



### Introduction:

In 2007, Vino Farms, Inc. joined with River Partners to implement a habitat restoration project on approximately 22.5 floodplain acres adjacent to their Mokelumne River vineyards. The goal of this project is to improve wildlife habitat by removing invasive plant species and planting native vegetation. This restoration project was designed to benefit a number of native riparian species including Neotropical migrant songbirds, Swainson's hawk (*Buteo swainsoni*), and the valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*). This project also has the potential to provide a future source for in-stream large wood critical to restoring salmon habitat in this region

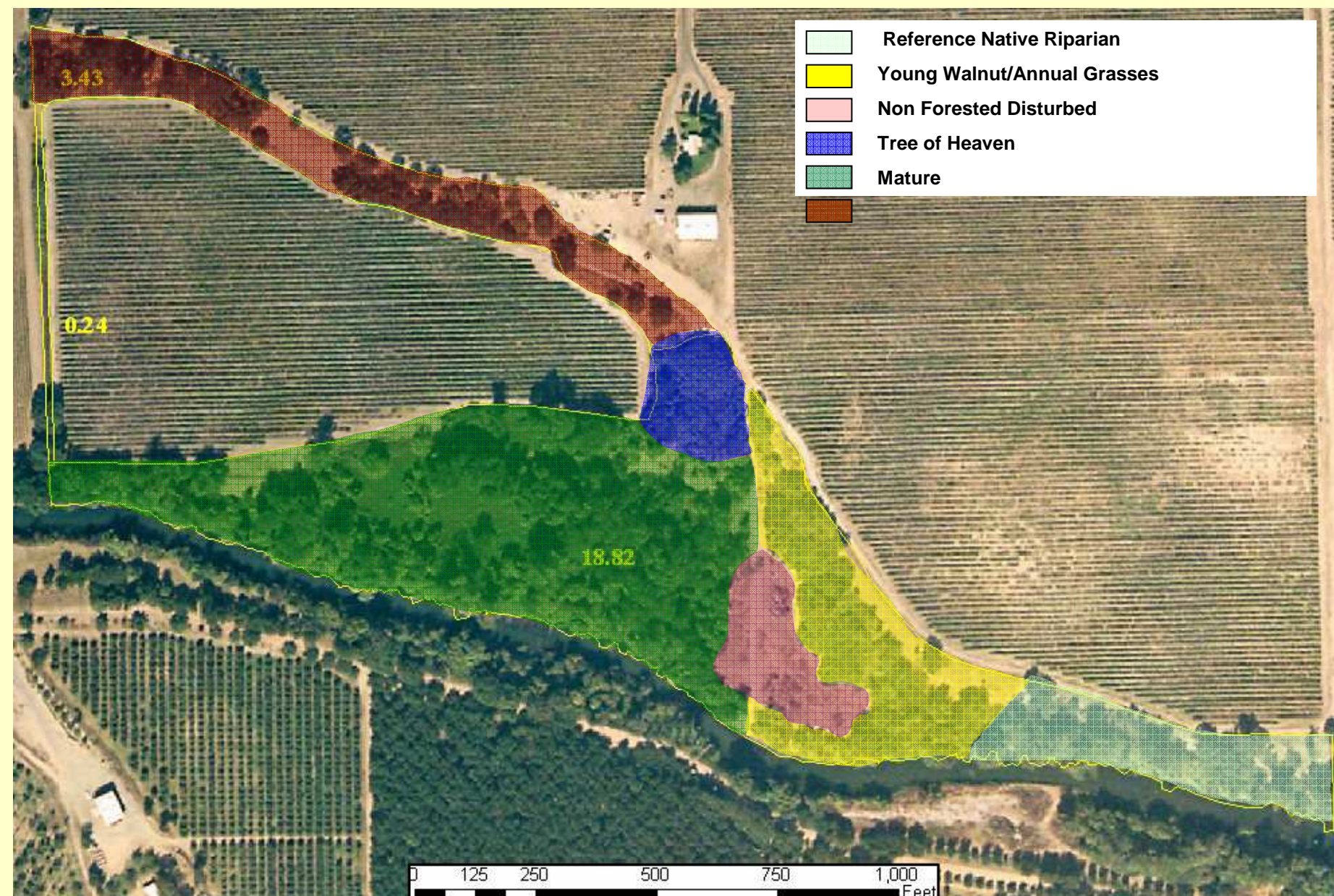


Figure 1: Pre-restoration communities on Vino Farms

### Pre-restoration Conditions:

Prior to restoration, the floodplain fields on Vino Farms were dominated by Himalayan blackberry (*Rubus armeniacus*) tree-of-heaven (*Ailanthus altissima*) and hybridized black walnuts. This area provided little habitat for wildlife. River Partners was contracted to remove this vegetation and re-establish a native riparian community as part of Vino Farms sustainable agricultural program (Figure 1).



Figure 2a: Blackberry and Walnut in Floodplain fields

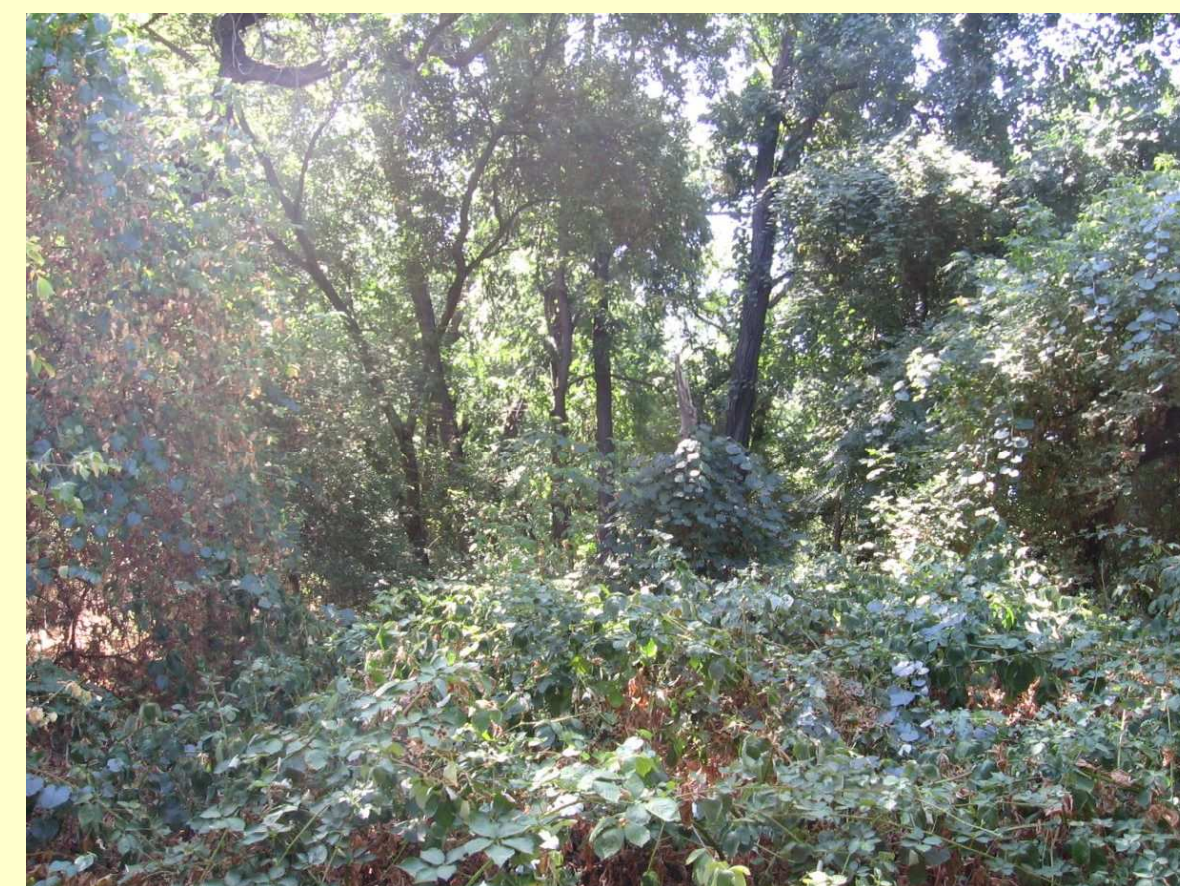


Figure 2b: Blackberry in floodplain fields

### Invasive Plant Removal:

Himalayan blackberry was grazed by brush goats for 4 weeks before the canes were cleared by a mechanical masticator. Black walnuts were mechanically removed from 14.5 acres and tree-of-heaven was cleared from 1 acre. Following removal, fields were disced to remove resprouting walnuts and Himalayan blackberry. In some areas, Garlon 4 was selectively applied. The application was mixed with a mist-control and herbicide activator and applied with handheld tanks and sprayers to increase our precision and eliminate any chance of contaminating the vineyards.



Figure 3: Goats removing blackberries



Figure 4: After goats reduced biomass, a mechanical masticator was used for final clearing

### Restoration:

After removal of the invasive species in April 2008, River Partners planted approximately 2,000 trees and shrubs in four areas: two floodplain fields, along the bluff overlooking the river, and as a small hedgerow along the property boundary. Approximately 500 live oak (*Quercus wislizenii*), valley oak (*Quercus lobata*) and snowberry (*Symphoricarpos albus*) will be planted in Fall, 2008.

### Species Composition:

Interior Live Oak ( <i>Quercus wislizenii</i> )*	5%	Valley Oak ( <i>Quercus lobata</i> )*	10%
Arroyo Willow ( <i>Salix lasiolepis</i> )	10%	Red Willow ( <i>Salix laevigata</i> )	6%
Freemont Cottonwood ( <i>Populus fremontii</i> )	10%	Coyote brush ( <i>Baccharis pilularis</i> )	5%
Snowberry ( <i>Symphoricarpos albus</i> )	4%	Elderberry ( <i>Sambucus mexicana</i> )	8%
California rose ( <i>Rosa californica</i> )	14%	California blackberry ( <i>Rubus ursinus</i> )	28%

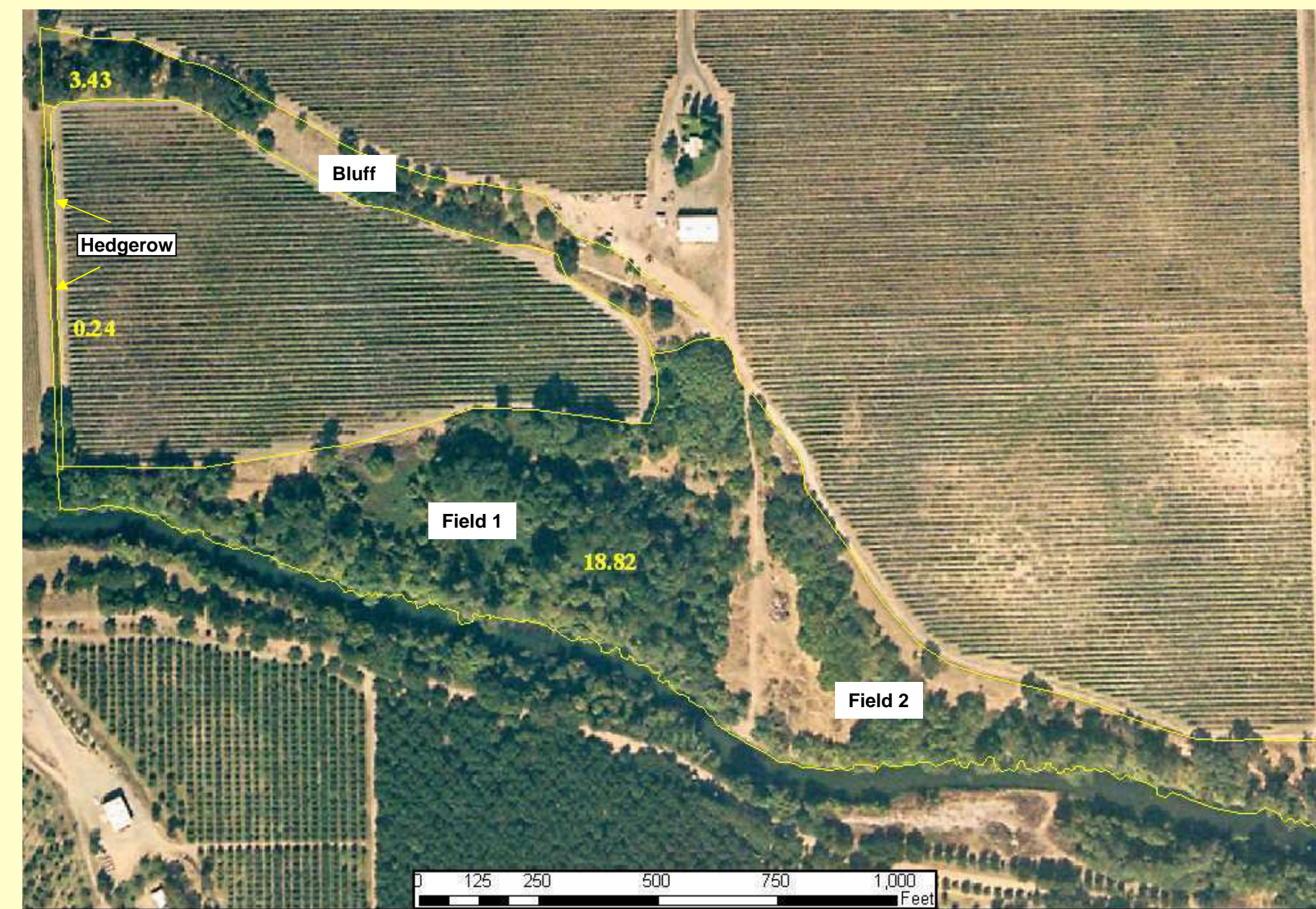


Figure 5: Restoration Areas

### Design Considerations:

This project was designed to provide immediate (<3 years) habitat benefits with a high probability of long-term survival. To achieve this goal, we planted a mix of willow species and cottonwoods which, in the short-term will provide several generations of targeted bird species with nesting and foraging habitat. As the restoration matures, shade tolerant oaks will mature maximizing quality habitat. Planting of species with rapid growth, and a dense native understory will also provide strong completion against invasive weeds.

This project was designed to provide a variety of plant species to create habitat diversity for resident and migratory birds. Data from the Point Reyes Bird Observatory suggests that bird diversity is greatest in areas with 5-7 shrub species over a 50-m<sup>2</sup> area. Design considerations include creating structural differences, creating vegetative patches, and planting associated herbaceous species (Geupel et al. 1997). Species expected to benefit from this restoration include species of special concern such as the yellow-breasted chat (*Icteria virens*), common yellowthroat (*Geothlypis trichas*), and yellow warbler (*Dendroica petechia*).

Blue elderberry was planted to provide habitat for the valley elderberry longhorn beetle. Cottonwoods were planted as a potential source of in-stream wood for salmon.

The restoration design also took into account the general flow direction of the stream by orienting bands of vegetation parallel to the general flow direction and away from levees and other sensitive structures.



Figure 6: Floodplain Restoration



Figure 7: Floodplain Restoration

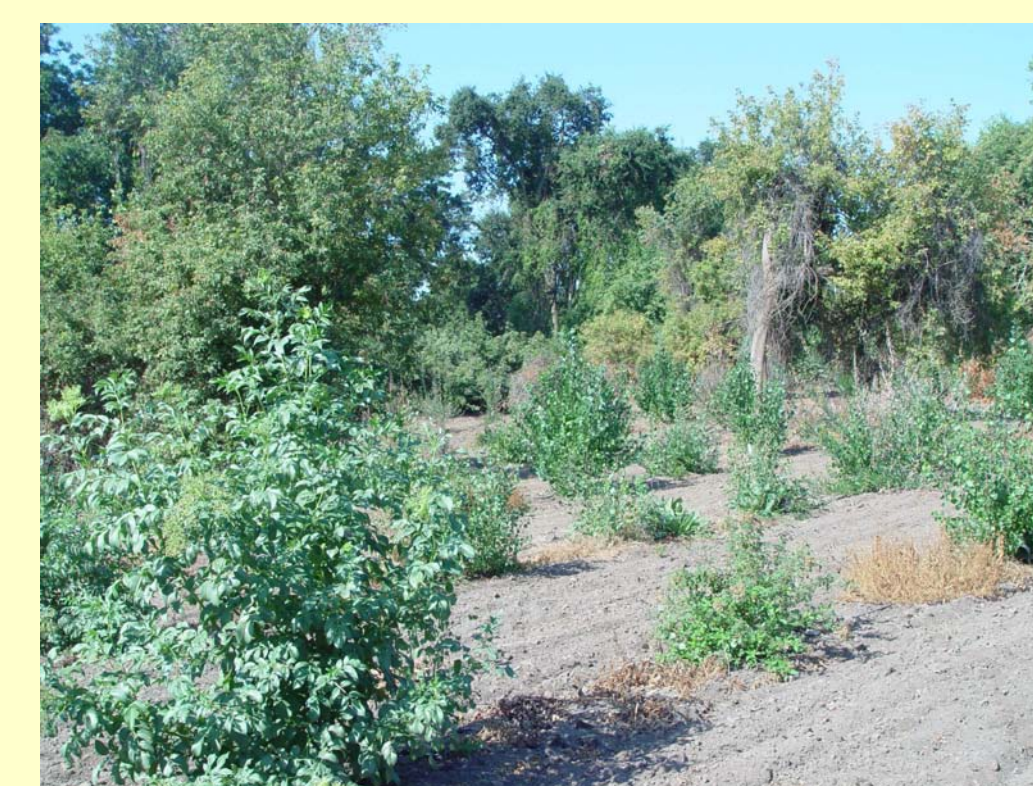


Figure 8: Floodplain Restoration



Figure 9: Hedgerow Restoration

### Initial Plant Survey:

Restoration plantings were censused in late July, 2008. For this census, all plants were surveyed and classified as live, dead, or missing. With the exception of the bluff enhancement plantings, survivorship of planted species exceeded 85 % (Figures 10-12). A replanting plan will be developed from this census and replanting will occur in late 2008. At this time, River Partners will also plant the oaks and snowberry which were not planted in the initial planting.

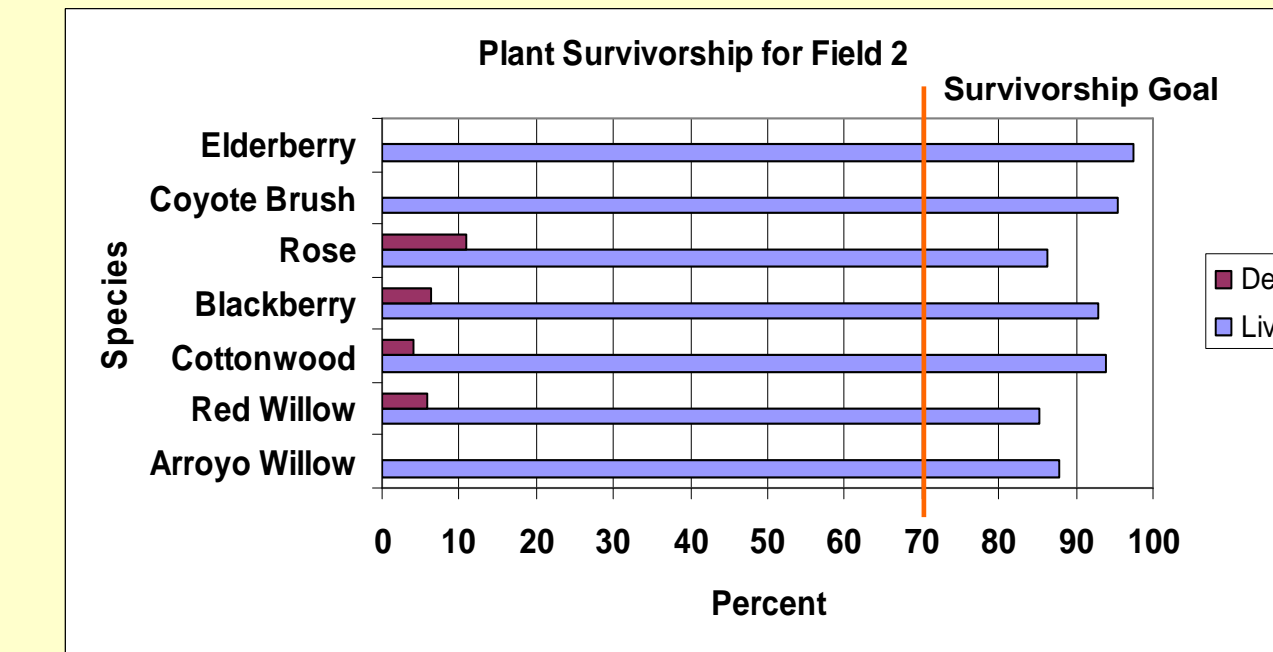


Figure 10: Survivorship in Field 2

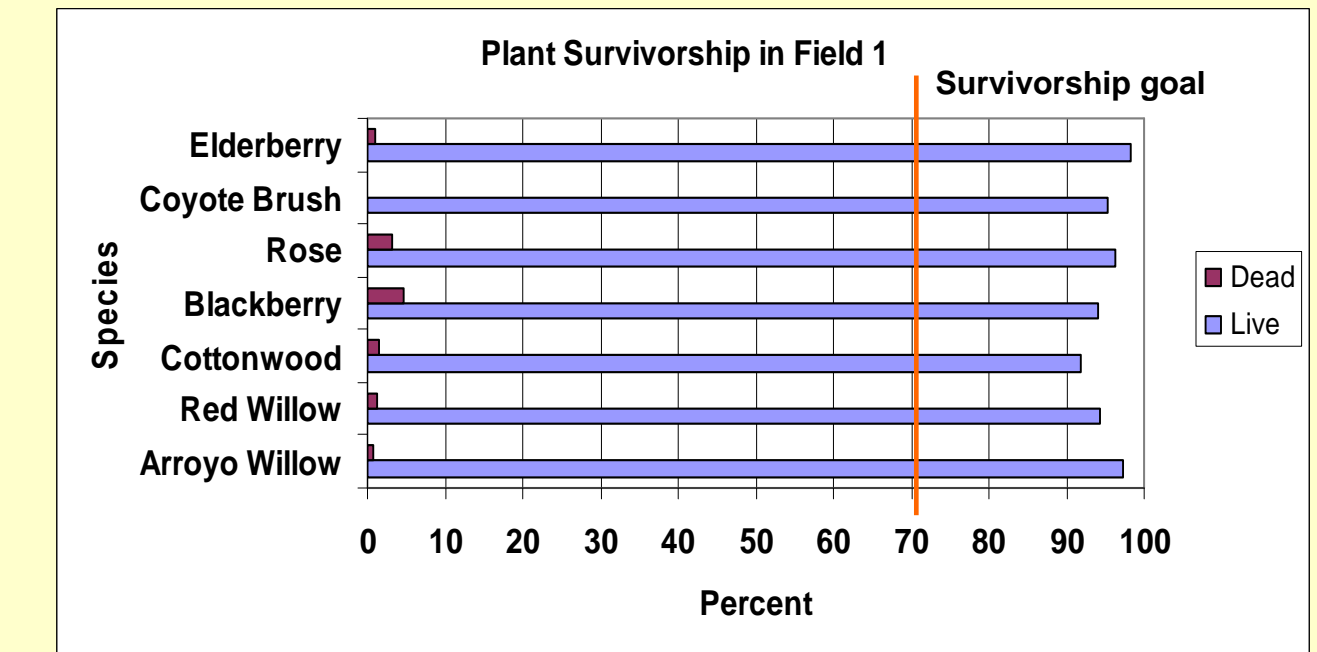


Figure 11: Survivorship in Field 1

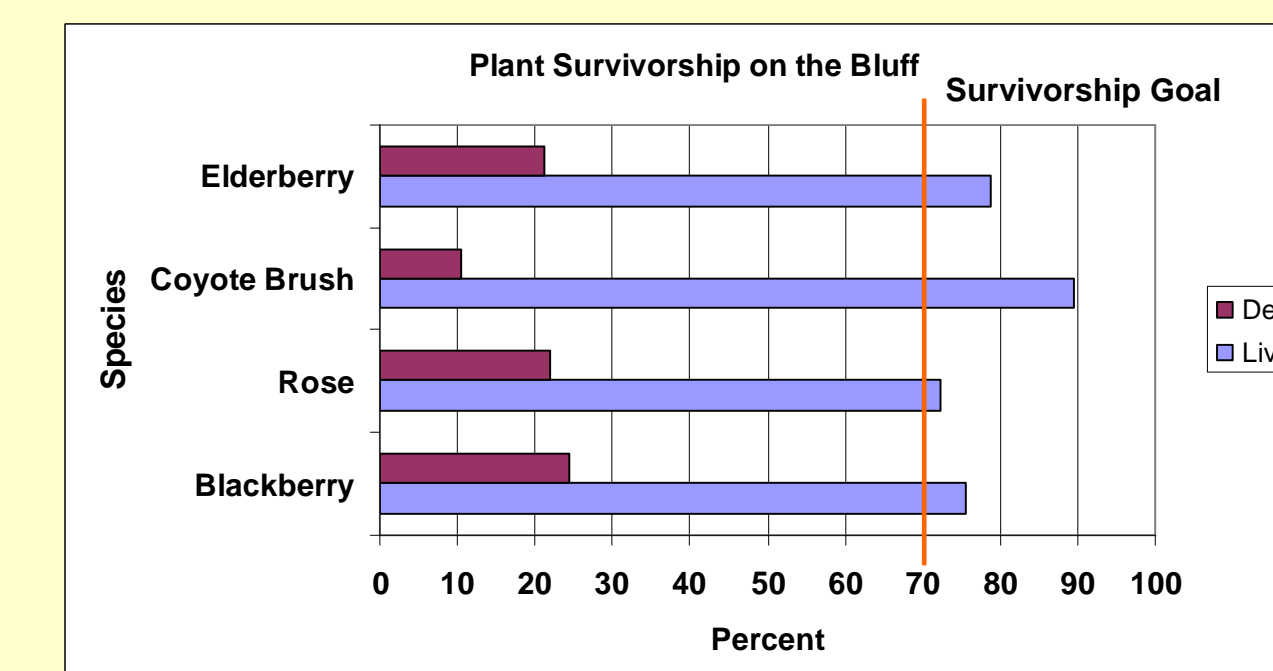


Figure 12: Survivorship on the Bluff

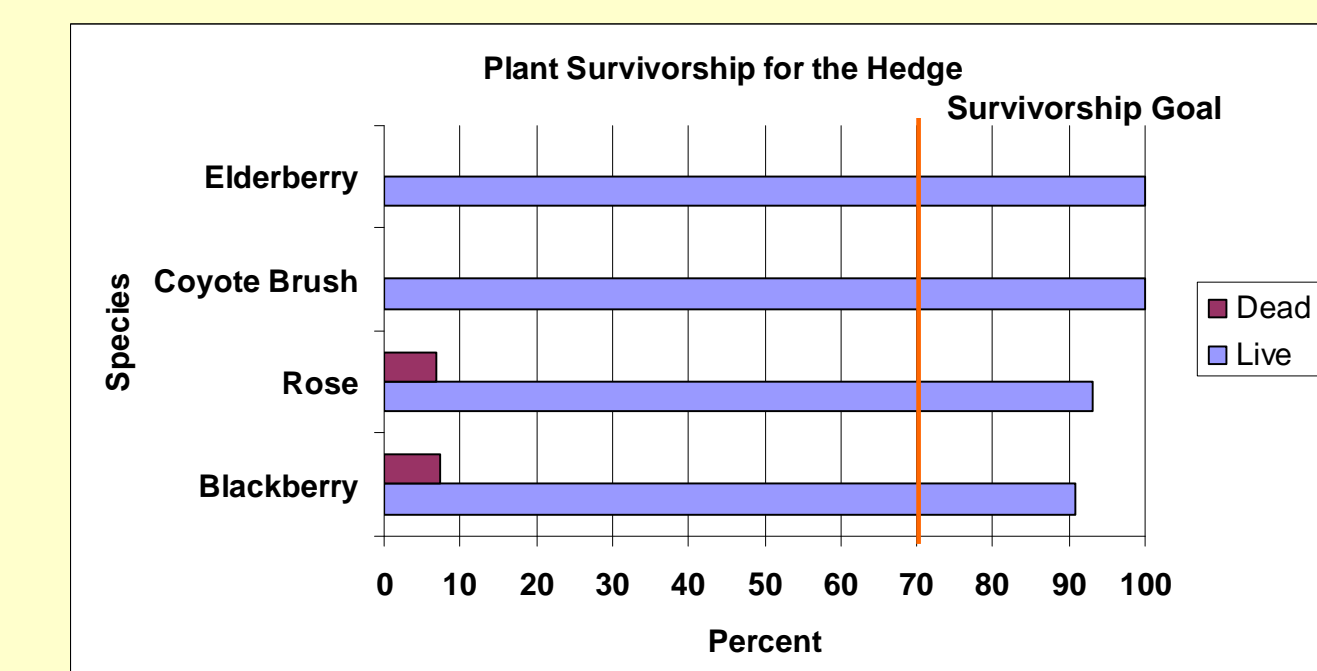


Figure 13: Survivorship in the Hedgerow

**Tree Survey:** The 2008 census showed that tree growth was rapid on this site. To better quantify this growth, all cottonwoods onsite, as well as all willow species in Field 2 were surveyed to quantify tree height and canopy cover (Figures 14-15). The height of cottonwoods planted in the floodplain fields averaged 1.79 m ± 0.34 with an average canopy width of 1.42 m ± 0.43. The average height of the arroyo willows was 1.78m ± 0.49 and the average height for the red willow was 1.47m ± 0.37. Canopy widths averaged 1.20 m ± 0.59 for arroyo willow and 1.08 m ± 0.37 for red willow.

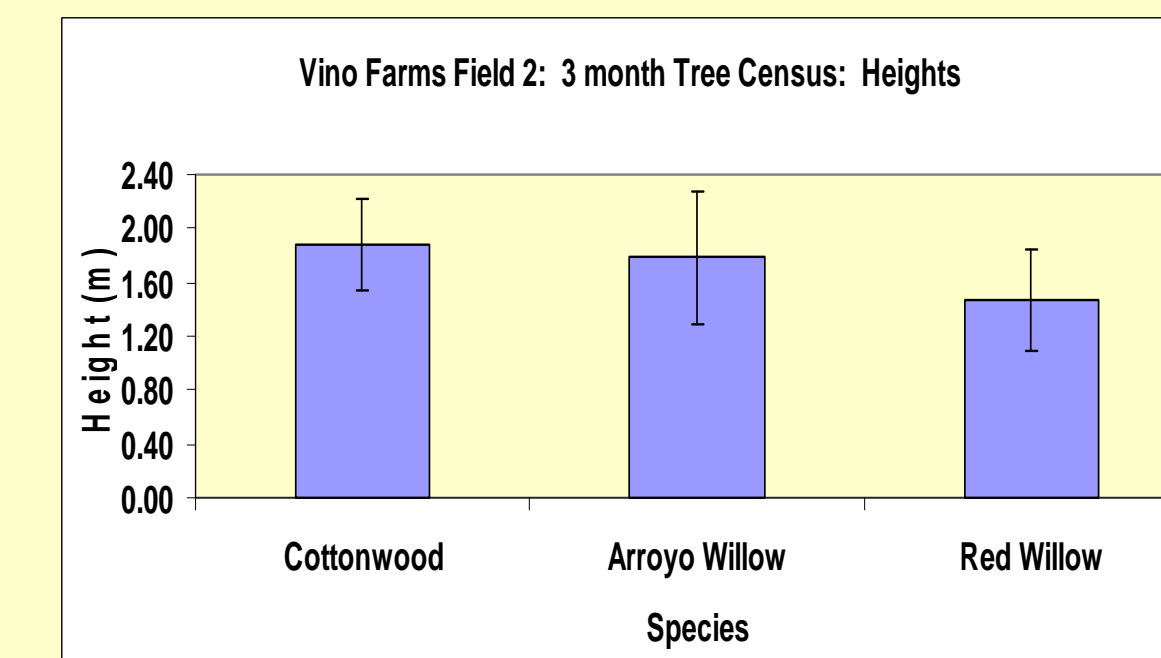


Figure 14: Tree heights in Field 2

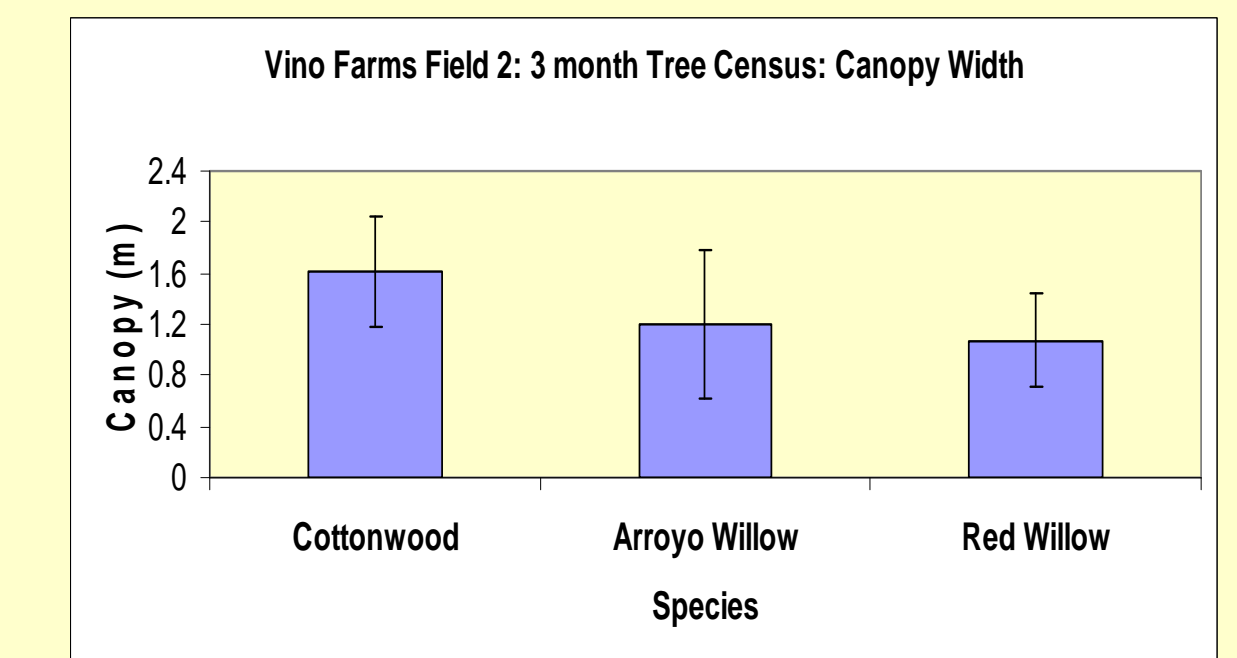


Figure 15: Average tree canopy cover

### Discussion:

Integrated Pest Management (IMP) is a strategy that utilizes biological controls, habitat manipulation and modifications to cultural practices to manage pests in an ecologically sound manner. IMP is a critical part of Vino Farm's sustainable agriculture program. The establishment of a diverse native community on this site will provide habitat niches for a number of resident and migratory birds as well as attract native pollinators. These benefits will increase the effectiveness of their IMP program.

On a larger scale, the Mokelumne River is one of the few rivers in the Central Valley with extant salmon spawning. Restoration of riparian habitat is critical for reducing sediment loading into the stream and as a source of wood critical for salmon habitat (Opperman and Merenlender, 2008). Live salmon (via excretion) and salmon carcasses play an important role as a food and nutrient source for many riparian species (Cederholm et al. 1999).

Salmon have also been shown to have an economic benefit to riparian landowners. Nitrogen 15 (<sup>15</sup>N) is a stable isotope used to track the source of nutrients in an ecosystem. Surveys on the Mokelumne River have shown that vegetation near spawning beds, including wine grapes, derived 18-25 % of their nitrogen from marine sources (i.e. salmon), reducing fertilizer costs (Mertz and Moyle, 2006). Restoration of native vegetation at Vino Farms therefore has the potential to provide ecological and economic benefits at a number of scales.

River Partners will continue monitoring and maintenance on this site for two more years. 20m by 50 permanent plots will be established in 2009 and surveyed for tree height and canopy cover in 2009 and 2010. In Fall 2009, a herbaceous native understory will be planted between the rows. At the end of the monitoring period, it is expected that a diverse native community will be well established at this site which should prevent future large-scale establishment of invasive plants.

### Literature Cited:

Cederholm, C.J., M.D. Kunze, T. Murota, and A. Sibatani. 1999. Pacific salmon carcasses: essential contributions of nutrients and energy for aquatic and terrestrial ecosystems. *Fisheries* 24:6-15.

Geupel, G.R., N. Nur, A. King, and G. Ballard. 1997. Songbird monitoring on the San Luis National Refuge: Results from the 1996 field season. PRBO unpublished report to the US Fish and Wildlife Service. Stinson Beach, CA.

Indejit, S. ed. 2005. *Invasive Plants: Ecological and Agricultural Aspects*. Birkhäuser Basel

Mertz, J.E. and P.B. Moyle. 2006. Salmon, wildlife and wine: marine-derived nutrients in human-dominated ecosystems of Central California. *Ecological Applications*. 16(3) pp.999-1009

Opperman, J.J. and A.M. Merenlender. 2007. Living trees provide stable large wood in streams. *Earth Surface Processes and Landforms*. 32:1229-1238.

**Acknowledgements:** We would like to thank Vino Farms, Inc. We would also like to thank Nick Bronken, Mike Lung and Stephanie Woick for help on the field survey.