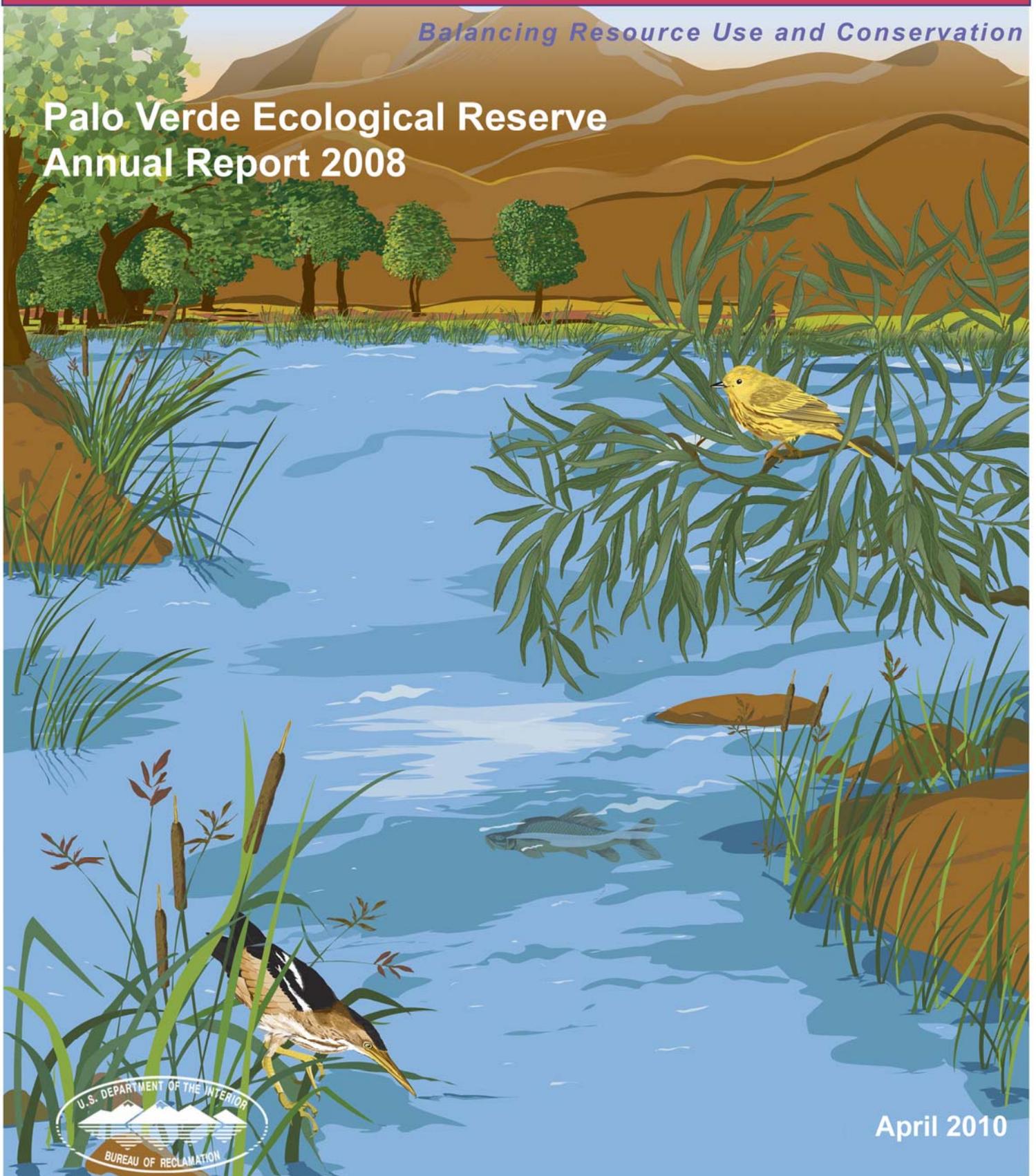




# Lower Colorado River Multi-Species Conservation Program

*Balancing Resource Use and Conservation*

## Palo Verde Ecological Reserve Annual Report 2008



April 2010

# Lower Colorado River Multi-Species Conservation Program Steering Committee Members

## **Federal Participant Group**

Bureau of Reclamation  
U.S. Fish and Wildlife Service  
National Park Service  
Bureau of Land Management  
Bureau of Indian Affairs  
Western Area Power Administration

## **Arizona Participant Group**

Arizona Department of Water Resources  
Arizona Electric Power Cooperative, Inc.  
Arizona Game and Fish Department  
Arizona Power Authority  
Central Arizona Water Conservation District  
Cibola Valley Irrigation and Drainage District  
City of Bullhead City  
City of Lake Havasu City  
City of Mesa  
City of Somerton  
City of Yuma  
Electrical District No. 3, Pinal County, Arizona  
Golden Shores Water Conservation District  
Mohave County Water Authority  
Mohave Valley Irrigation and Drainage District  
Mohave Water Conservation District  
North Gila Valley Irrigation and Drainage District  
Town of Fredonia  
Town of Thatcher  
Town of Wickenburg  
Salt River Project Agricultural Improvement and Power District  
Unit "B" Irrigation and Drainage District  
Wellton-Mohawk Irrigation and Drainage District  
Yuma County Water Users' Association  
Yuma Irrigation District  
Yuma Mesa Irrigation and Drainage District

## **Other Interested Parties Participant Group**

QuadState County Government Coalition  
Desert Wildlife Unlimited

## **California Participant Group**

California Department of Fish and Game  
City of Needles  
Coachella Valley Water District  
Colorado River Board of California  
Bard Water District  
Imperial Irrigation District  
Los Angeles Department of Water and Power  
Palo Verde Irrigation District  
San Diego County Water Authority  
Southern California Edison Company  
Southern California Public Power Authority  
The Metropolitan Water District of Southern California

## **Nevada Participant Group**

Colorado River Commission of Nevada  
Nevada Department of Wildlife  
Southern Nevada Water Authority  
Colorado River Commission Power Users  
Basic Water Company

## **Native American Participant Group**

Hualapai Tribe  
Colorado River Indian Tribes

## **Conservation Participant Group**

Ducks Unlimited  
Lower Colorado River RC&D Area, Inc.  
The Nature Conservancy



# Lower Colorado River Multi-Species Conservation Program

## Palo Verde Ecological Reserve Annual Report 2008

Lower Colorado River  
Multi-Species Conservation Program  
Bureau of Reclamation  
Lower Colorado Region  
Boulder City, Nevada  
<http://www.lcrmscp.gov>

April 2010

## List of Common and Scientific Names

### Bird

Abert's towhee	<i>Pipilo aberti</i>
black-tailed gnatcatcher	<i>Polioptila melanura</i>
black-chinned hummingbird	<i>Archilochus alexandri</i>
brown-headed cowbird	<i>Molothrus ater</i>
Bullock's oriole	<i>Icterus bullockii</i>
cliff swallow	<i>Petrochelidon pyrrhonota</i>
common raven	<i>Corvus corax</i>
Gambel's quail	<i>Callipepla gambelii</i>
greater roadrunner	<i>Geococcyx californianus</i>
great-tailed grackle	<i>Quiscalus mexicanus</i>
horned lark	<i>Eremophila alpestris</i>
house finch	<i>Carpodacus mexicanus</i>
killdeer	<i>Charadrius vociferus</i>
marsh wren	<i>Cistothorus palustris</i>
mourning dove	<i>Zenaida macroura</i>
northern mockingbird	<i>Mimus polyglottos</i>
northern rough-winged swallow	<i>Stelgidopteryx serripennis</i>
red-winged blackbird	<i>Agelaius phoeniceus</i>
song sparrow	<i>Melospiza melodia</i>
southwestern willow flycatcher	<i>Empidonax trailli extimus</i>
yellow-breasted chat	<i>Icteria virens</i>
western kingbird	<i>Tyrannus verticalis</i>
western meadowlark	<i>Sturnella neglecta</i>
white-winged dove	<i>Zenaida asiatica</i>
yellow-headed blackbird	<i>Xanthocephalus xanthocephalus</i>

### Small Mammal

Colorado River cotton rat	<i>Sigmodon arizonae</i>
cactus mouse	<i>Peromyscus eremicus</i>
deer mouse	<i>Peromyscus maniculatus</i>
desert pocket mouse	<i>Chaetodipus penicillatus</i>
house mouse	<i>Mus musculus</i>

### Bat

Townsend's big-eared bat	<i>Corynorhinus townsendii</i>
western red bat	<i>Lasiurus blossevillii</i>
western yellow bat	<i>Lasiurus xanthinus</i>
California leaf-nosed bat	<i>Macrotus californicus</i>
hoary bat	<i>Lasiurus cinereus</i>
silver-haired bat	<i>Lasionycteris noctivagans</i>
pocketed free-tailed bat	<i>Nyctinomops femorosaccus</i>
western pipistrelle	<i>Parastrellus hesperus</i>
cave myotis	<i>Myotis velifer</i>

# Background

The Palo Verde Ecological Reserve (PVER) encompasses 1,352 acres of the historical floodplain of the Colorado River near Blythe, California. Formerly, the property was known as the Riverview Ranch and was owned by the Travis family. The ranch was acquired by the Trust for Public Lands in 2004 to offset degradation of wildlife habitat along the lower Colorado River. On September 3, 2004, the property was conveyed to the State of California. California has identified up to 1,300 acres of active agricultural lands on this property for habitat restoration under the Lower Colorado River Multi-Species Conservation Program (LCR MSCP), a 50-year multi-partner program administered by the Bureau of Reclamation (Reclamation) (LCR MSCP 2004).

The California Department of Fish and Game (CDFG) and the LCR MSCP are jointly planning the conversion of portions of PVER from agricultural crops to a mix of native plant species. After planting is complete, the created habitats will be managed for species covered under the MSCP throughout the 50-year life of the program.

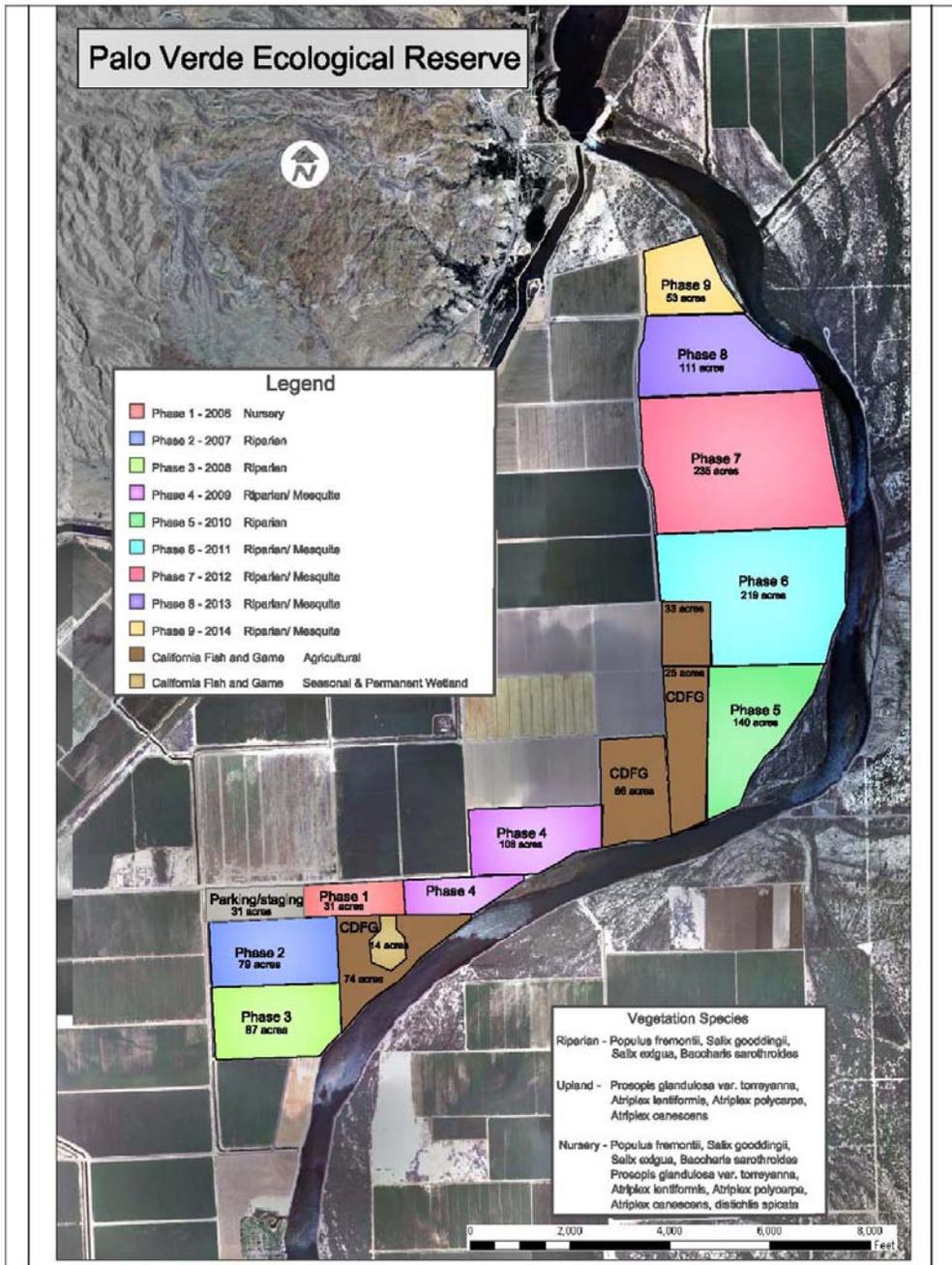
The project is being developed using a phased approach over a nine-year period, with an estimated completion date of 2014 (Figure 1). An overview restoration development plan for the entire site was completed in 2006 (LCR MSCP 2006a). In 2006, Phase 1, a 30-acre riparian nursery, was planted (LCR MSCP 2006b). In 2007, 80 acres of cottonwood-willow land cover type were planted during Phase 2 (LCR MSCP 2006c).

## Site Information

### Purpose

This annual report will provide information pertaining to the development and maintenance of riparian habitat, and summarized monitoring reports/results that will be used as part of the adaptive management plan. Currently, 83% of the acreage at PVER is planted in alfalfa and wheat. The intent is to eventually convert approximately 1,100 acres to riparian habitat, which will be managed for the southwestern willow flycatcher (SWFL) and other LCR MSCP covered species that utilize cottonwood-willow land cover types.

Figure 1. Proposed Phasing Map



## **Location/Description**

PVER lies within the historic floodplain of the Colorado River in southeastern Riverside County, California, at townships 5 and 6 South and ranges 23 and 24 East. PVER is one of the northernmost parcels of agricultural land within the Palo Verde Valley, approximately 5 miles north of Blythe.

Existing infrastructure consists primarily of an irrigation system comprising 9.2 miles of lined and unlined irrigation ditches and associated slide gates, a 100-horsepower electric pump, and approximately 14 miles of access roads. All the acreage has been in agricultural crops of grain, small melons, and alfalfa since the late 1930s. Currently, the land is leased and farmed with crops such as alfalfa and grain.

## **Land Ownership**

PVER is owned by CDFG; the agency leases approximately 1,000 acres to a local farmer who raises alfalfa and small grains. CDFG intends to continue the agricultural lease until the entire property comes under development by Reclamation.

## **Water**

The Palo Verde Irrigation District (PVID) has an entitlement to Colorado River water for use on up to 104,500 acres of land within the PVID pursuant to a contract between the United States and PVID dated February 7, 1933. CDFG, as a landowner within the PVID, has the right to order Colorado River water from PVID for pumping through the PVID canal system to its fields. CDFG will make Colorado River water available for irrigation of the native plants.

## **Agreements**

Reclamation and CDFG have signed an agreement to insure that the land and water resources will be available for the 50-year term of the LCR MSCP (*Agreement for Restoration Activities Consistent with the LCR MSCP, Palo Verde Ecological Reserve 2007*).

# **2008 Habitat Development**

## **Planting**

Approximately 45 acres (18.2 hectares) of cottonwood-willow land cover type were planted in Phase 3 (Figure 2). According to the design, 57 acres of cottonwood-willow were scheduled to be planted; however, some of the trees' quality and health were compromised by heat prior to planting. As a result, a decision was made not to plant the stressed trees at that time.

Approximately 12 acres of cottonwood-willow land cover type will be planted in the spring of 2009, as well as 22 acres of mesquite for a combined total of 79 acres.

Soil samples were taken by the contract crop consultant in Phase 1 and Phase 2 and prior to planting in Phase 3. The samples in phases 1 and 2 indicated deficiencies of NO<sub>3</sub>-N (nitrogen) and PO<sub>3</sub>-P (phosphorus). An application of 10-34-0 was added in an irrigation cycle to these phases. In Phase 3, additional deficiencies of K (potassium) and Zn (zinc) were also found. Prior to planting Phase 3, an application of urea 11-52-0 muriate and zinc sulfate was applied.

The field was prepared and leveled using standard farming practices. The field was then divided into 10 checks (divisions of the acreage bordered by earthen mounds in which irrigation water can be controlled). A cover crop of 30 lbs. (13.6 kg) of alfalfa seed and 5 lbs. (2.3 kg.) of ryegrass seed per acre were planted in checks 1-10. The cover crop was planted the day before the mass transplanting of the trees and shrubs. The purpose of planting the dense cover crop was to eliminate or reduce weed infestations by reducing the unplanted surface areas available for invasive plant germination. Additionally, certain cover crops such as alfalfa fix nitrogen in the soil.

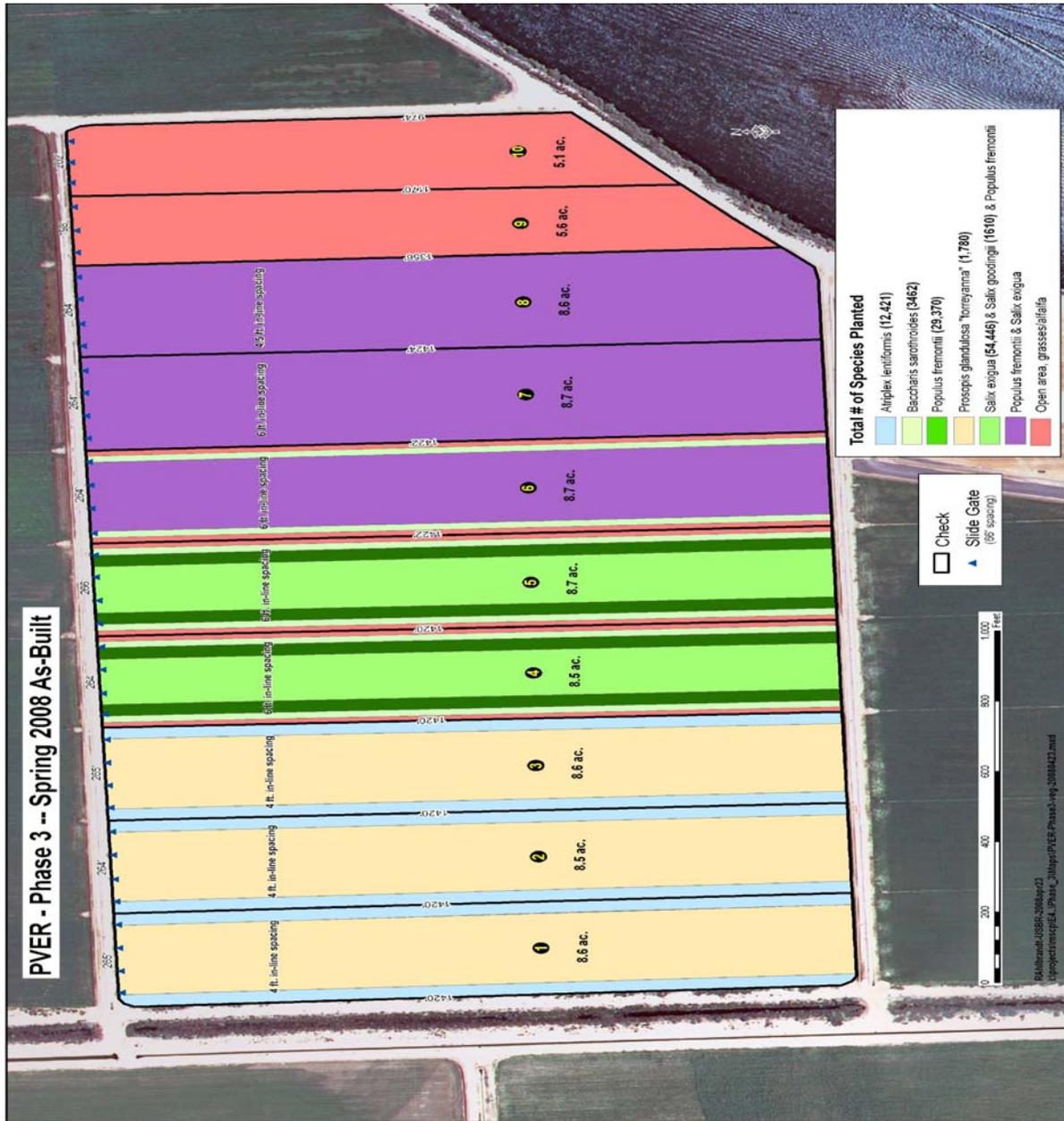
In March 2008, trees and shrubs were planted in 40-inch rows with 6-foot in-line spacing in checks 1-8, utilizing mass transplanting techniques (Figure 3). Over 101,000 trees and shrubs were planted within a 3-day period. The checks were planted according to the design (*Palo Verde Ecological Reserve: Restoration Development Plan Phase 3, 2007*), with exception of checks 9 and 10, which were left in a cover crop until the spring of 2009. The 2008 planting contains the following percentages of plants and trees: 13% *Atriplex*, 29% cottonwood, 3% *Baccharis*, 2% Goodding’s willow, and 53% coyote willow. The average number of plants is 2,800 per acre (Table 1).

Checks 1-3 edges were planted with *Atriplex*, and the midsection of each of these checks remained planted with only the cover crop in anticipation of planting mesquite the following spring. The unplanted areas were planted with cover crops to keep the integrity of ground prep (leveling) while discouraging the growth of invasive weeds.

**Table 1: Number of trees & shrubs planted, Spring 2008**

Species	Check 1	Ck 2	Ck 3	Ck 4	Ck 5	Ck 6	Ck 7	Ck 8	Ck 9 to be planted 2009	Ck 10 to be planted 2009
<i>Baccharis</i>	0	0	0	1,127	1,127	1,208	0			
Cottonwood	0	0	0	5,149	5,793	6,555	6,790	5,283		
G. Willow	0	0	0	1,127	483	0	0			
C. Willow	0	0	0	8,690	8,690	9,660	9,770	17,686		
<i>Atriplex</i>	4260	4260	4260	0	0	0	0	0		
<i>Mesquite</i>	To be planted 2009	To be planted 2009	To be planted 2009							

Figure 2. Phase 3 - As built



**Figure 3. Mass transplanting of riparian trees**



**Figure 4. Aerial photos; Phase 1, 2 and 3 taken in October 2008.**



## Phases 1-4

In Phase 1 during Fiscal Year 2006 (FY06), 30 acres of riparian nursery were planted. In Phase 2 (FY07), 80 acres were planted, and in Phase 3 (FY08), 45 acres of cottonwood-willow land cover type (CW) were planted (Figure 4). In Phase 4 (FY09), 100 acres were planted; 34 acres of CW will be planted will be planted in 2009 as part of Phase 3 (Table 2). Additional information on the design, planting, and monitoring of phases 1-3 can be found in the reports, *Palo Verde Ecological Reserve Restoration Development Plan: Phase 1*, *Palo Verde Ecological Reserve Restoration Development Plan: Phase 2*, *Palo Verde Ecological Reserve Restoration Development Plan: Phase 3*, and *Palo Verde Ecological Reserve Restoration Development Plan: Phase 4*, which available on the LCR MSCP Web site.

**Table 2: Phase 1-4 Planted Acres**

Phase	Fiscal year	Acres planted	Land cover type	Cumulative Total
1	2006	30	CW	30
2	2007	80	CW	110
3	2008	45	CW	155
3	2009	34 *To be planted	CW	189
4*	2009	100 *To be planted	CW	289

## Irrigation

The fields at PVER are flood irrigated; Table 3 indicates the amount of irrigation water applied in 2008. Irrigation water applied (af) is calculated on the assumption that the irrigation delivery ditch is running at full capacity (25 cubic feet per second or 0.707 cubic meter per second) (Pair et al. 1975). Average irrigation water applied in 2008 was 12.62 af.

**Table 3: Irrigation Water Applied in 2008**

Phase	Total hours of Irrigation water applied	*Amount of Irrigation water applied in af
Phase 1 - Cottonwood-Willow Nursery - 20 acres	110 hours	11.45 af
Phase 1- Mesquite Nursery -10 acres	36 hours	7.5 af
Phase 2 - Cottonwood-Willow Habitat - 72 acres	587 hours	16.98 af
Phase 3 - Cottonwood-Willow Habitat - 80 acres	510 hours	14.55 af

\*Amount of water applied does not reflect consumptive use or unmeasured return.

## Site Maintenance

No major site maintenance, such as irrigation ditch replacement or road maintenance, was performed in 2008.

## Management of existing habitat

### Weed management

Phase 2 was treated in the spring with an application of the pre-emergent herbicide, Treflan, to control pigweed. Spot areas of dodder were treated with Round-up. Invasive weeds and plant material were removed adjacent to the irrigation ditches to protect the integrity of the ditch.

### Pest management

No pest management was needed in 2008.

### Nursery management

Plant material will be collected from the nursery in November 2008 (Figure 5). The plant material will be tagged with species identification and will be transported in a refrigerated truck and delivered to the greenhouse to be propagated and grown for 2009 trees (Figure 6).

**Figure 5. Collection of plant material**



**Figure 6. Plant ID for propagation**



## **2007 Monitoring**

### **MacNeill's Sootywing Skipper**

The only sootywing population within an MSCP restoration site was found at PVER. Unfortunately, the quailbush supporting this population bordered a lined irrigation canal and was cleared by Palo Verde Irrigation District during fall 2008.

### **Vegetation Monitoring**

In 2008, vegetation was monitored using an updated protocol that was designed to characterize current plant community composition and structure, monitor changes in plant community composition and structure over time, and determine when vegetation components meet defined habitat criteria needed for accomplishment of LCR MSCP conservation measures.

Initial habitat creation efforts have been designed to provide information on potential habitat mosaics. In order to evaluate different planting mosaics, vegetation monitoring plots are being established using a stratified random sampling design. Permanent repeatable plots will be established within each habitat type to evaluate change in plant communities over time.

Several plots at PVER Phase 3 were located in areas that have not been planted and will serve as pre-monitoring sites in 2008. As such, the data has been separated between planted and non-planted areas for PVER Phase 3. Plots 1-6 and plots 17-20 in Phase 3 are either bare fields or alfalfa. The results presented are from planted areas, as only low ground vegetation is found in the non-planted and first year planted areas. For example, crown closure, a measure of canopy cover, was only measured for Phase 2 because Phase 3, in its first year of growth, had no crown closure.

## **Methods**

### ***Overstory***

Within a 26.3-foot (8.0-m) radius around plot center, every live tree measuring at least 4.5 feet (1.37 m) in height and 5.0 inches (12.7 cm) at Diameter at Breast Height (DBH) was measured and recorded by species, total height, and DBH. Trees between 16.4 feet (5.0 m) and 26.3 feet (8.0 m) and at least 4.5 feet (1.37 m) in height and 3.1 to 4.9 inches (8.0-12.6 cm) DBH were tallied by species. Trees that branched below 4.5 feet (1.37 m) in height were considered separate individuals and were measured independently if they met these criteria. The number of stems greater than 1.0 inches (2.5 cm) at DBH were estimated.

### ***Shrubs and Intermediate Trees***

Within a 16.4-foot (5.0-m) radius circle around plot center, all woody stem saplings and shrubs were recorded. Any individual at least 4.5 feet (1.37 m) in height and 3.1 inches (8.0 cm) DBH was measured and recorded by species, height, and DBH. Any stem at least 4.5 feet (1.37 m) in height but less than 3.1 inches (8.0 cm) DBH was tallied by species and DBH class.

DBH was recorded by size classes: Class 1 = <0.4 inches (<1 cm), Class 2 = 0.4-1.0 inches (1-2.5 cm), Class 3 = 1.1-2.2 inches (2.6-5.5 cm), and Class 4 = 2.3-3.1 inches (5.6-7.9 cm). DBH was not measured on trees less than 4.5 feet (1.37 m) in height; these trees were tallied by species only.

### ***Ground Cover***

The ground cover and herbaceous component of each site was estimated using the line-intercept method. Four 32.8-foot (10-m) lines were established from the center of each fixed plot in the four cardinal directions. The horizontal, linear length of each herbaceous plant that intercepted the transect line was measured and recorded by species. Areas along each transect that were covered by woody debris, bare ground, rock, or woody stem were measured and recorded as such.

### ***Crown Closure***

Crown closure, the measure of the horizontal canopy cover, was measured along the same line transects established to monitor ground cover. An estimate of canopy cover was made every 16.4 feet (5.0 m) using a spherical densitometer.

### ***Total Vegetation Volume***

Total vegetation volume (TVV) was measured to describe foliage height diversity by height class for each sample plot (Mills et al. 1991). Along the line transects established to monitor ground cover and crown closure, TVV was estimated every 16.4 feet (5.0 m) with a 7.5 meter survey rod extended through the canopy. TVV was estimated for each meter height class throughout the stand and for the entire site.

## **Results Phase 2**

### ***Summary Data***

Data for density of all trees measured, ground cover, and crown closure are summarized, per habitat type, for Phase 2 in Table 4.

**Table 4. Total Tree Density, Ground Cover, and Crown Closure, Phase 2.**

Habitat Type	# of Plots	Tree Density		Total Ground Cover		Crown Closure	
		Avg	SE	Avg	SE	Avg	SE
Mesquite	2	125	75	85.0%	15.0%	0.0%	0.0%
Cottonwood	4	1300	106	92.5%	7.5%	89.6%	5.1%
Coyote Willow	4	1450	318	100.0%	0.0%	41.8%	17.7%
Goodding's Willow	4	893	186	100.0%	0.0%	37.4%	20.9%
<b>All Veg Plots</b>	<b>14</b>	<b>1,059</b>	<b>157</b>	<b>95.7%</b>	<b>2.9%</b>	<b>48.2%</b>	<b>10.9%</b>

**Overstory**

Within an 8-meter radius from plot center, trees of sufficient size (5 inches DBH) to include in density counts for overstory trees were found only in cottonwood and Goodding’s willow habitats (Table 5). Average height and DBH of overstory trees, by habitat type, are summarized in Table 6.

**Table 5. Density of Cottonwood and Willow Trees, Overstory, Phase 2**

Habitat	# of Plots	Avg Density	SE
Cottonwood	4	925	140
Goodding's Willow	4	155	142
All Vegetation Points	14	309	121

**Table 6. Average DBH and Height, Overstory Trees, Phase 2**

Habitat	# of Trees	Avg Height (m)	SD	SE	Avg DBH (cm)	SD	SE
Cottonwood	186	5.5	0.9	0.1	17.7	3.4	0.2
Goodding's Willow	31	6.4	0.8	0.1	19.7	3.8	0.7
All Vegetation Plots	217	5.6	0.9	0.1	18.0	3.5	0.2

**Shrubs and Intermediate Trees**

Within a 5-meter radius of plot center, the average height and DBH of trees at least 4.5 feet in height and 3.1 inches DBH are summarized in Table 7. Table 8 summarizes density of trees by habitat type within a 5-meter radius of plot center.

**Table 7. Average Height and DBH of Larger Shrubs and Intermediate Trees**

Habitat Type	# of Trees	Avg Height (m)	SE	Avg DBH (cm)	SE
Cottonwood	11	4.1	0.2	10.2	0.3
Coyote Willow	3	3.2	0.03	7.9	0.0
Goodding's Willow	7	3.7	0.3	8.7	0.4
All Vegetation Plots	21	3.6	0.2	8.5	0.3

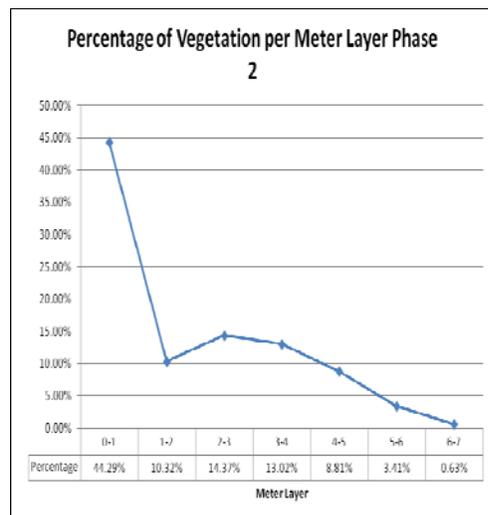
**Table 8. Shrub and Intermediate Tree Density**

Habitat Type	# of Plots	Avg Tree Density	SE
Mesquite	2	125	75
Cottonwood	4	375	151
Coyote Willow	4	1,450	318
Goodding's Willow	4	738	276
All Vegetation Plots	14	750	177

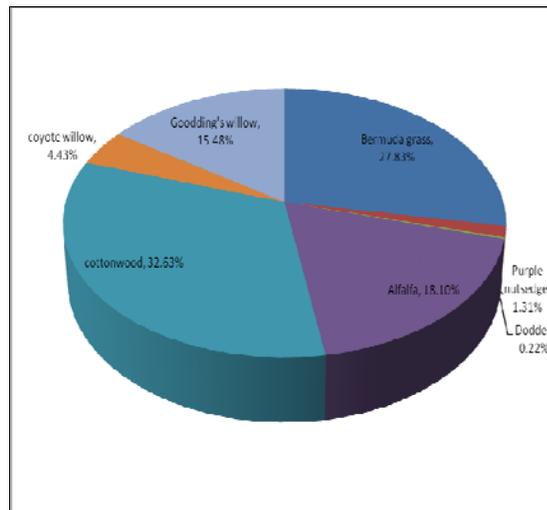
**Total Vegetation Volume (TVV) and Species Composition**

The percent of all vegetation recorded per meter layer (TVV) is depicted in Figure 7. The species composition for all meter layers, across all habitat types is in Figure 8. These are followed by paired figures for TVV and species composition of each individual habitat type (Figures 9-14). For mesquite, the method used to measure TVV was not sensitive enough to record the presence of mesquite in the plots (i.e. there were no “hits” actually recorded for mesquite (see methods)). All vegetation recorded in the areas planted with mesquite was within the first meter layer, with a volume of 35% (Figure 15).

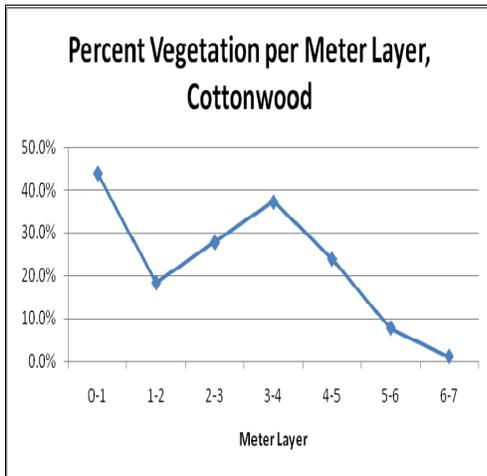
**Figure 7.**



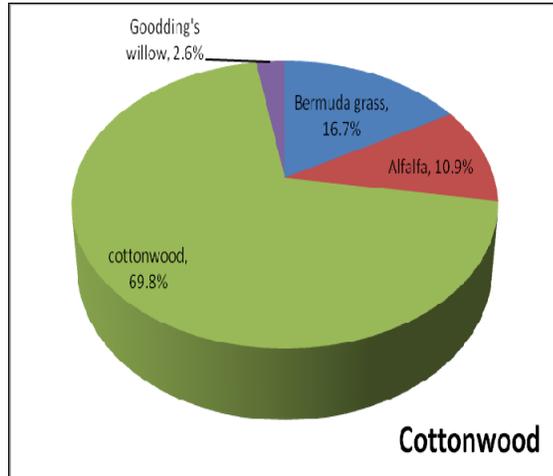
**Figure 8. Species Composition, All Habitats**



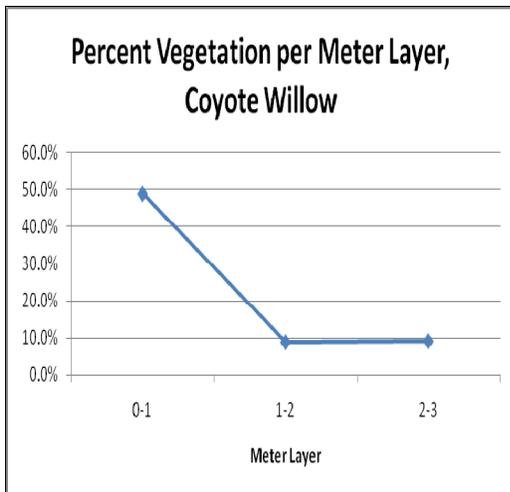
**Figure 9.**



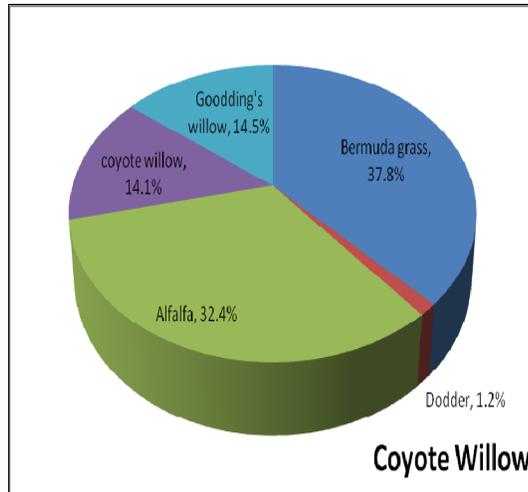
**Figure 10. Species Composition, Cottonwood**



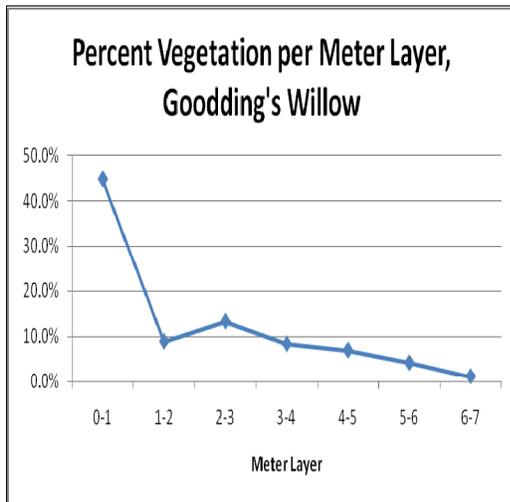
**Figure 11.**



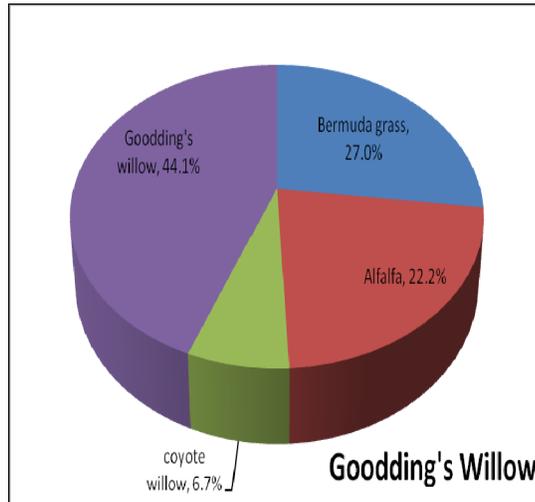
**Figure 12. Species Composition, Coyote Willow**



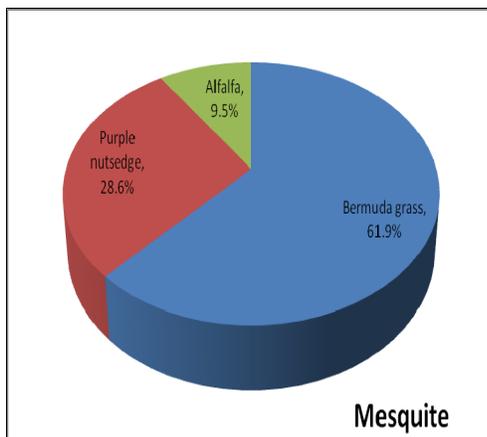
**Figure 13.**



**Figure 14. Species Composition, Goodding's Willow**



**Figure 15. Species Composition by Percent, Mesquite Habitat**



### Results, Phase 3

Phase 3 was in its first year of growth when surveyed in 2008. The random sampling method resulted in some plots in Phase 3 being established in areas that have not yet been planted. These bare fields or alfalfa fields will serve as pre-monitoring (control) sites. Results from these fields are not presented here, but the data will be available for use in comparing unplanted fields to restored fields. Results from Phase 3 for tree density, average height, and DBH provide information on survival and growth during the first year following planting.

No trees with a DBH of greater than 5 inches were found in Phase 3; therefore, no data for overstory were collected. There were no shrubs or intermediate sized trees in Phase 3 that met the criteria for individual measurement (>4.5 feet Height and >3.1 inches DBH). Therefore, all shrubs and intermediate sized trees at least 4.5 feet in height, but less than 3.1 inches DBH

within a 5-meter radius from plot center were tallied by species and DBH class. The average density of all DBH classes of cottonwood, coyote willow, and Goodding's willow trees planted in Phase 3 was 1,070 trees/acre (SE = 107).

## Discussion

This is the first year that vegetation has been surveyed using this protocol; therefore, not enough data has been collected yet to compare results with those being gathered for individual covered species, such as the southwestern willow flycatcher. Approximately 2,400 trees per acre (29,569 cottonwood, 54,496 coyote willow, and 1,610 Goodding's willow) were planted in Phase 3 in March 2008. At the end of the first growing season, a density of 1,070 trees per acre was calculated based on data from 10 plots, a survival rate of 44%. In Phase 2, approximately 2,432 trees per acre (20,592 cottonwood, 41,580 coyote willow, and 39,960 Goodding's willow) were planted in 2007. At the end of the 2008 growing season, a density of 1,059 trees per acre was calculated from 14 plots.

The methods used to determine density of planted areas may lack the sensitivity to detect some species that are planted sparsely, plants with little foliage, or plants that are hidden by surrounding grasses. By early spring 2009, it was observed that some of the plants in Phase 3 may have suffered a die-back. Although a portion of these were showing green sprouts, several bare spots and dead plants were noted within the areas planted with coyote willow, supporting the calculated density estimate.

## Small Mammal Monitoring

### Background

Based on presence-absence survey results of small mammal trapping conducted since 2004, trapping is now focusing on habitat patches similar to what is present where cotton rats have been found (Dodge 2006, Calvert 2007). For *Sigmodon arizonae plenus*, this includes a dense herbaceous understory dominated by tall grasses where cotton rats can create runways. In 2007 and 2008, trapping to collect data on areas prior to their conversion from agriculture to riparian cover types was conducted. Fallowed cotton fields and actively farmed alfalfa fields were surveyed for small mammals (Calvert 2007, Calvert 2008 in prep). No cotton rats were documented utilizing either of these pre-development cover types. Trapping in pre-development areas planted with various cover crops will not be conducted annually, but may be repeated periodically as different cover crops are used for restoration purposes (see Adaptive Management section).

### Methods

A general description of methods for all small mammal trapping can be found in Calvert (2007). Methods specific to PVER are described here.

Within the mesquite cover type planted at PVER in 2008, small patches of open, grassy areas that contain ground vegetation dominated by Bermudagrass, with small patches of Johnsongrass, were the most similar to other areas where cotton rats have been found. Small mammals were surveyed within these areas on February 27, September 25 and 26, and October 8, 2008. The number of traps placed depended on the size and shape of the area, but, in general, traps were placed 10 m apart with transects placed approximately 15 m apart.

Habitat that was considered suitable, based on findings elsewhere on the LCR, was found on a bench of silt deposit just above the water level at a bend in the river adjacent to PVER. This area was adjacent to, but slightly higher than the bulrush and cattail present. This site still contained moist soils, but vegetation was composed of grasses and shrubs (Figures 16 and 17). These plants are currently being identified to species. Ninety traps were placed 10 m apart along three 150-m long transects (30 traps per transect) spaced approximately 15 meters apart for one night on October 8.

**Figures 16 and 17. Habitat adjacent to PVER where *Sigmodon* were captured**



## Results

Results of trapping are shown in Tables 9 and 10. No cotton rats were found within the plantings at PVER. At the strip of land adjacent to PVER, 14 cotton rats were captured. Laboratory analysis of blood samples to examine DNA has confirmed they are *Sigmodon arizonae plenus*.

**Table 9. Species of small mammals and number captured at PVER**

Actual Captures for Phases 2 and 3, 2008			
Species	Spring	Fall	Totals
House Mouse ( <i>Mus musculus</i> )	8	52	60
Deer Mouse ( <i>Peromyscus maniculatus</i> )	1	5	6
Cactus Mouse ( <i>Peromyscus eremicus</i> )	0	1	1
Desert Pocket Mouse ( <i>Chaetodipus penicillatus</i> )	0	5	5
Totals	9	63	72

**Table 10. Number of small mammal traps used per season and totals, PVER**

Number of Traps Deployed	Spring	Fall	Totals
Phase 2	255	115	370
Phase 3	0	40	40
Totals	255	155	410

## Discussion

Thus far, surveys of cover crops (planted prior to or during restoration activities) and fallow fields have not resulted in captures of this species during trapping efforts. Cotton rats have been found using dense groundcovers consisting of various grass and shrub species.

## Bat Monitoring

### Acoustic Surveys

#### Methods

Up to 12 Anabat bat detectors were deployed for two nights quarterly from dusk to dawn, within a given habitat creation area, for a total of four surveys (eight nights) per year. Bat detectors record the echolocation calls a bat makes as it passes by the detector. The minimum frequency, duration, and shape of each call is compared with reference calls to identify the bat to species or species group (Table 11). These calls are then converted into the number of minutes each species/species group is recorded, which is then used to create activity indices. These indices are a proportion of bat minutes per species/species group divided by the total number of bat minutes. Two metrics are given in this report to characterize bat use of the riparian restoration and adjacent habitats: total number of bat minutes for the four covered and evaluation species, and indices of relative bat activity for all species/species groups. For a thorough overview of all bat activity within each habitat creation area see Broderick (in press).

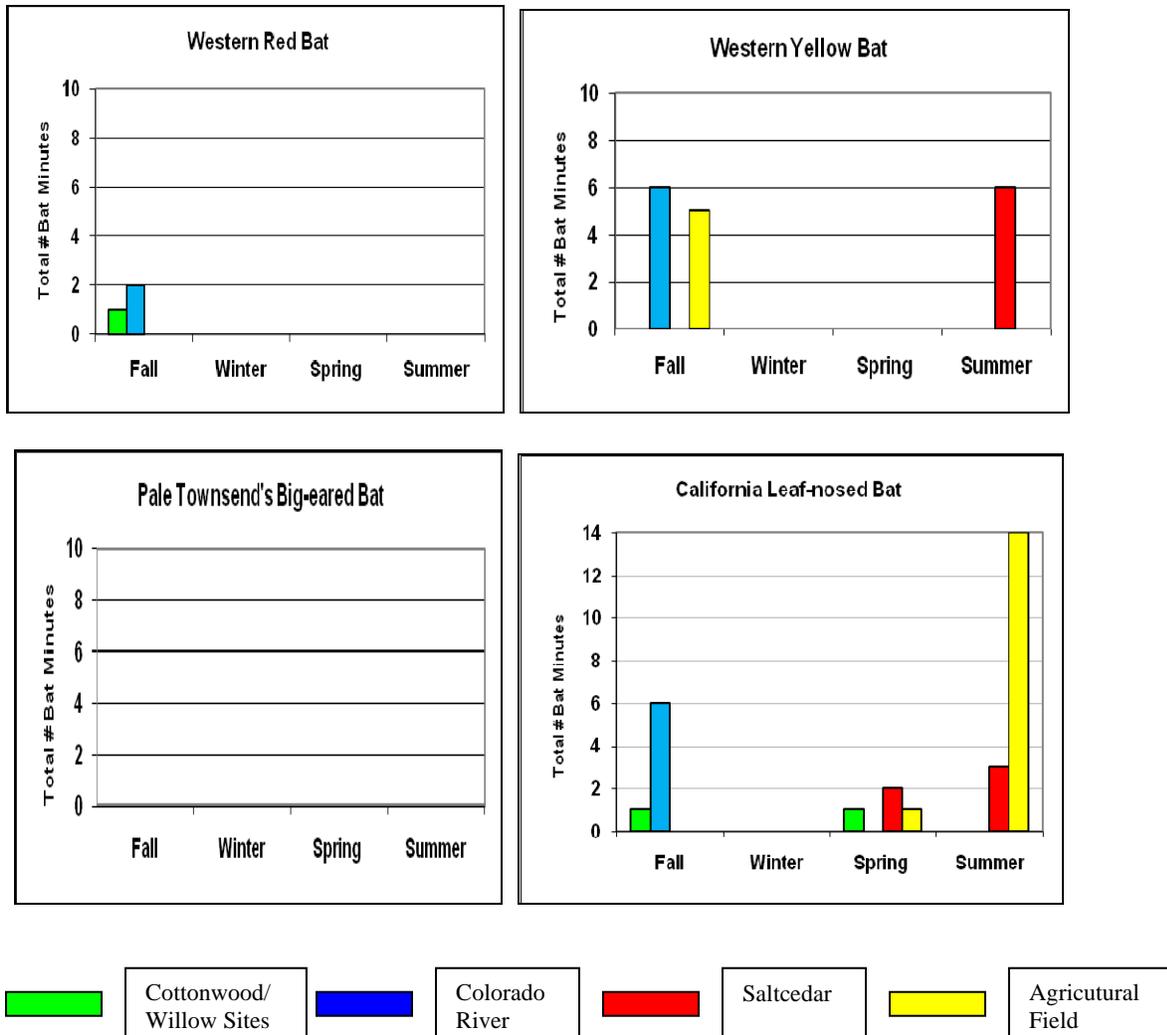
**Table 11. All species and species groups for bats identified at habitat creation areas**

Common Name	Scientific Name	Species Code
<b>Individual Species</b>		
Pallid bat	<i>Antrozous pallidus</i>	Anpa
Townsend's big-eared bat	<i>Corynorhinus townsendii</i>	Coto
Western red bat	<i>Lasiurus blossevillii</i>	Labl
Yellow bat	<i>Lasiurus xanthinus</i>	Laxn
California leaf-nosed bat	<i>Macrotus californicus</i>	Maca
Hoary bat	<i>Lasiurus cinereus</i>	Laci
Pocketed free-tailed bat	<i>Nyctinomops femorosaccus</i>	Nyfe
Mastiff bat	<i>Eumops perotis</i>	Eupe
Western pipistrelle	<i>Parastrellus hesperus</i>	Pahe
Cave Myotis	<i>Myotis velifer</i>	Myve
<b>Species Groups:</b>		
20 Khz	Overlapping calls of Nyfe, Nyma, Laci, Tabr	
25-30 Khz	Overlapping calls of Epfu, Tabr, Anpa	
35 Khz	Various calls at 35 khz primarily Anpa, Myve, Laxa	
40 Khz	Primarily Myve	
45-55 Khz	Overlapping calls of Myca, Myyu, and some Pahe	
<b>Species included in the groups listed above:</b>		
Big brown bat	<i>Eptesicus fuscus</i>	Epfu
Mexican free-tailed bat	<i>Tadarida brasiliensis</i>	Tabr
California myotis	<i>Myotis californicus</i>	Myca
Yuma myotis	<i>Myotis yumanensis</i>	Myyu

**Results**

Forty-four detector nights were completed for nine monitoring sites at PVER. A total of 16,676 call files were obtained, edited, and identified to species or species group. There was 48 total minutes of bat activity for the four covered species, of which the California leaf-nosed bat was the most numerous. Three western red bat minutes were recorded in October at PVER (Figure 18), 1 minute in a young cottonwood stand, and 2 minutes along the edge of the lower Colorado River. PVER was second only to CRIT in number of western yellow bat calls recorded. Seventeen bat minutes were recorded, 6 minutes of which were along the river’s edge in October, 6 minutes in saltcedar in July, and 5 minutes in agriculture in October (Figure 18). No minutes of bat activity were recorded for the Townsend's big-eared bat (Figure 18). A total of 28 minutes of bat activity was recorded for the California leaf-nosed bat, most of which occurred in July in agriculture (14), with 3 minutes being recorded in saltcedar in July (Figure 18). Six minutes were recorded along the river’s edge in October with only 1 minute recorded in young cottonwood in October. There was no activity recorded during the February sample period. Light activity was recorded in spring, with 1 minute recorded in young cottonwood, 2 minutes in saltcedar, and 1 minute in agriculture.

**Figure 18. Bat Minutes by Season in Riparian and Adjacent Habitats**



An index of relative bat activity was developed for riparian restoration sites and for the adjacent agricultural and saltcedar sites using the total number of bat minutes for each species and species group (Table 12). Western pipistrelles formed a disproportionately high amount of the total bat activity at the riparian restoration sites at PVER (39.7%), compared to 39.7% on the river's edge, 33.2% in saltcedar, and 47% in the agriculture sites. California leaf-nosed bats comprised only 0.1% for restoration sites and river's edge sites, and 0.7% for the agriculture sites. Western red bats comprised 0.1% of the restoration and river's edge sites bat activity and none for saltcedar or agriculture. The four focal bat species comprised a very small proportion of the relative abundance of the overall bat community.

**Table 12. Index of relative bat activity for all habitats for Palo Verde Ecological Reserve.**

Cottonwood/Willow		River's Edge		Saltcedar		Agriculture	
Pahe	39.7	Pahe	39.7	Pahe	33.2	Pahe	47.0
25-30Khz	25.5	25-30Khz	25.5	25-30Khz	29.8	45-55Khz	29.8
45-55Khz	23.8	45-55Khz	23.8	45-55Khz	16.8	25-30Khz	10.6
Nyfe	4.8	Nyfe	4.8	Myve	8.5	Myve	5.8
Myve	3.8	Myve	3.8	Nyfe	6.4	Nyfe	2.8
20Khz	1.5	20Khz	1.5	20Khz	3.6	20Khz	2.6
Eupe	0.6	Eupe	0.6	Eupe	1.3	Maca	0.7
Laci	0.1	Laci	0.1	Laxa	0.2	Eupe	0.4
Maca	0.1	Maca	0.1	Maca	0.2	Laxa	0.2
Labl	0.1	Labl	0.1	Coto	0.0	Laci	0.1
Coto	0.0	Coto	0.0	Labl	0.0	Coto	0.0
Laxa	0.0	Laxa	0.0	Laci	0.0	Labl	0.0

## Avian Monitoring

### System-wide Avian Surveys

In 2007, a system-wide avian survey was implemented in order to develop a baseline inventory of bird populations within the LCR MSCP area (Bart and Manning 2008). Within this overall study plan, data for PVER specifically has been summarized here. Complete data for the LCR and more detailed methods and results will be available in a report titled, *System Monitoring for Riparian Obligate Avian Species (Work Task D6) and Avian Use of Restoration Sites (Work Task F2)* (GBBO 2008, in prep). Results for surveys conducted for yellow-billed cuckoos are reported separately in this report.

### Methods

Two types of surveys were used for avian monitoring based on the age of habitats at PVER. Rapid area search surveys were conducted on pre-development plots (agricultural or unplanted fields) or plots planted with cottonwood and willow (*Populus fremontii/Salix* spp.) in the first year of growth. This type of survey included two visits to each site and results in an index of relative abundance (GBBO 2008). Results of rapid area searches are reported here as an average of detections per survey. Intensive area search surveys were conducted on post-development

plots (i.e., cottonwood and willow habitat in at least the second year of growth). Eight visits were made to each intensive area search plot and all bird activity was recorded. Results from intensive area searches result in an unbiased density estimate for breeding birds and an index of abundance for non-breeding birds (GBBO 2008). Due to the small numbers detected, breeding birds are reported as pairs per survey rather than densities. Information on the determination of breeding status and other methods can be found in GBBO (2008).

Phase 1 of PVER was excluded from monitoring because it has been designated as a nursery to supply plant materials for future projects. At the time of the surveys, phases 4, 7, 8, and 9 remained agricultural and were randomly chosen from all future phases at PVER for pre-development monitoring. Each phase comprised one rapid area search plot (GBBO 2008). Phase 3, also cottonwood and willow, but in its first year of growth, also comprised one rapid area search plot (GBBO 2008 in prep). Phase 2, planted with cottonwood and willow and in its second year of growth, was split into two intensive area search plots (Table 13).

**Table 13. Phases, Cover Types, Survey Type, Number of Plots Surveyed, and Dates of Surveys.**

Phase	Cover Type/Age	# Surveys, Type, # plots	Date Surveyed
1	Nursery	none	n/a
2	Cottonwood-Willow-2 years	8 Intensive Area Searches, 2 plots	3 May thru 29 June
3	Cottonwood-Willow-1 year	2 Rapid Area Searches, 1 plot	29 April 19 June
4	Pre-development-Agriculture	2 Rapid Area Searches, 1 plot	29 April 23 June
7	Pre-development, Agriculture	2 Rapid Area Searches, 1 plot	18 May 12 June
8	Pre-development, Agriculture	2 Rapid Area Searches, 1 plot	18 May 12 June
9	Pre-development, Agriculture	2 Rapid Area Searches, 1 plot	19 May 12 June

### **Results**

In the pre-development phases (phases 4, 7, 8, and 9), an average of 302 birds per survey were detected between the two survey periods. Thirty-one species were detected. In Phase 3, where the habitat was in its first year of growth, an average of 39 birds per survey of eight species were detected. There were 17 pairs of birds comprising eight species that were detected breeding in Phase 2, which was in its second year of growth (Table 14). One LCR MSCP covered species, the Arizona Bell's vireo (*Vireo bellii arizonae*), was detected in Phase 2. An average of 56 non-breeding birds per survey were also found in Phase 2. A complete species list of all birds found at PVER during all surveys is in Table 15 (GBBO 2008).

**Table 14. Number of Breeding Pairs, per Species (GBBO 2008), Phase 2.**

Species	Number of Territories	Species	Number of Territories
BLUE GROSBEAK	5	ARIZONA BELL'S VIREO	1
COMMON YELLOWTHROAT	4	HOUSE FINCH	1
SONG SPARROW	2	MALLARD	1
WHITE-TAILED KITE	2	NORTHERN HARRIER	1

**Table 15. All Species Detected at PVER (excluding flyovers and incidental detections)**

Common Name	Scientific Name
GREAT BLUE HERON	<i>Ardea herodias</i>
CATTLE EGRET	<i>Bubulcus ibis</i>
GREEN HERON	<i>Butorides virescens</i>
WHITE-FACED IBIS	<i>Plegadis chihi</i>
MALLARD	<i>Anas platyrhynchos</i>
WHITE-TAILED KITE	<i>Elanus leucurus</i>
NORTHERN HARRIER	<i>Circus cyaneus</i>
GAMBEL'S QUAIL	<i>Callipepla gambelii</i>
KILLDEER	<i>Charadrius vociferus</i>
LONG-BILLED CURLEW	<i>Numenius americanus</i>
FORESTER'S TERN	<i>Sterna forsteri</i>
WHITE-WINGED DOVE	<i>Zenaida asiatica</i>
MOURNING DOVE	<i>Zenaida macroura</i>
COMMON GROUND-DOVE	<i>Columbina passerina</i>
GREATER ROADRUNNER	<i>Geococcyx californianus</i>
BURROWING OWL	<i>Athene cunicularia</i>
BLACK-CHINNED HUMMINGBIRD	<i>Archilochus alexandri</i>
ANNA'S HUMMINGBIRD	<i>Calypte anna</i>
SAY'S PHOEBE	<i>Sayornis saya</i>
ASH-THROATED FLYCATCHER	<i>Myiarchus cinerascens</i>
WESTERN KINGBIRD	<i>Tyrannus verticalis</i>
BELL'S VIREO	<i>Vireo bellii</i>
ARIZONA BELL'S VIREO	<i>Vireo bellii arizonae</i>
COMMON RAVEN	<i>Corvus corax</i>
HORNED LARK	<i>Eremophila alpestris</i>
NORTHERN ROUGH-WINGED SWALLOW	<i>Stelgidopteryx serripennis</i>
CLIFF SWALLOW	<i>Petrochelidon pyrrhonota</i>
VERDIN	<i>Auriparus flaviceps</i>
NORTHERN MOCKINGBIRD	<i>Mimus polyglottos</i>
AMERICAN PIPIT	<i>Anthus rubescens</i>
LUCY'S WARBLER	<i>Vermivora luciae</i>
SONORAN YELLOW WARBLER	<i>Dendroica petechia sonorana</i>
YELLOW WARBLER	<i>Dendroica petechia</i>
TOWNSEND'S WARBLER	<i>Dendroica townsendi</i>
COMMON YELLOWTHROAT	<i>Geothlypis trichas</i>
YELLOW-BREASTED CHAT	<i>Icteria virens</i>
ABERT'S TOWHEE	<i>Pipilo aberti</i>
LARK SPARROW	<i>Chondestes grammacus</i>
SONG SPARROW	<i>Melospiza melodia</i>

<b>Common Name</b>	<b>Scientific Name</b>
BLACK-HEADED GROSBEAK	<i>Pheucticus melanocephalus</i>
BLUE GROSBEAK	<i>Passerina caerulea</i>
RED-WINGED BLACKBIRD	<i>Agelaius phoeniceus</i>
WESTERN MEADOWLARK	<i>Sturnella neglecta</i>
YELLOW-HEADED BLACKBIRD	<i>Xanthocephalus xanthocephalus</i>
GREAT-TAILED GRACKLE	<i>Quiscalus mexicanus</i>
BROWN-HEADED COWBIRD	<i>Molothrus ater</i>
BULLOCK'S ORIOLE	<i>Icterus bullockii</i>
HOUSE FINCH	<i>Carpodacus mexicanus</i>

## Yellow-billed Cuckoo

### **Methods**

This is the first year that surveys have been conducted for yellow-billed cuckoos at PVER. Yellow-billed cuckoos were surveyed on five dates between June 10 and September 28, 2008. The survey involved using a tape-playback method in which surveyors broadcast a recorded cuckoo call at predetermined intervals along a predetermined route within appropriate riparian habitat. Complete results of this monitoring effort will be in the 2008 yellow-billed cuckoo report, which will be available on the LCR MSCP Web site.

### **Results**

Results of the presence/absence surveys for cuckoos are listed in Table 16. During five surveys and two follow-up visits, one individual was detected on June 26, and one on July 17. Both detections were auditory only. Due to the small size of the site and the limited number of detections, it is unlikely that breeding occurred at this site.

**Table 16. Yellow-billed Cuckoo Detections by Date**

| <b>Date/# Cuckoos</b> |
|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| 9 June/0              | 26 June/1             | 17 July/1             | 6 August/0            | 28 August/0           |

### **Discussion**

Yellow-billed cuckoos nested at Cibola Valley Conservation Area (CVCA) in 2008 in habitat that is just one year older than the habitat at PVER. Phase 2 at PVER totals 80 ac (32 ha) and the species is estimated to require 10-40 ha habitat blocks, so the size of the habitat block at PVER is adequate. Cuckoos were surveyed in 2008 in the nursery, which was planted in 2006, and were found using the site, but were not confirmed as nesting. Cuckoos will continue to be surveyed in appropriate habitat in 2009.

# **Established Land Cover and Habitat Credit**

The process for Habitat Credit has not been finalized. Once the process is finalized, information in this section will be utilized to establish credit.

The land cover for Phase 2 is cottonwood-willow VI, as defined by Anderson and Ohmart (1976, 1984). The cottonwood-willow VI structure type is described as having one layer of vegetation with the bulk of the volume between 0 and 2 m (0 to 6.5 ft) tall. Land cover has not been determined for Phase 3, as it was planted in the spring of 2008.

## **Adaptive Management**

### **Operation and Maintenance**

There are no major irrigation canal repairs scheduled for 2009. Minor irrigation repairs and maintenance are done on an as needed basis. No major road work is scheduled for 2009; maintenance and minor repairs will be done as needed.

### **Soil Management**

A crop consultant will be contracted to perform soil samples, which will be analyzed to determine fertilizer needs. Fertilizer will be applied as suggested by the crop consultant report.

### **Water Management**

Irrigation water will continue to be applied as determined by Reclamation or contracted crop consultants. Site conditions and observation will provide the data necessary to determine an appropriate irrigation schedule.

### **Vegetation Management**

The nursery will be used in the fall/winter 2008-2009 as the source for plant material for propagation cuttings. Initially, branches will be cut from 2008 growth to provide plant material for 2009 plantings. A number of trees (15-30) will be cut down to approximately 2 feet from the ground. These trees are intended to be used at the Yuma restoration site. Trees and shrubs will continue to be planted densely to provide habitat for covered species and to limit invasive species infestations. Manual and aerial weed control will be implemented, when necessary, until the planted vegetation has shaded out the invasive species. No other vegetation management is scheduled for 2009.

## **Wildfire Management**

As guided by commitments in the HCP, wildfire management practices on PVER would:

- Reduce the risk of the loss of created habitats to wildfires by contributing to and integrating with local, state, and Federal agency fire management plans.
- Develop a fire management plan to contain wildfire and facilitate rapid response to suppress fire.
- Implement land management and habitat creation measures to support the reestablishment of native vegetation that is lost to wildfire.

## **Public Use**

CDFG has the authority to regulate hunting and recreation uses pursuant to CDFG statutes, regulations, and policies. In cooperation with Reclamation, CDFG will coordinate its public use and related activities so they are consistent with and do not adversely affect restoration activities at PVER.

## **Law Enforcement**

CDFG is responsible for law enforcement at PVER. Reclamation will work with CDFG to ensure these activities do not conflict with the LCR MSCP HCP.

## **Future Habitat Development**

Phase 4 at PVER will be developed for cottonwood-willow land cover type in 2009. Approximately 100 acres will be developed at that time.

## **Monitoring Modifications**

Vegetation monitoring methods used in 2008 will be continued, with additional plots established as acres of restored habitat are increased. Microhabitat data was not collected during 2008. In 2009, this data will be collected at each vegetation monitoring plot.

# Literature Cited

Bart J. and A Manning 2008. Lower Colorado River Riparian Bird Surveys 2007. U.S Geological Survey, Boise, Idaho.

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