.
- California Department of Fish and Game. 2005. *California Natural Diversity Database. RareFind 3*. Updated May 27, 2005. Wildlife and Habitat Data Analysis Branch, Sacramento, CA.
- California Department of Fish and Game. 2005. *California's Plants and Animals*. Wildlife and Habitat Data Analysis Branch, Sacramento, CA. Retrieved from:
<http://www.dfg.ca.gov/hcpb/species/species.shtml>.
- California, Department of Water Resources. 2002. *GIS of the middle Sacramento River, California*. Northern District, Red Bluff, California.
- Coleman, J.S., S.A. Temple, and S.R. Craven. 1997. *Facts on cats and wildlife: a conservation dilemma*. University of Wisconsin Extension, Madison, WI.
- Ehrlich, P. R., D.S. Dobkin and D. Wheye. 1988. *The Birder's Handbook*. Simon and Schuster, Inc., New York, NY.
- Ingles, L.G. 1965. *Mammals of the Pacific States*. Stanford University Press, Stanford, CA.
- Moyle, P. 1976. *Inland Fishes of California*. University of California Press, Berkeley, CA.
- National Geographic. 1999. *Field Guide to the Birds of North America*. National Geographic Society, Washington, D.C.
- Ralph, C. J., G.R. Geupel, P. Pyle, T.E. Martin, and D.F. DeSante. 1993. *Handbook of field methods for monitoring landbirds*. Gen. Tech. Rep. PSW-GTR-144. Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture, Albany, CA.
- Small, S. S., J. DeStaebler, G.R. Geupel, and A. King. 1999. *Landbird response to riparian restoration on the Sacramento River system: preliminary results of the 1997 and 1998 field season*. Submitted to The Nature Conservancy and U.S. Fish and Wildlife Service, October 1999, by Point Reyes Bird Observatory, Stinson Beach, CA.
- Stebbins, R.C. 1985. *A Field guide to Western Amphibians and Reptiles*. Peterson Field Guide Series. Houghton Mifflin Company, Boston, MA.
- Whitaker Jr., J.O. 1991. *The Audubon Society Field Guide to North American Mammals*. Alfred A. Knopf, Inc., New York, NY.
- Whisson, D. and A. Engilis Jr.. 2005. *Predation of songbirds in California riparian areas (ongoing research)*. Retrieved from:
<http://wfcb.ucdavis.edu/www/Faculty/desley/research.htm>
Department of Wildlife, Fish, and Conservation Biology, University of California, Davis, CA.