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# Amargosa Canyon Songbird Project
# 2007 Progress Report (DRAFT)

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## SUMMARY

From 2005-2007, PRBO Conservation Science surveyed approximately 120 hectares of native and *Tamarix*-dominated riparian habitat on the Amargosa River (Shoshone and Tecopa, CA) for Least Bell's Vireos and Southwestern Willow Flycatchers (Figures 1a - c). Over this period, we found one Least Bell's Vireo nesting territory on the Amargosa River, a pair that nested within 100m of the southern edge of the 2002 catastrophic burn. This pair was present in 2005 and in 2006, and all four nests were built in saltcedar (hence referred to as *Tamarix*, to represent a complex of *Tamarix ramocissima*, *Tamarix chinensis*, and *T. ramocissima* X *T. chinensis* found in the Southwestern United States), an exotic. We also found one unmated Bell's Vireo territory (in 2005) and one unmated Willow Flycatcher territory (in 2006), each in the burned area of the Amargosa Canyon. Therefore, Bell's Vireos and Willow Flycatchers still have not re-occupied the burned section of the Amargosa Canyon, five years after a fire occurred.

We initiated three all-species nest plots, which were selected to ensure complete coverage of *Tamarix* eradication areas. These plots were also designed with an eye toward contrasting passerine productivity and abundance across pre- and post-*Tamarix* removal, and exotic (*Tamarix*-dominated) versus native (willow-dominated and mesquite-dominated) habitats.

Though *Tamarix*-dominated habitat held higher passerine density on the Amargosa River, it held less breeding bird diversity and species richness. Breeding bird diversity and species richness were significantly higher at the willow-dominated, mesic northern end of the Amargosa Canyon than at the *Tamarix*-dominated southern end of the Amargosa Canyon. Breeding species diversity and richness were greater, though not significantly, at the willow-dominated northern Amargosa Canyon than at the more xeric, mesquite-dominated Shoshone reach of the Amargosa River. The mesquite-dominated Shoshone reach held comparable breeding species diversity and richness to the *Tamarix*-dominated southern Amargosa Canyon. Breeding passerine abundance was highest within *Tamarix*-dominated habitats of the southern Amargosa Canyon.

We located and monitored 311 nests for 29 different species on nest plots near Shoshone, at the northern entrance to the Amargosa Canyon near Tecopa, and in the southern Amargosa Canyon near at Modine Meadows from 2005-2007. Breeding species included federally and state endangered Bell's Vireos, as well as Lucy's Warblers, Yellow Warblers, Yellow-breasted Chats, and Crissal Thrashers, all California Bird Species of Special Concern. In addition, we confirmed the first Inyo County breeding record for Green Herons, in 2005.

On the Amargosa River, passerines had higher nest success when nesting in native plants than in *Tamarix*. However, much of this difference was due to the prevalence of cavity and dome nests in native willows and mesquites, which held much higher success than open-cup nests. For open cup nests, there was little difference in nest success between *Tamarix* and native substrates, and there was little difference in nest success between pre and post-*Tamarix* eradication sites.

Nesting success varied among species, as did Brown-headed Cowbird parasitism. Cowbird parasitism was high, with close to 50% of potential cowbird hosts' nests parasitized before the 2007 season. In 2007, Brown-headed cowbird trapping appeared to have drastically

cut parasitism rates (parasitism dropped 60% in 2007), while drastically increasing nesting success rates of potential cowbird hosts (proportional success increased 50%).

There was evidence that Brown-headed Cowbird populations at our study sites were in fact oversaturated prior to trapping in 2007. In 2005 and 2006, over 40% of parasitized nests had greater than one cowbird egg in them, a sign of egg-dumping. Yet in 2007, 0% of parasitized nests held greater than one cowbird egg.

We began Brown-headed Cowbird trapping in April of 2007, monitoring 7 traps in total (3 in/near Shoshone, 2 in/near Tecopa, and 2 at China Ranch). To ensure success, we secured Brown-headed Cowbird decoys from a Bureau of Reclamation-funded project on the Colorado River, in Arizona. This was critical, for we were unable to capture cowbirds prior to use of decoys. From June 2 through July 13, we captured 158 Brown-headed Cowbirds: 111 males, 26 females, and 21 juveniles. Males and juveniles were released, so these 132 birds may include re-captures. Female Brown-headed Cowbirds were euthanized, and 2 males perished while in traps due to stress.

# INTRODUCTION

Riparian habitats cover only a small percentage of California (<0.5%), yet they may be the most important habitat for landbird species in California (Riparian Habitat Joint Venture 2004). Desert riparian habitats are by definition isolated and rare, and they face multiple threats. These threats include exotic plant invasions, increased fire frequency, domesticated and feral livestock over grazing, groundwater pumping, and outright loss to urbanization (Moore 2001). Only 2 – 15% of California's original desert riparian still exists, and much of California's remaining riparian habitats are fragmented and degraded (RHJV 2004).

In the Mojave Desert alone, three key desert riparian areas have been decimated to catastrophic fire in the last five years: the Amargosa Canyon in Inyo County (2002), Piute Spring in San Bernardino County (2005), and Morongo Canyon in Riverside County (2006 and 2007). As desert riparian habitats increase in importance to wildlife preservation and decrease in extent, it is critical to monitor their plant and animal communities in order to provide land managers with decision support tools to ensure the perpetuation of our fragile desert riparian ecosystems.

In 2005, PRBO Conservation Science initiated the Amargosa Canyon Songbird Project (ACSP) in collaboration with the Bureau of Land Management Barstow Field Office and United States Fish and Wildlife Service Ventura Office. The ACSP began as an effort to locate breeding territories and nests of federally endangered Southwestern Willow Flycatchers and Least Bell's Vireos in advance of *Tamarix* (members of the *T. ramocissima* X *chinensis* complex and *Tamarix aphylla*) removal on BLM, California Department of Fish and Game, and private landholdings on the Amargosa River and its tributary, Willow Creek (USFWS 2005). Much of the *Tamarix* removal project area lies within the Amargosa Canyon Area of Critical Environmental Concern, and is Wilderness. The entire project area also lies within the Shoshone-Tecopa Important Bird Area (IBA), one of only 148 Important Bird Areas designated by California Audubon within the state.

Partners In Flight (PIF) represents a cooperative approach to land bird conservation amongst federal, state, and local agencies, academia, non-profit organizations, industry, and philanthropic groups (http://www.partnersinflight.org/description.cfm ). It has existed since 1990. As members of PIF and its California Partners In Flight (CalPIF) state chapter, PRBO Conservation Science, the BLM, and the FWS have sought to follow PIF's core objectives of helping species at risk, keeping common birds common, and developing voluntary partnerships for birds, habitats, and people by providing high-quality data collection and analyses to PIF contributors throughout the western United States. Thus PRBO has placed strong emphasis on all-species data monitoring and data collection, in order to contribute our findings on the entire avian community to land managers, to California Partners In Flight, and to inter-agency planning efforts such as the Riparian Joint Venture.

As such, surveying for Southwestern Willow Flycatchers (*Empidonax traillii extimus*) and Least Bell's Vireos (*Vireo bellii pusillus*) on the Amargosa River has presented PRBO a unique opportunity to stretch agency funds and gather territory and nest data on the Amargosa Canyon's entire avian community, in order to gauge the avian community's response to *Tamarix* removal and Brown-headed Cowbird (*Molothrus ater*) trapping.

The Amargosa River's riparian habitat is highly isolated due to its location near Death Valley in the central Mojave Desert, and it houses disjunct populations of several riparian bird species that are susceptible to local extirpation in the absence of sound management practices. Importantly, aside from Least Bell's Vireos and Southwestern Willow Flycatchers, several other species of concern are found to breed on the Amargosa River at Amargosa Canyon and Shoshone. Crissal Thrashers (*Toxostoma crissale*), Lucy's Warblers (*Vermivora luciae*), Yellow Warblers (*Dendroica petechia*), Yellow-breasted Chats (*Icteria virens*), and Loggerhead Shrikes (*Lanius ludovicianus*) are all California Species of Special Concern (Shuford and Gardali 2008) that we have found to breed at our study sites on the Amargosa. In addition, the Amargosa River represents the northwestern edge of the breeding ranges of several Mojave and Sonoran Desert species, such as Lucy's Warblers, Crissal Thrashers, Verdin (*Auriparus flaviceps*), Black-tailed Gnatcatchers (*Polioptila melanura*), Brown-crested Flycatchers (*Myiarchus tyrannulus*), Ladder-backed Woodpeckers (*Picoides scalaris*), and a Sonoran Desert subspecies of Song Sparrow (*Melospiza melodia fallax*).

To assign value of *Tamarix* eradication, we should consider value to the riparian avian community, we should consider the effects of geography, landscape, and the likelihood that the restored riparian zone will provide high-quality native habitat (Sogge et al. 2006). Yet though *Tamarix* removal from southwestern riparian habitats is a significant objective for several federal and state agencies, these agencies lack pre- and post-treatment land bird data to apply adaptive management to *Tamarix* eradication projects (Sogge et al. 2006).

In the meantime, the current data that does exist on avian response to *Tamarix* eradication is mixed. Sogge et al. (2006) found that *Tamarix* habitats were not detrimental to Southwestern Willow Flycatcher physiology, immunology, site fidelity, productivity, and survivorship in Arizona (2005). Ellis (1995) found that bird species richness does not diminish in *Tamarix*-dominated habitats, but species composition changes – suggesting that maintenance of native riparian habitats will be necessary to conserve certain land bird breeding species in riparian zones of the Southwest. Sogge et al. (2005) found that the area and volume of *Tamarix* stands in the Grand Canyon were among the best positive predictors of bird species abundance, richness, and diversity. Sogge et al. (2008) noted that *Tamarix's* value as habitat varies substantially by geography and bird species under consideration. At the Lower Colorado River, Van Riper et al. (2008) found that while *Tamarix* monocultures have lower breeding bird abundance, breeding bird abundance increases significantly if native vegetation reaches 20-40% of riparian cover.

Thus our all-species approach at the Amargosa Canyon will provide the BLM and USFWS with up-to-date information on Bell's Vireo and Willow Flycatcher territory location to assist restoration efforts, while simultaneously providing much-needed data on the entire riparian avian community's response to *Tamarix* removal and Brown-headed Cowbird management.

# CHAPTER ONE: PATTERNS OF NEST SURVIVORSHIP

## 1.1 METHODS

### 1.1.1 Study Design

In order to thoroughly survey, spot-map, and nest-search for Southwestern Willow Flycatchers and Least Bell's Vireos, we initiated a 31.8 hectare plot near Shoshone (SHOS), a 32.7 ha plot at the north end of the Amargosa Canyon (AMNO), and a 34.5 ha plot in the southern Amargosa Canyon, at Modine Meadows (AMSO) (Figures 1a - c). Though the SHOS and AMNO plots each have contained significant amounts of *Tamarix*, they are generally dominated by native vegetation. The AMSO plot is dominated by *Tamarix*.

The AMNO plot was nearly entirely burned in a spring 2002 fire, and is in regeneration. The southern boundary of the AMNO plot matches the burn's southern extent. The AMNO plot is dominated by *Salix exigua* isolated, recovering clones of *Salix gooddingii*. By 2007, these *S. gooddingii* had recovered to reach over 5 m in height on occasion. In addition, upland transition areas of the AMNO plot hold large patches of dense *Atriplex lentiformis*, *Pluchea sericea*, and *Phragmites australis*, with isolated pockets of *Prosopis glandulosa* and *Prosopis pubescens*. Some of these *Prosopis* patches are tucked into rocky areas that escaped the 2002 burn. Finally, the wettest reaches of the AMNO plot are becoming choked with *Typha* and *Schoenoplectus maritimus.* Both native and exotic vegetation have recovered rapidly after the fire, and BLM crews removed *Tamarix* re-growth across the southern half of the plot in the winter of 2006. We have monitored the AMNO plot for all species each season, beginning in 2005.

The AMSO plot did not suffer from the 2002 fire, and it contains mature stands of *Tamarix* that can exceed 7 m in height. These *Tamarix* stands form a closed canopy throughout much of the plot, though the *Tamarix* is occasionally broken by *S. maritimus,* in wet areas, and by isolated *P. glandulosa* and *P. pubescens* even where the *Tamarix* is most dense. In addition, there are large swaths of *A. lentiformis* and *Suaeda moquinii* which are adjacent the Amargosa main stem's riparian and also adjacent spreading riparian channels within Modine Meadows. Finally, there is a semi-desiccated marsh in the northeastern section of Modine Meadows which holds *Typha*, *Schoenoplectus*, and sporadic, smaller *Tamarix*. The AMSO plot was assessed for all-species in 2005 and 2007.

The SHOS plot is approximately 20 miles upstream of Amargosa Canyon, on the Amargosa River near the town of Shoshone,. The SHOS plot was initiated in 2006, prior to *Tamarix* removal. The SHOS plot is more xeric than the Amargosa Canyon plots, and prior to *Tamarix* eradication, the SHOS plot was dominated by *P. pubsescens, P. glandulosa*, and *A. lentiformis*, with significant *Tamarix* cover as well. In addition, the SHOS plot also held isolated groves of *T. aphylla* that reached approximately 10 m in height. Nearly all of this *Tamarix* cover was removed by the BLM prior to the 2007 field season, and the BLM has returned to the SHOS plot to control *Tamarix* regeneration after the 2007 field season as well. We monitored the SHOS plot for all species in 2006 and 2007. In addition, we surveyed approximately 25 hectares of the riparian zone south of Highway 178 in 2007 for Least Bell's Vireos and Southwestern Willow Flycatchers in preparation for scheduled *Tamarix* eradication.

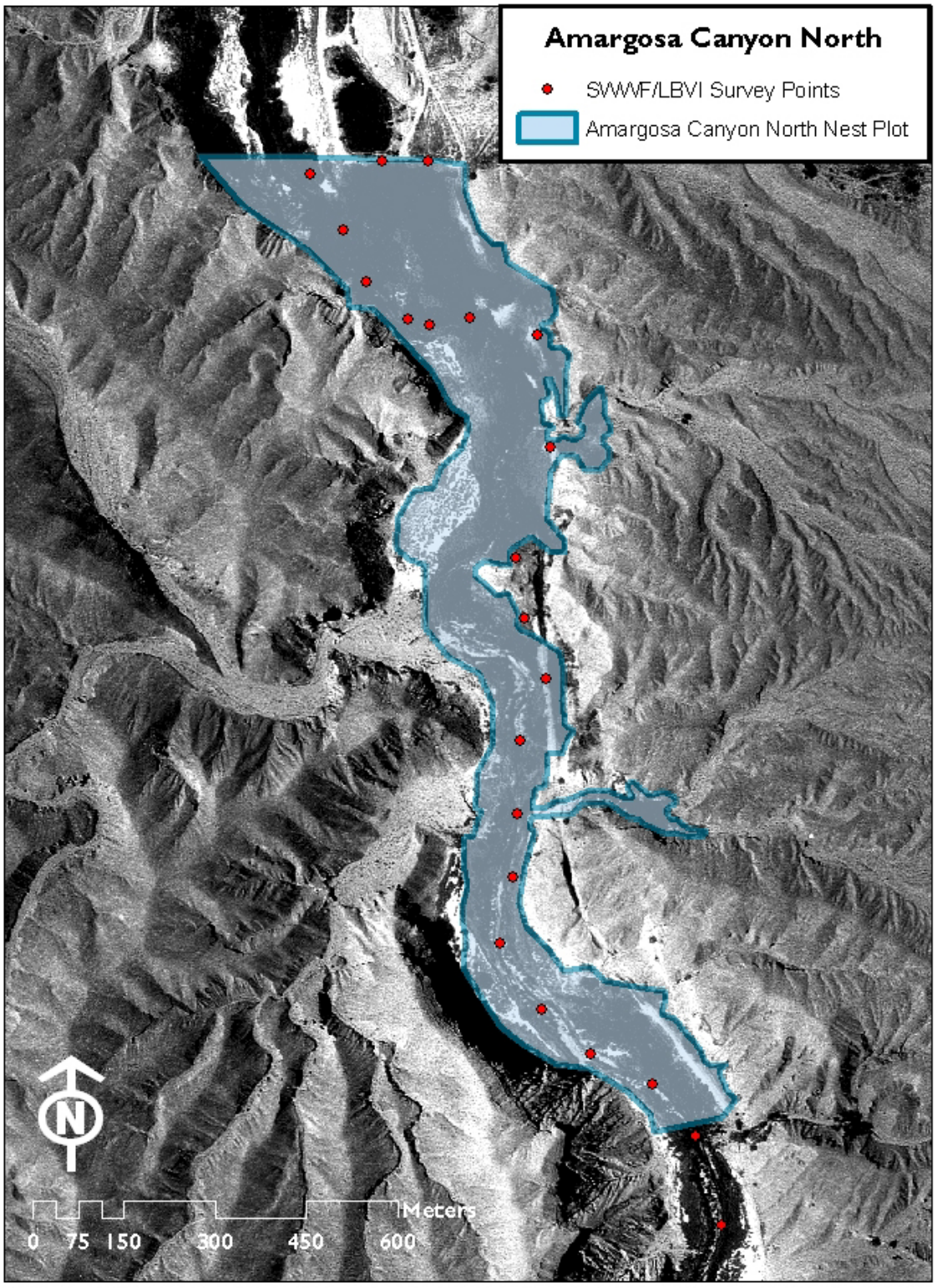



**Figure 1a.** Amargosa North (AMNO) nest plot, with Southwestern Willow Flycatcher and Least Bell's Vireo playback survey points. Monitored 2005-2007.

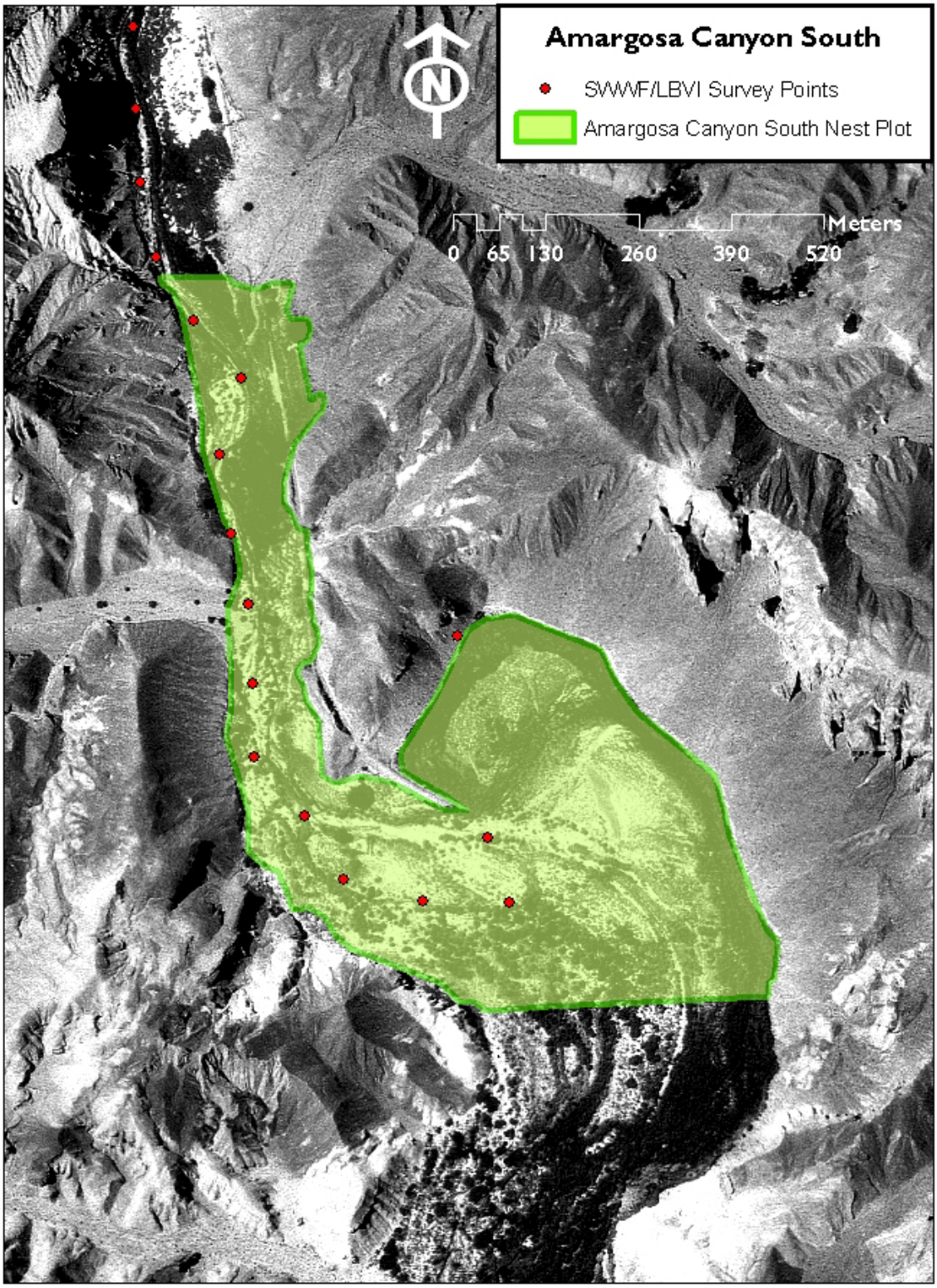



**Figure 1b.** Amargosa South (AMSO) nest plot, with Southwestern Willow Flycatcher and Least Bell's Vireo playback survey points. Monitored 2005 and 2007.

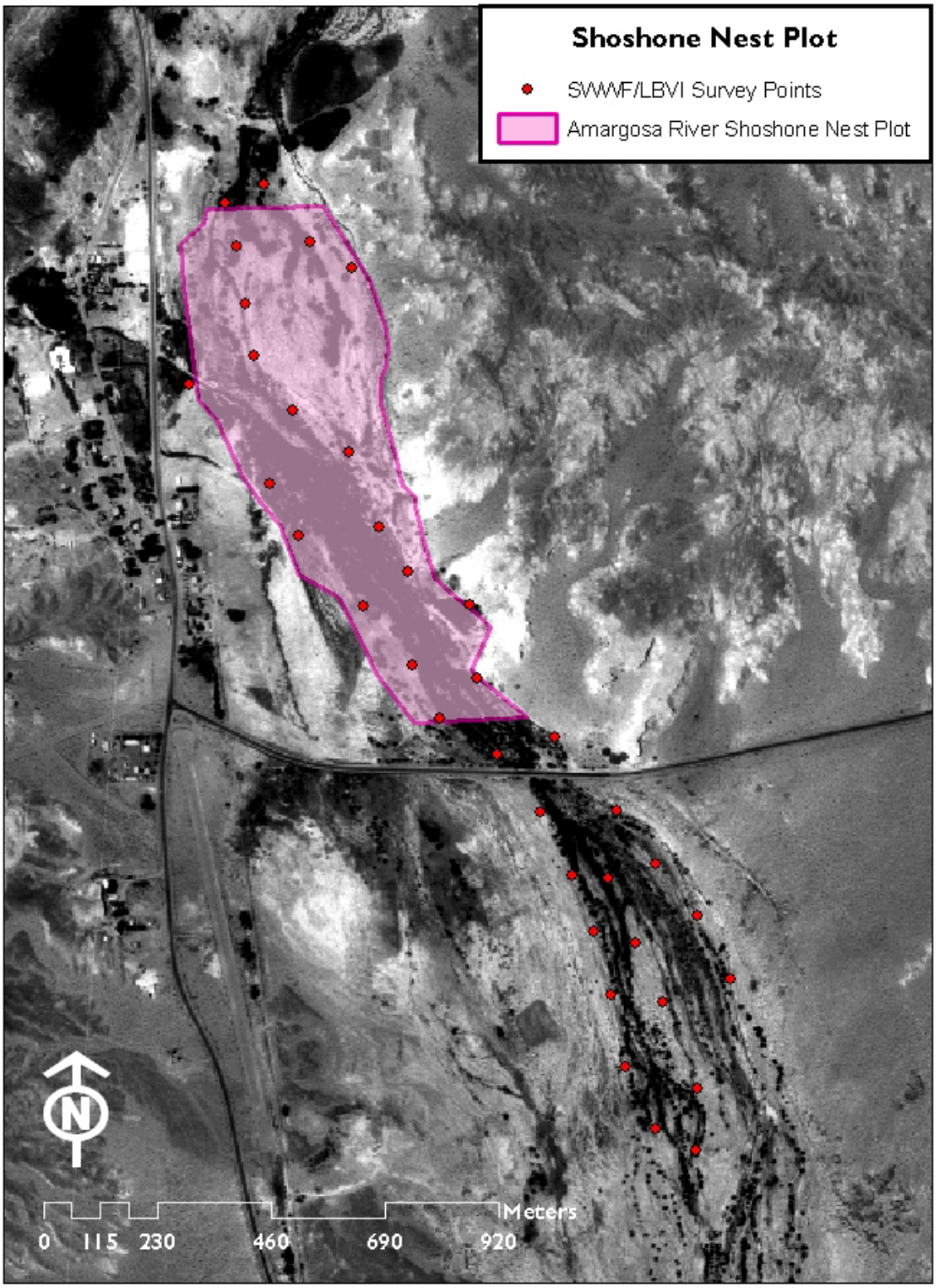



**Figure 1c.** Shoshone (SHOS) nest plot, with Southwestern Willow Flycatcher and Least Bell's Vireo playback survey points. Monitored 2006-2007.

### 1.1.2 Territory Mapping.

On UTM-gridded maps and using GPS Garmin V receivers, we mapped territorial behavior and nests for all species present on each plot three to four days per week, April 1 – July 31, 2005-2007. We followed guidelines suggested in International Bird Census Committee recommendations (IBCC 1970) and following Ralph et al. (1993). At the end of the season, daily spot maps were compiled to create territory maps of all breeding species. Territory numbers were summarized following Hall (1964). Non-territorial species (e.g. Mourning Doves, House Finches) were summarized by number of detected nesting females.

### 1.1.3 Nest Finding and Monitoring and Nest Vegetation Measurements

We located nests on each plot, which we then monitored at least once every four days, following protocols described in Martin and Geupel (1993), Martin et al. (1997), and Rourke (1999). On each visit to the nest, nest contents were recorded, and Brown-headed Cowbird parasitism noted. After nesting was complete, 5 m-radius and 11.3 m-radius vegetation assessments about each nest were conducted also following Martin et al. (1997). Using the same protocol, thirty non-nest vegetation assessments were conducted at randomly-generated locations on each plot for each season.

Nest and non-nest assessments included absolute cover estimates of shrub cover, non-woody cover, and groundcover. Groundcover was broken into "litter", "bare ground", and "rock". Relative covers (by species) of absolute shrub and non-woody cover were estimated; relative species covers were then multiplied by absolute shrub and non-woody cover to give by-species absolute cover estimates for analysis. Numbers of "tree" stems (by species, stems over 8 cm in diameter at breast height (DBH)) were recorded by DBH size categories, in 11.3 m-radius plots around each nest and non-nest point. Canopy measurements included: "canopy height", the maximum height of the canopy within 11.3 m of the nest, and "canopy cover", the percent of the 11.3 m-radius plot covered by vegetation greater than 5 meters in height.

### 1.1.4 Brown-headed Cowbird Censuses

Tallies of Brown-headed Cowbirds were conducted daily on all plot visits from beginning of surveys until the end, in order to provide a per-hour index of cowbird abundance. Tallies are only indices of occurrence, not absolute counts.

### 1.1.5 Statistical Analyses

Nest survivorship calculations were limited to a pool of nests with known outcome and which were observed with at least one egg or young. Nest survivorship was calculated using two methods: Mayfield (1975, 1961) as recommended by Johnson (1979), and Proportion Successful (Martin 1992). The Mayfield method calculates the probability of nest success based on the daily survival rate of the given sample of nests. The method corrects for the fact that nests in any sample are likely to be found at various stages in the nest cycle. The recommended number of nests for use of the Mayfield method is 75 per species, however 20 nests is considered the absolute minimum sample size (Nur et al. 1999). We present Mayfield survival estimates for

some species with sample sizes under 20, to provide a glimpse of this method's capabilities once proper sample sizes are accrued over several seasons.

Host eggs that disappeared in coincidence with the appearance of a new cowbird egg were assumed to be ejected by Brown-headed Cowbirds. Eggs that did not hatch in parasitized nests were presumed to not hatch due to cowbird parasitism. Nests were considered successful if at least one fledgling was observed, if parents were observed with repeated food carries to single locations, or nestlings were seen within four days of the expected fledge date (and subsequent timing of re-nesting attempts did not point to nest failure of the original nest).

Statistical analyses were conducted with Stata Release 8.0 (STATA Corp. 2003) and Program R 2.6.2 (R Development Team 2008).

## 1.2. RESULTS AND DISCUSSION

### 1.2.1 Territory Density

We found that the native-dominated AMNO plot held significantly higher breeding species diversity than the *Tamarix*-dominated AMSO plot ($p<0.05$, $t=3.72$, $n_{AMNO}= 3$ years and $n_{AMSO}= 2$ years). The AMNO plot, dominated by willow, also held close to significantly higher breeding species diversity than the more xeric, mesquite-dominated SHOS plot ($p=0.09$, $t=2.49$, $n_{AMNO} = 3$ years, $n_{SHOS} = 2$ years). Breeding species diversity was not significantly different between the AMSO and SHOS plots ($p = 0.35$, $t=1.22$, $n=2$).

We also found that the native-dominated AMNO plot held significantly higher breeding species richness ($\bar{x} = 21.7$ species) than the *Tamarix*-dominated AMSO plot ($\bar{x} = 12$ species, $p=0.04$, $t=3.72$, $n_{AMNO}= 3$ years and $n_{AMSO}= 2$ years). The AMNO plot held higher species richness than the more xeric SHOS plot ($\bar{x} = 16$ species), but not significantly so. The SHOS plot and AMSO plots' breeding species richness also did not differ significantly, though breeding species richness on the mesquite-dominated SHOS plot was also higher than on the *Tamarix*-dominated AMSO plot.

Though we found higher territory abundance (for all species combined) on the *Tamarix*-dominated AMSO plot ($\bar{x} = 96$ territories) than on either the native-dominated AMNO ($\bar{x} = 79.2$ territories) or SHOS ($\bar{x} = 85.8$ territories) plots (Tables 1a-c), differences were not significant (AMSO mean versus AMNO mean: $p=.19$, $t=1.64$; AMSO mean versus SHOS mean: $p=.53$, $t=.75$).

Figure 2a illustrates an example of our spot-mapping efforts, showcasing territory density and locations for Song Sparrows on the Amargosa Canyon South (AMSO) plot in 2005. Figure 2b depicts Song Sparrow territories on the Amargosa Canyon North (AMNO) plot during the same year.

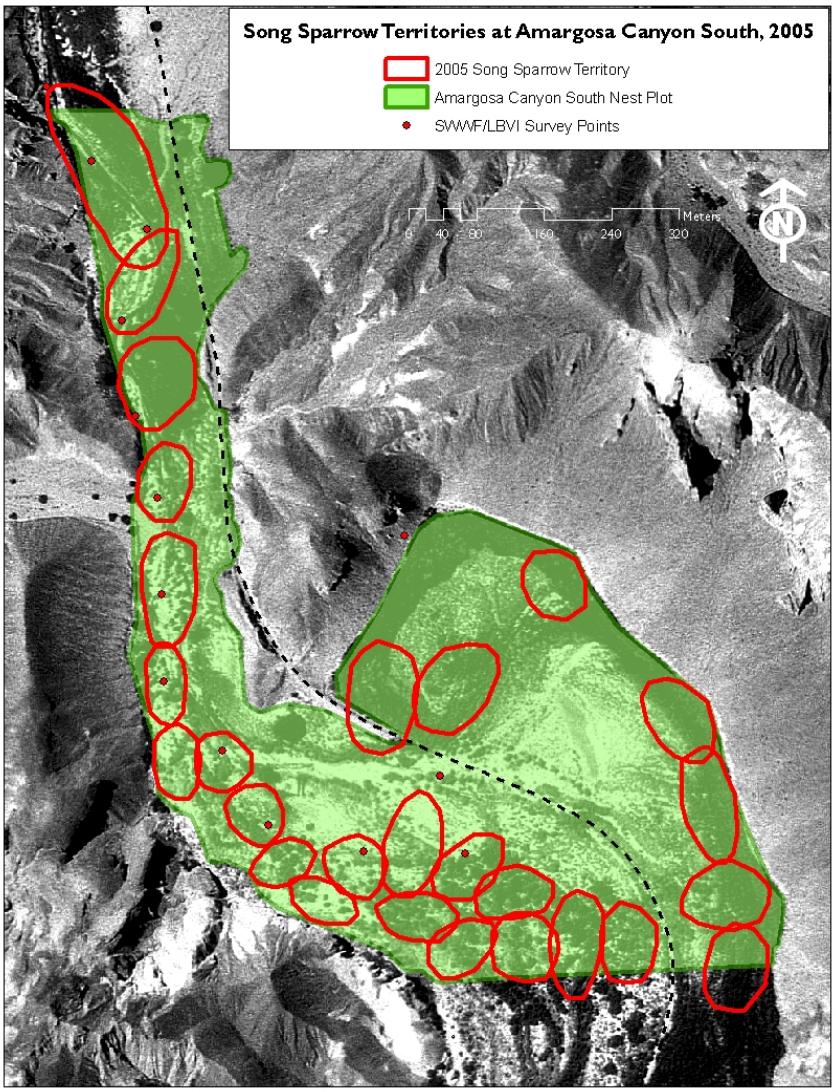



**Figure 2a.** Song Sparrow (*Melospiza melodia*) territories on the AMSO nest plot, 2005.

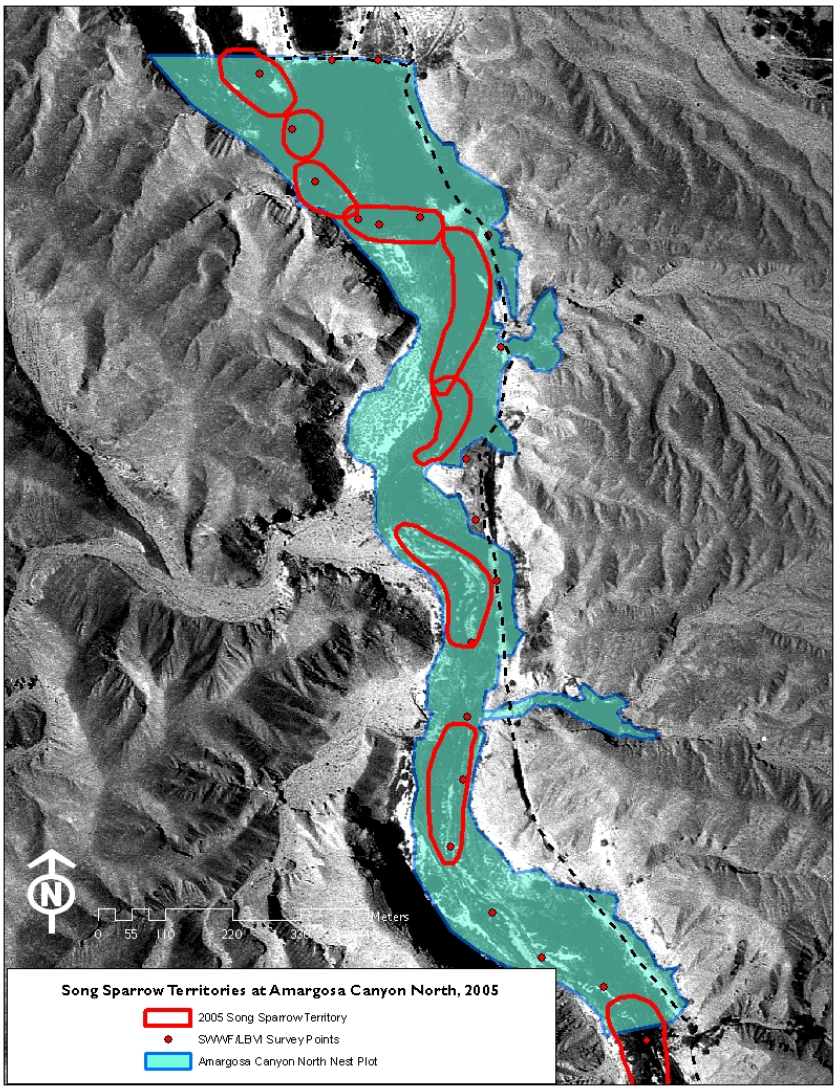



**Figure 2b.** Song Sparrow (*Melospiza melodia*) territories on the AMNO nest plot, 2005.

Tables 1a-c displays territory densities for all species at all plots, 2005-2007.

**Table 1a.** Number of territories at Amargosa Canyon North (AMNO) for all breeding species, 2005-2007. To calculate density per hectare, divide number of territories by 34.5 ha.

| Species | 2005 | 2006 | 2007 |
|---|---|---|---|
| American Kestrel | 1 | 1 | 1 |
| Ash-throated Flycatcher | 3 | 3 | 2 |
| Brown-crested Flycatcher | 2 | 2 | 1.5 |
| Bell's Vireo | 1 | - | - |
| Bewick's Wren | 6 | 5 | 2 |
| Blue-gray Gnatcatcher | 1 | - | - |
| Blue Grosbeak | 7 | 7.5 | 6 |
| Black-tailed Gnatcatcher | 1 | 1 | 1 |
| Costa's Hummingbird | - | 1 | - |
| Common Raven | 1 | 1 | 1 |
| Common Yellowthroat | 13 | 13 | 12.5 |
| Crissal Thrasher | 5.5 | 6 | 3.5 |
| Green Heron | 1 | 1 | 1 |
| Greater Roadrunner | 1 | 1 | 1 |
| House Finch | - | 1 | - |
| Ladder-backed Woodpecker | 2 | 1 | 1.5 |
| Loggerhead Shrike | 1 | - | - |
| Lucy's Warbler | 3.5 | 3.5 | 1 |
| Mourning Dove | - | 2 | 3 |
| Phainopepla | - | - | - |
| Rock Wren | 0.5 | - | - |
| Say's Phoebe | 3 | 3 | - |
| Song Sparrow | 8 | 9 | 4 |
| Verdin | 3.5 | 3 | 7 |
| Virginia Rail | - | 1 | - |
| Western Kingbird | 1 | 1 | - |
| Willow Flycatcher | - | 1 | - |
| Yellow-breasted Chat | 9.5 | 10 | 11 |
| Yellow Warbler | 7 | 8 | 8 |
| TOTAL TERRITORIES | **82.5** | **87** | **68** |
| BREEDING SPECIES RICHNESS | **23** | **24** | **18** |

**Table 1b.** Number of territories at Amargosa Canyon South (AMSO) for all breeding species, 2005 and 2007. To calculate density per hectare, divide number of territories by 32.7 ha.

| Species | 2005 | 2007 |
|---|---|---|
| American Kestrel | - | - |
| Ash-throated Flycatcher | - | - |
| Brown-crested Flycatcher | - | - |
| Bell's Vireo | - | - |
| Bewick's Wren | 17.5 | 7 |
| Blue-gray Gnatcatcher | - | - |
| Blue Grosbeak | 5 | 7 |
| Black-tailed Gnatcatcher | 4 | 3 |
| Costa's Hummingbird | - | - |
| Common Raven | - | - |
| Common Yellowthroat | 3 | 5 |
| Crissal Thrasher | 4 | 3 |
| Green Heron | - | - |
| Greater Roadrunner | 2 | - |
| House Finch | - | - |
| Ladder-backed Woodpecker | - | - |
| Loggerhead Shrike | 1 | - |
| Lucy's Warbler | 15 | 9 |
| Mourning Dove | - | - |
| Phainopepla | 1 | - |
| Rock Wren | - | - |
| Say's Phoebe | - | - |
| Song Sparrow | 26.5 | 26 |
| Verdin | 5.5 | 12.5 |
| Virginia Rail | 1 | - |
| Western Kingbird | - | - |
| Willow Flycatcher | - | - |
| Yellow-breasted Chat | 16 | 12 |
| Yellow Warbler | 4 | 2 |
| TOTAL TERRITORIES | **105.5** | **86.5** |
| BREEDING SPECIES RICHNESS | **14** | **10** |

**Table 1c.** Number of territories at Shoshone (SHOS) for all breeding species, 2006-2007. To calculate density per hectare, divide number of territories by 31.8 ha.

| Species | 2006 | 2007 |
|---|---|---|
| American Kestrel | 1 | - |
| Ash-throated Flycatcher | 1 | 3 |
| Brown-crested Flycatcher | - | - |
| Bell's Vireo | - | - |
| Bewick's Wren | 12.5 | 2 |
| Blue-gray Gnatcatcher | 3 | 4 |
| Blue Grosbeak | 4.5 | 4 |
| Black-tailed Gnatcatcher | 3 | 1 |
| Costa's Hummingbird | - | - |
| Common Raven | 2 | 2 |
| Common Yellowthroat | 4 | 2.5 |
| Crissal Thrasher | 4.5 | 5.5 |
| Green Heron | - | - |
| Greater Roadrunner | 1 | - |
| House Finch | - | 4.5 |
| Ladder-backed Woodpecker | 0.5 | - |
| Loggerhead Shrike | - | - |
| Lucy's Warbler | 10 | 6 |
| Mourning Dove | 1 | - |
| Phainopepla | 11.5 | 5 |
| Rock Wren | - | - |
| Say's Phoebe | - | - |
| Song Sparrow | 3 | 1 |
| Verdin | 22 | 29 |
| Virginia Rail | - | - |
| Western Kingbird | - | - |
| Willow Flycatcher | - | - |
| Yellow-breasted Chat | 10 | 6.5 |
| Yellow Warbler | 1 | - |
| TOTAL TERRITORIES | **95.5** | **76** |
| BREEDING SPECIES RICHNESS | **18** | **14** |

Table 2 underlines differences in breeding species diversity between plots, using number of territories as a surrogate for number of individuals.

**Table 2.** Breeding species diversity at three Amargosa River locations, Inyo County, CA by year (2005-2007), using number of territories was used rather than number of individuals.

| Plot | AMNO | AMSO | SHOS |
|---|---|---|---|
| 2005 | 15.77 | 8.92 | - |
| 2006 | 16.67 | - | 11.31 |
| 2007 | 12.32 | 7.71 | 8.76 |

### 1.2.2 Nest Success

From 2005 through 2007, we located and monitored 310 nests of 26 species on the Amargosa River (Table 3). Overall proportional nesting success, for all species, sites, and years combined was 51%. Open-cup nesting species and Brown-headed Cowbird hosts had much lower proportional success (42% and 40%, respectively).

We located 3 nests for the State and Federally Endangered Least Bell's Vireo, which will be further discussed in Chapter 2. We also found and located nests for the following California Species of Special Concern: (Yellow Warbler (*n*=46 nests), Yellow-breasted Chat (*n*=30), Lucy's Warbler (*n*=19), and Crissal Thrasher (*n*=11). In 2005, we recorded Inyo County's first Green Heron nesting record (Heindel pers. comm.).

Seventy-six nests were parasitized by Brown-headed Cowbirds, or 23% of all nests found. However, 40% of the 190 nests built by potential Brown-headed Cowbird hosts were parasitized, a much higher percentage. Brown-headed Cowbird parasitism will be discussed in Chapter 3. Proportional nest success, particularly for potential Brown-headed Cowbird hosts, was highest in 2007, the year we instituted Brown-headed Cowbird trapping.

**Table 3.** List of species for which nests were found, whether or not the species is a Brown-headed Cowbird host, type of nest built, total number of nests and active nests (nests with host eggs or young) found, total proportional success and proportional success in 2005, 2006, and 2007.

| Species | BHCO Host | Nest Type | Total Nests | Total Active Nests | Percent Success | 2005 success | 2006 success | 2007 success |
|---|---|---|---|---|---|---|---|---|
| Verdin | no | dome | 56 | 43 | 76.7 | 100.0 | 68.8 | 76.2 |
| Yellow Warbler | yes | cup | 46 | 38 | 23.7 | 15.0 | 20.0 | 62.5 |
| Song Sparrow | yes | cup | 40 | 35 | 45.7 | 35.2 | 75.0 | 50.0 |
| Yellow-breasted Chat | yes | cup | 30 | 27 | 66.7 | 63.6 | 50.0 | 75.0 |
| Lucy's Warbler | yes | cavity | 19 | 16 | 43.8 | 55.6 | 25.0 | 0 |
| Mourning Dove | no | cup | 17 | 11 | 36.3 | 57.1 | 0 | 0 |
| Phainopepla | no | cup | 15 | 13 | 23.1 | 0 | 18.1 | 100.0 |
| Blue Grosbeak | yes | cup | 15 | 12 | 33.3 | 28.6 | 66.7 | 0 |
| Black-tailed Gnatcatcher | yes | cup | 13 | 10 | 20.0 | 25.0 | 0 | 25.0 |
| Crissal Thrasher | no | cup | 11 | 11 | 63.6 | 0 | 100.0 | 57.1 |
| Bewick's Wren | no | cavity | 10 | 10 | 80.0 | 83.3 | 0 | 100.0 |
| Ash-throated Flycatcher | no | cavity | 6 | 4 | 50.0 | 100.0 | 0 | 0 |
| Western Kingbird | no | cup | 5 | 4 | 25.0 | 50.0 | 0 | 0 |
| Blue-gray Gnatcatcher | yes | cup | 4 | 4 | 25.0 | 100.0 | 0 | 0 |
| Common Raven | no | cup | 4 | 4 | 75.0 | 0 | 100.0 | 100.0 |
| Brown-crested Flycatcher | no | cavity | 3 | 3 | 100.0 | 100.0 | 100.0 | 100.0 |
| Bell's Vireo | yes | cup | 3 | 3 | 33.0 | 50.0 | 0 | 0 |
| Say's Phoebe | no | cavity | 3 | 2 | 100.0 | 100.0 | 0 | 100.0 |
| House Finch | no | cup | 2 | 2 | 50.0 | 0 | 50.0 | 0 |
| Ladder-backed Woodpecker | no | cavity | 2 | 2 | 100.0 | 100.0 | 100.0 | 0 |
| Red-tailed Hawk | no | cup | 2 | 2 | 100.0 | 100.0 | 100.0 | 0 |
| Costa's Hummingbird | no | cup | 1 | 0 | 0 | 0 | 0 | 0 |
| Common Yellowthroat | yes | cup | 1 | 1 | 0 | 0 | 0 | 0 |
| Green Heron | no | cup | 1 | 1 | 100.0 | 100.0 | 0 | 0 |
| Red-winged Blackbird | yes | cup | 1 | 1 | 100.0 | 0 | 0 | 100.0 |
| Lesser Goldfinch | yes | cup | 1 | 1 | 100.0 | 100.0 | 0 | 0 |
| **TOTAL** | | | **311** | **260** | **51.7** | **49.0** | **43.2** | **63.3** |
| **ALL CUP NESTS** | | | **212** | **180** | **41.7** | **38.5** | **36.7** | **55.8** |
| **ALL CAVITY NESTS** | | | **99** | **80** | **71.3** | **80.8** | **56.0** | **77.8** |
| **ALL BHCO HOSTS** | | | **172** | **147** | **40.1** | **36.1** | **33.3** | **53.4** |
| **ALL NON-BHCO HOSTS** | | | **139** | **113** | **64.6** | **78.1** | **50.0** | **75.0** |

Tables 4a and 4b illustrate that we are steadily accumulating sample sizes necessary to assess potential *Tamarix* eradication and Brown-headed Cowbird trapping impacts on songbird productivity on the Amargosa River. Nur et al. (1999) cited an absolute minimum of 20 nests per group to analyze Mayfield daily nest survival of passerines.

**Table 4a.** Mayfield estimates of nest success for study species with 10 or more nests at the Amargosa River, CA (2005-2007, all plots combined). Mayfield estimates of nest success for nests built in native or *Tamarix* substrates also provided. Proportional success (Table 3) generally overestimates nest success.

| Species | All Nests Mayfield Total | | | Native Substrate Mayfield Total | | | *Tamarix* Mayfield Total | | |
|---|---|---|---|---|---|---|---|---|---|
| | *n* | Survival | SE | *n* | Survival | SE | *n* | Survival | SE |
| Verdin | 43 | 0.64 | 0.004 | 38 | 0.64 | 0.004 | 5 | 0.68 | 0.012 |
| Yellow Warbler | 38 | 0.17 | 0.014 | 32 | 0.22 | 0.013 | 6 | 0.28 | 0.030 |
| Song Sparrow | 35 | 0.23 | 0.013 | 9 | 0.62 | 0.013 | 26 | 0.15 | 0.017 |
| Yellow-breasted Chat | 26 | 0.59 | 0.008 | 14 | 0.61 | 0.01 | 12 | 0.56 | 0.012 |
| Lucy's Warbler | 15 | 0.31 | 0.015 | 6 | 0.36 | 0.018 | 9 | 0.25 | 0.025 |
| Phainopepla | 13 | 0.06 | 0.023 | 11 | 0.09 | 0.022 | 2 | 0.00 | 0.112 |
| Blue Grosbeak | 11 | 0.37 | 0.015 | 7 | 0.44 | 0.017 | 4 | 0.27 | 0.030 |
| Black-tailed Gnatcatcher | 11 | 0.08 | 0.028 | 11 | 0.08 | 0.028 | - | - | - |
| Crissal Thrasher | 11 | 0.43 | 0.013 | 10 | 0.39 | 0.015 | 1 | 1.00 | 0 |
| Mourning Dove | 10 | 0.11 | 0.028 | 8 | 0.05 | 0.041 | 2 | 1.00 | 0 |
| Bewick's Wren | 10 | 0.60 | 0.010 | 6 | 0.67 | 0.012 | 4 | 0.49 | 0.020 |

**Table 4b.** Mayfield estimates of nest success for study species with 10 or more nests at the Amargosa River, CA (2005-2007, all plots combined). Mayfield estimates of nest success for nests built before and after *Tamarix* eradication also provided. Proportional success (Table 3) generally overestimates nest success.

| Species | All Nests Mayfield Total | | | Pre-Eradication Mayfield Total | | | Post-Eradication Mayfield Total | | |
|---|---|---|---|---|---|---|---|---|---|
| | *n* | Success | SE | *n* | Success | SE | *n* | Success | SE |
| Verdin | 43 | 0.64 | 0.004 | 16 | 0.76 | 0.005 | 27 | 0.55 | 0.007 |
| Yellow Warbler | 38 | 0.17 | 0.014 | 5 | 0.16 | 0.03 | 33 | 0.21 | 0.013 |
| Song Sparrow | 35 | 0.23 | 0.013 | 26 | 0.17 | 0.017 | 9 | 0.48 | 0.016 |
| Yellow-breasted Chat | 26 | 0.59 | 0.008 | 12 | 0.46 | 0.014 | 14 | 0.71 | 0.008 |
| Lucy's Warbler | 15 | 0.31 | 0.015 | 10 | 0.37 | 0.018 | 5 | 0.24 | 0.025 |
| Phainopepla | 13 | 0.06 | 0.023 | 12 | 0.02 | 0.029 | 1 | 1.00 | 0 |
| Blue Grosbeak | 11 | 0.37 | 0.015 | 3 | 0.07 | 0.057 | 8 | 0.51 | 0.014 |
| Black-tailed Gnatcatcher | 11 | 0.08 | 0.028 | 4 | 0.08 | 0.045 | 7 | 0.08 | 0.035 |
| Crissal Thrasher | 11 | 0.43 | 0.013 | 1 | 1.00 | 0 | 10 | 0.39 | 0.015 |
| Mourning Dove | 10 | 0.11 | 0.028 | 3 | 0.46 | 0.028 | 7 | 0.05 | 0.044 |
| Bewick's Wren | 10 | 0.60 | 0.010 | 3 | 0.47 | 0.022 | 7 | 0.68 | 0.011 |

### 1.2.3 Nesting Success in Native and *Tamarix* Substrates

*Tamarix*-dominated habitat held lower breeding species diversity, richness, and all-species nesting success than native-dominated habitats on the Amargosa River. However, it held higher overall passerine abundance (for all species combined).

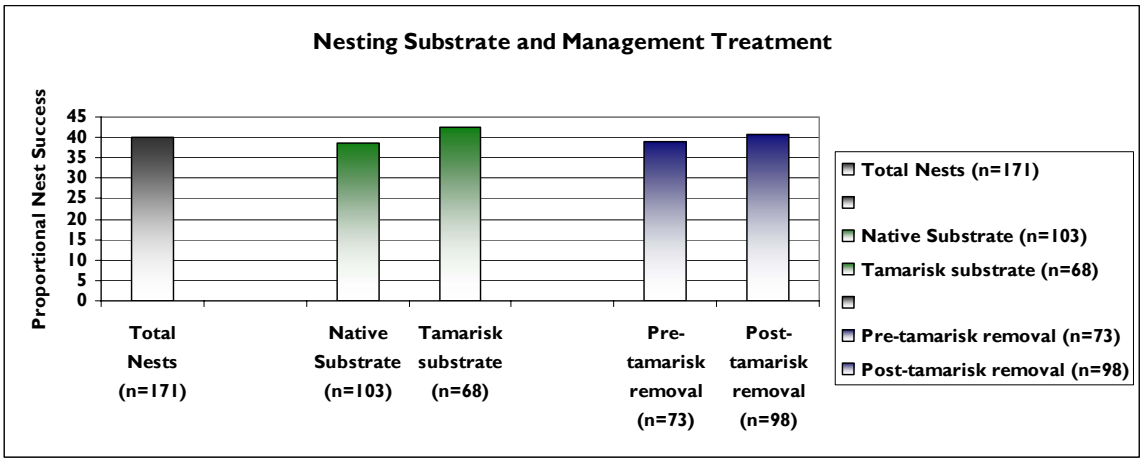
Proportional nest success of potential Brown-headed Cowbird hosts appeared to be unaffected by whether the nesting substrate was *Tamarix* or native, and nest success of potential Brown-headed Cowbird hosts was similar in pre and post-eradication areas. Regardless of substrate or *Tamarix* treatment, proportional success of potential Brown-headed Cowbird hosts hovered around 40%. Thus it appears that while *Tamarix* habitats hold less passerine diversity, individuals of host species (which are generally open-cup nesting species) that do nest in *Tamarix*-dominated habitats have comparable nest success to their counterparts nesting in native-dominated habitats.

However, it is critical to note that more data is required to fully answer this question. Because nest-searching in *Tamarix*-dominated habitats is difficult, nests are often found later in the nesting cycle, increasing the chance to overestimate nesting success using proportional nest success as a measure. Tables 4a and 4b show that when using Mayfield estimates of nest success, native and post-eradication nests do indeed seem to have higher success than nests built in *Tamarix*, or in areas that have not yet been treated with *Tamarix* eradication. Additional sample size will enable us to utilize more complex analysis tools in addressing substrate and management impacts on nesting success.

For all species combined, nests built in native vegetation or rock (53.6%, $n$ = 181) had a higher proportional success than nests built in *Tamarix* (48.1%, $n$ =83). However, native vegetation holds a higher number of cavity and dome-nesting species, which typically have higher nesting success than open-cup nests (Table 3).

Considering only potential Brown-headed Cowbird hosts (which includes Sensitive Species Least Bell's Vireo, Lucy's Warbler, Yellow-breasted Chat, and Yellow Warbler), nests built in *Tamarix* had higher proportional success than nests built in native substrates, though the difference was small (Figure 3). In addition, nests of potential Brown-headed Cowbird hosts built in post-*Tamarix* eradication areas had a slightlyhigher proportional success than nests built in pre-eradication areas, but only slightly higher.

**Figure 3.** Proportional nest success for potential Brown-headed Cowbird hosts, Amargosa River, CA. Nest success percentages provided for all nests, native versus *Tamarix* substrate, and pre- versus post-*Tamarix* removal.



### 1.2.4 Before and After *Tamarix* Eradication: Shoshone

**Territory Abundance**

The Shoshone plot (SHOS) provides us with a unique opportunity to assess all-species songbird breeding density and nesting success immediately before and after *Tamarix* eradication. In comparison, at the Amargosa Canyon north plot (AMNO), *Tamarix* eradication was much more minor in extent, and at the Amargosa Canyon south plot (AMSO), where *Tamarix* eradication has not yet occurred.

Table 1c shows that on SHOS, total territories for all species combined dropped from 95.5 in 2006 territories to 76 territories in 2007, a large decline. Bewick's Wrens, Lucy's Warblers, Song Sparrows, Yellow-breasted Chats, and Phainopeplas were responsible for the bulk of this decline in abundance. Verdins were the exception, and their numbers increased from 22 to 29 territories from pre-eradication 2006 to post-eradication 2007.

Lucy's Warblers and Bewick's Wrens commonly nest in *Tamarix* (Table 4a), and the loss of *Tamarix* at Shoshone may be responsible for their decline. However, Lucy's Warblers and Bewick's Wrens also declined on AMSO and AMNO during the same period (Tables 1a and 1b), and subsequent seasons' data will be required to distinguish abundance changes on Shoshone from perhaps climatic or larger demographic causes for observed declines in these species.

Yellow-breasted Chats and Song Sparrows also commonly nest in *Tamarix*, and while their numbers declined on SHOS, changes in their numbers were mixed on AMNO and AMSO during the same period (Tables 1a-1c). Subsequent years' data will be critical in understanding these two species' responses to *Tamarix* eradication, but our 2007 data suggests that *Tamarix* eradication may result in density declines for Song Sparrows and Yellow-breasted Chats.

Phainopeplas more commonly nest in native substrates than *Tamarix*, and are heavily dependent on a mesquite-dependent parasite, Desert Mistletoe (*Phoradendron californicum*), to provision themselves and their chicks. It is likely that *Tamarix* eradication is not responsible for the large decrease in Phainopepla territories on SHOS between 2006 and 2007, but rather, a decrease in mistletoe berries due to much drier conditions in 2007.

**Nesting Success**

Though proportional nesting success increased markedly on Shoshone from 2006 (pre-eradication) to 2007 (post-eradication), neither *Tamarix* eradication nor Brown-headed Cowbird trapping (2007) on Shoshone appeared to have little effect on nesting success in themselves.

Rather, though Table 5 demonstrates that proportional nest success increased markedly on SHOS between 2006 and 2007 (from 47% to 70%) much of this increase was due to a decrease in Phainopepla nests in 2007, which drove down overall success in 2006. As stated, Phainopepla density decreases were likely attributable to much drier conditions in 2007, and not *Tamarix* removal nor cowbird trapping.

**Table 5.** Proportional nest success on the Shoshone plot (SHOS), Amargosa River, CA (2006 and 2007). *Tamarix* eradication occurred in the winter of 2006, prior to the 2007 breeding season.

| Species | BHCO Host | Nest Type | *2006 n* | Percent Success 2006 | *2007 n* | Percent Success 2007 |
|---|---|---|---|---|---|---|
| Verdin | no | dome | 12 | 83.3 | 18 | 83.3 |
| Phainopepla | no | cup | 11 | 18.2 | 1 | 100.0 |
| Crissal Thrasher | no | cup | - | - | 5 | 40.0 |
| Yellow-breasted Chat | yes | cup | 2 | 50.0 | 2 | 50.0 |
| Lucy's Warbler | yes | cavity | 3 | 33.3 | 1 | 0 |
| Blue-gray Gnatcatcher | yes | cup | 2 | 0 | 1 | 0 |
| Bewick's Wren | no | cavity | 1 | 0 | 1 | 100.0 |
| Mourning Dove | no | cup | 1 | 0 | - | - |
| Blue Grosbeak | yes | cup | 1 | 0 | - | - |
| Common Raven | no | cup | 1 | 100.0 | - | - |
| House Finch | no | cup | 1 | 100.0 | - | - |
| Song Sparrow | yes | cup | 1 | 100.0 | - | - |
| Say's Phoebe | no | cup | - | - | 1 | 100.0 |
| | | **TOTAL** | **36** | **47.2** | **30** | **70.0** |
| | | **ALL CUP NESTS** | **20** | **30.0** | **10** | **50.0** |
| | | **ALL CAVITY NESTS** | **16** | **68.9** | **20** | **80.0** |
| | | **ALL BHCO HOSTS** | **9** | **33.3** | **4** | **25.0** |
| | | **ALL NON-BHCO HOSTS** | **27** | **51.2** | **26** | **76.9** |

# CHAPTER TWO: ENDANGERED SPECIES SURVEYS

## 2.1 METHODS

In its *Biological Opinion for the Saltcedar Removal and Riparian Restoration Project within the Amargosa River Drainage* (2005), the USFWS asserted that the BLM should survey for federally-endangered Southwestern Willow Flycatchers (*Empidonax traillii extimus*) and Least Bell's Vireos (*Vireo bellii pusillus*), to minimize potential take during *Tamarix* eradication efforts (29).

We followed all Southwestern Willow Flycatcher and Least Bell's Vireo survey techniques and schedules outlined in Attachments A and B of the USFWS *Biological Opinion* (USFWS 2005), Sogge (2000 and 1997) and Rourke et al. (1999) in order to locate, map, find and monitor nests, and establish buffers for these species in advance of *Tamarix* eradication. In addition, our constant spot-mapping effort on the SHOS, AMNO, and AMSO plots enabled us to detect additional Bell's Vireos and Willow Flycatchers not detected during presence/absence surveys. Spot-mapping and nest-monitoring methodologies are found in Section 1.1.3 of this report.

Survey point locations are provided in Figures 1a-1c. All points in the Amargosa Canyon were surveyed in 2005, 2006, and 2007. Points near Shoshone were surveyed in 2006 and 2007 (north of Highway 178), and in 2007 (south of Highway 178).

## 2.2 RESULTS AND DISCUSSION

### 2.1.1 Nests and Territories

From 2005-2007, we located one nesting pair of Bell's Vireos, which were present in the same location in 2005 and 2006 (Figures 4 a-c). In 2005, this pair initiated a clutch April 7, and the nest fledged four young on May 6. The pair attempted to double brood, initiating a second clutch on June 28. This double brood attempt was parasitized by Brown-headed Cowbirds. Though both vireo and cowbird young managed to hatch, the nest was depredated with young, before either the vireos or cowbird could fledge.

We detected a mated pair of Bell's Vireos in 2006, in the same location as in 2005. None of the adults found on this territory were banded, so while it is likely the same male returned in 2006, the 2005 and 2006 females were not necessarily the same individuals, as their first 2006 nesting attempt was nearly a month later than in 2005. This attempt was abandoned, but the pair re-nested and initiated a clutch on May 20. This nest was parasitized by Brown-headed Cowbirds, and only one vireo egg hatched, along with the cowbird egg. Only the cowbird chick survived to fledge.

All four Bell's Vireo nests were constructed in *Tamarix*.

In 2007, a male was detected at this same location, during surveys on April 17 and April 21. However, he was not observed to be mated, and he vanished from this location within ten days of the original sighting. Surveyors made isolated detections of Bell's Vireos at other locations (never during playback surveys) during the rest of the season, but these individuals never remained for more than a day – leading us to believe that no Bell's Vireos nested on the Amargosa River in 2007.

In addition to the nesting pair of Bell's Vireos described above, we recorded multiple detections of unmated males of both Bell's Vireos and Willow Flycatchers in 2005 and 2006 (Figures 4 a-c). In 2005, an unmated Bell's Vireo remained in the northeast corner of the Amargosa Canyon for just over two weeks in May. In 2006, an unmated male Willow Flycatcher held a territory at the northern end of the Amargosa Canyon from May 31 to June 22.

The Southern Sierra Research Station (SSRS) conducted Willow Flycatcher and Bell's Vireos during the breeding season immediately after the Amargosa Canyon 2002 burn (Whitfield 2002). Some of the SSRS surveys were conducted south of Modine Meadows, and thus south of the areas we covered from 2005-2007. But in addition, the SSRS surveyed an area from Modine Meadows to the southern edge of the 2002 burn, corresponding to our AMSO plot.

The SSRS also detected Willow Flycatchers during their surveys, but were unable to conclude whether or not Willow Flycatchers were breeding in the Amargosa Canyon. We do not believe Willow Flycatchers nested on the Amargosa River from 2005-2007. However, regenerating willow habitat in the northwestern section of AMNO is over 5m high, and we believe that this habitat may be of high enough quality to support breeding Willow Flycatchers in the future.

The SSRS did not detect Bell's Vireos in the reach of the Amargosa Canyon we covered, which was where we located the only nesting pair of Bell's Vireos present during our study. It may be that this pair was not present in 2002, three years before our study began.

The SSRS felt that Bell's Vireos would re-occupy the burned area of Amargosa Canyon within a year after the 2002 fire (Whitfield 2002). This has not occurred, underlining the complexity and difficulty in bringing back endangered species after catastrophic events such as fire. Bell's Vireos were present and nesting in northern Amargosa Canyon prior to the burn (Whitfield 2002, McCreedy pers. obs.), and the recovering northern section of the canyon would appear to have regenerated enough habitat to support breeding Bell's Vireos. Yet we have been unable to detect a mated Bell's Vireo pair in three years of intensive nest searching in the burned section of the Amargosa Canyon.

The institution of cowbird trapping at nearby areas within the *Tamarix* removal project area, including at China Ranch, where Bell's Vireos are prevalent, will hopefully increase Bell's Vireo productivity and produce colonists which can then re-occupy their traditional breeding grounds within the Amargosa Canyon.

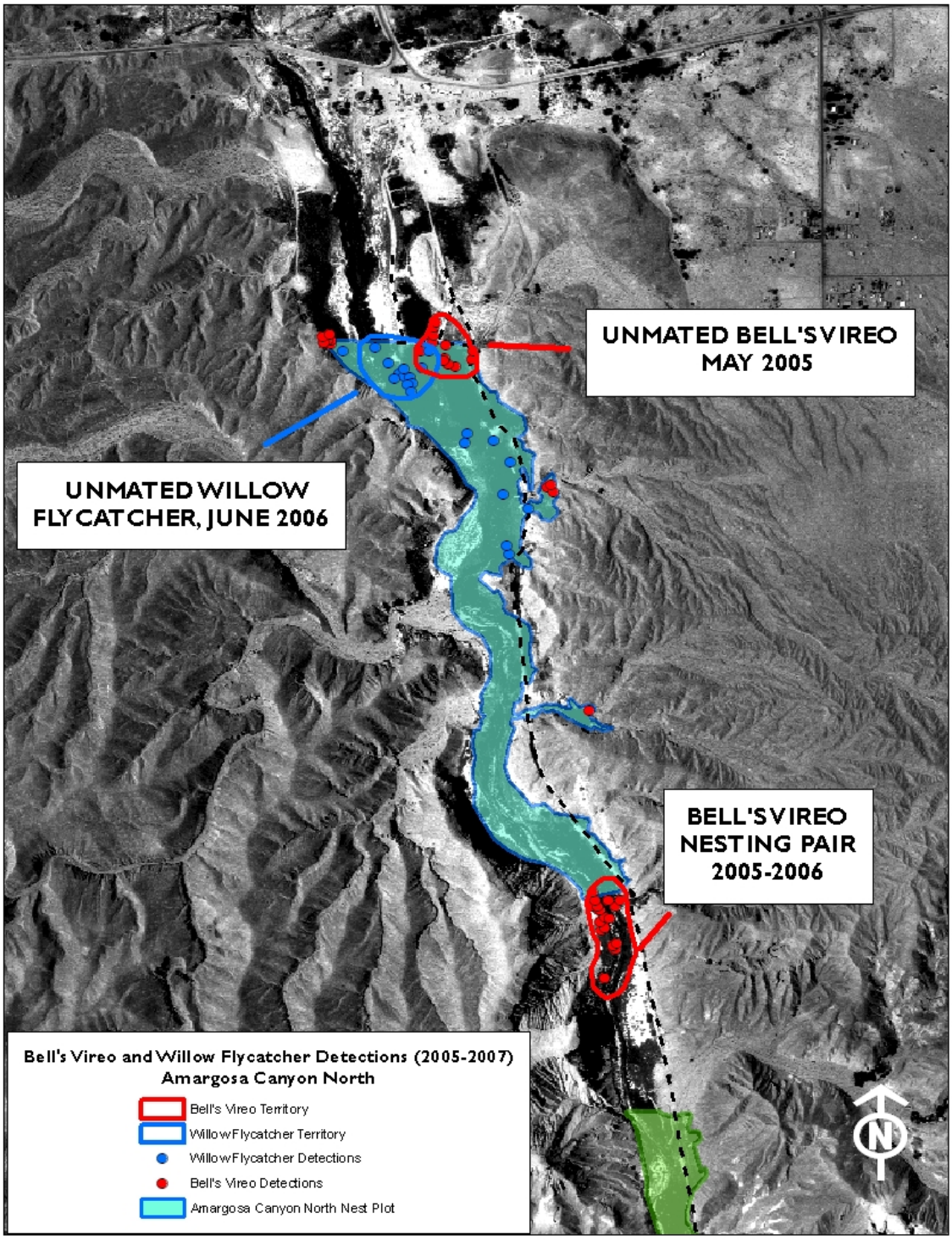



**Figure 4a.** Bell's Vireo and Willow Flycatcher detections (2005-2007) on the Amargosa River, CA. Circles denote territories held for over two weeks by male adults.

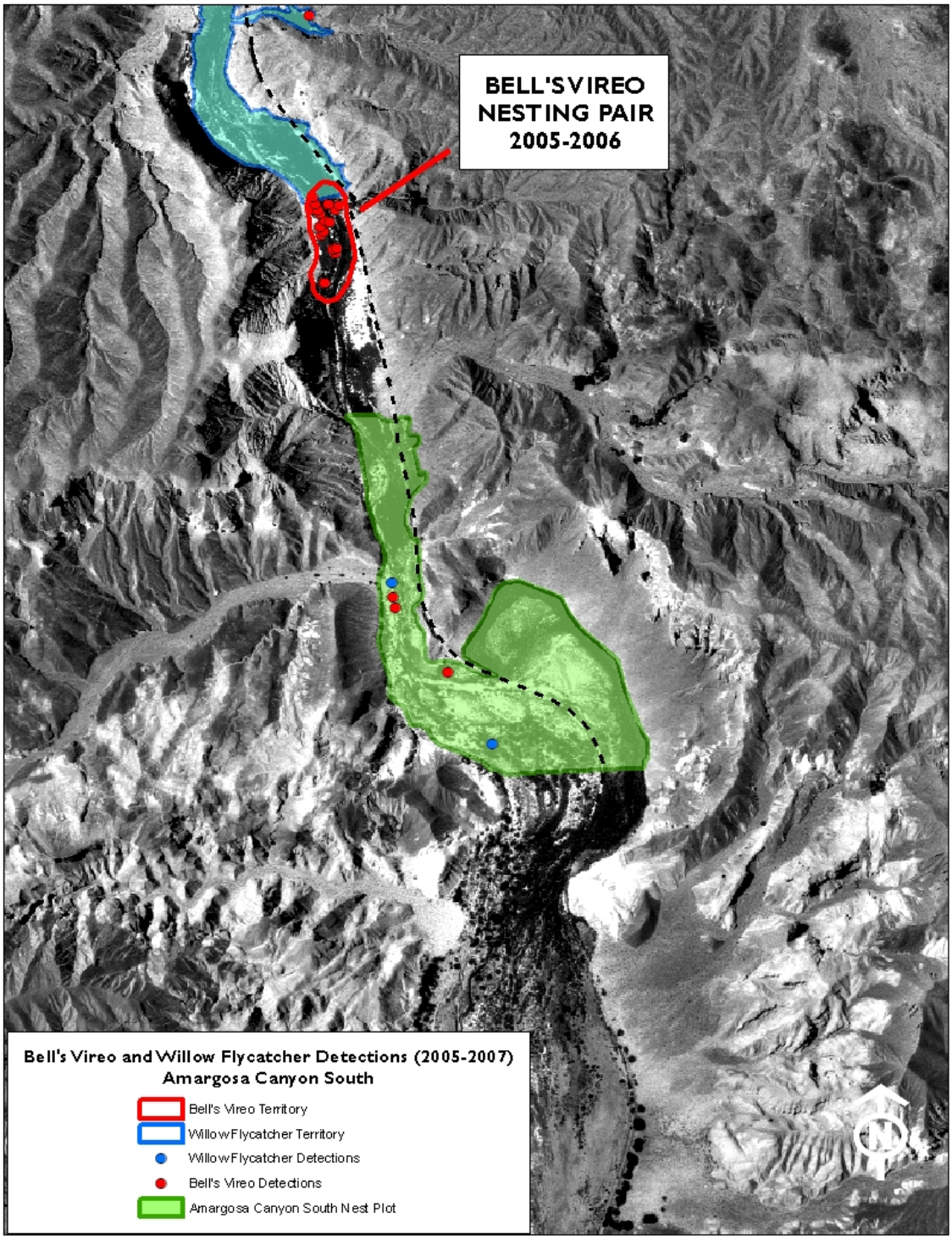



**Figure 4b.** Bell's Vireo and Willow Flycatcher detections (2005-2007) on the Amargosa River, CA. Circles denote territories held for over two weeks by male adults.

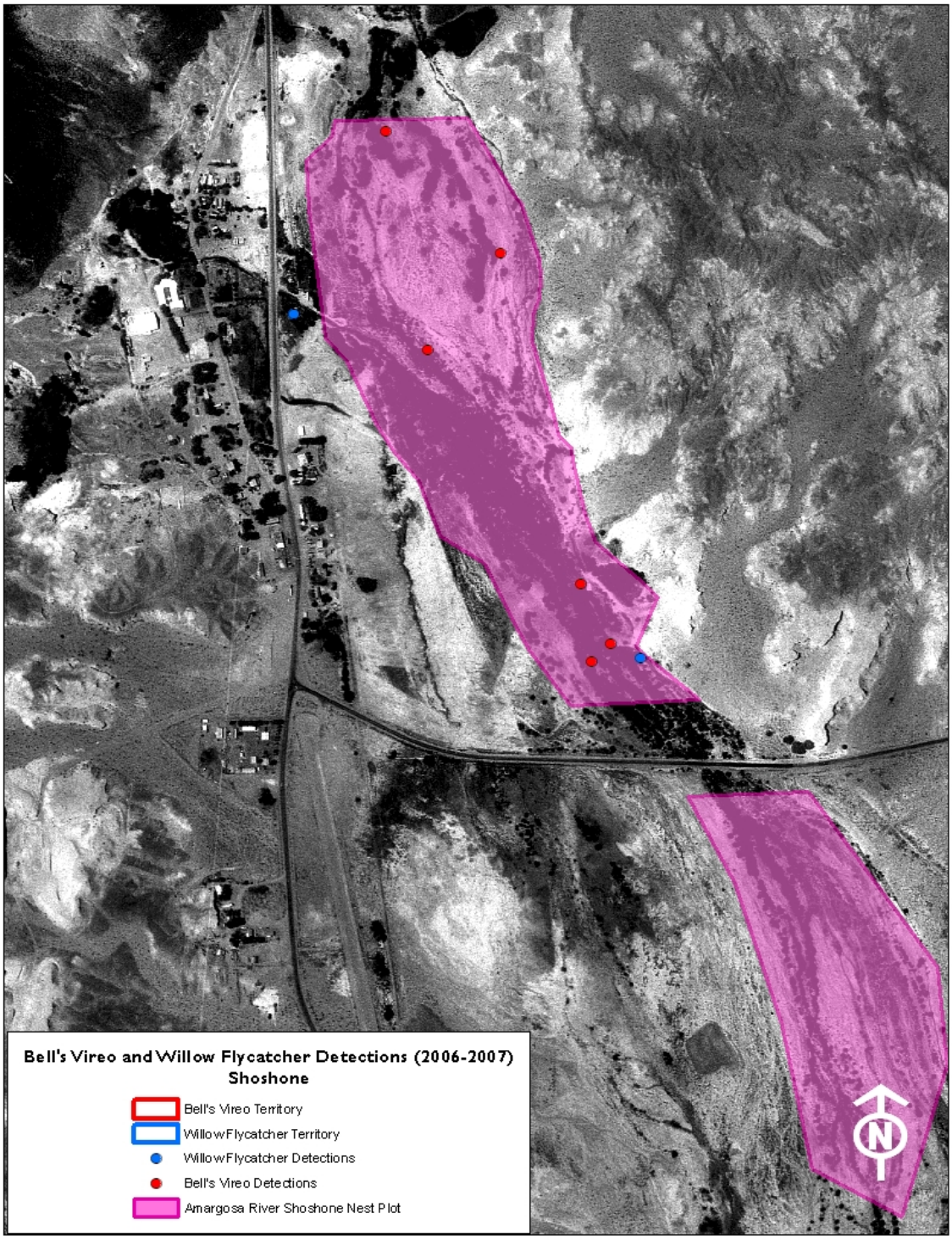



**Figure 4c.** Bell's Vireo and Willow Flycatcher detections (2005-2007) on the Amargosa River, CA. Circles denote territories held for over two weeks by male adults.

# CHAPTER THREE: BROWN-HEADED COWBIRD TRAPPING

## 3.1 METHODS

The FWS secured funding in 2007 to build and monitor eight Brown-headed Cowbird traps at select locations within the Saltcedar Removal and Riparian Restoration Project's area. With the help of several private land owners at Shoshone, Tecopa, and China Ranch, we set up seven of these traps in 2007, saving the eighth trap as a spare.

We conducted Brown-headed Cowbird trapping following methods described in McLeod et al. (2007). We used eight funnel-shaped Brown-headed Cowbird traps, also described in McLeod et al. (SWCA Consultants, which produced the McLeod et al. report, built the cowbird traps used on the Amargosa River).

Trap locations are depicted in Figures 5a-c. We placed two traps on the SHOS plot, and one trap on the AMNO plot. In addition, we placed two traps at nearby China Ranch, where the densest population of Bell's Vireos in the project area exists. We also placed one trap near the AMNO plot in Tecopa, near a horse corral where Brown-headed Cowbirds were seen gathering in 2005 and 2006. We also placed a cowbird trap at a private residence in Shoshone, again, where cowbirds were seen to congregate in 2005 and 2006.

We opened one trap each at Shoshone, China Ranch, and the Amargosa Canyon on April 19, approximately at the same time migrating female Brown-headed Cowbirds arrive at project sites. We opened second traps each at Shoshone, China Ranch, and the Amargosa Canyon on May 5, and our third Shoshone trap on June 10.

McLeod et al. (2007) noted that ideally, traps should be placed within 400 m of breeding areas. We strove to follow this suggestion; however, the AMSO plot is in Wilderness, and is a two-mile hike from the closest entrance point, preventing placement of a cowbird trap within 400 m of this plot.. If cowbirds parasitize a higher percentage of nests on the AMSO plots than on SHOS or AMNO in the future, shooting may be the only potential control method for cowbirds breeding on the AMSO plot. However, with traps at AMNO, Tecopa, and at China Ranch, we have staked out the most likely entrance points for cowbirds commuting to the AMSO plot from their foraging grounds, and this may be enough to control them at this remote location.

McLeod et al. (2007) noted that three female and two male cowbird decoys seemed to work well in attracting new captures. SWCA Consultants in Lake Havasu City, AZ graciously provided two male and two females from their trapping efforts on May 31, and we placed these decoys in our traps on June 1.

Traps were checked at least once, and usually twice every 24 hours, and were replenished with water and seed regularly. Upon each trap check, we noted all new and existing cowbird captures, and recorded and released all non-target captures. At the direction of the FWS, only female cowbirds were euthanized. Juveniles were immediately released. Females and males' wings were clipped to prevent injury while being used as decoys, and males were cycled out of the traps if they had been used as a decoy for more than approximately seven to ten days.

Euthanized females were frozen and stored for potential future use in a United States Geological Survey study of cowbird immunity to pathogens.

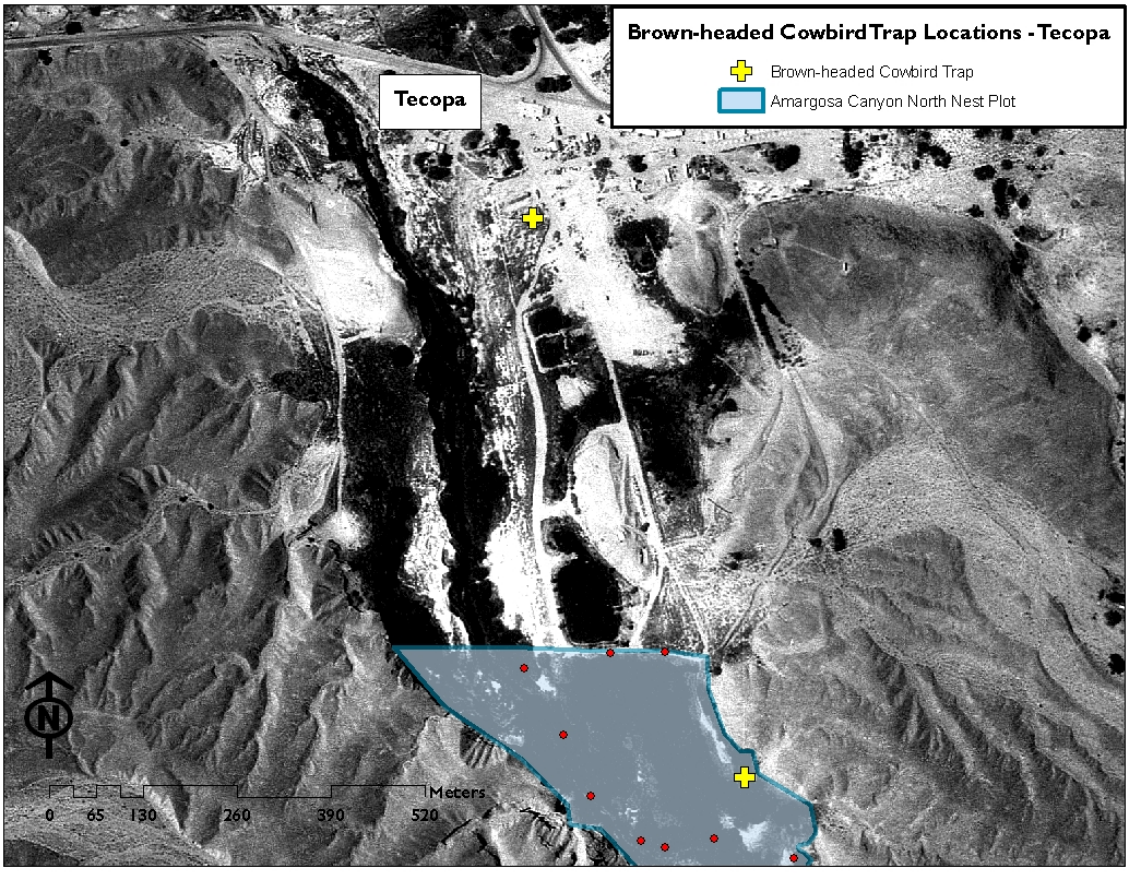



**Figure 5a.** Two Brown-headed Cowbird trap locations near the Amargosa River at Tecopa, CA. The Amargosa North (AMNO) nest plot is shaded blue.

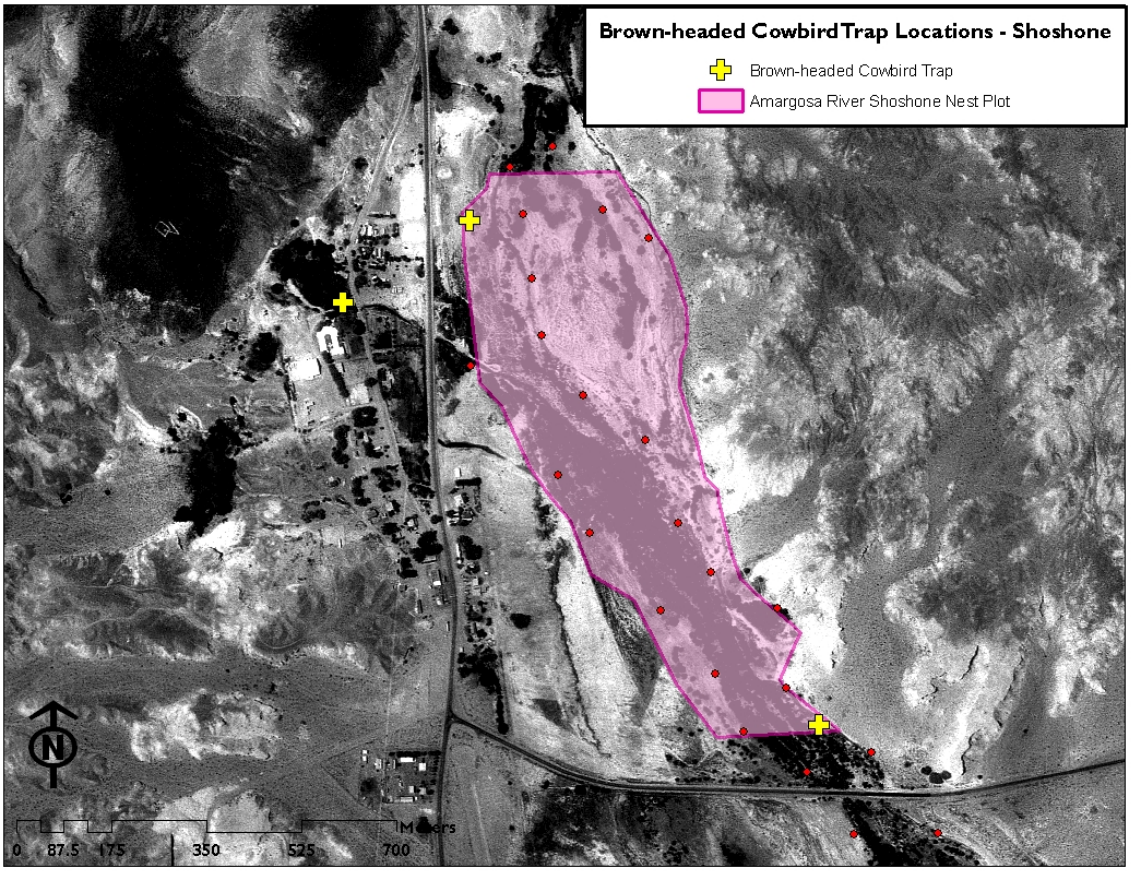



**Figure 5b.** Three Brown-headed Cowbird trap locations near the Amargosa River at Shoshone, CA. The Shoshone (SHOS) nest plot is shaded purple.

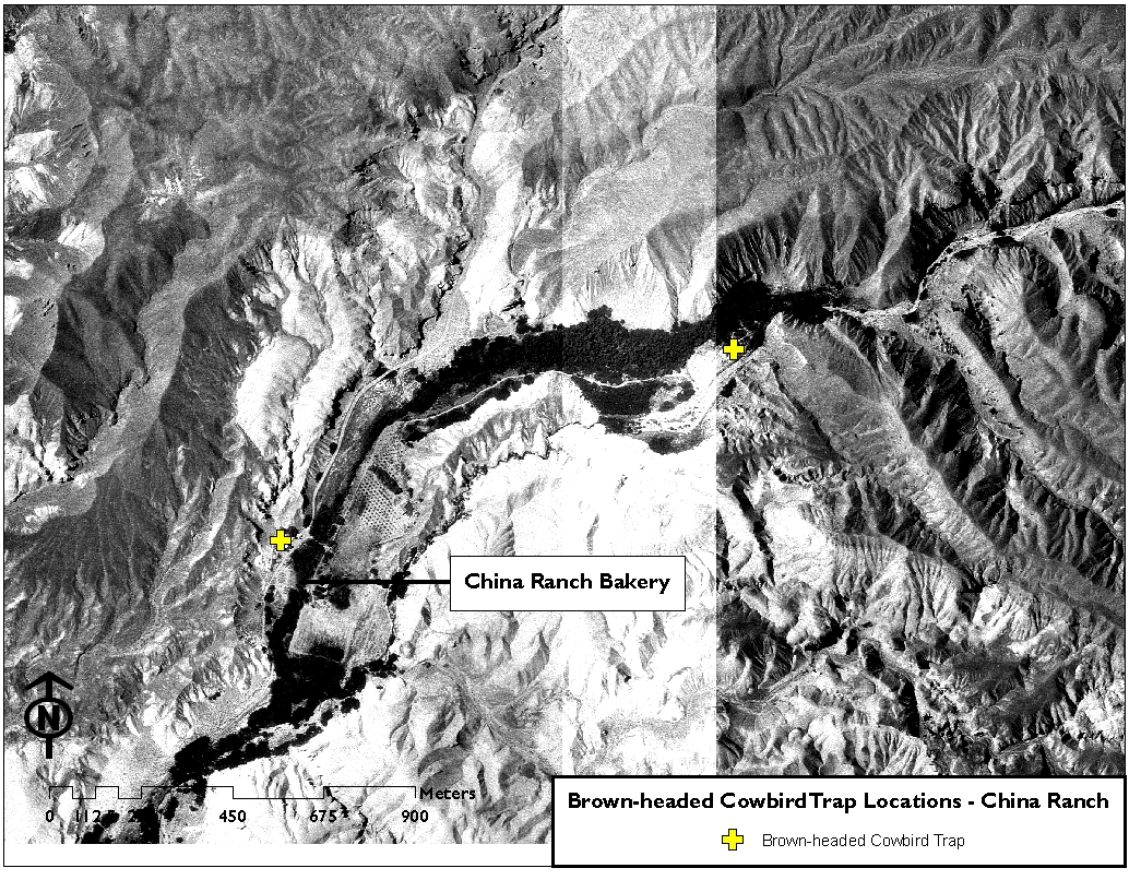



**Figure 5c.** Two Brown-headed Cowbird trap locations at China Ranch on Willow Creek, a tributary of the Amargosa River.

## 3.2 RESULTS AND DISCUSSION

### 3.2.1 Trap Captures

Importantly, we were not able to acquire and deploy Brown-headed Cowbird decoys until June 2. Thus we did not capture any Brown-headed Cowbirds until June 3, over five weeks into the cowbird and host nesting season

We recorded 138 Brown-headed Cowbird captures in 2007 at Shoshone, the Amargosa Canyon/Tecopa, and China Ranch (Table 6). Of these captures, 111 were males, 26 were females, and 21 were juveniles. Only females were euthanized, thus several of the male and juvenile captures may have been re-captures. We will band our captures in 2008, allowing us to report absolute captures of males and juvenile individuals in the future.

**Table 6.** Brown-headed Cowbird capture occurrences for three locations near the Amargosa River, CA in 2007. Two traps were placed at China Ranch and at Amargosa Canyon/Tecopa, and three traps were placed at Shoshone. All females were euthanized and figures represent absolute captures. Males and juveniles were released, thus totals represent only capture occurrences, due to the possibility of recapture.

| **China Ranch** | | | **Amargosa Canyon/Tecopa** | | | **Shoshone** | | |
|---|---|---|---|---|---|---|---|---|
| Males | Females | Juveniles | Males | Females | Juveniles | Males | Females | Juveniles |
| 55 | 16 | 11 | 23 | 5 | 9 | 33 | 5 | 1 |

Capture of non-target species can cause mortality and nest failure in other species (Rothstein et al. 2003). Only one non-target individual was lost to mortality, a wintering White-crowned Sparrow that was apparently killed by another White-crowned Sparrow in a Shoshone trap. In one instance, repeat capture of a wintering White-crowned Sparrow at Shoshone (captured every day for over two weeks) required us to temporarily close the Shoshone trap to ensure the survival of this individual.

While negative impacts on non-target species is generally perceived to be a necessary evil in Brown-headed Cowbird trapping (McLeod et al. 2007), we are pleased to report that impacts on non-target species were minimal during our trapping efforts in 2007 (Table 7).. The majority of non-target captures were either House Sparrows and House Finches. Only in two instances (the isolated captures of at least one and perhaps two different Hooded Orioles at China Ranch) did we catch a non-target Neotropical Migrant during its breeding season. We do not assess nesting success at China Ranch, and cannot know if these Hooded Oriole captures resulted in nesting failure. Otherwise, our only capture of a non-target nesting Neotropical Migrant was of a Blue Grosbeak at Shoshone, but this individual was captured in April, before commencement of the Blue Grosbeak nesting season.

**Table 7.** Non-target capture occurrences for three locations near the Amargosa River, CA in 2007. Two traps were placed at China Ranch and at Amargosa Canyon/Tecopa, and three traps were placed at Shoshone. Captured individuals were not banded, thus totals represent only occurrence of capture and not absolute numbers, due to the possibility of recapture.

| | China Ranch | Amargosa Canyon/Tecopa | Shoshone | Mortality |
|---|---|---|---|---|
| Loggerhead Shrike | | | 1 Juvenile | |
| Summer Tanager | 1 Juvenile | | | |
| White-crowned Sparrow | | | 20 | 1 |
| Blue Grosbeak | | | 1 | |
| Hooded Oriole | 2 | | | |
| Yellow-headed Blackbird | 4 Adult 1 Juvenile | | | |
| House Finch | | | 38 | |
| House Sparrow | 37 | 2 | 12 | |

### 3.2.2 Brown-headed Cowbirds and Host Nesting Success

Though we did not begin capturing Brown-headed Cowbirds until June 3, we recorded drastic declines in Brown-headed Cowbird parasitism rates and number of cowbird eggs per host nest in 2007, and drastic increases in nesting success of host species across all sites (Table 8). Parasitism (measured by proportion of nests parasitized and by number of cowbird eggs per nest) decreased approximately 60% from years before Brown-headed Cowbird trapping. Nesting success increased by nearly 50% in 2007, in comparison to 2005 and 2006, before cowbird trapping began.

Using our hourly cowbird abundance data, which we had gathered since 2005 and prior to cowbird trapping in 2007, we found that Brown-headed Cowbird activity on our nest plots declined significantly in 2007. Figures 6a and 6b show significant differences, particularly for females, between cowbird abundance in 2007 and in previous years, before cowbird trapping began.

We examined whether detection rates of brown-headed cowbirds varied between the year preceding trapping (2006) and the year in which trapping occurred (2007). As cowbird detections (and cowbird abundance) are known to vary within a season we included a linear and quadratic effect of Julian date (calendar days since January 1). We were primarily interested in the interaction between Julian date and year because we hypothesized that the effects of seasonal timing on cowbird detections varied between the two years (as an effect of the trapping). The overall model that included the effect of year, Julian date, and their interaction was significant ($F_{8,289}$=13, $p < 0.0001$, $r^2$=0.244, Figure 6b). Female cowbird detections in 2006 increased in a quadratic manner during the season and reached a maximum at day 165 (~June 15). However in 2007 there was a fairly linear decline in cowbird detections throughout the season as trapping occurred. There was a statistically significant decrease in cowbird numbers in 2007 from days 133-201 (95% confidence intervals did not overlap).

Furthermore, there is evidence that the Brown-headed Cowbird population at our sites was in fact oversaturated. Forty-one percent of parasitized nests in 2005 and 2006 held 2 or 3 Brown-headed Cowbird eggs, a possible sign of egg-dumping due to a lack of new nests to parasitize (Lowther 1993). In contrast zero of nine parasitized nests held >1 cowbird egg in 2007.

**Table 8.** Total nests of potential Brown-headed Cowbird hosts, total parasitized, number of successful nests, proportional success, and Brown-headed Cowbird eggs per nest by year and by plot at the Amargosa River, CA. Proportional success is calculated by the number of successful nests divided by active nests. Active nests are nests that contained at least one host egg or young at some point. Potential Brown-headed Cowbird hosts include Bell's Vireo, Black-tailed Gnatcatcher, Blue-gray Gnatcatcher, Blue Grosbeak, Lucy's Warbler, Song Sparrow, Yellow Warbler, and Yellow-breasted Chat. Bell's Vireos are Federally and State Endangered, while Lucy's Warblers, Yellow Warblers, and Yellow-breasted Chats are California Bird Species of Special Concern.

| | Total nests | Total parasitized | Percent parasitized | Nests Successful | Proportional success | Cowbird eggs/nest |
|---|---|---|---|---|---|---|
| **2005** | **81** | **38** | **46.9** | **25** | **36.2** | **0.6** |
| Amargosa Canyon North | 45 | 22 | 48.9 | 14 | 35.9 | 0.6 |
| Amargosa Canyon South | 36 | 16 | 44.4 | 11 | 36.7 | 0.6 |
| **2006** | **38** | **18** | **47.3** | **9** | **31.0** | **0.9** |
| Amargosa Canyon North | 27 | 13 | 48.1 | 6 | 30.0 | 1.0 |
| Shoshone | 11 | 5 | 45.5 | 3 | 33.3 | 0.6 |
| **2007** | **48** | **9** | **18.8** | **21** | **50.0** | **0.2** |
| Amargosa Canyon North | 17 | 3 | 17.6 | 11 | 68.8 | 0.2 |
| Amargosa Canyon South | 26 | 4 | 15.4 | 9 | 42.9 | 0.2 |
| Shoshone | 5 | 2 | 40.0 | 1 | 20.0 | 0.4 |

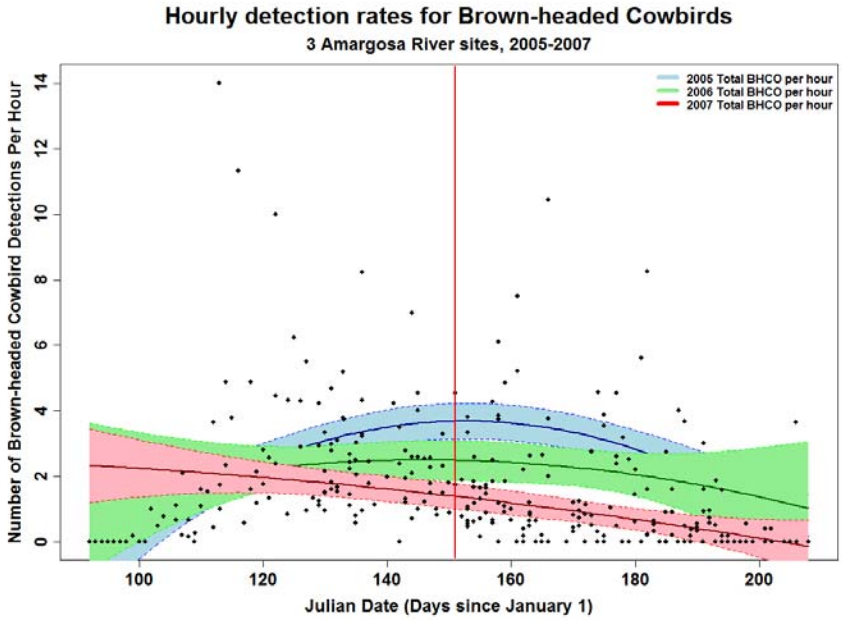



**Figure 6a.** Hourly Brown-headed Cowbird detections (males and females combined) at the Amargosa River, CA, 2005-2007. Shaded area denotes 95% confidence interval for each year (2005 blue, 2006 green, 2007 red). Vertical red line denotes June 2, 2007 – when cowbird captures began.

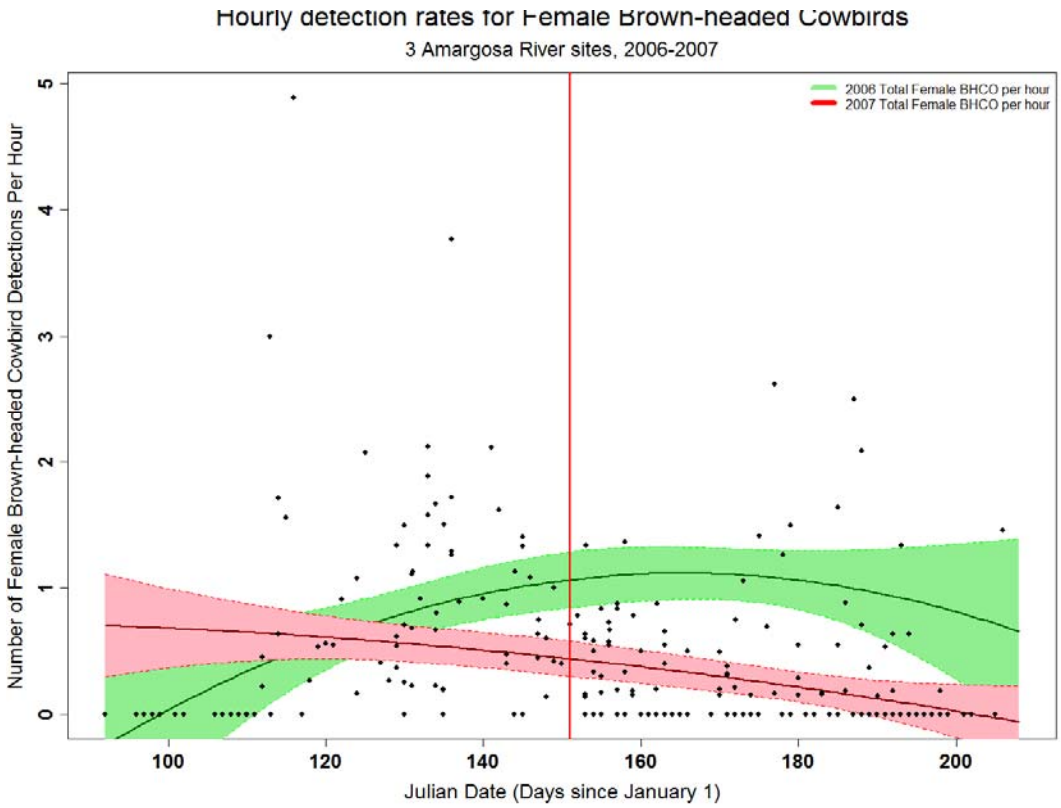



**Figure 6b.** Hourly Brown-headed Cowbird detections females only) at the Amargosa River, CA, 2006-2007. Shaded area denotes 95% confidence interval for each year (2006 green, 2007 red). Vertical red line denotes June 2, 2007 - When cowbird captures began.

# CONCLUSIONS

From 2005 through 2007, we completed three years of endangered species surveys and all-species spot-mapping and nest-monitoring on the Amargosa, as well as one season of Brown-headed Cowbird trapping. Though we still need more data to address passerine response to *Tamarix* and its eradication, we are able to address some conclusions from our work in order to provide information and recommendations to the Bureau of Land Management, United States Fish and Wildlife Service, the Nature Conservancy, and private land owners with property on the Amargosa River and its tributary Willow Creek.

Our most important recommendation is ***increased future monitoring***. The USGS and other authors have repeatedly highlighted that despite the millions of dollars spent on *Tamarix* removal in the southwestern United States, very little data exists on the effect *Tamarix* eradication has on most of the bird species that rely on the habitats that we are ostensibly working to improve.

**1. Bell's Vireos, and Summer Tanagers have not re-occupied the northern section of the Amargosa Canyon that was razed in the spring 2002 burn. Though it is unknown if Willow Flycatchers nested in the northern Amargosa Canyon previous to the 2002 burn, they have not nested in this section of the Amargosa Canyon in 2005, 2006, or 2007. This prolonged period of extirpation after fire should be addressed when considering the potential removal of large stands of mature tamarisk from the southern Amargosa Canyon and Modine Meadows.**

As stated in the *Biological Opinion for the Saltcedar Removal and Riparian Restoration Project within the Amargosa River Drainage* ( USFWS 2005), the burned section of the Amargosa Canyon held "some of the best quality native riparian habitat in the canyon (15)." Federally endangered Bell's Vireos and Summer Tanagers, a California species of special concern, were both observed to be nesting in this section of the canyon immediately prior to the burn, in 2001 (McCreedy pers. obs.). Though the burned section of the canyon has for the most part regenerated at a rapid rate, these two species have yet to return. Though no density data exists for other breeding species prior to the 2002 burn, it is possible that densities for some if not a majority of the northern reach's breeding bird species have yet to return to pre-burn levels.

However, we have observed unmated Willow Flycatchers and Bell's Vireos to remain for extended periods in the recovering northern Amargosa Canyon. Continued monitoring will provide the BLM and USFWS with data on the length of time necessary for various passerines to re-occupy Mojave Desert riparian habitat after fire.

**2. Though our nesting pair of Bell's Vireos occupied *Tamarix*-dominated habitat, for the most part, Willow Flycatcher and Bell's Vireo detection in *Tamarix* were rare, and much less-common than in the native-dominated, mesic northern section of the Amargosa Canyon.**

Studies in Arizona and on the Lower Colorado River have shown that *Tamarix* of certain age and structure can support breeding Willow Flycatcher territories (Sogge et al. 2006).

However, this has not occurred at the Amargosa Canyon. The age of the southern Amargosa Canyon's *Tamarix* stands is unknown, and it is unknown whether these stands could grow to necessary height and density to support Willow Flycatchers in the future.

**3. Standing Goodding's Willow snags left after the 2002 fire are steadily collapsing, leaving the Amargosa Canyon's cavity nesting species with dwindling nesting opportunities.**

Cavity-nesting Ladder-backed Woodpeckers, Brown-crested Flycatchers, and Ash-throated Flycatchers have managed to persist six seasons after the 2002 burn due to the persistence of several snags after the fire. However, several of these snags have fallen in recent years, and Goodding's Willow re-growth may not be rapid enough to replace these fallen snags, resulting in the potential extirpation of these cavity-nesting species from the Amargosa Canyon avian community.

**4. Though more data is required to address this issue fully, preliminary data showed that open cup nest success was roughly equal between native and *Tamarix* substrates. Overall nesting success for all species was higher in *Tamarix* substrates, due in large part for a tendency for cavity and dome-nesting species (which have higher nest success than open cup-nesting species) to nest in native plants.**

**5. *Tamarix* appeared to have a mixed effect on passerine abundance and diversity on the Amargosa River.**

**a. The mesic, willow-dominated northern Amargosa Canyon held significantly higher breeding species diversity and species richness than the *Tamarix*-dominated southern Amargosa Canyon, and held close to significantly higher breeding species diversity and richness than the more xeric mesquite-dominated Shoshone reach of the Amargosa River. Mesquite-dominated habitat held higher (though not significantly so) breeding species diversity and species richness than the *Tamarix*-dominated southern Amargosa Canyon.**

**b. Though differences were not significant, the *Tamarix*-dominated southern Amargosa Canyon held higher territory abundance (for all species combined) than native-dominated habitats in the northern Amargosa Canyon and at Shoshone.**

Sogge et al. (2008), Hunter (1988), and Ellis (1995) have pointed out that *Tamarix* invasion can have mixed effects on avian abundance and diversity. These effects depend on geography, climate, and the bird species that compose the community. Thus while *Tamarix* invasion in New Mexico (Ellis 1995, Hunter 1988) and the Grand Canyon (Sogge et al. 2008) may have increased riparian passerine diversity, *Tamarix* monocultures in the southern Lower Colorado River Valley appear to have decreased passerine diversity and abundance and density (Van Riper et al. 2008, Rosenberg et al. 1991).

At the Amargosa Canyon, the species that successfully nest in *Tamarix* habitat (Song Sparrows, Lucy's Warblers, Bewick's Wrens, Yellow-breasted Chats, Verdin, and Crissal Thrashers) have built up high densities in these *Tamarix* stands. However, many other species exist only in small numbers in *Tamarix* habitat (Yellow Warblers, Blue Grosbeaks, Common

Yellowthroats, Black-tailed Gnatcatchers, Blue-gray Gnatcatchers, Phainopeplas) and several do not exist in *Tamarix* habitat at all (Ladder-backed Woodpeckers, Ash-throated Flycatchers, Brown-crested Flycatchers, Green Herons).

**6. Prior to eradication of *Tamarix* in the southern Amargosa Canyon, the BLM and USWFS should consider its effect on breeding birds using these habitats.**

Currently, the southern Amargosa Canyon is supporting dense populations of breeding Lucy's Warblers, Bewick's Wrens, Yellow-breasted Chats, Song Sparrows, and Crissal Thrashers. Each of these species' populations may be significantly and negatively impacted by *Tamarix* eradication in and around Modine Meadows. Lucy's Warblers, Yellow-breasted Chats, and Crissal Thrashers are all California Bird Species of Special Concern, and each of these species has limited nesting opportunities outside of the Amargosa Canyon, due to the Mojave Desert geography and climate.

Van Riper et al. (2008), Shafroth et al. (2008), and Sogge et al. (2008) expressed concern that complete *Tamarix* eradication, without clear re-vegetation goals and knowledge of the site's capability to support high-quality native habitat, can have negative impacts on the riparian bird community. This concern is particularly relevant if there is an absence of native vegetation to assist in passive restoration.

Important questions (all from Shafroth et al. 2008) should continue to be asked such as 1) how quickly can the southern Amargosa Canyon regenerate quality riparian habitat after eradication? 2) does the southern Amargosa Canyon have high enough water availability, flooding frequency, adequate flood timing, and slow flood recession to support significant stands of willow? 3) does the southern Amargosa Canyon have sufficient dry season flow to support willow seedlings? 4) is the southern Amargosa Canyon's soil salinity high enough to support regenerating willow or mesquite? 5) do the soils of the southern Amargosa Canyon still hold sufficient soil microbes/mycorrhizal fungi to support willow or mesquite? 6) did the southern Amargosa Canyon support quality native vegetation (complex vegetation structure with significant willow and/or mesquite) prior to *Tamarix* invasion?

If the southern Amargosa Canyon cannot support dense willow stands of proper vegetative structure, the site will never hold breeding Willow Flycatchers. If the site cannot be quickly restored to high-quality mesquite stands, it will also be unlikely to hold breeding Bell's Vireo territories. Even the Shoshone reach, which holds scattered dense stands of mesquite, has failed to support breeding Bell's Vireos during the course of our study. If restoration of the southern Amargosa Canyon can reach the amount of mesquite cover we have found at Shoshone, this will take several years – at the expense of the habitat which currently holds the highest densities of Lucy's Warblers, Bewick's Wrens, Song Sparrows, and Yellow-breasted Chats in our study area.

If the BLM is unable to successfully regenerate high-quality mesquite habitat in the southern Amargosa Canyon (which may be easier to achieve than regenerating high-quality willow habitat), the two most likely post-eradication outcomes will be either *Tamarix* and/or *Atriplex lentiformis* re-sprouting (Shafroth et al. 2008). Each scenario would only set back the clock for the Amargosa Canyon's riparian bird community.

As an alternative, Van Riper et al. (2008) found that on the Lower Colorado River, a native component of only 40-60% of riparian cover produced the highest avian abundances. It may be more cost effective, and more beneficiary to the Amargosa River avian community for the BLM, TNC, and USFWS to explore an alternative directed toward *increasing* mesquite and willow cover, rather than *eradicating Tamrix* cover in the southern Amargosa Canyon.

**7. Due to high aridity, slash piles of *Tamarix* persist for several years, creating a fire hazard and preventing regeneration of the riparian corridor.**

Several slash piles from recent *Tamarix* eradication still exist on the Sorrell property at Shoshone, in the northern Amargosa Canyon south of Cowboy Canyon, and just south of the Bell's Vireo territory in the southern Amargosa Canyon. This slash is a virtual dead zone, with little to no riparian vegetation emerging through it.

It is of note that we have discovered slash piles from previous eradication attempts during our spot-mapping of Modine Meadows, along the old Tonopah-to-Tidewater causeway and in the heart of Modine Meadows. It is undetermined exactly how old these brush piles are, but they are several years old. Nothing has regenerated under them, and our biologists use them as paths to navigate the otherwise densely-vegetated Meadows.

**8. Brown-headed Cowbird trapping has appeared to have halted high parasitism rates on the Amargosa River, and to have drastically increased nesting success of potential cowbird hosts.**

We have only trapped for one season, so further monitoring is required to know for certain if this trend will continue with subsequent years of trapping. It will also be important to determine whether decreased parasitism and increased nest success actually translates to higher passerine densities on the Amargosa River.

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## APPENDIX A: SPECIES LIST

Breeding statuses following Breeding Bird Atlas criteria (Corman and Wise-Gervais 2005) were assigned to all species detected at all sites during all visits in 2007:

**OBSERVED**

| CODE | DESCRIPTION |
|---|---|
| **0** | Nonbreeder or migrant observed during breeding season, but not believed to be breeding; for species observed in unlikely breeding habitat or with no indication of breeding. |

**POSSIBLE**

| CODE | DESCRIPTION |
|---|---|
| **2** | Species observed or identified by vocalization in suitable nesting habitat during its breeding season. Male observed singing on single occasion in potential breeding habitat, but also applicable to species without true songs (owls, woodpeckers, corvids, raptors). Not applicable to species singing on migration which have not been found to breed in study habitats. |

**PROBABLE**

| CODE | DESCRIPTION |
|---|---|
| **3** | **1) Pair** observed in suitable habitat during its breeding season. **2)** Permanent territory presumed through **song** at same location on at least two occasions seven or more days apart. **3) Courtship** behavior or **copulation**. **4)** Visiting **probable nest site**, but no further evidence obtained. This applies to cavity and aerie-nesters. **5) Agitated** behavior or anxiety calls by the adult which signal a nest or young may be nearby. **6) Nest-building** by specific species known to build roost nests, such as Verdin, wrens, and woodpeckers. |

**CONFIRMED**

| CODE | DESCRIPTION |
|---|---|
| **1** | **1)** Bird seen carrying **nesting material**, applies for all species save Verdin, wrens, and woodpeckers. **2) Nest building** observed at nest site. **3)** Distraction display observed in defense of nest or young. This does not include agitated behavior, listed under Probable. **4) Used nest or eggshells** found. **5)** Recently **fledged** altricial young incapable of sustained flight, or downy precocial young restricted to natal area by dependence on adults. **6) Occupied nest** found with eggs or young, or adult observed exiting and/or entering nest if nest contents cannot be seen. **7)** Adults **carrying food**, excluding raptors, corvids, roadrunners, shrikes, and kingfishers. Adults of these species can carry food for some distance before eating it themselves. **8)** Adults feeding recently fledged young. **9)** Adult carrying **fecal sac**. |

**Appendix A.** Breeding statuses for sites on the Amargosa River, Inyo County, CA. Species with confirmed breeding in **bold** type with blue background. Species order follows the American Ornithologists' Union Seventh Edition checklist, available at http://www.aou.org/checklist/index.php3 .

| SPECIES (Common Name) | SCIENTIFIC NAME | Amargosa Canyon | Shoshone |
|---|---|---|---|
| Wood Duck | *Aix sponsa* | 0 | |
| Mallard | *Anas platyrhnchos* | 0 | |
| Cinnamon Teal | *Anas cyanoptera* | | 0 |
| Green-winged Teal | *Anas crecca* | 0 | |
| **Gambel's Quail** | ***Callipepla gambelii*** | **1** | 3 |
| Least Bittern | *Ixobrychus exilis* | 2 | |
| Great Blue Heron | *Ardea herodias* | 0 | 0 |
| Great Egret | *Ardea alba* | 0 | |
| Snowy Egret | *Egretta thula* | | 0 |
| **Green Heron** | ***Butorides virescens*** | **1** | 0 |
| Black-crowned Night Heron | *Nycticorax nyticorax* | 0 | |
| Turkey Vulture | *Cathartes aura* | 0 | 0 |
| Osprey | *Pandion haliaetus* | 0 | |
| Northern Harrier | *Circus cyaneus* | 0 | |
| Sharp-shinned Hawk | *Accipiter striatus* | 0 | 0 |
| Cooper's Hawk | *Accipiter cooperii* | 0 | 0 |
| **Red-tailed Hawk** | ***Buteo jamaicensis*** | **1** | 0 |
| Golden Eagle | *Aquila chrysaetos* | 0 | |
| **American Kestrel** | ***Falco sparverius*** | **1** | **1** |
| Peregrine Falcon | *Falco peregrinus* | 0 | |
| Prairie Falcon | *Falco mexicanus* | 2 | 0 |
| **Virginia Rail** | ***Rallus limicola*** | **1** | 0 |
| American Coot | *Fulica americana* | 0 | 0 |
| Killdeer | *Charadrius vociferus* | 0 | 0 |
| Spotted Sandpiper | *Actitis macularius* | | 0 |
| Solitary Sandpiper | *Tringa solitaria* | | 0 |
| Long-billed Dowitcher | *Limnodromus scolopaceus* | 0 | 0 |
| Wilson's Snipe | *Gallinago delicata* | | 0 |
| Rock Pigeon | *Columba livia* | 0 | |
| Eurasian Collared-dove | *Streptopelia turtur* | 0 | 2 |
| White-winged Dove | *Zenaida asiatica* | 0 | |
| **Mourning Dove** | ***Zenaida macroura*** | **1** | 3 |
| **Greater Roadrunner** | ***Geococcyx californianus*** | **1** | 3 |
| Barn Owl | *Tyto alba* | 0 | |

**Appendix A.** Breeding statuses for sites on the Amargosa River, Inyo County, CA. Species with confirmed breeding in **bold** type with blue background. Species order follows the American Ornithologists' Union Seventh Edition checklist, available at http://www.aou.org/checklist/index.php3 .

| SPECIES (Common Name) | SCIENTIFIC NAME | Amargosa Canyon | Shoshone |
|---|---|---|---|
| Lesser Nighthawk | *Chordeiles acutipennis* | 2 | 0 |
| Common Poorwill | *Phalaenoptilus nuttallii* | 0 | |
| Vaux's Swift | *Cahetura vauxi* | | 0 |
| White-throated Swift | *Aeronautes saxatalis* | 3 | 2 |
| Black-chinned Hummingbird | *Archilochus alexandri* | | 0 |
| Anna's Hummingbird | *Calypte anna* | | 0 |
| **Costa's Hummingbird** | ***Calypte costae*** | **1** | |
| Belted Kingfisher | *Ceryle alcyon* | 0 | |
| **Ladder-backed Woodpecker** | ***Picoides scalaris*** | **1** | 2 |
| Red-shafted Flicker | *Colaptes auratus* | 0 | 0 |
| Olive-sided Flycatcher | *Contopus cooperii* | 0 | |
| Western Wood-pewee | *Contopus sordidulus* | 0 | 0 |
| Willow Flycatcher | *Empidonax traillii* | 0 | 0 |
| Hammond's Flycatcher | *Empidonax hammondii* | 0 | 0 |
| Gray Flycatcher | *Empidonax wrightii* | 0 | 0 |
| Dusky Flycatcher | *Empidonax oberholseri* | 0 | 0 |
| Western Flycatcher | *Empidonax difficilis* | 0 | |
| Black Phoebe | *Sayornis nigricans* | 0 | 0 |
| **Say's Phoebe** | ***Sayornis saya*** | **1** | **1** |
| **Ash-throated Flycatcher** | ***Myiarchus cinerascens*** | **1** | 2 |
| **Brown-crested Flycatcher** | ***Myiarchus tyrannulus*** | **1** | 0 |
| **Western Kingbird** | ***Tyrannus verticalis*** | **1** | 2 |
| Eastern Kingbird | *Tyrannus tyrannus* | | 0 |
| **Loggerhead Shrike** | ***Lanius ludovicianus*** | **1** | 2 |
| **Bell's Vireo** | ***Vireo bellii*** | **1** | 0 |
| Plumbeous Vireo | *Vireo plumbeus* | 0 | 0 |
| Cassin's Vireo | *Vireo cassinii* | 0 | |
| Warbling Vireo | *Vireo gilvus* | 0 | 0 |
| American Crow | *Corvus brachyrynchos* | | 0 |
| **Common Raven** | ***Corvus corax*** | **1** | **1** |
| Horned Lark | *Eremophila alpestris* | 0 | |
| Tree Swallow | *Tachycineta bicolor* | 0 | |
| Violet-green Swallow | *Tachycineta thalassina* | 0 | 0 |
| **Northern Rough-winged Swallow** | ***Stelgidopteryx serripennis*** | **1** | 3 |

**Appendix A.** Breeding statuses for sites on the Amargosa River, Inyo County, CA. Species with confirmed breeding in **bold** type with blue background. Species order follows the American Ornithologists' Union Seventh Edition checklist, available at http://www.aou.org/checklist/index.php3 .

| SPECIES (Common Name) | SCIENTIFIC NAME | Amargosa Canyon | Shoshone |
|---|---|---|---|
| Barn Swallow | *Hirundo rustica* | 0 | 0 |
| Cliff Swallow | *Petrochelidon pyrrhonata* | | 0 |
| **Verdin** | ***Auriparus flaviceps*** | **1** | **1** |
| **Rock Wren** | ***Salpinctes obsoletus*** | **1** | 0 |
| **Bewick's Wren** | ***Thryomanes bewickii*** | **1** | **1** |
| House Wren | *Troglodytes aedon* | 0 | 0 |
| Marsh Wren | *Cistothorus palustris* | 0 | 0 |
| Ruby-crowned Kinglet | *Regulus calendula* | 0 | 0 |
| **Blue-gray Gnatcatcher** | ***Polioptila caerulea*** | **1** | **1** |
| **Black-tailed Gnatcatcher** | ***Polioptila melanura*** | **1** | **1** |
| Hermit Thrush | *Catharus guttatus* | | 0 |
| Northern Mockingbird | *Mimus polyglottos* | 0 | 2 |
| **Crissal Thrasher** | ***Toxostoma crissale*** | **1** | **1** |
| European Starling | *Sturnus vulgaris* | 0 | 0 |
| Cedar Waxwing | *Bombycilla cedrorum* | 0 | 0 |
| **Phainopepla** | ***Phainopepla nitens*** | **1** | **1** |
| Orange-crowned Warbler | *Vermivora celata* | 0 | 0 |
| Nashville Warbler | *Vermivora ruficapilla* | | 0 |
| **Lucy's Warbler** | ***Vermivora luciae*** | **1** | **1** |
| Northern Parula | *Parula americana* | 0 | |
| **Yellow Warbler** | ***Dendroica petechia*** | **1** | **1** |
| Audubon's Warbler | *Dendroica coronata* | 0 | 0 |
| Myrtle Warbler | | 0 | |
| Black-throated Gray Warbler | *Dendroica nigrescens* | 0 | |
| Townsend's Warbler | *Dendroica townsedii* | 0 | 0 |
| Hermit Warbler | *Dendroica occidentalis* | | 0 |
| Black-and-white Warbler | *Mniotilta varia* | 0 | |
| Prothonotary Warbler | *Protonotaria citrea* | 0 | |
| MacGillivray's Warbler | *Oporornis tolmiei* | 0 | 0 |
| **Common Yellowthroat** | ***Geothlypis trichas*** | **1** | 3 |
| Wilson's Warbler | *Wilsonia pusilla* | 0 | 0 |
| Painted Redstart | *Myioborus pictus* | 0 | |
| **Yellow-breasted Chat** | ***Icteria virens*** | **1** | **1** |
| Summer Tanager | *Piranga rubra* | 0 | 0 |

**Appendix A.** Breeding statuses for sites on the Amargosa River, Inyo County, CA. Species with confirmed breeding in **bold** type with blue background. Species order follows the American Ornithologists' Union Seventh Edition checklist, available at http://www.aou.org/checklist/index.php3 .

| SPECIES (Common Name) | SCIENTIFIC NAME | Amargosa Canyon | Shoshone |
|---|---|---|---|
| Western Tanager | *Piranga ludoviciana* | 0 | 0 |
| Green-tailed Towhee | *Pipilo chlorurus* | 0 | 0 |
| Chipping Sparrow | *Spizella passerina* | 0 | |
| Brewer's Sparrow | *Spizella breweri* | 0 | 0 |
| Black-throated Sparrow | *Amphispiza bilineata* | 0 | |
| Sage Sparrow | *Amphispiza bellii* | 0 | |
| Savannah Sparrow | *Passerculus sandwichensis* | 0 | 0 |
| Fox Sparrow | *Passerella iliaca* | 0 | |
| **Song Sparrow** | ***Melospiza melodia*** | **1** | **1** |
| Lincoln's Sparrow | *Melospiza lincolnii* | 0 | 0 |
| White-crowned Sparrow | *Zonotrichia leucophrys* | 0 | 0 |
| Golden-crowned Sparrow | *Zonotrichia atricapilla* | | 0 |
| Rose-breasted Grosbeak | *Pheucticus ludovicianus* | 0 | |
| Black-headed Grosbeak | *Pheucticus melanocephalus* | 0 | |
| **Blue Grosbeak** | ***Passerina caerulea*** | **1** | **1** |
| Lazuli Bunting | *Passerina amoena* | 0 | 0 |
| Indigo Bunting | *Passerina cyanea* | 0 | 0 |
| **Red-winged Blackbird** | ***Agelaius phoeniceus*** | **1** | 0 |
| Western Meadowlark | *Sturnella neglecta* | 0 | |
| Yellow-headed Blackbird | *Xanthocephalus xanthocephalus* | 0 | 0 |
| Brewer's Blackbird | *Euphagus cyanocephalus* | 0 | |
| Great-tailed Grackle | *Quiscalus mexicanus* | 0 | |
| **Brown-headed Cowbird** | ***Molothrus ater*** | **1** | **1** |
| Hooded Oriole | *Icterus cucullatus* | 0 | 0 |
| Bullock's Oriole | *Icterus bullockii* | 0 | 0 |
| **House Finch** | ***Carpodacus mexicanus*** | **1** | **1** |
| Pine Siskin | *Carduelis pinus* | 0 | |
| **Lesser Goldfinch** | ***Carduelis psaltria*** | **1** | **1** |
| **House Sparrow** | ***Passer domesticus*** | 0 | **1** |
| TOTAL SPECIES | | 114 | 94 |
| SPECIES CONFIRMED BREEDING | | 34 | 18 |