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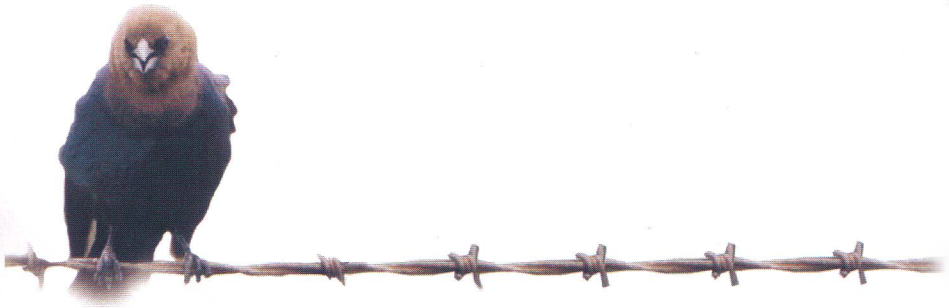
SOUTHWESTERN WILLOW FLYCATCHER SURVEYS, DEMOGRAPHY, AND ECOLOGY ALONG THE LOWER COLORADO RIVER AND TRIBUTARIES, 2004

Contract No. 03-CS-30-0093



Submitted to
U.S. Bureau of Reclamation
Lower Colorado Region
400 Railroad Avenue
Boulder City, NV 89005

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SOUTHWESTERN WILLOW FLYCATCHER SURVEYS, DEMOGRAPHY, AND ECOLOGY ALONG THE LOWER COLORADO RIVER AND TRIBUTARIES, 2004

Contract # 03-CS-30-0093

Annual Report

Submitted to

U.S. BUREAU OF RECLAMATION
Lower Colorado Region
400 Railroad Avenue
Boulder City, NV 89005

Submitted by

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TABLE OF CONTENTS

Table of Contents, continued

Table of Contents, continued

Table of Contents, continued

Table of Contents, continued

Table of Contents, continued

List of Figures

List of Tables

List of Tables, continued

List of Tables, continued

EXECUTIVE SUMMARY

The Southwestern Willow Flycatcher (*Empidonax traillii extimus*), listed as federally endangered in 1995, breeds in dense, mesic riparian habitats at scattered, isolated sites in New Mexico, Arizona, southern California, southern Nevada, southern Utah, southwestern Colorado, and, at least historically, extreme northwestern Mexico. Historical breeding records and museum collections indicate a sizable population of Southwestern Willow Flycatchers may have existed along the extreme southern stretches of the lower Colorado River region. Factors contributing to the decline of flycatchers on the breeding grounds include loss, degradation, and/or fragmentation of riparian habitat; invasion by nonnative plants; and brood parasitism by Brown-headed Cowbirds (*Molothrus ater*).

Willow flycatcher studies have been conducted along the Virgin and lower Colorado Rivers and tributaries annually since 1996, in compliance with requirements set forth by the U.S. Fish and Wildlife Service regarding U.S. Bureau of Reclamation routine operations and maintenance along the lower Colorado River. From 1997 to 2003, breeding populations of Southwestern Willow Flycatchers were documented along the Virgin and lower Colorado Rivers and tributaries at seven study areas from Mesquite, Nevada, south to the Bill Williams River in Arizona. Willow flycatchers also have been detected during the breeding season at several sites along the Colorado River south of the Bill Williams River to the Mexico border, with over 200 detections recorded in 2003. Behavioral observations and timing of detections strongly suggest this section of the river corridor is a major flyway for migrant willow flycatchers in spring. The degree to which Southwestern Willow Flycatchers use this riparian corridor is unknown and requires further study.

SWCA Environmental Consultants was contracted by the U.S. Bureau of Reclamation to continue surveys, monitoring, and demographic and ecological studies of the Southwestern Willow Flycatcher in suitable and/or historical riparian and wetland habitats throughout the Virgin and lower Colorado River regions in 2004. We completed presence/absence surveys and site descriptions at 92 pre-selected sites in 15 study areas from the Pahranagat National Wildlife Refuge (NWR), Nevada, south to Yuma, Arizona. We also conducted intensive life history studies at 4 of the 15 areas: Pahranagat NWR, Mesquite, and Mormon Mesa, Nevada, and Topock Marsh, Arizona. At these life history study areas, we monitored willow flycatcher nests to document predation and brood parasitism rates and nesting success; color-banded and resighted as many willow flycatchers as possible to determine the breeding status of territorial flycatchers and document movement and recruitment; measured characteristics of vegetation and microclimate at nest sites and at unused sites to assess factors important in nest-site selection; and implemented trapping and removal of Brown-headed Cowbirds to evaluate the effects of trapping on nest brood parasitism and flycatcher nest success.

We used recorded broadcasts of willow flycatcher song and calls to elicit responses from willow flycatchers at 92 sites, ranging in size from 1 to 92 ha, along the Virgin and lower Colorado Rivers and tributaries between 15 May and 25 July 2004, following a 10-survey protocol. We detected willow flycatchers on at least one occasion at 72 of these sites. Resident, breeding flycatchers were detected at 17 sites within the following six study areas: Pahranagat NWR, Littlefield, Mesquite, Mormon Mesa, Grand Canyon, and Topock Marsh. South of Bill Williams,

over 600 willow flycatchers were recorded at 35 of the 37 sites between 15 May and 24 June, with a single detection recorded on 23 July. Monitoring results at these sites suggest these flycatchers were not resident, breeding individuals and were most likely migrants.

We used targeted mist net and passive netting techniques to capture and uniquely color-band adult and fledgling willow flycatchers at the four life history study areas and at all survey sites where resident willow flycatchers were detected. Nestlings were banded between 8 and 10 days of age. We banded each adult and fledged willow flycatcher with a single anodized (colored), numbered U.S. federal aluminum band on one leg and one colored aluminum band on the other. Nestlings were banded with a single anodized numbered federal band, uniquely identifying it as a returning nestling in the event it returns in a subsequent year. We used binoculars to determine the identity of previously color-banded flycatchers by observing, from a distance, the unique color combination on its legs.

At the four life history study areas and at Littlefield, Muddy River, Grand Canyon, and Bill Williams (all monitoring sites), we color-banded a total of 57 new adult flycatchers; recaptured 23 individuals banded in previous years, including 7 flycatchers banded as juveniles in 2003; and resighted an additional 30 previously banded flycatchers. Of the resighted flycatchers, 24 could be identified to individual, including 2 that had been banded as juveniles in 2003. Of the resighted flycatchers that could not be identified to individual, two had been banded as juveniles in 2003. We banded 81 nestlings from 35 nests. In addition, we recaptured three fledglings that had been banded as nestlings, and captured five previously unbanded fledglings.

Color-banding effort in 2004 was expanded in Nevada to include Key Pittman Wildlife Management Area and lands along the Virgin River near Mesquite. Field personnel from unrelated willow flycatcher projects were surveying and/or monitoring flycatchers in these areas and provided us with the locations of nests and territorial flycatchers. Banding was conducted opportunistically at both areas. At Key Pittman, we captured and color-banded two new adults, recaptured one individual banded as a nestling in 2003, and banded six nestlings from three nests. Along the Virgin River at Mesquite, we captured and color-banded four new adults and recaptured two adult flycatchers. One of the recaptured adults had been banded as a nestling in 2003, and the other had been banded as a nestling in 2002 and not detected in 2003. We also banded two nestlings along the Virgin River.

As in 2003, we conducted color-banding studies at sites along the Gila River and the Colorado River from Martinez Lake south to the Mexico border from 10 to 30 June to better determine flycatcher residency, breeding status, and movement patterns in this area. Of 40 willow flycatcher detections, we captured and color-banded four adults at one site. All four individuals were determined to be second-year birds (hatched in 2003). Flycatcher behavioral observations strongly suggest these individuals were northbound migrants.

At the four life history study areas and at Littlefield, Muddy River, Grand Canyon, and Bill Williams we recorded a total of 81 territories. Of these, 64 (79%) consisted of paired flycatchers and 17 (21%) consisted of unpaired individuals. Eight breeding males were polygynous, each being paired with two females.

Of the 54 adult willow flycatchers identified to individual in 2003, 28 (52%) returned in 2004; all returned to the same study area. At the same area where it was originally banded, we detected one individual banded as an adult in 2000 and not detected in 2003. No adult within-season movements were recorded in 2004.

Of 61 juveniles banded in 2003 that were known to have fledged, 13 (21%) were detected in 2004. Of these, 11 were identified to individual: 9 at monitoring sites and 2 at the two banding areas added in 2004. Of the 11 returning juveniles of known identity, 6 (55%) were detected at a different study area than where originally banded, and 5 (45%) were detected at the same study area. Of eight individuals banded as juveniles in 2002 or earlier and not detected in 2003, two (25%) were detected at study areas other than where they were originally banded, and six (75%) were detected at the same study area. The median dispersal distance for all returning juvenile flycatchers exhibiting between-year movements in 2004 was 58 km. Juvenile dispersal is an important population variable in terms of both gene flow and the establishment of new flycatcher populations.

We documented a total of 91 willow flycatcher nesting attempts at the four life history study areas, Littlefield, and Grand Canyon, 81 (89%) of which contained eggs and were used in calculating nest success and productivity. Thirty-eight (47%) nests were successful and fledged young; 41 (51%) failed; and two were of undetermined fate. Mayfield survival probability at the four life history study areas and Littlefield ranged from 0.24 to 0.73 and was 0.44 for all sites combined; survival probabilities were not calculated for the Grand Canyon nesting attempts because nest fate was undetermined. Depredation was the major cause of nest failure at all sites, accounting for 47% of all failed nests and 59% of nests that failed after flycatcher eggs were laid.

Twenty-one of the 81 nests (26%) that contained flycatcher eggs were brood parasitized by Brown-headed Cowbirds. The effect of parasitism on nest fate was variable, but parasitism reduced the likelihood that a nest that contained flycatcher eggs would fledge flycatcher young. Three nests parasitized prior to flycatcher eggs being laid were subsequently abandoned, and we observed six nests in which the disappearance of flycatcher eggs coincided with a parasitism event, with cowbirds suspected of ejecting the eggs. Therefore, an undetermined number of depredation events on eggs and nestlings were probably attributable to cowbirds. Cowbird impacts to flycatcher populations may be more severe than parasitism rates alone suggest, and baseline nesting studies in conjunction with cowbird control experiments need to be continued to determine whether brood parasitism presents a serious problem for populations at the life history study areas.

For the second consecutive year, we used a variation of the Australian crow trap to capture and remove Brown-headed Cowbirds at each of the four life history study areas. Cowbird traps were deployed at least two weeks prior to the initiation of flycatcher nesting (mid-May) and continually operated until all nests were past the egg stage (mid-August). We captured and removed 77, 21, 25, and 45 Brown-headed Cowbirds at Pahranagat, Mesquite, Mormon Mesa, and Topock, respectively. Similar to 2003 results, variability in trapping success among sites did not appear to be directly related to the total number of traps per site or relative abundance of cowbirds at each site. Landscape characteristics of the sites and/or trap locations may have affected capture success.

Compared to data collected in 1997–2002, preliminary 2004 data indicate a significant decline in parasitism rate at Pahranagat since the implementation of trapping, with no brood parasitism documented in 2003 or 2004. There was no change in parasitism rates at Mesquite, Mormon Mesa, or Topock. At Mesquite, cowbird brood parasitism rates have been high (16 to 60%) since flycatcher monitoring began in 1997, with a relatively large number of nest failures directly attributed to cowbirds. Extensive human development immediately adjacent to the study area has greatly enhanced cowbird habitat. Further study is needed to investigate whether a more aggressive cowbird removal program is warranted at Mesquite.

We gathered data on vegetation and habitat characteristics at 79 nest plots and 75 non-use plots within the four life history study areas. To obtain an overall description of entire habitat blocks at each life history study area, we gathered data at an additional 37 randomly selected plots. The life history study areas vary in vegetation age, structure, and species composition. The habitat block at Pahranagat consists of mature, native, large-diameter trees with little shrub and sapling understory. The habitat blocks at Mesquite, Mormon Mesa and Topock are composed primarily of very dense stands of both mixed-native (Mesquite and Mormon Mesa) and exotic (Topock) woody vegetation.

We found willow flycatchers nesting in a diverse array of riparian habitats. Willow flycatcher nest heights ranged from 1.1 to 10.0 m (mean = 3.2 m, SE = 0.2). Flycatchers placed 63% of all nests in tamarisk (*Tamarix* sp.), 12% in coyote willow (*Salix exigua*), 20% in Goodding willow (*Salix gooddingii*), and 5% in snags. Differences in nest-site characteristics between study areas were reflective of the differences in overall habitat characteristics of the sites. Nest sites consistently differed from non-use sites in several variables. We found greater canopy closure at nest sites than at non-use sites, and three of the four life history study areas (Mesquite, Mormon Mesa, and Topock) had taller canopy height at nest sites than at non-use sites. At all study areas, vertical foliage density was greatest at and immediately above mean nest height. Breeding riparian birds in the desert Southwest are exposed to extreme environmental conditions, and dense vegetation at the nest may be needed to provide a more suitable microclimate for raising offspring.

We collected microclimate data simultaneously at nest, within-territory, and non-use sites at the four life history study areas between May and July 2004. The microclimate assessment indicated that Southwestern Willow Flycatchers placed their nests in habitats that were cooler, exhibited smaller temperature fluctuations, were more humid, and had higher soil moisture than non-use sites. To a lesser extent, flycatchers also placed nests within their territories at sites exhibiting cooler temperatures and smaller temperature fluctuations.

CHAPTER 1

INTRODUCTION

PROJECT HISTORY

In response to the 1994 designation of critical habitat along the lower Colorado River for endangered fish species, the U.S. Bureau of Reclamation (USBR) and other federal, state, and tribal agencies formed a partnership to develop and implement the Multi-Species Conservation Program (MSCP). This program seeks to protect threatened, endangered, and sensitive (TES) species and their habitats along the lower Colorado River while maintaining river regulation and water management required by law. The MSCP was recently finalized and evaluated through an Environmental Impact Statement, as required by the National Environmental Policy Act of 1969 (42 USC §4321 et seq.).

Because all federal agencies are required to ensure their actions do not violate the Endangered Species Act (ESA) of 1973 (16 USC §1531 et seq.), the USBR prepared a Biological Assessment (BA) in August 1996 as part of planning for the MSCP, evaluating the effects of dam operations and maintenance activities on TES species. These species included the Southwestern Willow Flycatcher (*Empidonax traillii extimus*), which was listed by the U.S. Fish and Wildlife Service (USFWS) as endangered in 1995 (60 FR 10694–10715). In response to the BA, the USFWS issued a Biological Opinion in April 1997 outlining several terms and conditions the USBR must implement in order not to jeopardize the species. Among these terms and conditions was the requirement to survey and monitor occupied and potential habitat for Southwestern Willow Flycatchers along the lower Colorado River for a period of five years. The studies were intended to determine the number of willow flycatcher territories, status of breeding pairs, flycatcher nest success, the biotic and abiotic characteristics of occupied willow flycatcher sites, and Brown-headed Cowbird (*Molothrus ater*) brood parasitism rates. In anticipation of these requirements, the USBR initiated willow flycatcher studies along the lower Colorado River in 1996. The studies have been conducted every year since.

A separate Biological Opinion for Interim Surplus Criteria, Secretarial Implementation Agreements, and Conservation Measures was issued in January 2001. This Opinion required annual presence/absence surveys and nest monitoring for up to five years in suitable habitat surrounding Lake Mead and between Parker and Imperial Dams. In 2002, the USBR completed a second BA on the effects of continued dam operations and maintenance on TES species along the lower Colorado River. The USFWS responded with a Biological Opinion in April 2002 requiring continued Southwestern Willow Flycatcher studies along the lower Colorado River through April 2005. The Opinion also required implementation of a study to evaluate the effectiveness of Brown-headed Cowbird trapping for conservation of the flycatcher. Willow flycatcher studies along the lower Colorado River are currently anticipated to continue through 2007.

From 1996 through 2002, the USBR's Southwestern Willow Flycatcher studies along the lower Colorado and Virgin Rivers were completed under the direction and management of the San Bernardino County Museum, Redlands, California. In 2003 and 2004, these studies were continued by SWCA Environmental Consultants under contract to USBR (Contract # 03-CS-30-0093). This contract has annual option years through 2007.

SPECIES INTRODUCTION

The Southwestern Willow Flycatcher (*Empidonax traillii extimus*) is one of four subspecies of willow flycatcher currently recognized (Unitt 1987), although Browning (1993) posits a fifth subspecies (*E. t. campestris*) occurring in the central portions of the United States (Figure 1.1). The Southwestern Willow Flycatcher breeds in dense, mesic riparian habitats at scattered, isolated sites in New Mexico, Arizona, southern California, southern Nevada, southern Utah, southwestern Colorado, and, at least historically, extreme northwestern Mexico (Unitt 1987). In the Southwest, most willow flycatcher breeding territories are found within small breeding sites containing five or fewer territories; only two sites are known to have 50 or more territories (Sogge et al. 2003). One of the last long-distance Neotropical migrants to arrive in North America during spring migration, willow flycatchers have a short, approximately 100-day breeding season, with individuals typically arriving in May or June and departing in late August (Sogge et al. 1997, Sedgwick 2000). All four subspecies of willow flycatchers spend the non-breeding season in portions of southern Mexico, Central America, and northwestern South America (Stiles and Skutch 1989, Ridgely and Tudor 1994, Howell and Webb 1995, Unitt 1997). Willow flycatchers have been recorded on the wintering grounds from central Mexico to southern Central America as early as mid-August (Stiles and Skutch 1989, Howell and Webb 1995), and wintering, resident individuals have been recorded in southern Central America as late as the end of May (Koronkiewicz 2002).

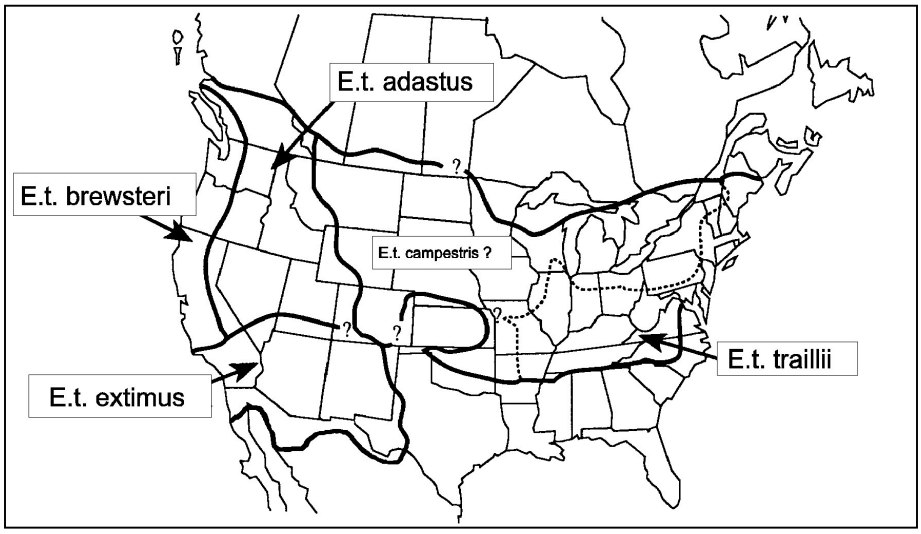

Figure 1.1. Breeding range distribution of the subspecies of the willow flycatcher (*Empidonax traillii*). Adapted from Unitt (1987), Browning (1993), and Sogge et al. (1997).

Historical breeding records and museum collections indicate that a sizable population of Southwestern Willow Flycatchers may have existed along the extreme southern stretches of the lower Colorado River region (Unitt 1987). However, no nests have been located south of the Bill Williams River, Arizona, in over 65 years (Unitt 1987), though northbound and southbound migrant willow flycatchers use the riparian corridor (Phillips et al. 1964; Brown et al. 1987; McKernan 1997; McKernan and Braden, 1999, 2001a, 2001b, 2002; Koronkiewicz et al. 2004; this document). Factors contributing to the decline of flycatchers on the breeding grounds include loss, degradation, and/or fragmentation of riparian habitat; invasion by nonnative plants; and brood parasitism by Brown-headed Cowbirds (USFWS 1995, Marshall and Stoleson 2000). Because of low population numbers range-wide, identifying and conserving willow flycatcher breeding sites is thought to be crucial to the recovery of the species (USFWS 2002).

From 1997 to 2003,[1] breeding populations of Southwestern Willow Flycatchers were documented at seven study areas along the Virgin and lower Colorado Rivers and tributaries: (1) Pahranagat National Wildlife Refuge (NWR), Nevada; (2) Mesquite and (3) Mormon Mesa on the Virgin River, Nevada; (4) Overton Wildlife Management Area located in the lower Virgin River Valley on the Overton Arm of Lake Mead; (5) Grand Canyon, Arizona; (6) Topock Marsh on the Colorado River, Havasu NWR, Arizona; and (7) Bill Williams River NWR (hereafter Bill Williams), Arizona (McKernan and Braden 2002; Koronkiewicz et al. 2004; Braden and McKernan, unpubl. data). Willow flycatchers were detected during the breeding season at several sites along the Colorado River south of the Bill Williams River to the Mexico border, but more information is needed to determine flycatcher residency, breeding status, and demography in this area.

PURPOSE AND DESCRIPTION OF STUDY

The purpose of the 2004 study is to continue surveys, monitoring, and demographic and ecological studies of the Southwestern Willow Flycatcher in suitable and/or historical riparian and wetland habitats throughout the lower Colorado and Virgin River region. This project encompasses two types of studies: (1) presence/absence surveys, including site descriptions, at pre-selected sites along the lower Colorado and Virgin Rivers and tributaries, including the lower Grand Canyon and Bill Williams River; and (2) intensive, long-term life history studies at four specific study areas (Pahranagat NWR, Mesquite, and Mormon Mesa, Nevada, and Topock Marsh, Arizona) to assess Southwestern Willow Flycatcher demographics and ecology, habitat selection, and the effects of Brown-headed Cowbird brood parasitism. SWCA's contract specifies the following field tasks:

(1) **Presence/absence Surveys**: At approximately 136 sites[2] along the lower Colorado River, complete the following:

[1] Studies in 1996 did not include any sites in Nevada.

[2] A site is defined as one contiguous area that can be surveyed by one person in one morning. The contract specifies 136 survey sites; however, this number reflects studies performed before 2003 in which several areas were counted as multiple sites. In fact, 92 sites were surveyed in 2004, as described in the results section of Chapter 2 of this report.

(a) conduct presence/absence surveys, following a 10-survey protocol (per Braden and McKernan 1998);

(b) provide a general site description for each site;

(c) conduct nest searches if territorial flycatchers are located and monitor any nests found;

(d) collect habitat and physical measurements around each nest site; and

(e) band as many adult and juvenile flycatchers as possible with unique color-bands.

(2) **Life History Studies:** At the four life history study areas, complete the following tasks in addition to all tasks listed above under Presence/absence Surveys:

(a) conduct Brown-headed Cowbird trapping and determine its effectiveness in reducing brood parasitism rates;

(b) conduct in-depth vegetation sampling of the whole habitat block;

(c) replicate all habitat measurements collected at nest sites at unused sites of similar structure; and

(d) monitor microclimatic conditions of soil moisture, temperature, and humidity.

Each distinct aspect of the 2004 study is addressed in a separate chapter in this report, as follows:

Chapter 2 – Presence/absence Surveys and Site Descriptions. This chapter presents the methodology and results for presence/absence surveys and gives a general site description for each survey site, including life history sites.

Chapter 3 – Color-banding and Resighting. Details of banding activities in 2004 and resighting of previously banded flycatchers are presented in this chapter. Also included are the identities and locations of all Southwestern Willow Flycatchers that could be identified to individual and discussions of within- and between-year movement of individual flycatchers.

Chapter 4 – Nest Monitoring. This chapter summarizes nesting attempts, nest fates, and productivity for all Southwestern Willow Flycatcher nesting activity documented during this study.

Chapter 5 – Brown-headed Cowbird Trapping. This chapter summarizes the efforts and results of cowbird trapping at the four life history study areas.

Chapter 6 – Vegetation Sampling. Vegetation and habitat characteristics of all nest and non-use sites are presented and compared in this chapter. Vegetation characteristics of the whole habitat block at each life history study area are also presented.

Chapter 7 – Microclimate. The methodology and results of monitoring temperature, humidity, and soil moisture within each life history study area at nest and non-use sites are presented.

CHAPTER 2

PRESENCE/ABSENCE SURVEYS AND SITE DESCRIPTIONS

INTRODUCTION

Broadcasts of recorded conspecific vocalizations are useful in eliciting responses from nearby willow flycatchers, and multiple broadcast surveys conducted throughout the breeding season are the standard technique for determining the presence or absence of *E. t. extimus* (Sogge et al. 1997). Willow flycatchers detected between approximately 15 June and 20 July in the breeding range of *E. t. extimus* probably belong to the southwestern subspecies (Sogge et al. 1997, USFWS 2002). However, because northbound individuals of all subspecies of the willow flycatcher migrate through areas where *E. t. extimus* are actively nesting, and southbound migrants occur where *extimus* are still breeding (USFWS 2002, Sogge et al. 1997), field confirmation of the southwestern subspecies is problematic.[3] For example, the northwestern *E. t. brewsteri*, far more numerous than *E. t. extimus*, has been documented migrating north in southern California as late as 20 June (Garrett and Dunn 1981 as cited in Unitt 1987), and Phillips et al. (1964 as cited in Unitt 1987) documented *E. t. brewsteri* collected in southern Arizona on 23 June. An understanding of willow flycatcher migration ecology in combination with multiple broadcast surveys conducted throughout the breeding season is therefore needed to assess the presence and residency of Southwestern Willow Flycatchers.

Migration routes used by *E. t. extimus* are not well documented, though more is known of northbound migration in spring than the southbound migration in fall because spring is the only time that willow flycatchers sing and can therefore be distinguished from other *Empidonax* species. During northbound migration, all subspecies of willow flycatchers use riparian habitats similar to breeding habitat along major river drainages in the Southwest such as the Rio Grande (Finch and Kelly 1999), Colorado River (McKernan and Braden 1999), San Juan River (Johnson and Sogge 1997), and the Green River (M. Johnson unpubl. data). Although migrating willow flycatchers may favor young, native willow habitats (Yong and Finch 1997), migrants are also found in a variety of unsuitable breeding habitats in both spring and fall. These migration stopover habitats, even though not used for breeding, are likely important for both reproduction and survival. For most long-distance Neotropical migrant passerines, migration stopover habitats are needed to replenish energy reserves to continue northbound or southbound migration.

In 2004, we completed multiple broadcast surveys at sites in 15 study areas along the lower Colorado River and its tributaries to detect both migrant and resident willow flycatchers (Figure 2.1).

[3] Throughout this document, the terms "flycatcher" and "willow flycatcher" refer to *E. t. extimus* when individuals are confirmed as residents. For individuals for which residency is undetermined, subspecies is unknown.

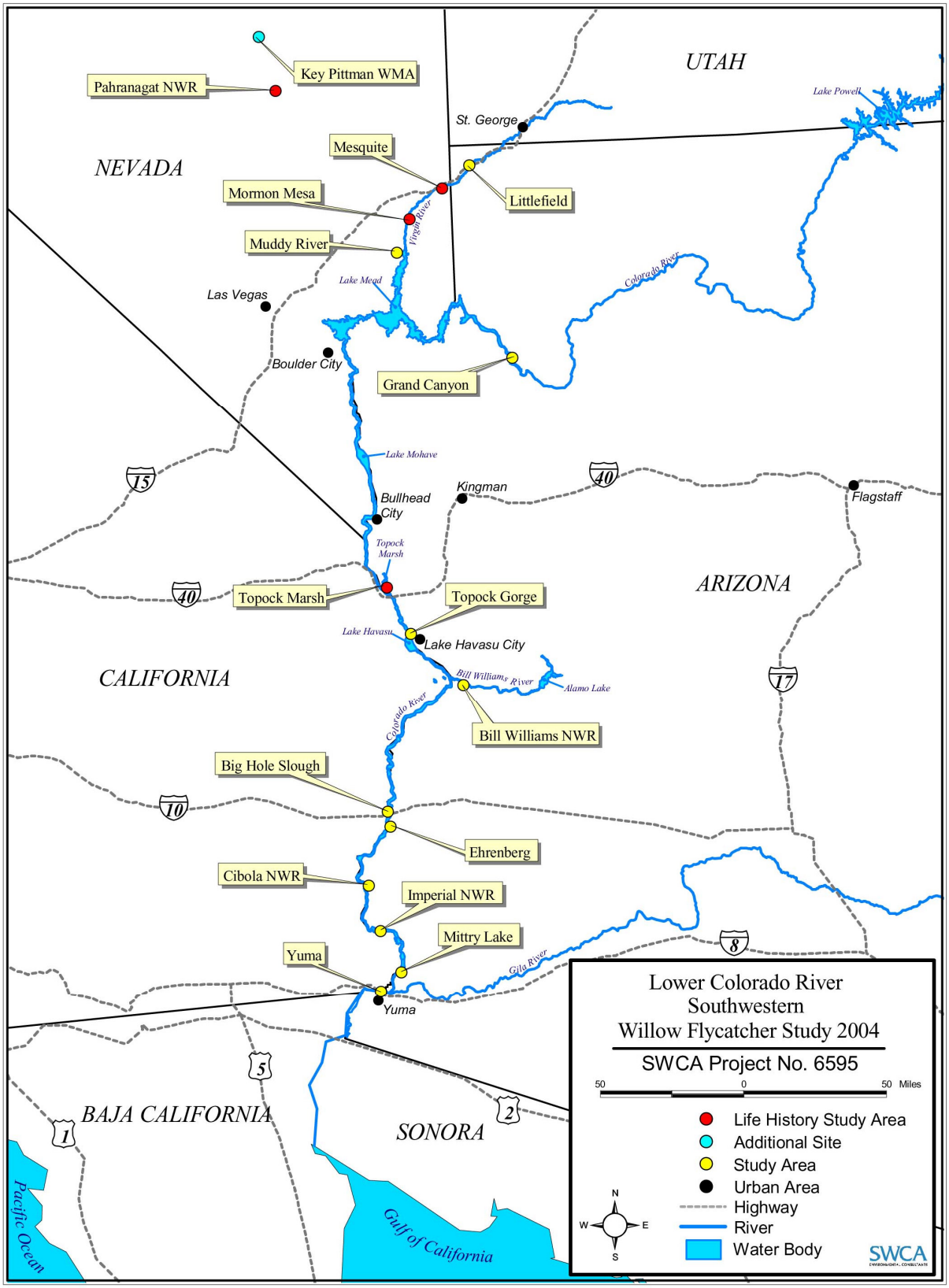

Figure 2.1. Locations of Southwestern Willow Flycatcher study areas along the lower Colorado River and tributaries, 2004. (*Note, study area labels represent the approximate center of multiple sites within that region, see Table 2.1 and Appendix B.)*

YELLOW-BILLED CUCKOO AND YUMA CLAPPER RAIL

The Yuma Clapper Rail (*Rallus longirostris yumanensis*) is listed as federally endangered by the USFWS, and the Yellow-billed Cuckoo (*Coccyzus americanus occidentalis*) is a candidate for federal listing. Both species occur along the lower Colorado River and its tributaries and are of concern to managing agencies. In most areas, we did not survey specifically for these species but recorded all incidental detections. We conducted species-specific surveys for Yellow-billed Cuckoos at two sites within Grand Canyon, at the request of the Grand Canyon National Park.

METHODS

SITE SELECTION

Survey sites were selected based on locations surveyed during previous years of willow flycatcher studies on the lower Colorado River (McKernan 1997; McKernan and Braden 1998, 1999, 2001a, 2001b, 2002; Koronkiewicz et al. 2004) and reconnaissance by helicopter, by boat, and on foot prior to the start of the 2004 survey period. USBR biologists Theresa Olson and John Swett guided and approved site selection. For sites that had been surveyed in previous years, we retained original site names. We provided field personnel with high-resolution aerial photographs of all selected survey sites. The photographs were overlain with a UTM grid (NAD 27) and an outline of the proposed survey area. The boundaries of all survey sites were refined to include potential flycatcher habitat actually present. New boundaries were delineated on the aerial photographs based on UTM coordinates obtained in the field. All UTM coordinates were obtained in NAD 27 using a Garmin Rino 110 GPS unit. All UTM coordinates in this report are presented in NAD 83 to comply with Federal Geographic Data Committee standards.

BROADCAST SURVEYS

To elicit responses from nearby willow flycatchers, we broadcast conspecific vocalizations previously recorded throughout the Southwest from 1996 to 1998. All flycatcher surveys were conducted according to methods described in Sogge et al. (1997), and we followed a modification of the 10-survey protocol proposed by Braden and McKernan (1998). We completed at least two surveys between 15 and 30 May, at least two surveys between 1 and 15 June, and six additional surveys between 16 June and 25 July. Surveys were separated by a minimum of five days whenever logistically possible. Field personnel surveyed within the habitat wherever possible, using a portable CD player (various models were used) coupled to a Radio Shack 277-1008C mini amplified speaker. Surveyors stopped every 30–40 m and broadcast willow flycatcher primary song (*fitz-bew*) and calls (*breets*). Field personnel watched for flycatchers and listened for vocal responses for approximately one to two minutes before proceeding to the next survey station. Wherever territorial flycatchers were detected, broadcast surveys were discontinued within a radius of 50 m of territories, and territory and nest monitoring commenced (see Chapter 4). If a willow flycatcher was observed but did not respond with song to the initial broadcast, we broadcast other conspecific vocalizations including *creets/breets*, *wee-oos*, *whitts*, *churr/kitters*, and a set of interaction calls given by a mated pair of flycatchers (per Lynn et al. 2003). These calls were frequently effective in eliciting a *fitz-bew*

song, thereby enabling surveyors to positively identify willow flycatchers. To produce a spatial representation of all survey areas, field personnel recorded survey start and stop UTM coordinates as well as the UTM coordinates of intermediate survey points. Observers recorded start and stop times and the location(s) and behavior of all willow flycatchers detected (see survey form, Appendix A). Field personnel also recorded the presence of Brown-headed Cowbirds and livestock, as requested by the Arizona Game and Fish Department. Cowbirds may affect flycatcher populations by decreasing flycatcher productivity (see Chapter 5), while livestock may substantially alter the vegetation in an area (USFWS 2002).

SITE DESCRIPTION

Because vegetation structure and hydrology within riparian habitats are seasonally dynamic, field personnel completed site description forms (Appendix A) for each survey site at least three times throughout the survey season: early season (mid-May to mid-June), mid-season (mid-June to mid-July), and late season (mid-July to August). Vegetation composition (native vs. exotic) at survey sites followed the definitions of Sogge et al. (1997) and the Southwestern Willow Flycatcher Range-wide Database. Vegetation composition was defined as (1) native: >90% of the vegetation at a site was native; (2) exotic: >90% of the vegetation at a site was exotic/ introduced; (3) mixed native: 50 to 90% of the vegetation at a site was native; and (4) mixed exotic: 50 to 90% of the vegetation at a site was exotic/introduced. Information from site description forms was used in conjunction with habitat photographs and comments in field notebooks and on survey forms to formulate qualitative site descriptions.

RESULTS

Field personnel spent 1,319 observer-hours conducting willow flycatcher broadcast surveys at 92 sites along the Virgin and lower Colorado Rivers and tributaries.[4,5] Willow flycatcher survey results are summarized in Table 2.1 and are presented below along with site descriptions. The UTM coordinates presented below are the centroid of each survey area. The boundaries of survey sites and occupancy in 2004 are shown on orthophotos in Appendix B, along with historically occupied habitat.[6] Because willow flycatchers detected between approximately 15 June and 20 July in the breeding range of *E. t. extimus* probably belong to the southwestern subspecies (USFWS 2002, Sogge et al. 1997), flycatcher detections after 15 June at sites where breeding or residency were not confirmed are summarized in Table 2.2. Yellow-billed Cuckoo and Yuma Clapper Rail detections are summarized in Tables 2.3 and 2.4. Hydrologic characteristics of each site are summarized in Table 2.5.

[4] For sites surveyed in previous years, we counted each survey area with a distinct name as one site. In previous years, several of these areas were counted as multiple sites. For example, the report from the 2001 field season (McKernan and Braden 2002) lists 41 sites at Topock (Table 2), but only 19 sites are named on the map (Appendix 4). Total acreage surveyed for all sites in 2004 differed little from previous years.

[5] We started the 2004 survey season with 94 survey sites. Surveys at five sites were discontinued because of loss of habitat to fire, and four sites were discontinued because of poor habitat quality. Seven sites were added to the survey protocol, and two additional sites in Grand Canyon were surveyed opportunistically.

[6] As per the USBR (1999), we defined occupied Southwestern Willow Flycatcher habitat as patches of vegetation that are similar to and contiguous with areas where willow flycatchers were detected after 15 June.

Table 2.1. Willow Flycatcher Detections along the Virgin and Colorado Rivers and Tributaries, 2004

Study Area[1]	Survey Site	Area (ha)	Number Detected (Date(s) of Detection)[2,3]
PAHR	Pahranagat North	4.5	32 (11 May–12 August)
	Pahranagat South	2.4	3 (14 May–6 August)
LIFI	Littlefield North	9.3	3 (26 May–10 August)
	Littlefield South	5.7	ND
MESQ	Mesquite West	18.2	30 (7 May–16 August)
MOME	Mormon Mesa North	15.8	4 (8 May–21 July)
	Mormon Mesa South	35.6	3 (19 May, 8 June, 23 June)
	Virgin River #1	92.6	15 (19 May–30 July)
	Delta West	12.3	5 (13 May–20 July)
MUDD	Overton WMA	12.6	4 (20 May–11 June, 12 July)
GRCA	Separation Canyon	8.0	ND
	RM 243S	1.8	ND
	Spencer Canyon	5.5	ND
	Surprise Canyon	4.8	ND
	Clay Tank Canyon	0.5	ND
	No WIFL Point	0.9	ND
	No WIFL Bay	1.1	ND
	Reference Point Creek	4.2	ND
	RM 257.5N	7.1	ND
	Burnt Springs	11.0	1 (8 and 24 June)
	Quartermaster Canyon	2.8	ND
	RM 260.5N	3.5	ND
	Columbine Falls	7.2	ND
	RM 274.5N	11.1	2 (5 June–22 July)
TOPO	Pipes #1	5.2	1 (15 May)
	Pipes #2	2.8	ND
	Pipes #3	5.7	5 (31 May–8 August)
	PC6-1	4.8	9 (4 June–11 August)
	Pig Hole	1.8	2 (19 May–26 July)
	In Between	8.0	12 (8 May–10 August)
	800M	6.2	4 (11 May–10 August)
	Pierced Egg	6.8	5 (20 May–26 July)
	Swine Paradise	3.7	3 (20 May–3 June)
	Barbed Wire	2.6	1 (25–29 May)
	IRFB03	1.0	ND
	IRFB04	1.5	ND
	Platform	1.3	1 (7–11 May)
	250M	2.3	2 (13 May–7 August)
	Hell Bird	3.7	9 (11 May–25 July)

Table 2.1. Willow Flycatcher Detections along the Virgin and Colorado Rivers and Tributaries, 2004, continued

Study Area[1]	Survey Site	Area (ha)	Number Detected (Date(s) of Detection)[2,3]
TOPO	Glory Hole	3.8	10 (11 May–9 August)
	Lost Lake	8.9	1 (8–16 June)
TOGO	Pulpit Rock	1.8	ND
	Picture Rock	5.5	ND
	Blankenship Bend North	27.6	2 (1 June)
	Blankenship Bend South	43.7	1 (27 May)
	Havasu NE	13.6	1 (26 May)
BIWI	Bill Williams Site 1	2.2	1 (27 May–9 June)
	Bill Williams Site 2	3.9	2 (19 May), 1 (9 June)
	Bill Williams Site 11	4.2	1 (15–16 June)
	Bill Williams Site 4	5.8	1 (16 June)
	Bill Williams Site 3	3.7	3 (13 May–5 July)
	Bill Williams Site 5	2.8	1 (30 May)
	Mineral Wash Complex	19.6	1 (23 May)
	Beaver Pond	21.3	3 (21 May), 4 (23 May), 2 (30 May), 2 (10 June), 1 (19 June)
	Bill Williams Site 8	10.3	1 (28 May)
BIHO	Big Hole Slough	16.5	1 (15 May), 3 (25 May), 14 (2 June), 2 (13 June)
EHRE	Ehrenberg	4.7	2 (15 May), 2 (25 May), 1 (2 June)
CIBO	Cibola Site 2	16.4	8 (26 May), 14 (1 June), 2 (11 June)
	Cibola Site 1	7.7	1 (26 May), 2 (1 June), 1 (11 June), 1 (14 June)
	Hart Mine Marsh	31.6	5 (25 May), 3 (1 June)
	Three Fingers Lake	70.2	11 (16 May), 33 (26 May), 6 (31 May), 3 (12 June)
	Cibola Lake #1 (North)	8.5	2 (25 May)
	Cibola Lake #2 (East)	4.5	1 (26 May), 1 (14 June)
	Cibola Lake #3 (West)	7.0	11 (25 May), 6 (1 June)
	Walker Lake	24.0	22 (25 May), 2 (31 May), 12 (9 June)
IMPE	Paradise	6.1	7 (25 May), 3 (31 May), 7 (9 June), 3 (13 June)
	Hoge Ranch	21.8	2 (20 May), 9 (30 May), 16 (2 June), 1 (11 June)
	Adobe Lake	8.2	3 (30 May), 5 (2 June)
	Rattlesnake[4]	1.7	ND
	Norton South[5]	1.5	1 (15 June)
	Picacho NW	11.0	2 (20 May), 4 (28 May), 4 (2 June), 1 (11 June)
	Milemarker 65	10.0	4 (20 May), 1 (28 May), 2 (2 June), 1 (11 June)
	Clear Lake/The Alley	8.3	1 (19 May), 3 (28 May), 1 (11 June)
	Imperial Nursery	1.4	3 (18 May), 3 (29 May), 4 (3 June)
	Ferguson Lake	29.1	2 (21 May), 16 (27 May), 6 (1 June), 3 (10 June)
	Ferguson Wash	6.8	2 (21 May), 6 (1 June), 3 (10 June)
	Great Blue	7.1	7 (17 May), 36 (29 May), 25 (3 June), 12 (10 June), 3 (11 June), 2 (12 June)

Table 2.1. Willow Flycatcher Detections along the Virgin and Colorado Rivers and Tributaries, 2004, continued

Study Area[1]	Survey Site	Area (ha)	Number Detected (Date(s) of Detection)[2,3]
IMPE	Powerline	2.1	1 (29 May), 1 (3 June)
	Martinez Lake	4.6	2 (18 May), 1 (29 May), 1 (3 June), 4 (10 June), 1 (24 June)
MITT	Mittry West	4.4	1 (17 May), 5 (27 May), 6 (11 June)
	Mittry South	15.5	15 (30 May), 1 (13 June)
	Potholes East	2.0	1 (18 May), 4 (27 May), 2 (10 June)
	Potholes West	6.6	1 (27 May), 3 (3 June), 2 (10 June)
YUMA	River Mile 33	20.6	11 (31 May), 2 (8 June), 2 (12 June), 1 (13 June)
	Gila Confluence West	5.6	1 (19 May), 9 (30 May), 5 (8 June)
	Gila Confluence North	4.6	5 (18 May), 14 (29 May), 1 (8 June)
	Gila River Site 2	8.1	1 (17 May), 1 (27 May), 4 (8 June)
	Fortuna Site 1[6]	2.8	ND
	Fortuna North	4.8	5 (27 May), 2 (8 June)
	Gadsden Bend	4.4	8 (18 May), 8 (28 May), 1 (9 June), 2 (13 June), 1 (14 June), 1 (23 July)
	Gadsden	24.3	4 (18 May), 22 (28 May), 3 (9 June)
	Hunter's Hole	16.5	5 (18 May), 37 (30 May), 4 (9 June)

[1] PAHR = Pahranagat National Wildlife Refuge; LIFI = Littlefield; MESQ = Mesquite West; MOME = Mormon Mesa; MUDD = Muddy River; GRCA = Grand Canyon; TOPO = Topock Marsh; TOGO = Topock Gorge; BIWI = Bill Williams National Wildlife Refuge; BIHO = Big Hole Slough; EHRE = Ehrenberg; CIBO = Cibola National Wildlife Refuge; IMPE = Imperial National Wildlife Refuge; MITT = Mittry Lake; YUMA = Yuma.

[2] ND = no willow flycatchers were detected.

[3] See Chapter 3 for details on territories, residency, pairing, and color-banding; see Chapter 4 for details on nesting activity.

[4] Site first surveyed 16 June.

[5] Site first surveyed 15 June.

[6] Site first surveyed 28 June.

Table 2.2. Detections of Willow Flycatchers Recorded after 15 June 2004 at Sites Where Breeding or Residency Was Not Confirmed

Study Area[1]	Site	Date	Comments
IMPE	Martinez Lake	24 June	Lone flycatcher not very responsive or territorial.
YUMA	Gadsden Bend	23 July	Lone flycatcher responded to playbacks

[1] IMPE = Imperial National Wildlife Refuge; YUMA = Yuma.

Table 2.3. Yellow-Billed Cuckoo Detections along the Virgin, Lower Colorado, and Gila Rivers, 2004*

Study Area[1]	Site	Date(s)	Behavioral Observations
PAHR	Pahranagat North	10 July	One silent individual preening and foraging
TOPO	Hell Bird	3 August	Calls heard, one individual
BIWI	Beaver Pond	9 July	One individual perched on high branches, sang primary song once
YUMA	River Mile 33	28 June	Primary song heard
	Hunter's Hole	9 July	Calls heard
		14 July	Calls and primary song heard, two individuals
		23 July	Calls heard

* Unless otherwise stated, number of individual cuckoos was undetermined.

[1] PAHR = Pahranagat National Wildlife Refuge; TOPO = Topock Marsh; BIWI = Bill Williams River National Wildlife Refuge; YUMA = Yuma.

Table 2.4. Yuma Clapper Rail Detections along the Virgin and Lower Colorado Rivers, 2004*

Study Area[1]	Site	Date(s)	Behavioral Observations
TOPO	Hell Bird	3 August	Counter singing, four individuals
CIBO	Cibola Lake North	14 May	Fly over
	Cibola Lake West	21 July	Calls heard
	Three Fingers Lake	14 May	Fly over
		11, 22 July	Calls heard
IMPE	Ferguson Lake	7 July	Calls heard

* Unless otherwise stated, number of individuals was undetermined.

[1] TOPO = Topock Marsh; CIBO = Cibola National Wildlife Refuge; IMPE = Imperial National Wildlife Refuge.

Table 2.5. Summary of Hydrologic Conditions at Each Survey Site along the Virgin and Lower Colorado Rivers and Tributaries, 2004*

Study Area[1]	Survey Site	% Site Inundated[2]	Depth (cm) of Surface Water[2]	% Site with Saturated Soil[2,3]	Distance (m) to Surface Water or Saturated Soil[2]
PAHR	Pahranagat North[4]	90/20/10	50/10/10	0/30/10	0/0/0
	Pahranagat South[5]	10/10/10	50/30/50	5/5/0	0/0/0
LIFI	Littlefield North	30/20/20	30/30/50	10/5/20	0/0/0
	Littlefield South	5/5/5	50/30/30	0/0/0	0/0/0
MESQ	Mesquite West	50/10/40	30/10/10	40/40/50	0/0/0

Table 2.5. Summary of Hydrologic Conditions at Each Survey Site along the Virgin and Lower Colorado Rivers and Tributaries, 2004*, continued

Study Area[1]	Survey Site	% Site Inundated[2]	Depth (cm) of Surface Water[2]	% Site with Saturated Soil[2,3]	Distance (m) to Surface Water or Saturated Soil[2]
MOME	Mormon Mesa North	0/0/0	0/0/0	20/0/0	0/0/>30
	Mormon Mesa South	0/0/0	0/0/0	10/5/0	0/0/>100
	Virgin River #1	35/10/0	30/5/0	20/20/0	0/0/>100
	Delta West	80/0/0	30/0/0	20/10/0	0/0/>100
MUDD	Overton WMA	20/30/10	30/70/30	30/20/20	0/0/0
GRCA	Separation Canyon	<1/0/0	<5/0/0	0/0/0	0/0/0
	RM 243S[4]	0/0/2	0/0/30	4/0/0	0/0/0
	Spencer Canyon	15/10/10	15/25/15	25/10/10	0/0/0
	Surprise Canyon	15/5/20	30/--/30	40/3/0	0/0/0
	Clay Tank Canyon[4]	15/5/10	15/--/10	20/2/15	0/0/0
	No Wifl Point[4]	0/0/0	0/0/0	0/0/0	0/0/0
	No Wifl Bay[4]	0/0/0	0/0/0	0/0/0	0/0/0
	Reference Point Creek[4]	0/0/0	0/0/0	0/0/0	0/0/0
	RM 257.5N[4]	0/0/0	0/0/0	0/0/0	0/0/0
	Burnt Springs	0/0/0	0/0/0	0/0/0	0/0/0
	Quartermaster Canyon	--/0/0	--/0/0	--/0/0	0/0/0
	RM 260.5N[4]	0/0/0	0/0/0	0/0/0	0/0/0
	Columbine Falls	2/3/10	5/5/--	5/2/0	0/0/0
	RM 274.5N[4]	3/2/4	10/50/--	5/8/6	0/0/0
TOPO	Pipes #1	0/0/0	0/0/0	5/0/0	0/100/100
	Pipes #2	0/0/--	0/0/--	0/0/--	100/100/--
	Pipes #3	80/10/1	30/5/5	20/70/10	0/0/0
	PC6-1	--/5/1	--/5/5	--/95/50	0/0/0
	Pig Hole	--/--/--	--/--/--	--/--/--	--/--/--
	In Between	2/0/--	10/0/--	1/2/--	0/0/--
	800M	--/10/--	--/5/--	--/30/--	--/0/--
	Pierced Egg	20/1/1	10/10/5	60/5/--	0/0/0
	Swine Paradise[6]	0/5/0	0/5/0	15/0/0	0/0/0
	Barbed Wire	0/0/0	0/0/0	10/0/0	0/200/200
	IRFB03	0/0/0	0/0/0	0/0/0	150/150/150
	IRFB04	0/0/0	0/0/0	0/0/0	100/100/100
	Platform[6]	--/0/--	--/0/--	--/10/--	0/0/0
	250M[6]	10/1/1	30/5/5	30/--/--	0/0/0
	Hell Bird	50/40/30	30/30/10	40/60/50	0/0/0

Table 2.5. Summary of Hydrologic Conditions at Each Survey Site along the Virgin and Lower Colorado Rivers and Tributaries, 2004*, continued

Study Area[1]	Survey Site	% Site Inundated[2]	Depth (cm) of Surface Water[2]	% Site with Saturated Soil[2,3]	Distance (m) to Surface Water or Saturated Soil[2]
TOPO	Glory Hole	50/30/35	30/30/30	40/60/65	0/0/0
	Lost Lake[6]	10/30/--	10/30/--	50/10/--	0/0/--
TOGO	Pulpit Rock[5]	1/1/1	5/5/5	--/5/5	0/0/0
	Picture Rock[5]	10/10/10	10/10/5	2/2/2	0/0/0
	Blankenship Bend North[5]	20/20/20	30/30/30	10/10/10	0/0/0
	Blankenship Bend South[5]	20/20/20	30/30/30	10/10/10	0/0/0
	Havasu NE[4]	--/0/--	--/0/--	--/0/--	--/0/--
BIWI	Bill Williams Site 1[4]	5/15/10	10/10/10	10/30/20	0/0/0
	Bill Williams Site 2[4]	0/0/0	0/0/0	0/0/0	0/0/0
	Bill Williams Site 11[4]	0/--/--	0/--/--	0/--/--	0/0/0
	Bill Williams Site 4	0/0/0	0/0/0	0/0/0	>100/>100/>100
	Bill Williams Site 3	0/0/0	0/0/0	3/2/2	0/0/0
	Bill Williams Site 5	3/3/0	30/10/0	0/0/2	0/0/0
	Mineral Wash Complex	1/1/0	10/5/0	5/5/0	0/0/>35
	Beaver Pond	30/10/1	30/30/5	10/5/5	0/0/0
	Bill Williams Site 8	--/10/--	--/70/--	--/--/--	0/0/0
BIHO	Big Hole Slough	25/25/25	10/5/--	--/--/--	0/0/0
EHRE	Ehrenberg	1/0/0	5/0/0	1/0/0	0/10/10
CIBO	Cibola Site 2[7,8]	--/--/--	--/--/--	--/--/--	0/0/0
	Cibola Site 1[7,8]	--/--/--	--/--/--	--/--/--	0/0/0
	Hart Mine Marsh[7]	30/25/20	70/50/30	4/15/--	0/0/0
	Three Fingers Lake[4]	30/30/30	>100/>100/ >100	--/0/--	0/0/0
	Cibola Lake #1 (North)[4]	0/0/0	0/0/0	0/0/0	0/0/0
	Cibola Lake #2 (East)[4]	0/0/0	0/0/0	0/0/0	0/0/0
	Cibola Lake #3 (West)[4]	0/0/0	0/0/0	0/0/0	0/0/0
	Walker Lake[4,6]	0/0/0	0/0/0	0/0/0	0/0/0
IMPE	Paradise[4]	20/0/5	10/0/10	30/5/10	0/0/0
	Hoge Ranch[4]	--/40/45	--/10/15	--/0/--	0/0/0
	Adobe Lake[4]	0/0/0	0/0/0	0/0/0	0/0/0
	Rattlesnake	--/0/--	--/0/--	--/25/--	--/0/--
	Norton South[6]	--/15/10	--/10/30	--/--/15	--/0/0
	Picacho NW[4]	1/0/0	5/0/0	6/0/0	0/30/30
	Milemarker 65[4]	0/0/0	0/0/0	--/0/--	0/0/0

Table 2.5. Summary of Hydrologic Conditions at Each Survey Site along the Virgin and Lower Colorado Rivers and Tributaries, 2004*, continued

Study Area[1]	Survey Site	% Site Inundated[2]	Depth (cm) of Surface Water[2]	% Site with Saturated Soil[2,3]	Distance (m) to Surface Water or Saturated Soil[2]
IMPE	Clear Lake/The Alley[4]	0/0/0	0/0/0	0/0/0	0/0/0
	Imperial Nursery	0/0/20	0/0/0	0/0/5	40/40/0
	Ferguson Lake[4]	0/0/0	0/0/0	0/0/0	0/0/0
	Ferguson Wash[4]	0/0/--	0/0/--	0/--/--	0/0/0
	Great Blue[4]	0/0/0	0/0/0	0/0/0	0/0/0
	Powerline[4]	0/0/0	0/0/0	0/0/0	0/0/0
	Martinez Lake[4]	0/0/0	0/0/0	0/2/0	0/0/0
MITT	Mittry West	70/5/15	30/30/30	30/40/20	0/0/0
	Mittry South[4]	0/0/0	0/0/0	0/0/0	0/0/0
	Potholes East[7]	30/30/30	--/--/--	0/0/0	0/0/0
	Potholes West[7]	20/20/20	>100/>100/ >100	0/0/0	0/0/0
YUMA	River Mile 33	10/2/5	40/10/--	1/25/15	0/0/0
	Gila Confluence West[4]	1/0/0	5/0/0	0/0/0	0/0/0
	Gila Confluence North[4]	15/0/0	30/0/0	10/15/0	0/0/0
	Gila River Site 2[4]	0/0/0	0/0/0	2/0/0	0/0/0
	Fortuna Site 1	--/--/15	--/--/30	--/--/15	--/--/0
	Fortuna North[4]	0/0/0	0/0/0	0/0/0	0/0/0
	Gadsden Bend	0/5/15	0/10/--	0/10/--	0/0/0
	Gadsden[4]	5/5/5	30/50/50	0/0/0	0/0/0
	Hunter's Hole	7/10/15	30/70/50	2/0/2	0/0/0

* Values are given for each site as recorded in mid-May, mid-June, and mid-July.

[1] PAHR = Pahranagat National Wildlife Refuge; LIFI = Littlefield; MESQ = Mesquite West; MOME = Mormon Mesa; MUDD = Muddy River; GRCA = Grand Canyon; TOPO = Topock Marsh; TOGO = Topock Gorge; BIWI = Bill Williams National Wildlife Refuge; BIHO = Big Hole Slough; EHRE = Ehrenberg; CIBO = Cibola National Wildlife Refuge; IMPE = Imperial National Wildlife Refuge; MITT = Mittry Lake; YUMA = Yuma.

[2] -- = Hydrologic information not recorded.

[3] Percent of site with saturated soil does not include inundated areas.

[4] Site bordered by a river or lake.

[5] Site not surveyed until July.

[6] Site borders marsh.

[7] Site borders canal.

[8] Site contains cattail marshes, but hydrologic conditions within marshes unknown.

PAHRANAGAT NATIONAL WILDLIFE REFUGE, NEVADA

Pahranagat National Wildlife Refuge consists of a series of lakes and marshes in Pahranagat Valley approximately 150 km north of Las Vegas, Nevada. Patches of primarily native vegetation exist at the inflow and outflow of Upper Pahranagat Lake.

PAHRANAGAT NORTH

Area: 4.5 ha Elevation: 1,026 m UTM 665800E 4130979N

Pahranagat North is a stand of large-diameter Goodding willow (*Salix gooddingii*) at the inflow of Upper Pahranagat Lake. Fremont cottonwood (*Populus fremontii*) lines the northern, upland edge of the site and extends in narrow stringers around the edge of the lake. Canopy height within the patch is 15–18 m, and canopy closure is >90%. The entire site was inundated with up to approximately 1 m of water in mid-May and became progressively drier through the flycatcher breeding season. By mid-June only half the site had standing water, and only 10% of the site was inundated by late July.

We located 24 resident, breeding willow flycatchers at Pahranagat North. We detected two additional territorial flycatchers and six additional flycatchers for which residency or breeding status could not be determined. Details of occupancy, pairing, color-banding, and breeding are presented in Chapters 3 and 4. Areas of Pahranagat North not known to be occupied by willow flycatchers were surveyed throughout the breeding season. The site lies immediately adjacent to a cattle pasture, but livestock have access only to the cottonwood stringer on the northwest corner of the lake. Brown-headed Cowbirds were detected only once during surveys.

PAHRANAGAT SOUTH

Area: 2.4 ha Elevation: 1,023 m UTM 666691E 4128034N

Pahranagat South consists of a relatively small stringer of Goodding willow, coyote willow (*Salix exigua*), and Fremont cottonwood lining a human-made channel that carries the outflow from Upper Pahranagat Lake. The cottonwoods reach approximately 20 m in height, while the willows are generally less than 10 m. The site is bordered to the west by an open marsh and to the east by upland scrub. Tamarisk (*Tamarix* spp.) and Russian olive (*Elaeagnus angustifolia*) form a sparse understory. Overall canopy closure at this site is approximately 50%.

We detected two resident, breeding willow flycatchers at Pahranagat South, and an additional territorial flycatcher was detected 16 May–11 June. Details of occupancy, color-banding, and breeding are presented in Chapters 3 and 4. Areas of Pahranagat South not known to be occupied by willow flycatchers were surveyed throughout the breeding season. Brown-headed Cowbirds were detected during two surveys in May.

LITTLEFIELD, ARIZONA

We surveyed two adjacent sites at Littlefield, one at the confluence of the Virgin River with Beaver Dam Wash just upstream of the I-15 overpass and the other just downstream of the I-15 overpass.

LITTLEFIELD NORTH

Area: 9.3 ha Elevation: 543 m UTM: 774264E 4087820N

This mixed-native site is a stand of mature Fremont cottonwood with an understory of willow, tamarisk, and Russian olive. Stands of cattail (*Typha* sp.) and arrowweed (*Pluchea sericea*) are also present. The site extends from the I-15 bridge over the Virgin River upstream to the confluence of the Virgin River and Beaver Dam Wash and up Beaver Dam Wash approximately 250 m to a golf course. Canopy height is 10–15 m, and overall canopy closure is 25–50%. The site had standing water and saturated soil throughout the survey period.

We detected two resident, breeding willow flycatchers and one additional territorial flycatcher at Littlefield North. Details of occupancy, color-banding, and breeding are presented in Chapters 3 and 4. Areas of Littlefield North not known to be occupied by flycatchers were surveyed 11 times throughout the breeding season, totaling 18.0 observer-hours. Cowbirds were recorded on all but two visits, and there was no sign of livestock use.

LITTLEFIELD SOUTH

Area: 5.7 ha Elevation: 543 m UTM: 774284E 4087358N

This mixed-native site extends along the Virgin River for 550 m immediately downstream from the I-15 bridge and encompasses a backwater area. Vegetation in the area is primarily an overstory of cottonwood and willow 6 m in height mixed with tamarisk 3 m in height. The site also contains areas of cattail, arrowweed, and seep willow (*Baccharis salicifolia*). Overall canopy closure is 25–50%. The only water within the survey area was within the Virgin River channel.

We did not detect willow flycatchers at Littlefield South. We surveyed the site 11 times, totaling 15.3 observer-hours. Cowbirds were recorded on 10 visits, and there was no sign of livestock use.

MESQUITE, NEVADA

MESQUITE WEST

Area: 18.2 ha Elevation: 470 m UTM: 757960E 4075481N

This mixed-native site lies within the floodplain of the Virgin River in Mesquite, Nevada. Vegetation at the site is supported by runoff from two golf courses immediately adjacent to the site. The site is a mosaic of cattail and bulrush (*Schoenoplectus californicus*) marshes separated by narrow (40–50 m) strips of dense coyote willow with interspersed tamarisk. The willows are generally 5 m in height, and canopy closure is >90%. Water levels within the site varied daily according to irrigation activities at the golf course.

We located 24 resident, breeding willow flycatchers at Mesquite West and detected an additional 6 individuals for which occupancy could not be determined. Details of occupancy, color-banding, and breeding are presented in Chapters 3 and 4. Areas of Mesquite West not known to be occupied by flycatchers were surveyed throughout the breeding season. Cowbirds were detected on all but one survey. Cattle sign (tracks and dung) was noted on the periphery of the site, but no evidence of livestock use was observed on portions of Mesquite West occupied by breeding flycatchers.

MORMON MESA, NEVADA

For approximately 15 km upstream from its outflow to Lake Mead, the Virgin River flows through a 1-km-wide floodplain with a mosaic of habitats including tamarisk and willow forest, cattail marsh, and mixed-native and exotic forest. Much of the area is seasonally inundated from snowmelt in the spring and monsoon rains in mid and late summer. Vegetation in much of the floodplain near the Lake Mead Delta is dead or dying as the result of fluctuating reservoir levels. Except for one small site, all the areas surveyed at Mormon Mesa are at least 10 km upstream of Lake Mead. All the areas we surveyed are used extensively by cattle, and cowbirds were detected on almost every survey.

MORMON MESA NORTH

Area: 15.8 ha Elevation: 390 m UTM: 739706E 4058088N

This mixed-exotic site is north of a dry channel of the Virgin River that cuts from east to west across the floodplain. The site is bordered to the west by a seasonally inundated cattail marsh and to the east by the active channel of the Virgin River. From the river channel toward the cattails, the site grades from dense arrowweed to tamarisk with arrowweed understory to a mixture of tamarisk, Goodding willow, and coyote willow. The areas with a mix of tamarisk and willow forest were muddy in mid-May but had completely dry soils by mid-June. The active channel of the Virgin River contained flowing water in May and June but was dry by mid-July. Canopy height in Mormon Mesa North is generally 4–5 m and extends to 8 m where willow is present. Canopy closure is approximately 70–90%.

We found one breeding pair at Mormon Mesa North and detected two additional flycatchers. Details of occupancy, breeding activity, and color-banding are presented in Chapters 3 and 4. Portions of the site not known to be occupied were surveyed throughout the breeding season, totaling 23.8 observer-hours.

MORMON MESA SOUTH

North half: Area: 24.0 ha Elevation: 385 m UTM: 739505E 4057375N
South half: Area: 11.6 ha Elevation: 385 m UTM: 739387E 4056872N

Mormon Mesa South was split into two contiguous areas to facilitate tracking of survey activity. Mormon Mesa South consists of a mosaic of tamarisk 4 m in height and patches of willow and cattail. A long stringer of willow runs north to south through the east-central portion of the

northern half and along the eastern edge of the southern half of the site. Canopy height of the willows is approximately 6–8 m. Canopy closure varies throughout the site, averaging around 50%. This site did not contain any standing water during the survey season of 2004.

We detected three willow flycatchers in the northern half of Mormon Mesa South, one each on 19 May and 8 and 23 June. Details of occupancy and color-banding are presented in Chapter 3. No other flycatchers were detected in 10 surveys totaling 43.1 observer-hours.

VIRGIN RIVER #1

North half: Area: 43.3 ha	Elevation: 380 m	UTM: 739264E 4056219N
South half: Area: 49.3 ha	Elevation: 380 m	UTM: 739272E 4055493N

Virgin River #1 was also divided into two contiguous areas to facilitate streamlining of field logistics: Virgin River #1 North and Virgin River #1 South. Virgin River #1 North contains both tamarisk and willow habitats. The western half of Virgin River #1 North contains dense tamarisk 4 m in height and the eastern half is a mixture of tamarisk, Goodding willow, and coyote willow with cattails in the understory. Canopy height in the willow areas is approximately 10 m. Canopy closure throughout the site is approximately 70%. The willow areas had standing water up to 40 cm deep in mid-May and 5 cm deep in mid-June but were completely dry by mid-July.

We located four breeding pairs of willow flycatchers in the eastern half of Virgin River #1 North. We detected seven additional flycatchers for which occupancy or breeding status could not be determined. Details of occupancy, color-banding, and breeding activity are presented in Chapters 3 and 4. Portions of the site not known to be occupied were surveyed 14 times throughout the breeding season, totaling 40.3 observer-hours.

Virgin River #1 South was surveyed throughout the season, although it represents poor willow flycatcher habitat. This area is primarily tamarisk approximately 4 m in height with many dry, open areas. Canopy closure in vegetated areas is approximately 80%. The northeastern portion of Virgin River #1 South contains a few Goodding willow. This portion of the site had standing water in May and saturated soils in June, but all of Virgin River #1 South was dry by mid-July. Virgin River #1 South was surveyed 14 times, totaling 29.6 observer-hours. No flycatchers were detected.

VIRGIN RIVER #2

Area: 67.2 ha	Elevation: 380 m	UTM: 738919E 4054757N

Site reconnaissance and a single survey were completed at this site on 3 June and confirmed the assessment made in 2003 that this area is poor willow flycatcher habitat. The site is primarily a monotypic stand of tamarisk 4 m in height with 50–70% canopy closure. Occasional, small patches of willow are also present in this site. Canopy height within the willow patches is approximately 10 m. There was no standing water or saturated soils within the site during the survey on 3 June, and no additional surveys were completed at this site in 2004.

DELTA WEST

Area: 12.3 ha Elevation: 370 m UTM: 738165E 4047565N

This site is approximately 7 km downstream of Virgin River #2 and in some previous years was called Virgin River Delta #4. The site lies along the western edge of the floodplain, between the river channel and upland desert. The upland edge of the site is vegetated by tamarisk and arrowweed, while the interior of the site contains a mix of Goodding and coyote willow forest with an understory of tamarisk. Canopy height of the willows is up to 15 m and overall canopy closure is around 70%. Most (80%) of this site was inundated with up to 0.5 m of water in mid-May. By mid-June a few patches of saturated soil remained, and by mid-July the site was completely dry. This site contained a large, active Great Blue Heron (*Ardea herodias*) and Black-crowned Night Heron (*Nycticorax nycticorax*) rookery.

We located two pairs of willow flycatchers in Delta West and detected an additional flycatcher from 6 to 10 June. Details of occupancy, color-banding, and nesting are presented in Chapters 3 and 4. Field personnel spent 18.1 observer-hours surveying unoccupied portions of the site throughout the breeding season.

MUDDY RIVER, NEVADA

OVERTON WILDLIFE MANAGEMENT AREA

Area: 12.6 ha Elevation: 378 m UTM: 731540E 4044648N

The Overton Wildlife Management Area is at the inflow of the Muddy River into the Overton Arm of Lake Mead. This site was surveyed in previous years by USBR biologists. Vegetation is dominated by very dense tamarisk approximately 4 m in height with canopy closure of 70–90%. The site also contains a small patch of coyote willow. The Muddy River bisects the site, and cattails border the stream in some areas. Flowing water was present in the Muddy River throughout the survey season.

We detected one territorial flycatcher and three additional flycatchers for which occupancy could not be determined. We did not detect pairing or breeding behavior at this site. Details of occupancy and color-banding are presented in Chapter 3. This site was surveyed 11 times, totaling 23.8 observer-hours. Cowbirds were detected on 9 of the 11 surveys, and no evidence of livestock use was observed at the site.

GRAND CANYON, ARIZONA

The Colorado River in Grand Canyon downstream of Separation Canyon is strongly influenced by water levels in Lake Mead. Potential willow flycatcher habitat in this area has changed dramatically in the last four years as the result of a 27-m drop in the level of Lake Mead since 2000. Areas that were inundated in the late 1990s are now well above the current water level, and the existing riparian vegetation in many of these areas is dead or dying. Survey efforts focused on side canyons that receive water from tributaries and on the few areas along the main

channel of the Colorado River that still contain live, dense, riparian vegetation. Site names below indicate side canyons (if applicable) and the river mile, as measured downstream from Lees Ferry. River left and river right are indicated by "S" (south) and "N" (north), respectively. Livestock do not use any of the survey sites within Grand Canyon.

SEPARATION CANYON (RM 239.5N)

Area: 8.0 ha Elevation: 378 m UTM: 810231E 3970376N

This mixed-exotic site consists of dense patches of tamarisk 5 m in height interspersed with open areas along a streambed in a narrow side canyon of the Colorado River. Overall canopy closure is <50%. The streambed was dry throughout the survey season except for a small section that had surface water in May. Seep willow dominates the understory near the mouth of the canyon, while young coyote willow (1–3 m in height) dominates the understory farther up the canyon. Mesquite trees (*Prosopis* sp.) are also present at this site.

We did not detect willow flycatchers or Brown-headed Cowbirds at this site. The site was surveyed 10 times, totaling 9.8 observer-hours.

RM 243S

Area: 1.8 ha Elevation: 366 m UTM: 805683E 3971830N

This site lies immediately adjacent to the Colorado River and is vegetated by dense tamarisk 5 m in height. Canopy closure is 70–90%. A dry wash draining a narrow side canyon cuts through the downstream end of the site. A small pool was present periodically throughout the survey season near the confluence of this wash with the Colorado River.

We detected no willow flycatchers or Brown-headed Cowbirds at this site. The site was surveyed 10 times, totaling 7.3 observer-hours.

SPENCER CANYON (RM 246S)

Area: 5.5 ha Elevation: 366 m UTM: 802710E 3969485N

This mixed-native site consists of a patch of dense tamarisk approximately 5 m in height bordering the Colorado River and stringers of cottonwood and willow along Spencer Creek, which is perennial. Fremont cottonwood and willow form an overstory of variable height, and willow and tamarisk are present in the understory. Portions of the stream are lined with cattails and seep willow, and overall canopy closure is around 70%.

We did not detect willow flycatchers or Brown-headed Cowbirds at this site. The site was surveyed 10 times, totaling 12.6 observer-hours.

SURPRISE CANYON (RM 248.5N)

Area: 4.8 ha Elevation: 365 m UTM: 801880E 3973132N

This mixed-exotic site consists of stringers of tamarisk and coyote willow along both sides of an intermittent stream in the bottom of a narrow canyon. The stream contained pools of water throughout the survey season but did not have a continuous, aboveground flow. Canopy height is approximately 4 m, and overall canopy closure is 25–50%. Small stands of cattails surround some of the pools, particularly near the mouth of the canyon.

We did not detect willow flycatchers or Brown-headed Cowbirds at this site. The site was surveyed nine times, totaling 7.5 observer-hours.

CLAY TANK CANYON (RM 249S)

Area: 0.5 ha Elevation: 363 m UTM: 800936E 3973719N

This mixed-exotic site consists of a small patch of tamarisk and arrowweed between the Colorado River and a large pond. A stream was flowing from the pond to the river throughout the survey season. Tamarisk at this site ranges from 3 to 5 m in height, and overall canopy closure is around 70%.

We did not detect willow flycatchers or Brown-headed Cowbirds at this site. The site was surveyed 10 times, totaling 2.5 observer-hours.

NO WIFL POINT (RM 249.5S)

Area: 0.9 ha Elevation: 363 m UTM: 800744E 3974111N

This mixed-exotic site consists of a narrow (20–40 m) band of tamarisk 3 m in height with seep willow bordering the site along the river. Canopy closure is approximately 50%. No standing water or saturated soils occurred in the site during the survey season, but the site borders the Colorado River.

No willow flycatchers or Brown-headed Cowbirds were detected at this site. The site was surveyed nine times, totaling 3.4 observer-hours.

NO WIFL BAY (RM 249.5N)

Area: 1.1 ha Elevation: 363 m UTM: 800790E 3974368N

This mixed-exotic site borders the Colorado River and consists of a narrow (20–40 m) band of tamarisk 3 m in height with seep willow bordering the edge of the site along the river and arrowweed scattered throughout the site. No standing water or saturated soils occurred in the site during the survey season, and the site is elevated approximately 3 m above the Colorado River. Canopy closure is approximately 50%.

No willow flycatchers or Brown-headed Cowbirds were detected at this site. The site was surveyed nine times, totaling 4.5 observer-hours.

REFERENCE POINT CREEK (RM 252S)

Area: 4.2 ha Elevation: 360 m UTM: 7964871E 3976288N

This site, at the confluence of Reference Point Creek with the Colorado River, is vegetated almost entirely by tamarisk 4 m in height, and a dry, backwater pond in part of the site is growing in with young tamarisk. Open, grassy areas occur in the center of the site. Soils at this site were dry throughout the survey season, and the nearest water is the Colorado River. Overall canopy closure at the site is approximately 80%.

We did not detect willow flycatchers at this site. Cowbirds were detected on 2 of the 10 visits, which totaled 18.2 observer-hours.

RM 257.5N

Area: 7.1 ha Elevation: 360 m UTM: 794199E 3982463N

This mixed-exotic site borders the Colorado River. Immediately adjacent to the river, vegetation is primarily a thin band of dying willow approximately 5 m in height. Behind the willow, the site is dominated by dense tamarisk 3–4 m in height. The site was dry throughout the survey season and was elevated approximately 3 m above the level of the river. Vegetation throughout the site, particularly in the northern half of the site, is dead or dying. Canopy closure at the site is approximately 60%.

We did not detect willow flycatchers or Brown-headed cowbirds at this site. The site was surveyed 11 times, totaling 20.4 observer-hours.

BURNT SPRINGS (RM 259.5N)

Area: 11.0 ha Elevation: 363 m UTM: 793321E 3985796N

Vegetation within the first 200 m of Burnt Springs Canyon upstream from the Colorado River consists of monotypic tamarisk approximately 4 m in height. The next 150 m of the canyon is vegetated by very young tamarisk. This is followed by an approximately 700-m stretch of mature Goodding willow 15 m in height with an understory of cattails. Canopy closure is approximately 70–90%. No standing water was noted at the site, but the presence of live cattails suggests recent inundation or subsurface water.

We detected a willow flycatcher at this site on 8 and 24 June. Biologists from the Hualapai Department of Natural Resources reported detecting a flycatcher at this site on 28 May. The site was surveyed 11 times, totaling 26.9 observer-hours. Brown-headed Cowbirds were recorded on seven visits.

QUARTERMASTER CANYON (RM 260S)

Area: 2.8 ha Elevation: 360 m UTM: 792228E 3985130N

This mixed-exotic site lies at the confluence of the Colorado River and Quartermaster Canyon. Vegetation along the river is predominately tamarisk 4 m in height, and canopy height decreases with distance from the river. There is a patch of dying Goodding willow that occupies approximately 5% of the site, and dry cattail marshes occupy 10% of the site. Soils at the site were dry throughout the survey season. Canopy closure is approximately 50%.

We did not detect willow flycatchers at this site. The site was surveyed 10 times, totaling 11.2 observer-hours. Brown-headed Cowbirds were detected on two visits.

RM 260.5N

Area: 3.5 ha Elevation: 354 m UTM: 791476E 3985765N

This site borders the Colorado River and stands about 3 m above the river level. Vegetation at the site is dominated by tamarisk ranging in height from 1 to 4 m. The interior of the site is open and dry, with many dead and dying trees, and dead willows line the riverbank. Canopy closure at the site is approximately 50%.

We did not detect willow flycatchers at this site. The site was surveyed nine times, totaling 12.8 observer-hours. Brown-headed Cowbirds were detected on six visits.

COLUMBINE FALLS (RM 274.5S)

Area: 7.2 ha Elevation: 354 m UTM: 777043E 3998961N

This mixed-native site is located at the confluence of Cave Canyon and the Colorado River, and the site receives water from springs above Columbine Falls. Approximately 5–10% of the site had shallow, standing water or saturated soil throughout the survey season. Vegetation at the site is a mix of willow 5–6 m in height and tamarisk 2–3 m in height, and canopy closure is approximately 50%.

We did not detect willow flycatchers at this site. The site was surveyed 10 times, totaling 15.1 observer-hours. Brown-headed Cowbirds were detected on three visits.

RM 274.5N

Area: 11.1 ha Elevation: 354 m UTM: 777054E 3999649N

This mixed-exotic site lies immediately adjacent to the Colorado River and contains seeps and small creeks. Approximately 10% of the site contained saturated soil or standing water up to 50 cm deep throughout the survey season. Vegetation at the site is a mix of Goodding willow and tamarisk. Canopy height averages about 5 m, but canopy height and relative proportions of the two species vary throughout the site. Overall canopy closure is approximately 50%.

We detected one breeding pair of willow flycatchers at this site. Details of occupancy, color-banding, and nesting are presented in Chapters 3 and 4. Portions of the site not known to be occupied by flycatchers were surveyed 11 times, totaling 31.1 observer-hours. Brown-headed Cowbirds were detected on nine visits.

OTHER SURVEY AREAS

The Strip (RM 247N): Area: 0.8 ha Elevation: 366 m UTM: 802215E 3970878N

This site is between Spencer and Surprise Canyons and was surveyed on 20 June and 2 and 5 July, totaling 0.9 observer-hour. The site consists of a strip of tamarisk with an understory of arrowweed. Overall canopy closure is approximately 70%. No surface water was present in the site, though the site borders the Colorado River. This site was surveyed opportunistically in the middle of the flycatcher survey season.

Dry Falls (RM 251N): Area: 1.5 ha Elevation: 362 m UTM: 798669E 3975513N

This mixed-exotic site was surveyed on 20 June and 1 and 5 July, totaling 2.7 observer-hours. Habitat at the site consists of tamarisk approximately 6 m in height with an understory of arrowweed. Canopy closure is approximately 70%. Seep willow borders the edge of the site closest to the river. No surface water was present at the site. This site was surveyed opportunistically in the middle of the flycatcher survey season.

RM 262.5S: Area: 12.8 ha Elevation: 354 m UTM: 789924E 3989460N

Surveys at this site were discontinued after three visits. Vegetation at the site consists primarily of dead tamarisk and willow, with a narrow (2-m) strip of live vegetation along the river. Canopy closure within areas of live vegetation is 70–90%. Cowbirds were detected on two of the three surveys.

Tincanebitts: Area: 7.2ha Elevation: 354 m UTM: 790055E 3990748N

This site consists of patches of tamarisk 3–5 m in height separated by areas of dead willows. Canopy closure is 25–50%. No surface water was present at the site. Reconnaissance of the site on 28 May and 4 June did not reveal potential flycatcher habitat and surveys were discontinued.

RM 268N: Area: 7.2 ha Elevation: 354 m UTM: 784433E 3994079N

Surveys at this site were discontinued after two visits because most vegetation at the site is dead. The majority of the vegetation consists of brittle tamarisk 3 m in height, large areas of dead cattails, and dead willows. The site contained no surface water, and cowbirds were detected on one visit.

TOPOCK MARSH, ARIZONA

Topock Marsh lies within Havasu NWR and encompasses over 3,000 ha of open water, cattail and bulrush marsh, and riparian vegetation. A large expanse (over 2,000 ha) of riparian vegetation occupies the Colorado River floodplain between the Colorado River on the western edge of the floodplain and the open water of Topock Marsh on the eastern edge of the floodplain. The vegetation is primarily monotypic tamarisk with isolated patches of tall Goodding willow, and seasonally wet, low-lying areas are interspersed throughout the riparian area. Brown-headed Cowbirds were detected during the entire season. No cattle were present, but feral pigs frequented all areas surveyed.

PIPES

Pipes #1: Area: 5.2 ha	Elevation: 140 m	UTM: 726906E 3856907N
Pipes #2: Area: 2.8 ha	Elevation: 140 m	UTM: 726959E 3856717N
Pipes #3: Area: 5.7 ha	Elevation: 140 m	UTM: 727012E 3856517N

These three contiguous sites are vegetated primarily by monotypic tamarisk 5–7 m in height, and canopy closure generally exceeds 70%. The northern edge of Pipes #1 has larger stems and taller canopy than the rest of Pipes and has little deadfall. The central and southern portions of Pipes #1 have many dead stems and clusters of fallen trees. Pipes #2 is very dense, with most stems <3 cm in diameter, and large, impenetrable areas of deadfall are present within the site. Pipes #1 and Pipes #2 had dry soil throughout the survey season. Pipes #3, particularly the southern portion of the site, contained the wettest areas and had small, marshy openings. All of Pipes #3 had standing water or saturated soil in mid-May. Much of the standing water was gone by mid-June, and by mid-July only 10% of the site had saturated soils.

We detected one willow flycatcher at Pipes #1 on 15 May. Five willow flycatchers, all of which were in breeding pairs, were detected in Pipes #3. Details of color-banding, occupancy, and breeding are presented in Chapters 3 and 4. Surveys of Pipes #2 were discontinued on 27 June after five surveys totaling 7.0 observer-hours because of poor habitat quality. Portions of Pipes #1 and #3 not known to be occupied by flycatchers were surveyed 10 and 11 times, respectively, totaling 34.1 observer-hours. Multiple Brown-headed Cowbirds were detected on almost all visits to Pipes.

PC6-1

Area: 4.8 ha	Elevation: 140 m	UTM: 727235E 3855838N

This mixed-exotic site has a scattered overstory of Goodding willow approximately 10 m in height, a continuous mid-story of tamarisk 6–7 m in height, and patches of arrowweed and cattails in the understory. The portion of the site within approximately 50 m of the refuge road is very dry with thick stands of arrowweed. The portion of the site with marshy areas and willows is approximately 100 m from the refuge road. This part of PC6-1 had standing water or saturated

soil throughout the survey season. Canopy closure in the interior of the site is approximately 90%, while canopy closure on the periphery of the site near the road is about 50%.[7]

In PC6-1, we detected nine willow flycatchers, of which eight were members of breeding pairs. Details of color-banding, occupancy, and nesting are presented in Chapters 3 and 4. Portions of PC6-1 not known to be occupied by willow flycatchers were surveyed 10 times, totaling 16.8 observer-hours. Multiple cowbirds were recorded on all but one visit.

PIG HOLE

Area: 1.8 ha Elevation: 140 m UTM: 727242E 3855395N

Pig Hole is between PB2001 (see Other Survey Areas, below) and In Between. This was not a survey site at the beginning of the season, but a new site was delineated when breeding birds were discovered outside of existing survey sites. The site is monotypic tamarisk 5–6 m in height with canopy closure 70–90%. This site was not formally surveyed but was visited every 2–4 days for territory and nest monitoring.

We detected two willow flycatchers (one breeding pair) in Pig Hole. Details of color-banding and nesting are presented in Chapters 3 and 4.

IN BETWEEN AND 800M

In Between: Area: 8.0 ha Elevation: 140 m UTM: 727038E 3855165N
800M: Area: 6.2 ha Elevation: 140 m UTM: 726883E 3854997N

These two contiguous sites consist of approximately 50-m-wide linear patches of monotypic tamarisk between swampy areas. The tamarisk patches have stems spaced at approximately 0.5 to 1.0 m intervals. Canopy height is approximately 7 m, with the lowest 3 m of the stand generally lacking foliage, resulting in a relatively open understory. Canopy closure in the tamarisk stands is over 90%. In mid-May, these sites had saturated soils and some standing water, with knee-deep water in the adjacent swamps. The sites became progressively drier through the breeding season, and by late June the swamps had largely dried out.

We located 12 breeding adults at In Between and 4 breeding adults in 800M. Details of pairing, occupancy, color-banding, and nesting are presented in Chapters 3 and 4. Brown-headed Cowbirds were detected at these sites during the entire season.

PIERCED EGG

Area: 6.8 ha Elevation: 140 m UTM: 726668E 3855001N

This mixed-exotic site borders the western edge of 800M and consists of dense tamarisk 7 m in height with a scattered overstory of Goodding willow 15 m in height. Areas with willows tend to

[7] Surveys of this site were discontinued during the 2003 breeding season because field personnel evaluated only the portion of the site within 50 m of the road, and the habitat in that portion was unsuitable for flycatchers.

have a more open understory and contain patches of cattails. Overall canopy closure is approximately 90%. Approximately 20% of the site was inundated in May, but only a few puddles remained by mid-July. The northern portion of the site is drier than the southern portion and contains stands of dense arrowweed.

We detected five willow flycatchers at Pierced Egg. Details of occupancy, color-banding, and nesting are presented in Chapters 3 and 4. Brown-headed Cowbirds were detected at this site throughout the breeding season.

SWINE PARADISE

Area: 3.7 ha Elevation: 140 m UTM: 726247E 3854460N

This mixed-exotic site borders the open water of Topock Marsh. Near the marsh, vegetation at the site is dominated by Goodding willow 10 m in height, with some coyote willow and very little tamarisk. The remainder of the site, on both sides of the main refuge road, is vegetated by tamarisk 5–7 m in height. Overall canopy closure is approximately 90%.

We detected three willow flycatchers at Swine Paradise. Details of occupancy are presented in Chapter 3. We surveyed the site 10 times, totaling 11.6 observer-hours. Cowbirds were detected on nine visits.

BARBED WIRE

Area: 2.6 ha Elevation: 140 m UTM: 726155E 3854547N

This site is contiguous with Swine Paradise. There is one large, emergent Goodding willow at the site; otherwise, the site is vegetated by tamarisk of varying height and density. The northeastern portion of the site contains taller stems, less dead wood in the understory, and fewer large canopy openings than the southwestern portion of the site. Soils in the northeastern part of the site were saturated in mid-May but dry by mid-June.

We detected one willow flycatcher at this site. Details of occupancy are presented in Chapter 3. We surveyed the site nine times, totaling 10.5 observer-hours. Cowbirds were detected on eight visits.

IRFB03 AND IRFB04

IRFB03: Area: 1.0 ha Elevation: 140 m UTM: 725948E 3854349N
IRFB04: Area: 1.5 ha Elevation: 140 m UTM: 725944E 3854243N

These two contiguous sites are vegetated by a monotypic stand of tamarisk 7 m in height, which forms a dense canopy and relatively open understory. There is little deadfall, although many standing stems are dead, and lower branches and the ground are covered with thick layers of tamarisk duff. Soils within these sites were completely dry throughout the survey season. These sites are separated from the Barbed Wire site by a firebreak road.

We did not detect willow flycatchers at these sites. We surveyed these sites 10 times, totaling 9.1 observer-hours. Cowbirds were detected on five visits.

PLATFORM

Area: 1.3 ha Elevation: 140 m UTM: 725831E 3853980N

This site forms a narrow strip of vegetation between the main refuge road and the open marsh. Vegetation at the site consists of tamarisk 6 m in height with a few isolated, emergent Goodding willow. Overall canopy closure is approximately 70%. Bulrush and cattail line the eastern edge of the site adjacent to the marsh. Soils in the interior of the site were dry throughout the survey season.

We detected one willow flycatcher at Platform from 7 to 11 May, but no willow flycatchers were detected on 10 subsequent surveys, totaling 3.2 hours. Cowbirds were detected on two visits.

250M

Area: 2.3 ha Elevation: 140 m UTM: 725849E 3853499N

This site lies between the main refuge road and the open marsh. Vegetation composition and structure varies with distance from the marsh. Closest to the refuge road the site is very dry and is dominated by mesquite trees with an understory of arrowweed. The center of the site is dominated by tamarisk approximately 7 m in height. Closest to the marsh, the site contains patches of coyote willow and one large Goodding willow. Canopy closure within the site generally exceeds 70%. Approximately 40% of the site contained saturated soil or standing water in May. The water receded throughout the breeding season, and by mid-July only 1% of the site had standing water.

We detected two willow flycatchers (one breeding pair) in 250M. Portion of the site not known to be occupied by flycatchers were surveyed seven times, totaling 9.3 observer-hours. Cowbirds were detected on four surveys.

HELL BIRD AND GLORY HOLE

Hell Bird: Area: 3.7 ha Elevation: 140 m UTM: 725833E 3853252N
Glory Hole: Area: 3.8 ha Elevation: 140 m UTM: 725702E 3853064N

These contiguous sites are located on an island separated from the main riparian area by a narrow, deep channel. Vegetation composition and structure is highly variable, with the survey areas vegetated primarily by a mosaic of tamarisk 6 m in height and Goodding willow 12 m in height. Canopy closure ranges from 50 to 90%. Swampy areas vegetated by cattail and bulrush are interspersed throughout the survey areas. The survey areas are bordered on the west by a sand dune and on other sides by dense bulrush.

We recorded 10 willow flycatchers in Glory Hole and 9 flycatchers in Hell Bird. Details of occupancy, color-banding, and nesting activity are presented in Chapters 3 and 4.

LOST LAKE

Area: 8.9 ha Elevation: 140 m UTM: 727677E 3847125N

Lost Lake is located 6 km south of Glory Hole and Hell Bird. It is separated from the Colorado River to the west by a low ridge of barren sand dunes. Marshy areas lie to the east, and Lost Lake (a 200 × 500–m body of open water) is located north of the site. Vegetation at the site is variable. The northwestern portion of the site consists of an overstory of planted cottonwoods 10 m in height, with an understory of tamarisk 5 m in height. Many of the cottonwoods appear to be dying. Southeast of the cottonwoods, the site is a monotypic stand of tamarisk, 5–8 m in height. The southeastern end of the site is dominated by dense stands of coyote willow, 5–7 m in height, with an understory of arrowweed. Overall canopy closure is approximately 70%. Areas to the south and west of Lost Lake burned in the past few years and contain patches of young tamarisk and small willows.

We detected one willow flycatcher at Lost Lake. Details of occupancy and color-banding are presented in Chapter 3. We surveyed the site 10 times, totaling 15.5 observer-hours. Cowbirds were detected on seven visits.

OTHER SURVEY AREAS

PB2001: Area: 3.9 ha Elevation: 140 m UTM: 727331E 3855625N

This mixed-exotic site immediately south of PC6-1 was explored and surveyed twice in May. Surveys were discontinued after 30 May because the habitat consisted of dry tamarisk and dense stands of arrowweed. Exploration south of active nests on the southern edge of PC6-1 in July also revealed stands of short, dense tamarisk. The few Goodding willows within the site were dying and dropping their limbs.

TOPOCK GORGE, ARIZONA AND CALIFORNIA

Between Topock Marsh and Lake Havasu, the Colorado River winds through Topock Gorge. Throughout the Gorge, the river is confined between steep cliffs and high bluffs, and little vegetation grows along the river. We surveyed backwater areas that support marsh and riparian vegetation.

PULPIT ROCK

Area: 1.8 ha Elevation: 156 m UTM: 734071E 3838579N

The Pulpit Rock site is a small backwater area where an unnamed wash enters the Colorado River from the Mohave Mountains. The site is vegetated primarily by tamarisk and young Goodding willow 8 m in height. The northwestern edge of the site borders the river and is vegetated by cattails. The upland edges of the site are vegetated by arrowweed and mesquite. Overall canopy closure at the site is approximately 70%. Soils within the site were primarily dry throughout the survey period.

We did not detect any willow flycatchers at this site. We surveyed the site eight times, totaling 3.3 observer-hours. Cowbirds were detected on one visit. No livestock use at the site was recorded.

PICTURE ROCK

Area: 5.5 ha Elevation: 138 m UTM: 734563E 3833738N

Picture Rock is a backwater area where an unnamed wash enters the Colorado River from the west. The vegetation is mixed-exotic and is dominated by tamarisk 8 m in height with thick deadfall throughout the site. A few isolated, emergent Goodding willow are present. Canopy closure within the site is 70–90%. Bulrush and cattail are present on the edge of the site along the river, and the upland edges of the site contain arrowweed, mesquite, foothills paloverde (*Parkinsonia microphylla*), and brittlebush (*Encelia farinosa*), especially along the wash. The interior of the site was dry throughout the survey season.

We did not detect any willow flycatchers at this site. We surveyed the site nine times, totaling 7.5 observer-hours. Cowbirds were detected on four visits. Feral pigs and burros use the site and adjacent uplands.

BLANKENSHIP BEND

Blankenship Bend North: Area: 27.6 ha Elevation: 138 m UTM: 736550E 3832763N
Blankenship Bend South: Area: 43.7 ha Elevation: 133 m UTM: 736642E 3831470N

Blankenship Bend is a 2-km-long strip of riparian and marsh vegetation which lies along the east bank of the Colorado River adjacent to the Blankenship Valley. The eastern, upland edge of the site is vegetated by a 100-m-wide strip of mature tamarisk and mesquite. The northern half of the site contains a stand of large Goodding willows adjacent to a cattail marsh. Between the river and the strip of tamarisk, the southern half of the site consists of a mosaic of cattail, bulrush, and scattered islands of small willows and tamarisk. Canopy closure and height are highly variable throughout this mixed-exotic site.

We detected two flycatchers at Blankenship Bend North on 1 June and 1 flycatcher at Blankenship Bend South on 27 May. We surveyed the site eight times, totaling 11.8 observer-hours. Cowbirds were detected on three visits. Feral pigs, bighorn sheep, and burros use the site and adjacent uplands.

HAVASU NE

Area: 13.6 ha Elevation: m UTM: 741191E 3823825N

This mixed-native site consists of a 1.3-km-long and <100-m-wide strip of riparian vegetation along the northeastern shore of Lake Havasu. Vegetation at the site grades from cattails along the lakeshore to Goodding willow and tamarisk in the center of the site and a mix of tamarisk and mesquite on the upland edge. Canopy closure is approximately 50%. Soils within the site were dry throughout the survey season. Many Goodding willows at the site are mature, and stand 5 m above the 10-m-tall tamarisk and mesquite.

We detected one willow flycatcher at Havasu NE on 26 May. No breeding behavior was observed, and no other flycatchers were detected on nine surveys totaling 9.5 hours. Cowbirds were detected on six visits. Feral pigs and burros were observed at the site.

OTHER SURVEY AREAS

Topock Gorge North: Area: 3.8 ha Elevation: 136 m UTM: 736573E 3828921N
Topock Gorge South: Area: 2.6 ha Elevation: 140 m UTM: 736873E 3828642N

These sites burned between the 2003 and 2004 survey seasons and were not surveyed in 2004.

BILL WILLIAMS RIVER NATIONAL WILDLIFE REFUGE, ARIZONA

The Bill Williams NWR contains the last expanse of native cottonwood-willow forest on the lower Colorado River. The refuge encompasses over 2,500 ha along the Bill Williams River upstream from its mouth at Lake Havasu and contains a mixture of native forest, stands of monotypic tamarisk, beaver ponds, and cattail marsh. Livestock (cattle) were present only at the two most upstream survey sites (Beaver Pond and Site #8). Survey sites within Bill Williams are listed below from west to east, moving progressively farther upstream. All survey sites at Bill Williams that are influenced by water levels in the Bill Williams River were noticeably drier during the 2004 survey season than in 2003.

BILL WILLIAMS SITE #1

Area: 2.2 ha Elevation: 140 m UTM: 768913E 3798508N

This mixed-native site has an overstory of large Goodding willow and Fremont cottonwood 15 m in height and an understory of tamarisk and arrowweed. The site is surrounded by water and is accessible by kayak, with approximately 40% of the site vegetated by cattail. The site contains large quantities of downed wood, and some of the overstory trees have dropped large branches, creating gaps in the canopy. Overall canopy closure is <50%. Approximately 5% of the site was inundated in mid-May. Water levels rose in mid-June, at which time about 30% of the site was under ankle-deep water. The site got progressively drier through the remainder of the summer, with approximately 10% of the site inundated in mid-July.

We detected one willow flycatcher at Site #1 from 27 May to 9 June. Details of occupancy of all flycatchers at Bill Williams are presented in Chapter 3. Site #1 was surveyed nine times, totaling 11.0 observer-hours.

BILL WILLIAMS SITE #2

Area: 3.9 ha Elevation: 140 m UTM: 769062E 3798260N

This mixed-native site has an overstory of large Goodding willow and Fremont cottonwood trees up to 12 m in height and an understory of tamarisk 5 m in height. Soil within the site was dry throughout the survey season, and many branches and overstory trees had fallen since the 2003

survey season. Overall canopy closure is approximately 50%. Cattail marshes within the site were mostly dry and dead. The site is bordered on the southwest by a narrow channel of open water where an arm of Lake Havasu follows the channel of the Bill Williams River. The site is accessible by kayak.

We detected three willow flycatchers on the opposite side of the channel from Site #2. Details of occupancy are presented in Chapter 3. The site was surveyed eight times, totaling 11.3 observer-hours. Each detection location was also visited three times following the initial detection, with no further detections. Cowbirds were recorded on all visits.

BILL WILLIAMS SITE #11

Area: 4.2 ha Elevation: 140 m UTM: 769331E 3797914N

This mixed-native site has an overstory of Goodding willow and Fremont cottonwood trees up to 20 m in height, with canopy closure approximately 50%. Tamarisk is the dominant species in the understory, and there is thick deadfall up to 2 m in height. Soils within the site were dry throughout the survey period, though standing water was present in a narrow channel where an arm of Lake Havasu follows the channel of the Bill Williams River. The site is accessible by kayak.

We detected one willow flycatcher at the site on 15–16 June. The site was surveyed eight times, totaling 5.1 observer-hours. Cowbirds were recorded on five visits.

BILL WILLIAMS SITE #4 AND SITE #3

Site #4: Area: 5.8 ha Elevation: 140 m UTM: 769652E 3797492N
Site #3: Area: 3.7 ha Elevation: 140 m UTM: 769819E 3797320N

These two sites are contiguous and together are known as Mosquito Flats. Vegetation is mixed-native, with an overstory of Goodding willow and Fremont cottonwood 15 m in height and patches of monotypic tamarisk up to 8 m in height. Canopy closure is approximately 50%. Stands of dead cattails occupy approximately 20% of the site. Many large willows and cottonwoods have fallen since the 2003 survey season, leaving large gaps in the canopy. Ground cover in portions of the site consists of thick, dead, woody vegetation. Saturated soil was present throughout the breeding season in approximately 2% of Site #3; otherwise, soils at these sites were dry.

We detected one willow flycatcher in Site #4 and three willow flycatchers in Site #3. No breeding activity was recorded. Details of color-banding and occupancy are presented in Chapter 3. Portions of the sites not known to be occupied by flycatchers were surveyed over 10 times, totaling 62.5 observer-hours. Cowbirds were detected on all but one visit.

BILL WILLIAMS SITE #5

Area: 2.8 ha Elevation: 143 m UTM: 771644E 3796928N

Site #5 is located on the eastern edge of the Bill Williams River floodplain and is bordered to the east by upland desert. This site consists of mixed-native vegetation, with a canopy of Goodding willow and Fremont cottonwood 10 m in height and an understory of tamarisk 3 m in height. Some of the overstory trees are dead or dying, and overall canopy closure is approximately 25%. The site contained one pool of standing water, which was 30 cm deep in late May and was completely dry by early July.

We detected one willow flycatcher at Site #5 on 30 May. This bird was not detected on three subsequent visits to the detection location in the week following the initial detection. Site #5 was surveyed nine times, totaling 12.3 observer-hours. Cowbirds were recorded on seven visits.

MINERAL WASH COMPLEX

Area: 19.6 ha Elevation: 162 m UTM: 774558E 3795396N

A channel of the Bill Williams River runs through this mixed-native site, approximately 3 km upstream of Site #5. The site is similar in structure and composition to the other survey sites at Bill Williams, with an overstory of Fremont cottonwood and Goodding willow 15–20 m in height and an understory of tamarisk 3 m in height. Overall canopy closure is <50%. No flowing water was recorded at this site during the survey season. Isolated pools were present in the riverbed during May and June, but the site was completely dry by early July. Cattails that had grown in the riverbed were primarily dead by July. Many trees appear to be dead or dying, and several dead tamarisk within the site fell during the survey season.

We detected one willow flycatcher on 23 May. This bird was not detected on three subsequent visits to the detection location in the week following the initial detection. The site was surveyed nine times, totaling 16.5 observer-hours. Cowbirds were recorded on eight visits.

BEAVER POND

Area: 21.3 ha Elevation: 165 m UTM: 775247E 3794643N

This mixed-native site consists of Fremont cottonwood and Goodding willow with an understory of tamarisk lining a string of beaver ponds along the channel of the Bill Williams River. The cottonwoods are up to 20 m in height and are emergent above the willows. Many of the cottonwoods are dying, and their canopies are primarily leafless. Cattails line the beaver ponds, and areas not immediately adjacent to the river are dry and vegetated by tamarisk and honey mesquite (*Prosopis glandulosa*) 5–7 m in height. Overall canopy closure at the site is <50%. The beaver ponds contained water up to 30 cm deep in mid-May. The water level in these ponds dropped throughout the survey season, and by July very little standing water remained.

We detected willow flycatchers at this site on various dates between 21 May and 19 June. None of these birds displayed territorial behavior, and all were suspected to be migrants. The site was surveyed 10 times, totaling 25.8 observer-hours. Cowbirds were recorded on nine visits.

BILL WILLIAMS SITE #8

Area: 10.3 ha Elevation: 168 m UTM: 777902E 3794686N

This narrow, linear site borders the river channel approximately 3 km upstream from the Mineral Wash Complex, at the confluence of Mohave Wash and the Bill Williams River. This section of the river is confined between high cliffs on both banks. Cottonwood and willow trees 15 m in height line the river channel and the edges of beaver ponds, with an understory of tamarisk also present throughout the site. This site had flowing water in the river channel throughout the survey season, but soils away from the channel were dry. Overall canopy closure is <50%.

We detected one willow flycatcher at Site #8 on 28 May, but no flycatchers were detected on 10 subsequent surveys. Observer-hours totaled 19.4, and cowbirds were detected on 10 visits.

BIG HOLE SLOUGH, CALIFORNIA

BIG HOLE SLOUGH

Area: 16.5 ha Elevation: 82 m UTM: 728526E 3724192N

This mixed-native site consists of a cattail marsh edged with narrow bands of coyote willow 5 m in height and an understory of seep willow. Away from the marsh, the site contains tamarisk and honey and screwbean mesquite (*Prosopis pubescans*) 8 m in height with an understory of arrowweed. A few tall Goodding willow and Fremont cottonwood are present at the site. Overall canopy closure is approximately 50%. The cattail marsh (approximately 30% of the site) had shallow, standing water throughout the survey season.

We detected 1 willow flycatcher on 15 May, 3 on 25 May, 14 on 2 June, and 2 on 13 June. No willow flycatchers were detected during the last six surveys. The site was surveyed 10 times, totaling 25.5 observer-hours. Large flocks of cowbirds were detected on all visits, and no livestock use was noted.

EHRENBERG, ARIZONA

EHRENBERG

Area: 4.7 ha Elevation: 78 m UTM: 729946E 3715773N

This mixed-native site consists of a canopy of Fremont cottonwood and Goodding willow 15 m in height with an understory of coyote willow. The periphery of the site is vegetated with a mix of tamarisk and mesquite. Approximately 5% of the site is a cattail marsh that had 5 cm of standing water in mid-May but was dry by mid-June. The site is separated from the Colorado River by a levee. Canopy closure at the site is approximately 50%.

We detected two willow flycatchers at Ehrenberg on 15 and 25 May and one willow flycatcher on 2 June. No willow flycatchers were detected during the last seven surveys. The site was surveyed 10 times, totaling 14.5 observer-hours. Cowbirds were detected on six visits, and burros use the periphery of the site.

CIBOLA NATIONAL WILDLIFE REFUGE, ARIZONA AND CALIFORNIA

CIBOLA SITE #2 AND CIBOLA SITE #1

Cibola Site #2: Area: 16.4 ha Elevation: 65 m UTM: 716845E 3684106N
Cibola Site #1: Area: 7.7 ha Elevation: 65 m UTM: 717233E 3683564N

These adjacent, mixed-exotic sites consist of a 200-m-wide strip of vegetation bordering a canal east of the Colorado River. The sites are vegetated primarily by tamarisk, which is dry and scrubby on the eastern edge of the sites and becomes denser toward the cattail marshes on the western edge of the sites adjacent to the canal. Emergent Fremont cottonwood and Goodding willow occur primarily along the eastern edge of these marshy areas. The cottonwoods and tamarisk reach heights of 20 and 6 m, respectively, and overall canopy closure is 50–70%. No standing water or saturated soil was documented at these sites, though field personnel did not explore the cattail areas to determine if water was present.

We detected 9 willow flycatchers at these sites on 26 May, 16 on 1 June, 3 on 11 June, and 1 on 14 June. No willow flycatchers were detected during the last five surveys. We surveyed the sites 10 times, totaling 32.8 observer-hours. Cowbirds were recorded on all visits, and burro trails were noted on the periphery of the site.

HART MINE MARSH

Area: 31.6 ha Elevation: 65 m UTM: 717492E 3682569N

This mixed-exotic site parallels a canal just east of the Colorado River, immediately south of Cibola Site #1. The site consists of a mix of tamarisk and linear stretches of marsh, which make up approximately half the site. Canopy height of the tamarisk is approximately 5 m, and canopy closure is approximately 70%. The marsh held up to 70 cm of standing water in mid-May, and the water level fell throughout the survey season. Tamarisk areas contained dry soils throughout the survey season.

We detected five willow flycatchers on 25 May and three on 1 June. No willow flycatchers were detected during the last seven surveys. The site was surveyed 10 times, totaling 18.3 observer-hours. Cowbirds were detected on eight visits, and burro trails were noted on the east side of the site.

THREE FINGERS LAKE

Area: 70.2 ha Elevation: 65 m UTM: 715066E 3681800N

This mixed-exotic site consists of a large island with shores vegetated by cattails, bulrush, tamarisk 6 m in height, and a few large Goodding willow. Canopy closure along the shore is 50–70%. The interior of the island is vegetated primarily by arrowweed and had dry soils throughout the survey period.

We detected 11 willow flycatchers on 16 May, 33 on 26 May, 6 on 31 May, and 3 on 12 June. No willow flycatchers were detected during the last six surveys. The site was surveyed 10 times, totaling 35.7 observer-hours. Cowbirds were detected on all visits, and no livestock use was noted.

CIBOLA LAKE NORTH, EAST, AND WEST

Cibola Lake North:	Area: 8.5 ha	Elevation: 64 m	UTM: 716468E 3680005N
Cibola Lake East:	Area: 4.5 ha	Elevation: 64 m	UTM: 717146E 3679673N
Cibola Lake West:	Area: 7.0 ha	Elevation: 64 m	UTM: 716748E 3679317N

These mixed-exotic sites border Cibola Lake. The perimeter of each site adjacent to the lake is vegetated by cattail and bulrush. Areas immediately inland from the cattail marshes are vegetated by dense tamarisk 4–6 m in height with scattered Goodding willow. The interiors of the sites have patchy vegetation with a mix of tamarisk, arrowweed, and open sandy areas. Canopy closure along the marsh edges is 50–70%, while the interiors of sites have canopy closure <25%. Soils within all sites were dry throughout the survey period.

We detected two willow flycatchers at Cibola Lake North on 25 May. At Cibola Lake East, we detected one willow flycatcher on 26 May and 14 June. At Cibola Lake West, we detected 11 flycatchers on 25 May and 6 flycatchers on 1 June. No willow flycatchers were detected during the last five surveys. The sites were surveyed 10 times, totaling 44.6 observer-hours. Cowbirds were detected on all visits, and tracks of burros and feral pigs were noted at Cibola Lake East.

WALKER LAKE

Area: 24.0 ha Elevation: 64 m UTM: 716081E 3676249N

This mixed-exotic site is located between Walker Lake and the Colorado River. Most of the site consists of monotypic tamarisk approximately 5 m in height with 50–70% canopy closure. Patches of arrowweed, short tamarisk, and individual Goodding willow and Fremont cottonwood trees are interspersed throughout the site. A narrow band of common reed (*Phragmites* sp.) borders the site along the river. Soils in the interior of the site were dry throughout the survey season.

We detected 22 willow flycatchers at Walker Lake on 25 May, 2 on 31 May, and 12 on 9 June. No willow flycatchers were detected during the last seven surveys. The site was visited 10 times, totaling 11.0 observer-hours. Cowbirds were detected on eight visits, and no evidence of livestock was recorded.

IMPERIAL NATIONAL WILDLIFE REFUGE, ARIZONA AND CALIFORNIA

PARADISE

Area: 6.1 ha Elevation: 62 m UTM: 714108E 3666148N

This site is mixed-native habitat, with stringers of Fremont cottonwood and Goodding willow, 15–20 m in height, bordering a small cattail marsh. Tamarisk (5 m in height) and arrowweed (3 m in height) make up the understory. Standing water was present throughout the survey season in the cattail/marsh. The site is separated from the Colorado River by a narrow strip (50 m wide) of dense tamarisk. A cattail marsh borders the site to the south. Overall canopy closure is approximately 25%.

We detected seven willow flycatchers on 25 May, three on 31 May, seven on 9 June, and three on 13 June. No willow flycatchers were detected during the last six surveys. The site was surveyed 10 times, totaling 14.4 observer-hours. Cowbirds were detected on every visit, and no sign of livestock use was observed on the site.

HOGE RANCH

Area: 21.8 ha Elevation: 61 m UTM: 717191E 3660298N

This large site is mixed-exotic habitat, dominated by tamarisk (4–6 m in height), with some young (8 m in height) Goodding willows and, at the southern end of the site near the old ranch, a few emergent Fremont cottonwoods (15 to 18 m in height). There are pockets of cattails, bulrush, and common reed, which occupy less than 20% of the site. The marshes in the interior of the site were dry in May but had standing water in early July, which persisted throughout the remainder of the survey season. The site also borders the Colorado River. Canopy closure is approximately 70%.

We detected 2 willow flycatchers at Hoge Ranch on 20 May, 9 on 30 May, 16 on 2 June, and 1 on 11 June. No flycatchers were detected during the last six surveys. The site was surveyed 10 times, totaling 15.9 observer-hours. Cowbirds were detected on nine visits, and there were signs of wild burros using portions of the site.

ADOBE LAKE

Area: 8.2 ha Elevation: 60 m UTM: 717307E 3659034N

This site consists primarily of exotic vegetation, consisting of dense tamarisk (5 to 7 m in height) with many dead branches in the understory. There are scattered Goodding willows (10 m in

height) on the site, but no contiguous stands of willows. The site is adjacent to the Colorado River, but soils within the site were dry. Canopy closure within the site is 70–90%.

We detected three willow flycatchers on 30 May and five on 2 June. No willow flycatchers were detected during the last seven surveys. The site was surveyed 10 times, totaling 3.3 observer-hours. Cowbirds were detected on two visits, and there was no sign of livestock use of the site.

RATTLESNAKE

Area: 1.7 ha Elevation: 60 m UTM: 720031E 3659546N

This mixed-native site is a patchwork of emergent Goodding willow, strips of dense coyote willow 6–8 m in height, and tamarisk. Tamarisk is widespread in patches throughout the site but is not the dominant vegetation. Canopy closure is 70–90%. Large cattail marshes separate this site from the Colorado River. This site had saturated soils in late June and may have been inundated earlier in the season.

No willow flycatchers were detected at this site. The site was first surveyed on 16 June as a replacement for sites that had burned over the winter. This site is difficult to access but is extensive and warrants further exploration. The site was surveyed five times, totaling 7.6 observer-hours. Cowbirds were detected on four occasions, and no livestock use was noted.

NORTON SOUTH

Area: 1.5 ha Elevation: 60 m UTM: 720960E 3656695N

This mixed-native site consists of a planted stand of Goodding willow and Fremont cottonwood approximately 20 × 100 m in size. Canopy height is 15–20 m and overall canopy closure is around 50%. The understory is varied and contains tamarisk, arrowweed, seep willow, cattail, mesquite, and coyote willow. The site is bordered to the north by a cattail marsh on the margin of Taylor Lake and to the south by desert upland. The site had standing water and saturated soils in the cattail marsh on the north edge of the site.

We detected one willow flycatcher at Norton South on 15 June, the date the first survey of this site was completed. This site was selected as a replacement survey location for sites that had burned over the winter. This site was surveyed six times, totaling 6.2 observer-hours. Cowbirds were detected on four visits, and burros use the desert areas surrounding the site.

PICACHO NW

Area: 11.0 ha Elevation: 59 m UTM: 722799E 3656503N

This site is mixed-native habitat that was intensively managed in the 1990s to remove tamarisk and plant cottonwoods. It is currently a gallery forest of Fremont cottonwood and Goodding willow, 15–20 m in height, with canopy closure approximately 50%. The understory is 2–4 m in height and contains honey mesquite, arrowweed, seep willow, and tamarisk. The site borders the

Colorado River, and small portions of the site near the river contained saturated soil in May and June. The eastern portion of the site is fenced to exclude burros, and this portion of the site has a denser understory than unfenced portions. Outside of the managed area, the habitat is dominated by tamarisk and common reed.

We detected two willow flycatchers at Picacho NW on 20 May, four on 28 May and 4 June, and one on 11 June. No willow flycatchers were detected during the last six surveys. The site was surveyed 10 times, totaling 13.4 observer-hours. Cowbirds were detected on eight visits, and there was evidence of heavy use of the site by wild burros.

MILEMARKER 65

Area: 10.0 ha Elevation: 58 m UTM: 726646E 3657774N

Milemarker 65 is a narrow strip of mixed-exotic vegetation between the Colorado River and a backwater marsh, which is dominated by bulrush. Vegetation at the site consists primarily of dense tamarisk 6 m in height. Dense common reed, approximately 3 m in height, also occurs throughout the site and together with the tamarisk creates almost complete canopy closure. Soils within the site were dry during the survey period.

We detected four willow flycatchers on 20 May, one on 28 May, two on 2 June, and one on 11 June. The site was surveyed 10 times, totaling 6.4 observer-hours. Cowbirds were recorded on nine visits, and no livestock use was noted.

CLEAR LAKE/THE ALLEY

Area: 8.3 ha Elevation: 59 m UTM: 731425E 3657901N

Vegetation at this site is primarily exotic, consisting of monotypic tamarisk 8–10 m in height. Emergent Goodding willow, up to 13 m in height, are scattered throughout the site. The tamarisk is mature, with large amounts of deadfall ground cover, and canopy closure is approximately 90%. The site is surrounded on the east, north, and west by upland desert and is bordered on the south by cattail marshes and common reed. A narrow, backwater channel runs northward from the Colorado River into the center of the site, but soils outside of the channel were dry during the survey period.

We detected one willow flycatcher on 19 May, three on 28 May, and one on 11 June. No willow flycatchers were detected during the last six surveys. The site was surveyed 11 times, totaling 8.7 observer-hours. Cowbirds were detected on seven visits, and wild burros use the site and the surrounding uplands.

IMPERIAL NURSERY

Area: 1.4 ha Elevation: 58 m UTM: 734247E 3653822N

This site is a cottonwood planting managed by the Imperial NWR. The cottonwoods are approximately 10 m in height, and there is a 10-m-diameter clump of willows 4 m in height in one portion of the understory. Except for this clump of willows, the understory is completely open, and canopy closure is approximately 90%. The site is bordered to the north by a patchwork of cattails, common reed, and tamarisk. Refuge personnel periodically inundate the cottonwood plantation with up to 15 cm of water.

We detected three willow flycatchers on 18 and 29 May and four flycatchers on 3 June. The site was surveyed 13 times, totaling 7.5 observer-hours. Cowbirds were detected on nine visits, and there was no evidence of livestock using the site.

FERGUSON LAKE

Area: 29.1 ha Elevation: 57 m UTM: 733614E 3651765N

The Ferguson Lake site is on a strip of land between Ferguson Lake and the Colorado River. Vegetation is mixed-native, with stringers of Goodding willow and Fremont cottonwood, up to 15 m in height, forming a sparse overstory with <50% canopy closure along the western edge of the site bordering Ferguson Lake. On the eastern edge of the site adjacent to the Colorado River the area is vegetated by scattered tamarisk, arrowweed, and mesquite. Soils were dry during the survey period.

We detected 2 willow flycatchers at Ferguson Lake on 21 May, 16 on 27 May, 6 on 1 June, and 3 on 10 June. No flycatchers were detected on the last six visits. Cowbirds were detected on nine visits, and no evidence of livestock use was recorded.

FERGUSON WASH

Area: 6.8 ha Elevation: 58 m UTM: 733936E 3650383N

This mixed-exotic site, at the outflow of Ferguson Wash into Ferguson Lake, is dominated by dense, mature tamarisk, approximately 7 m in height, with dense deadfall in the understory. A few scattered, emergent Goodding willows are present near the lake, and canopy closure is around 90%. The site is bordered on the lakeside by cattails and bulrush and on the upland side by desertscrub. A backwater channel penetrates to the interior of the site.

We detected two willow flycatchers at Ferguson Wash on 21 May, six on 1 June, and three on 10 June. No willow flycatchers were detected during the last six surveys. The site was visited 10 times, totaling 12.8 observer-hours. Cowbirds were recorded on four visits, and burro trails were abundant on the periphery of the site.

GREAT BLUE HERON

Area: 7.1 ha Elevation: 58 m UTM: 736876E 3652307N

This site, on the eastern shore of Martinez Lake, consists of mixed-exotic vegetation. Near the shore of Martinez Lake, Goodding willows form an overstory 15 m in height, with an understory of tamarisk, common reed, and giant reed (*Arundo* sp.). Canopy closure in this area is 80%. Farther from the lake, the site is vegetated by scattered arrowweed and tamarisk 6 m in height, with canopy closure <50%. No standing water or saturated soils were noted within the site.

We detected 7 willow flycatchers on 17 May, 36 on 29 May, 25 on 3 June, 12 on 10 June, 3 on 11 June, and 2 on 12 June. The site was surveyed 11 times, with 38.2 observer-hours spent at the site. Flycatcher banding activities occurred at this site on 10–12 June. Cowbirds were recorded on nine visits, and burros use the uplands on the periphery of the site.

POWERLINE

Area: 2.1 ha Elevation: 58 m UTM: 737353E 3652098N

This site is located south of the Great Blue Heron site along the eastern shore of Martinez Lake. Vegetation is mixed-native, and consists of a strip of Goodding willow and Fremont cottonwood along the border of a dry cattail marsh. Overstory height is approximately 12 m, and canopy closure is <50%. Tamarisk, arrowweed, and seep willow are present in the understory. No standing water or saturated soils were noted within the site.

We detected one willow flycatcher at this site on 29 May and 3 June. The site was surveyed 11 times, with 7.4 observer-hours spent at the site. Cowbirds were recorded on nine visits, and burros use the uplands on the periphery of the site.

MARTINEZ LAKE

Area: 4.6 ha Elevation: 58 m UTM: 737362E 3651773N

This mixed-native site is adjacent to and south of the Powerline site on the eastern shore of Martinez Lake. Goodding willows <10 m in height are scattered throughout the northern portion of the site, and clustered Goodding willows and Fremont cottonwoods up to 15m in height are present in the southern portion. Arrowweed and tamarisk dominate the understory, and overall canopy closure is <25%. Cattails and common reed border the site along the lakeshore. No standing water or saturated soils were recorded within the site.

We detected two willow flycatchers at Martinez Lake on 18 May, one on 29 May and 3 June, four on 10 June, and one on 24 June. The site was visited 11 times, totaling 11.1 observer-hours. Cowbirds were detected on eight visits, and burros use the adjacent uplands.

OTHER SURVEY AREAS

Taylor Lake	Area: 3.0 ha	Elevation: 60 m	UTM: 721566E 3657387N
Picacho Camp Store:	Area: 3.3 ha	Elevation: 58 m	UTM: 724451E 3656575N

These sites burned over the winter prior to the 2004 flycatcher breeding season; thus, surveys of these sites were discontinued. Although these sites had burned and were essentially devoid of green vegetation, two willow flycatchers were detected at Taylor Lake and one at Picacho Camp Store on 20 May.

MITTRY LAKE, ARIZONA AND CALIFORNIA

MITTRY WEST

Area: 4.4 ha Elevation: 48 m UTM: 734967E 3638617N

The center of this mixed-native site is dominated by Goodding willow 12 m in height with a dense understory of arrowweed and tamarisk. Canopy closure is approximately 80%. Honey and screwbean mesquite are scattered throughout the site but are more common near the periphery. Portions of the site appear to have burned within the last several years. There are patches of cattail within the site, and standing water was present within the site throughout the survey season.

We detected one willow flycatcher on 17 May, five on 27 May, and six on 11 June. No flycatchers were detected during the last six surveys. The site was visited 10 times, totaling 17.0 observer-hours. Cowbirds were detected on all visits, and burros use the uplands adjacent to the site.

MITTRY SOUTH

Area: 15.5 ha Elevation: 46 m UTM: 735918E 3634361N

This monotypic tamarisk site borders Mittry Lake. Vegetation at the site is very dense, with abundant dead branches and deadfall in the understory. Canopy closure within the tamarisk is >90%, and canopy height is approximately 7 m. The site is bordered to the south by Mittry Lake, and the marshy edge of the site is vegetated by cattail, bulrush, and common reed. The northern edge of the site was dry during the survey period and is bordered by an area that has been recently bulldozed.

We detected 15 flycatchers at Mittry South on 30 May and 1 on 13 June. No willow flycatchers were detected during the last six surveys. The site was visited 10 times, totaling 15.2 observer-hours. Cowbirds were detected on eight visits, and no evidence of livestock use was recorded.

POTHOLES EAST

Area: 2.0 ha Elevation: 54 m UTM: 731831E 3634398N

This mixed-exotic site is located adjacent to the All American Canal. A cattail pond in the center of the site is surrounded by athel (*Tamarix aphylla*) and tamarisk 8 m in height and a few emergent Fremont cottonwoods up to 15 m in height. Overall canopy closure is <25%. Fan palms (*Washingtonia* sp.) are also present at the site, and honey mesquite trees grow on the upland edges of the site.

We detected one willow flycatcher on 18 May, four on 27 May, and two on 10 June. No willow flycatchers were detected during the last six surveys. The site was surveyed 10 times, totaling 4.9 observer-hours. Cowbirds were detected on eight visits, and evidence of burros was abundant in the upland areas surrounding the site.

POTHOLES WEST

Area: 6.6 ha Elevation: 53 m UTM: 730497E 3635593N

This mixed-exotic site is located adjacent to the All American Canal. A pond with cattails and bulrush occupies the center of the site and is surrounded by tamarisk and athel. Canopy closure is 50–70%, and canopy height ranges from 5 to 10 m. Soils away from the pond were very dry during the survey period, and there is a patch of mesquite trees on the north side of the site.

We detected one willow flycatcher on 27 May, three on 3 June, and two on 10 June. No willow flycatchers were detected during the last six surveys. The site was surveyed 10 times, totaling 7.5 observer-hours. Cowbirds were detected on nine visits, and burros use the uplands surrounding the site.

YUMA, ARIZONA

RIVER MILE 33

Area: 20.6 ha Elevation: 38 m UTM: 726379E 3623030N

This mixed-native site borders the Gila River. The center of the site consists of a stand of Goodding willow and Fremont cottonwood with a multilayered canopy up to 15 m in height. Tamarisk is present in the understory, and common reed occurs in dense clumps. Canopy cover is variable from 25 to 70%. This portion of the site was inundated with approximately 0.5 m of water in mid-May, but only saturated soil remained by 12 June. Cottonwoods and willows also occur in narrow stringers along irrigation ditches on the periphery of the site. Portions of the site that were dry throughout the survey period are vegetated by tamarisk, arrowweed, and young, dying willows.

At River Mile 33, we detected 11 willow flycatchers on 31 May, 2 on 8 and 12 June, and 1 on 13 June. An unsuccessful attempt was made to capture the flycatcher detected on 13 June.

No flycatchers were detected during the last six surveys. The site was surveyed 11 times, totaling 34.2 observer-hours. Cowbirds were recorded on all but one visit, and there was no evidence of livestock use at the site.

GILA CONFLUENCE WEST

Area: 5.6 ha Elevation: 37 m UTM: 729115E 3622896N

This mixed-native site borders the Colorado and Gila Rivers. Sparse Goodding willows and Fremont cottonwoods surround a dry cattail marsh in the center of the site. Canopy height is approximately 10 m, and canopy closure is 25–50%. Arrowweed and tamarisk form a patchy understory, with sandy, open areas throughout the site. Soils within the site were primarily dry during the survey period.

We detected one willow flycatcher on 19 May, nine on 30 May, and five on 8 June. No willow flycatchers were detected during the last seven surveys. The site was surveyed 10 times, totaling 9.7 observer-hours. Cowbirds were detected on eight visits, and no evidence of livestock use was noted.

GILA CONFLUENCE NORTH

Area: 4.6 ha Elevation: 40 m UTM: 729445E 3623131N

This mixed-native site borders the north side of the Colorado River at the confluence of the Gila and Colorado Rivers. Goodding willow, approximately 8 m in height and closely spaced, is the dominant vegetation at the site. Canopy closure is approximately 50%. Fremont cottonwoods up to 13 m in height are also scattered throughout the site, and arrowweed, tamarisk, and seep willow are common in the understory. Areas of cattails within the site were dry throughout the survey season, and the only inundated or saturated soils were adjacent to the Colorado River.

We detected 5 willow flycatchers at Gila Confluence North on 18 May, 14 on 29 May, and 1 on 8 June. No willow flycatchers were detected during the last seven surveys. The site was surveyed 10 times, totaling 14.3 observer-hours. Cowbirds were detected on six visits, and no evidence of livestock use was noted.

GILA RIVER SITE #2

Area: 8.1 ha Elevation: 45 m UTM: 736504E 3623771N

This mixed-native site consists of an overstory (up to 15 m in height) of Fremont cottonwood and Goodding willow, with an understory of arrowweed. Tamarisk is present along the northern edge of the site, and canopy closure is <50%. The site is bordered to the north by agricultural fields and to the south by an open, sandy area vegetated by arrowweed. A stringer of cottonwoods and Goodding willows extends to the west along the edge of the agricultural fields. There was no standing water or saturated soils within the site during the survey period, but the western edge of the site borders a large pond.

One willow flycatcher was detected on 17 and 27 May, and four flycatchers were detected on 8 June. No willow flycatchers were detected during the last eight surveys. Gila River Site #2 was surveyed 11 times, totaling 14.4 observer-hours. Cowbirds were detected on nine visits. No evidence of livestock use was observed within the site, though burros use adjacent areas.

FORTUNA SITE #1

Area: 2.8 ha Elevation: 45 m UTM: 737635E 3623622N

This mixed-native site consists of a narrow patch of Fremont cottonwood and Goodding willow about 10 m in height with 50–70% canopy closure. Tamarisk and arrowweed form a patchy understory on the periphery of the site. Within the densest cottonwood/willow areas, there is little understory but many downed branches. The site is bordered to the north by agricultural fields and to the south by a cattail marsh and the Gila River.

We did not detect any willow flycatchers at this site. Surveys of this site commenced on 28 June, after Gila River Site #1 had burned. We surveyed the site four times, totaling 4.4 observer-hours. Cowbirds were detected on three visits, and no evidence of livestock use was noted at the site.

FORTUNA NORTH

Area: 4.8 ha Elevation: 46 m UTM: 739761E 3625570N

This site is vegetated primarily by mature tamarisk approximately 8 m in height. Goodding willow and honey mesquite are scattered throughout the site but make up less than 10% of the vegetation. Canopy closure is approximately 80%. There was no standing water or saturated soils within the site during the survey period, but the western edge of the site borders the Gila River.

Five willow flycatchers were detected on 27 May, and two flycatchers were detected on 8 June. No willow flycatchers were detected during the last seven surveys. The site was surveyed 10 times, totaling 10.2 observer-hours. Cowbirds were detected on eight visits, and no sign of livestock use was recorded.

GADSDEN BEND

Area: 4.4 ha Elevation: 28 m UTM: 707180E 3605713N

This mixed-native site is adjacent to a beaver pond along backwater channels of the Colorado River. The canopy reaches 20 m in height and is composed of Fremont cottonwood and Goodding willow. Many of these trees appear to be dying, and canopy closure is <50%. The site contains a sparse understory of scattered tamarisk and patches of arrowweed and common reed. The site is bordered to the north and east by agricultural fields and to the south and west by a large stand of mesquite.

At Gadsden Bend, we detected eight willow flycatchers on 18 and 28 May, one on 9 June, two on 13 June, and one on 14 June and 23 July. No flycatchers were detected on five surveys between 14 June and 23 July. The flycatcher detected on 23 July appeared to have unusually dark plumage with prominent wing bars and a visible gape, suggesting it may have been a hatch-year bird. The site was surveyed 11 times, totaling 10.9 observer-hours. Cowbirds were detected on 10 visits. No livestock use was recorded at the site, but site receives heavy foot traffic by illegal immigrants.

GADSDEN

Area: 24.3 ha Elevation: 25 m UTM: 707181E 3603994N

This mixed-native site consists of stringers of Goodding willow and scattered Fremont cottonwood lining backwater channels of the Colorado River. Canopy height is variable, ranging from approximately 8 to 12 m, and canopy closure is <25%. The site is bordered to the east by agricultural fields. The backwater channels, portions of which are vegetated by cattail and bulrush, have open, sandy shores. Open, sandy areas between the channels comprise approximately 50% of the site and are sparsely vegetated by arrowweed.

We detected 4 willow flycatchers at Gadsden on 18 May, 22 on 28 May, and 3 on 9 June. No flycatchers were detected during the last eight surveys. The site was surveyed 10 times, totaling 16.0 observer-hours, and cowbirds were recorded on nine visits. No livestock use was recorded, but the site receives heavy foot traffic by illegal immigrants.

HUNTER'S HOLE

Area: 16.5 ha Elevation: 26 m UTM: 706429E 3600299N

This mixed-native site consists of two patches of Goodding willow separated by a pond surrounded by cattail and common reed. In the southern patch, stringers of willow 10 m in height surround an oxbow. Areas away from the oxbow are vegetated by arrowweed and tamarisk with sparse canopy. Water depth in the oxbow varied throughout the season from 0 to >100 cm, apparently as the result of irrigation or upstream water releases. The northern patch is a mixture of willow and scattered Fremont cottonwood in stringers along channels and ponds. Canopy closure along the stringers is approximately 50%. Between the stringers, vegetation is a mix of tamarisk and arrowweed. Water was present in ponds and in a small stream in the northern patch throughout the survey season. Agricultural fields border the site to the east.

At Hunter's Hole, we detected 5 willow flycatchers on 18 May, 37 on 30 May, and 4 on 9 June. No flycatchers were detected during the last seven surveys. The site was surveyed 10 times, totaling 15.8 observer-hours, and cowbirds were recorded on all visits. No livestock use was recorded at the site, but site receives heavy foot traffic by illegal immigrants.

OTHER SURVEY AREAS

Gila River Site #1: Area: 5.7 ha Elevation: 44 m UTM: 733877E 3623626N

This mixed-native site burned during the field season. The center of the site consisted of a grove of Fremont cottonwood up to 20 m in height. Stringers of cottonwood, Goodding willow, and tamarisk extended to the east and west, with pockets of arrowweed present throughout the site.

Eight willow flycatchers were detected at this site on 27 May. After the site burned between 27 May and 8 June 2004, surveys were discontinued.

DISCUSSION

In 2004, we found resident, breeding Southwestern Willow Flycatchers at the four life history study areas (Pahranagat NWR, Mesquite, Mormon Mesa, and Topock Marsh) as well as at Littlefield and Grand Canyon (details of occupancy and breeding presented in Chapters 3 and 4). Resident, territorial flycatchers were also detected at Overton Wildlife Management Area and Bill Williams NWR, but no breeding activity was recorded at these sites. These results differ from those of previous years (McKernan and Braden 2002, Koronkiewicz et al. 2004) in that breeding (a single pair) was detected at Littlefield for the first time in 2004, and no breeding was detected at Bill Williams for the first time since 1998. Survey sites at Bill Williams had noticeably less standing water or saturated soil in 2004 than in 2003, and many trees displayed leafless branches, fallen branches, or mortality during the 2004 breeding season. These changes in habitat structure and abiotic characteristics may have influenced flycatcher occupancy at Bill Williams. Willow flycatchers have been detected within Grand Canyon since surveys began in 1997, with breeding flycatchers detected in 1999–2001 but not in 2002 or 2003. Flycatchers in Grand Canyon may also be responding to dramatic changes in water levels and habitat structure. Water levels in Lake Mead have been dropping since 2002, and many areas along the banks of the Colorado River in lower Grand Canyon that were inundated in 1998 and 1999 are now several meters above water level. Much of the vegetation in these areas is dead or dying. New stands of vegetation have also been arising in areas exposed by the receding water. Breeding was once again recorded in Grand Canyon in 2004.

Although many flycatchers were recorded at all surveyed sites south of Bill Williams until 15 June, with single detections recorded on 24 June and 23 July, monitoring results at these sites suggest these flycatchers were not resident, breeding individuals. Based upon the variation in total numbers of flycatchers detected at a particular site over the survey period (e.g., 4 flycatcher detections at Gadsden on 18 May, 22 on 28 May, 3 on 9 June, and 0 on 13 June) and the overall lack of territorial, aggressive behaviors exhibited toward conspecific broadcasts, willow flycatchers detected at sites south of Bill Williams in 2004 were most likely migrants. Given that willow flycatchers are one of the last long-distance Neotropical migrant passerines to arrive in the Southwest in spring,[8] the occurrence of northbound, migrant flycatchers along the southern stretches of lower Colorado River until late June is not surprising. Furthermore, with over 200 willow detections recorded in 2003 (Koronkiewicz et al. 2004) and over 600 detections

[8] Migrants have been documented as late as 23 June in southern Arizona (Phillips et al. 1964), and resident, wintering individuals have been recorded as far south as Costa Rica until the end of May (Koronkiewicz 2002).

recorded in 2004, this section of the lower Colorado River corridor is undoubtedly a major flyway for migrant willow flycatchers in spring. Results at survey sites south of Bill Williams in 2004 are consistent with those of previous years from 1997 to 2003 (McKernan and Braden 2002, Koronkiewicz et al. 2004), with no confirmed nesting recorded since 1938 (Unitt 1987). The flycatcher detected on 23 July at Gadsden Bend south of Yuma had unusually dark plumage, prominent wing bars, and a visible gape, suggesting that it was a young of the year. It is unlikely that this individual fledged at the Gadsden Bend site, however, given that no flycatchers were detected on five surveys between 22 June and 14 July. Given that young flycatchers at breeding sites we monitored in 2004 fledged as early as 23 June, a hatch year individual recorded at this time of the year is not unusual.

Although conservative estimates of the total number of flycatchers detected at a site on a particular survey day are presented above, estimating the total number of flycatchers detected at a site throughout the season is problematic. Unless the birds are uniquely color-banded there is no way of determining if the same individuals were observed at a site multiple times or if different individuals were present on subsequent surveys. Although we did conduct color-banding studies at sites south of Bill Williams in 2004 (see Chapter 3), no resightings were recorded on subsequent visits to sites where flycatchers were captured and color-banded. Color-banding studies at sites south of Bill Williams will be conducted in subsequent years to better determine residency, breeding status, and movement patterns in this area.

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CHAPTER 3

COLOR-BANDING AND RESIGHTING

INTRODUCTION

Long-term monitoring of willow flycatchers of known identity, sex, and age is the only effective way to determine demographic life history parameters such as annual survivorship of adults and young, site fidelity, seasonal and between-year movements, and population structure. Thus, as an integral part of life history studies, we captured and uniquely color-banded as many willow flycatchers as possible, allowing field personnel to resight individuals throughout the breeding season, as well as in subsequent years. Resighting consisted of using binoculars to determine the identity of a color-banded flycatcher by observing, from a distance, the unique color combination on its legs. This allowed field personnel to detect and monitor individuals without recapturing each bird. This was our second consecutive year of color-banding studies and builds upon color-banding initiated at these sites in 1998 (McKernan and Braden 1999).

METHODS

COLOR-BANDING

From early May through mid-August, we captured, uniquely color-banded, and subsequently monitored adult, nestling, and fledged willow flycatchers at the four life history study areas. Color-banding and monitoring were also conducted at all survey areas where resident willow flycatchers were detected. These additional monitoring sites were the Beaver Dam Wash/Virgin River confluence at Littlefield, the Muddy River Delta at the Overton Wildlife Management Area, river mile 274 along the Colorado River in Grand Canyon, and the Bill Williams National Wildlife Refuge. Color-banding effort was also expanded to include Key Pittman Wildlife Management Area (WMA) in Nevada and lands along the Virgin River near Mesquite. Field personnel from unrelated willow flycatcher projects were surveying and/or monitoring flycatchers in these areas and provided us with the locations of nests and territorial flycatchers. Banding was conducted opportunistically at both areas.

For the second consecutive year, we conducted color-banding studies from 10–30 June along the extreme southern stretches of the lower Colorado River. In 2004, banding studies were conducted along the Colorado River from Martinez Lake south to the Gila River, along the Gila River, and along the Colorado River from its confluence with the Gila River south to the Mexico border. In conjunction with subsequent surveys and resighting at these sites through late July, these additional studies were conducted to better determine flycatcher residency, breeding status, and movement patterns in this area. Banding efforts at all sites were primarily dependent upon the presence of vocal willow flycatchers.

Adult and fledgling flycatchers were captured using mist-nets, which provide the most effective technique for live-capture of adult songbirds (Ralph et al. 1993). We used a targeted capture technique (per Sogge et al. 2001), whereby a variety of conspecific vocalizations are broadcast from a CD player and remote speakers to lure territorial flycatchers into the nets. In addition, we used "passive netting," whereby several mist-nets are erected and periodically checked, with no broadcast of conspecific vocalizations. We banded each adult and fledged willow flycatcher with a single anodized (colored), numbered U.S. federal aluminum band on one leg and a colored metal band on the other. We coordinated all color combinations with the Federal Bird Banding Laboratory and all other Southwestern Willow Flycatcher banding projects to minimize replication of color combinations. For each color-banded bird recaptured, we visually inspected the legs and noted any evidence of irritation or injury that may be related to the presence of leg bands. Color change and fading have been documented in Hughes's celluloid-plastic leg bands, making resighting difficult under field conditions (Lindsey et al. 1995, USGS unpubl. data). For birds recaptured with faded and indistinguishable plastic bands, we replaced the bands with metal color-bands. All plastic bands removed were collected and the color-band combination, if recognizable, recorded along with the federal band number.

Nestlings were banded at 8 to 10 days of age when they were large enough to retain the leg bands, yet young enough that they would not prematurely fledge from the nest (Whitfield 1990, Paxton et al. 1997). Nestlings were banded only when the location of the nest was such that nest access and removal/replacement of the nestlings would not endanger the nest, nest plant, or nestlings. Nestlings were banded with a single anodized, numbered federal band, uniquely identifying each bird as a returning nestling in the event it returns in a subsequent year.

For each captured adult and fledged willow flycatcher, we recorded morphological measurements including culmen, tail, wing, mass, fat level, and molt onto standardized data forms (Appendix A). Sex was determined based on the presence of a cloacal protuberance in males or brood patch and/or egg(s) in the oviduct for females. Because physical breeding characteristics are not always present on captured individuals, flycatchers observed engaging in lengthy, primary song from high perches (male advertising song) prior to capture were sexed as male. Captured flycatchers lacking breeding characteristics and not observed engaging in male advertising song as noted above were sexed as unknown. Flycatchers with retained primary, secondary, and/or primary covert feathers (multiple aged remiges) were aged as second year adults, and those without (uniformly aged remiges) were aged as after second year (per Kenwood and Paxton 2001 and Koronkiewicz et al. 2002). Individuals in juvenile plumage (unworn flight feathers and body plumage with broad, buff colored, wing bars and fleshy gape) were aged as hatch year.

RESIGHTING

We determined the identity of a color-banded flycatcher by observing with binoculars, from a distance, the unique color combination on its legs. Typically, territories and active nests were focal areas for resighting, but entire sites were surveyed. Field personnel typically spent the early part of each morning color-banding, and then redirected their efforts to resighting as daylight increased and flycatchers became more difficult to capture. All banding, monitoring, and survey field personnel coordinated resighting efforts and recorded observations of color-banded and unbanded flycatchers onto standardized data forms (Appendix A). For resighted

flycatchers, we recorded color-band combinations, territory number, site, standardize confidence levels of the resight, and behavioral observations. Willow flycatchers detected for one week or longer, regardless of whether a possible mate was observed, were considered resident at a site. Resighted flycatchers observed engaging in lengthy, primary song from high perches (male advertising song) were sexed as male. Resighted flycatchers observed not engaging in male advertising song as noted above were sexed as unknown. All inactive territories were visited at least three times (each visit four days apart) before territory visits stopped. All territories were assigned a unique alphanumeric code and were plotted onto high-resolution aerial photographs, thus producing a spatial representation of the flycatcher population at each study location. Flycatchers were determined to be unpaired if none of the following breeding behaviors were observed: presence of another unchallenged flycatcher in the immediate vicinity, counter calling (*whitts*) with a nearby flycatcher, interaction twitter calls (*churr/kitters*) with a nearby flycatcher, a flycatcher in the immediate vicinity carrying nesting material, a flycatcher in the immediate vicinity carrying food or fecal sac, or adult flycatchers feeding young (per Sogge et al. 1997).

Unbanded flycatchers could not be identified to individual, but an unbanded flycatcher detected in a given location on multiple, consecutive visits was assumed to be the same individual. If an unbanded flycatcher was detected at a given location on multiple visits but one or more intervening visits failed to detect a flycatcher, the detections were considered to be different individuals.

RESULTS

ALL MONITORING SITES

Color-Banding and Resighting – Field personnel color-banded 57 new adult flycatchers and recaptured 16 individuals banded in previous years, not including individuals banded as juveniles in 2003. An additional 31 adults banded in previous years were resighted, of which 24 (77%) could be identified to individual. Of the 24, 2 were banded as juveniles in 2003. We banded 81 nestlings from 35 nests and captured eight fledglings (three from a nest that was never located, two from a nest too high to reach, and three that had previously been banded as nestlings). Of the 81 nestlings banded, 9 were known to have died before fledging. Eleven individuals originally banded as juveniles in 2003 were detected, with nine (82%) identified to individual via recapture or resighting. Overall, 58% of the adult flycatchers detected at the monitoring sites were color-banded by the end of the breeding season (Table 3.1). For 38 adult flycatchers detected, we were unable to determine if these individuals were color-banded (that is, banding status was undetermined). Thus, the percentage of color-banded adult flycatchers at sites is a conservative estimate. For details on all flycatchers detected at the study areas from 2003 to 2004 see Appendix C.

Table 3.1. Summary of Willow Flycatchers Detected at Monitored Sites during the 2004 Breeding Season*

Study Area	Site	Adults								Nestlings Banded (# Nests)	Fledglings Captured	% of All Adults Banded
		Total Adults Detected	New Captured	Recaptured		Resighted (color combinations confirmed)	Unbanded	Band Status Undetermined	Banded[1] (color combinations unconfirmed)			
				Not including 2003 Nestlings	2003 Nestlings							
Pahranagat	North	32	16	7	1	0	4	1	3	25 (10)	2[1]	84
	South	3	2	1	0	0	0	0	0	0	3[2]	100
	Study Area Total	**35**	**18**	**8**	**1**	**0**	**4**	**1**	**3**	**25 (10)**	**5**	**86**
Littlefield	North	3	1	0	2	0	0	0	0	2 (1)	0	100
Mesquite	West	30	7	7	2	10[3]	2	0	2	12 (5)	2[4]	93
Mormon Mesa	North	4	0	0	0	1	2	0	1	3 (1)	0	50
	Virgin River #1 North	15	8	0	1	1[3]	2	3	0	3 (2)	0	73
	Delta West	5	3	0	0	0	1	1	0	2 (1)	0	60
	Mormon Mesa South	3	0	0	0	0	1	2	0	0	0	0
	Study Area Total	**27**	**11**	**0**	**1**	**2**	**6**	**6**	**1**	**8 (4)**	**0**	**59**
Muddy River	Overton WMA	4	1	0	0	0	0	3	0	0	0	25
Grand Canyon	RM 274.5	2	2	0	0	0	0	0	0	3 (1)	0	100
	Burnt Springs	1	0	0	0	0	1	0	0	0	0	0
	Study Area Total	**3**	**2**	**0**	**0**	**0**	**1**	**0**	**0**	**3 (1)**	**0**	**67**
Topock	Pipes 1	1	0	0	0	0	0	1	0	0	0	0
	Pipes 3	5	2	0	0	0	1	2	0	2 (1)	1[4]	40
	PC6-1	9	1	0	1	0	7	0	0	2 (1)	0	22
	Pig Hole	2	1	0	0	0	1	0	0	1 (1)	0	50
	In Between	12	3	0	0	7	1	1	0	9 (3)	0	83
	800M	4	1	0	0	1	2	0	0	5 (2)	0	50
	Pierced Egg	5	1	0	0	1[5]	3	0	0	4 (2)	0	40
	Barbed Wire	1	0	0	0	0	1	0	0	0	0	0
	Swine Paradise	3	0	0	0	0	0	3	0	0	0	0
	Platform	1	0	0	0	0	1	0	0	0	0	0
	250M	2	1	0	0	0	1	0	0	1 (1)	0	50

Table 3.1. Summary of Willow Flycatchers Detected at Monitored Sites during the 2004 Breeding Season*, continued

Study Area	Site	Adults								Nestlings Banded (# Nests)	Fledglings Captured	% of All Adults Banded
		Total Adults Detected	New Captured	Recaptured		Resighted (color combinations confirmed)	Unbanded	Band Status Undetermined	Banded (color combinations unconfirmed)			
				Not including 2003 Nestlings	2003 Nestlings							
Topock	Hell Bird	9	3	1	0	1[5]	1	3	0	3 (1)	0	56
	Glory Hole	10	2	0	0	1	5	2	0	4 (2)	0	30
	South Dike Road[6]	2	0	0	0	0	0	2	0	0	0	0
	Lost Lake	1	1	0	0	0	0	0	0	0	0	100
	Study Area Total	**67**	**16**	**1**	**1**	**11**	**24**	**14**	**0**	**31 (14)**	**1**	**45**
Bill Williams	Site 1	1	0	0	0	0	0	1	0	0	0	0
	Site 2	3	0	0	0	0	0	3	0	0	0	0
	Site 11	1	0	0	0	0	0	1	0	0	0	0
	Site 4	1	0	0	0	0	1	0	0	0	0	0
	Site 3	3	1	0	0	1	1	0	0	0	0	67
	Site 5	1	0	0	0	0	0	1	0	0	0	0
	Mineral Wash	1	0	0	0	0	0	1	0	0	0	0
	Beaver Pond	12	0	0	0	0	4	8	0	0	0	0
	Site 8	1	0	0	0	0	0	1	0	**0**	0	0
	Study Area Total	**24**	**1**	**0**	**0**	**1**	**6**	**16**	**0**	**0**	**0**	**8%**
TOTAL		**193**	**57**	**16**	**7**	**24**	**43**	**40**	**6**	**81 (35)**	**8**	**57%**

* Individuals are identified as new captures (previously unbanded), recaptures of previously banded birds, resightings of previously banded birds for which band combinations were confirmed, birds known to be unbanded, birds for which band status could not be determined, and resighting of previously banded birds for which band combinations were undetermined. Included are total numbers of adults detected and percent of all adults banded. For breeding and/or residency status of adults see Tables 3.2–3.15.

[1] Nest too high to band, young banded as fledglings.

[2] Nest never located, young banded as fledglings.

[3] One individual color-banded as a fledgling in 2003.

[4] Previously banded as a nestling.

[5] Banded as a nestling in 2003.

[6] Not a formal survey site, flycatcher detected en route.

SITE-BY-SITE COLOR-BANDING AND RESIGHTING

MONITORING SITES

Pahranagat – We detected 29 resident, adult willow flycatchers (color-banded and unbanded) from 17 territories at Pahranagat. In addition to resident adults, we detected six individuals, two of which were probably migrants, for which residency and/or breeding status could not be confirmed (Tables 3.2 and 3.3). Of the 17 territories recorded at Pahranagat, 14 consisted of breeding individuals and 3 consisted of unpaired individuals. Of the breeding individuals, two males were polygynous. Field personnel captured and color-banded 18 new adults, and recaptured nine adult flycatchers banded in previous years, including one individual banded as a nestling in 2003. We banded 25 nestlings from 10 nests and 5 fledglings from 2 nests (3 from a nest that was never located, 2 from a nest too high to band). Of the resident adults, three remained unbanded, and banding status could not be confirmed for two. For the six adult individuals for which residency and/or breeding status could not be confirmed, one remained unbanded, and banding status could not be confirmed for two.

Table 3.2. Paired, Nestling, and Fledgling Willow Flycatchers Banded and Resighted at Pahranagat, NV, in 2004

Site	Date Banded[1]	Federal Band #[1]	Color Combination[2]	Old Color Combination[1,2]	Age[3]	Sex[4]	Territory	Observation Status[5]
North	10-Aug-00	2370-39903	DD(M):XX	Rs:YY(P)	A6Y	F	1	R 12 Aug
North	INA	INA	banded	N/A	AHY	M	1	RS
North	12-Aug-04	2370-39902	XX:KY(M)	N/A	HY	U	1	N
North	12-Aug-04	2370-39904	YV(M):XX	N/A	HY	U	1	N
North	20-Jun-04	2320-31657	WO(M):EE	N/A	AHY	F	2	N
North	1-Jun-03	2320-31454	EE:DO(M)	EE:KR(M)	A3Y	M	2	R 18 May, 17 Jun
North	25-Jun-04	2320-31601	UB:EE	N/A	L	U	2	N
North	25-Jun-04	2320-31602	UB:EE	N/A	L	U	2	N
North	25-Jun-04	2320-31603	UB:EE	N/A	L	U	2	N
North	25-Jun-04	2320-31604	UB:EE	N/A	L	U	2	N
North	19-Jun-04	2320-31656	WD(M):EE	N/A	AHY	F	3	N
North	15-May-04	2320-31590	GR(M):EE	N/A	AHY	M	3, 74	N
North	22-Jun-04	2320-31665	UB:EE	N/A	L	U	3	N
North	22-Jun-04	2320-31666	UB:EE	N/A	L	U	3	N
North	22-Jun-04	2320-31667	UB:EE	N/A	L	U	3	N
North	1-Aug-04	2360-59721	UB:EE	N/A	L	U	3	N
North	1-Aug-04	2360-59723	UB:EE	N/A	L	U	3	N
North	1-Aug-04	2360-59724	UB:EE	N/A	L	U	3	N
South	6-Aug-04	2320-31669	ZK(M):EE	N/A	AHY	F	5	N

Table 3.2. Paired, Nestling, and Fledgling Willow Flycatchers Banded and Resighted at Pahranagat, NV, in 2004, continued

Site	Date Banded[1]	Federal Band #[1]	Color Combination[2]	Old Color Combination[1,2]	Age[3]	Sex[4]	Territory	Observation Status[1,5]
South	17-May-03	3500-68971	XX:DD(M)	EE:KK(M)[6]	A3Y	M	5	R 6 Aug
South	6-Aug-04	3500-68968	DW(M):XX	N/A	HY	U	5	N
South	6-Aug-04	3500-68969	XX:GG(M)	N/A	HY	U	5	N
South	6-Aug-04	3500-68972	GG(M):XX	N/A	HY	U	5	N
North	17-Jun-04	2320-31662	YY(M):EE	N/A	SY	F	6	N
North	14-May-04	2320-31589	EE:YD(M)	N/A	AHY	M	6	N, R 17 Jun
North	2-Jul-04	2320-31571	UB:EE	N/A	L	U	6	N
North	18-Jun-04	2320-31663	EE:GK(M)	N/A	AHY	F	10	N
North	28-May-03	2320-31453	EE:WW(M)	N/A	A3Y	M	10, 22	R 4 May
North	25-Jun-04	2320-31605	UB:EE	N/A	L	U	10	N
North	25-Jun-04	2320-31606	UB:EE	N/A	L	U	10	N
North	18-Jul-00	2140-66621[7]	WR(M):UB	Rs:KG(M)	A6Y	F	11	R 23 Jun
North	16-Jun-97	1590-97338	OG(M):XX	Rs:XX	A9Y	M	11	R 22 Jun
North	23-Jun-04	2320-31484	UB:EE	N/A	L	U	11	N
North	20-Jun-04	2320-31658	WK(M):EE	N/A	AHY	F	12	N
North	15-May-04	2320-31591	GY(M):EE	N/A	AHY	M	12	N, R 16 May
North	26-Jun-04	2320-31607	UB:EE	N/A	L	U	12	N
North	26-Jun-04	2320-31608	EE:UB	N/A	L	U	12	N
North	26-Jun-04	2320-31609	UB:EE	N/A	L	U	12	N
North	26-Jun-04	2320-31610	EE:UB	N/A	L	U	12	N
North	17-Jun-04	2320-31661	EE:DW(M)	N/A	SY	F	13	N
North	6-Aug-01	2320-31592	GO(M):EE	G(HP)/O(HP):Rs	4Y	M	13	R 17 May
North	29-Jun-04	2320-31446	UB:EE	N/A	L	U	13	N
North	29-Jun-04	2320-31448	UB:EE	N/A	L	U	13	N
North	2-Jul-04	2320-31568	YG(M):EE	N/A	AHY	F	14	N
North	18-May-04	2320-31594	EE:YO(M)	N/A	AHY	M	14	N
North	25-Jul-04	2320-31447	UB:EE	N/A	L	U	14	N
North	25-Jul-04	2320-31449	UB:EE	N/A	L	U	14	N
North	25-Jul-04	2320-31450	UB:EE	N/A	L	U	14	N
North	N/A	N/A	UB:UB	N/A	AHY	F	21	RS
North	18-May-04	2320-31593	EE:WV(M)	N/A	AHY	M	21	N
North	18-Jun-04	2320-31664	YW(M):EE	N/A	AHY	F	22	N
North	2-Jul-04	2320-31569	UB:EE	N/A	L	U	22	N
North	2-Jul-04	2320-31570	EE:UB	N/A	L	U	22	N
North	N/A	N/A	UB:UB	N/A	AHY	F	23	RS

Table 3.2. Paired, Nestling, and Fledgling Willow Flycatchers Banded and Resighted at Pahranagat, NV, in 2004, continued

Site	Date Banded[1]	Federal Band #[1]	Color Combination[2]	Old Color Combination[1,2]	Age[3]	Sex[4]	Territory	Observation Status[1,5]
North	INA	INA	undetermined	INA	AHY	M	23	N/A
North	22-Jun-04	2320-31668	ZG(M):EE	N/A	AHY	F	74	N

[1] N/A = not applicable; INA = information not available.
[2] **Color-band codes**: D = dark/navy blue, EE = electric yellow federal band, G = green, (HP) = half plastic bands/bands cut to half the height of a full plastic band, K = black, (M) = metal pin striped band, O = orange, (P) = full plastic band, R = red, Rs = red federal band, UB = unbanded, V = violet, W = white, XX = silver federal band, Y = yellow, Z = gold, banded = bird has color-bands but combination undetermined, undetermined = presence of bands could not be determined.
Color combinations are read as the bird's left leg and right leg, top to bottom; two letters designate every band; color-band designations for right and left legs are separated with a colon.
[3] **Age in 2004**: L = nestling, HY = hatch year, SY = 2 years, AHY = 2 years or older, 3Y = 3 years, A3Y = 3 years or older, 4Y = 4 years, A4Y = 4 years or older, etc.
[4] **Sex codes**: F = female, M = male, U = sex unknown.
[5] **Observation status codes**: N = new capture, R = recapture - followed by date recaptured, RS = resight.
[6] Original federal band number: 2320-31451.
[7] Federal band removed because of leg injury.

Table 3.3. Summary of Unpaired, Resident Willow Flycatchers and Individuals for which Residency and/or Breeding Status Could Not Be Confirmed, Pahranagat, 2004

Site	Date banded[1]	Federal Band #[1]	Color Combination[2]	Old Color Combination[1]	Age[3]	Sex[4]	Location[5]	Observation Status[6]
North	25-Jun-03	2320-31459	EE:DK(M)	EE:UB	SY	M	T9	R 23 Jun, unpaired, detected 7–27 June
North	19-May-04	2320-31596	EE:YG(M)	N/A	SY	M	T15	N, unpaired, detected 16 May–11 Jun
North	N/A	N/A	UB:UB	N/A	AHY	M	T30	RS; unpaired, detected 23–29 July
North	18-May-04	2320-31595	GV(M):EE	N/A	AHY	U	F4	N; not detected post-capture, suspected migrant
North	N/A	N/A	UB:UB	N/A	AHY	M	F7	RS; detected 8 Jun
North	INA	INA	banded	N/A	AHY	U	F19	RS; detected 9 Jun
North	INA	INA	banded	N/A	AHY	M	F31	RS, detected 18–20 Jun
North	12-Aug-04	2370-39901	OO(M):XX	N/A	AHY	U	F32	N, not detected post-capture, suspected migrant
North	14-Jul-01	2320-31597[7]	EE:UB	KK(M):XX	A5Y	M	F35	R 20 May, not detected post-capture

[1] N/A = not applicable; INA = information not available.
[2] **Color-band codes**: D = dark/navy blue, EE = electric yellow federal band, G = green, (HP) = half plastic bands/bands cut to half the height of a full plastic band, K = black, (M) = metal pin striped band, O = orange, (P) = full plastic band, R = red, Rs = red federal band, UB = unbanded, V = violet, W = white, XX = silver federal band, Y = yellow, Z = gold, banded = bird has color-bands but combination undetermined.
Color combinations are read as the bird's left leg and right leg, top to bottom; two letters designate every band; color-band designations for right and left legs are separated with a colon.
[3] **Age in 2004**: SY = 2 years, AHY = 2 years or older, A5Y = 5 years or older.
[4] **Sex codes**: M = male, U = sex unknown.
[5] **Location Codes**: T = territorial individual detected for at least 7 days, F = individual detected for less than 7 days.
[6] **Observation status codes**: N = new capture, R = recapture - followed by date recaptured, RS = resight.
[7] Original federal band (2190-76604) was removed because of leg injury.

Littlefield – We detected three resident, adult willow flycatchers from two territories at Littlefield, consisting of a breeding pair and an unpaired individual. Field personnel captured and color-banded one new adult and recaptured two individuals banded as nestlings in 2003. We banded two nestlings from a single nest (Table 3.4 and 3.5).

Mesquite – We detected 28 resident, adult willow flycatchers (color-banded and unbanded) from 16 territories at Mesquite. In addition to resident adults, we detected two individuals for which residency and/or breeding status could not be confirmed (Table 3.6 and 3.7). Of the 16 territories recorded at Mesquite, 12 consisted of breeding individuals and four consisted of unpaired individuals. Field personnel captured and color-banded seven new adults, and recaptured nine adult flycatchers, including two individuals originally banded as nestlings in 2003. We resighted 10 other returning banded individuals, one of which was banded as a fledgling in 2003. We banded 12 nestlings from five nests and captured two 2004 fledglings previously banded as nestlings.[9] Of the resident adults, one remained unbanded, and banding status could not be confirmed for two. Residency and/or breeding status could not be confirmed for an unbanded individual.

Mormon Mesa – We detected 14 resident, adult willow flycatchers (color-banded and unbanded) from seven territories at Mormon Mesa, with all territories composed of paired individuals. In addition to resident adults, we detected 13 individuals, 4 of which were most likely migrants, for which residency and/or breeding status could not be confirmed (Table 3.8 and 3.9). Field personnel captured and color-banded 11 new adults and recaptured an individual originally banded as a nestling in 2003. We resighted two other returning banded individuals, one of which was banded as a fledgling in 2003. We banded eight nestlings from four nests. Of the resident adults, two remained unbanded, and banding status could not be confirmed for three. For migrants and individuals for which residency and/or breeding status could not be confirmed, four remained unbanded, and four individuals of were of unknown band status.

Muddy River – We detected one resident, adult willow flycatcher and three individuals for which residency and/or breeding status could not be determined on the Muddy River Delta. Field personnel captured one new adult, and three individuals had undetermined band status (Table 3.10).

Grand Canyon – At River Mile 274.5 we detected a single, breeding pair that was captured and color-banded. Three nestlings were banded from a single nest (Table 3.11). We also detected an unbanded resident at Burnt Springs Canyon (Table 3.12).

[9] Individuals banded as nestlings and later captured as 2004 fledglings and provided with a second colored metal band are not included in the total of nestlings banded.

Table 3.4. Breeding and Nestling Willow Flycatchers Banded at Littlefield, AZ, in 2004

Site	Date Banded	Federal Band #	Color Combination[1]	Old Color Combination[2,3]	Age 2004[4]	Sex[5]	Territory	Observation Status[6]
North	23-Jul-03	2320-31486	YV(M):EE	UB:EE	SY	F	1	R 29 Jul
North	3-Jun-04	2320-31490	EE:OO(M)	N/A	AHY	M	1	N
North	29-Jul-04	2360-59760	UB:EE	N/A	L	U	1	N
North	29-Jul-04	2360-59761	UB:EE	N/A	L	U	1	N

[1] **Color-band codes**: EE = electric yellow federal band, (M) = metal pin striped band, O = orange, UB = unbanded, V = violet, Y = yellow.
Color combinations are read as the bird's left leg and right leg, top to bottom; two letters designate every band; color-band designations for right and left legs are separated with a colon.

[2] N/A = not applicable.

[3] Old combination included only if rebanded in 2004.

[4] **Age codes**: L = nestling, SY = 2 years, AHY = 2 years or older.

[5] **Sex codes**: F = female, M = male, U = sex unknown.

[6] **Observation status codes**: N = new capture, R = recapture - followed by date recaptured.

Table 3.5. Unpaired, Resident Willow Flycatchers at Littlefield, AZ, in 2004

Site	Date Banded	Federal Band #	Color Combination[1]	Old Color Combination[1,2]	Age[3]	Sex[4]	Location[5]	Observation Status[6]
North	1-Jul-03	2320-31475	EE:WR(M)	EE:UB	SY	M	T2	R 2 Jul; unpaired male detected 22 Jun–23 Jul

[1] **Color-band codes**: EE = electric yellow federal band, (M) = metal pin striped band, R = red, UB = unbanded, W = white.
Color combinations are read as the bird's left leg and right leg, top to bottom; two letters designate every band; color-band designations for right and left legs are separated with a colon.

[2] Old combination included only if rebanded in 2004.

[3] **Age in 2004**: SY = 2 years.

[4] **Sex codes**: M = male.

[5] **Location Code**: T = territorial individual detected for at least 7 days.

[6] **Observation status codes**: R = recapture - followed by date recaptured.

Table 3.6. Paired, Nestling, and Fledgling Willow Flycatchers Banded and Resighted at Mesquite, NV, in 2004

Site	Date Banded[1]	Federal Band #[1]	Color Combination[2]	Old Color Combination[1,2,3]	Age[4]	Sex[5]	Territory	Observation status[6]
West	1-Aug-03	2320-31445	EE:WK(M)	N/A	A3Y	F	1	R 27 Jun
West	4-Aug-00	2320-31614[7]	VY(M):EE	VG(M):Bs	5Y	M	1	R 27 Jun
West	6-Jul-04	2320-31573	WY(M):EE	N/A	AHY	F	2	N
West	3-Jul-04	2320-31622	VK(M):EE	N/A	AHY	M	2	N
West	INA	INA	banded	N/A	AHY	F	3	RS
West	31-Jul-02	2110-78842	OB(P):BEs	N/A	A4Y	M	3	RS
West	INA	INA	banded:EE[8]	N/A	AHY	F	5	RS
West	4-Jul-01	2390-92434	UB:XX	G(HP)/O(HP):XX	4Y	M	5	R 23 May
West	2-Jul-99	2390-92451	KW(M):XX	UB:XX[9]	6Y	F	8	R 3 Jul
West	5-Jul-03	2320-31438	RK(M):EE	N/A	SY	M	8	RS
West	8-Jul-04	2320-31616	EE:UB	N/A	L	U	8	N
West	8-Jul-04	2320-31617	UB:EE	N/A	L	U	8	N
West	8-Jul-04	2320-31618	EE:UB	N/A	L	U	8	N
West	29-Jun-03	2320-31471	EE:OW(M)	EE:UB	SY	F	9	R 11 Jun
West	N/A	N/A	UB:UB	N/A	AHY	M	9	RS
West	14-Jun-04	2320-31655	VW(M):EE	N/A	SY	F	12	N
West	18-Jul-04	2360-59717	RY(M):EE	N/A	AHY	M	12	N
West	16-Jul-04	2320-31633	UB:EE	N/A	L	U	12	N
West	16-Jul-04	2320-31634	UB:EE	N/A	L	U	12	N
West	26-Jun-03	2320-31479	GG(M):EE	N/A	3Y	F	21	RS
West	27-Jun-01	2390-92421	XX:WR(M)	N/A	4Y	M	21	RS
West	27-Jun-03	2320-31480	WR(M):EE	UB:EE	SY	F	22	R 1 Jul
West	22-Jul-02	2140-66709	Bs:GW(M)	N/A	A4Y	M	22	RS
West	24-Jul-01	2390-92470	KR(M):XX	B(HP)/G(HP):XX	4Y	F	31	R 17 Jun
West	17-May-00	2390-92350	XX:DY(M)	XX:YR(P)	A6Y	M	31	R 17 Jun, 29 Jun
West	21-Jun-04	2320-31660	UB:EE	N/A	L	U	31	N
West	21-Jun-04	2320-31483	RR(M):EE	UB:EE	HY	U	31	N, R 8 Jul
West	21-Jun-04	2320-31615	EE:OY(M)	UB:EE	HY	U	31	N, R 8 Jul
West	24-Jul-02	2320-31613[10]	DR(M):EE	O(HP)/Y(HP):Zs	A4Y	F	32	R 27 Jun
West	6-Jul-02	2110-78861	BEs:VK(M)	N/A	3Y	M	32	RS

Table 3.6. Paired, Nestling, and Fledgling Willow Flycatchers Banded and Resighted at Mesquite, NV, in 2004, continued

Site	Date Banded[1]	Federal Band #[1]	Color Combination[2]	Old Color Combination[1,2,3]	Age[4]	Sex[5]	Territory	Observation status[6]
West	7-Aug-04	2360-59762	EE:UB	N/A	L	U	32	N
West	7-Aug-04	2360-59763	EE:UB	N/A	L	U	32	N
West	7-Aug-04	2360-59766	EE:UB	N/A	L	U	32	N
West	31-Jul-03	2320-31444	RW(M):EE	N/A	A3Y	F	62	RS
West	26-Jul-01	2390-92475	XX:WY(M)	N/A	4Y	M	62	RS
West	25-Jun-04	2320-31500	EE:UB	N/A	L	U	62	N
West	25-Jun-04	2320-31611	EE:UB	N/A	L	U	62	N
West	25-Jun-04	2320-31612	EE:UB	N/A	L	U	62	N

[1] N/A = not applicable; INA = information not available.

[2] **Color-band codes**: B = light blue, BEs = berry federal band, Bs = blue federal band, D = dark/navy blue, EE = electric yellow federal band, G = green, (HP) = half plastic bands/bands cut to half the height of a full plastic band, K = black, (M) = metal pin striped band, O = orange, (P) = full plastic band, R = red, UB = unbanded, V = violet, W = white, XX = silver federal band, Y = yellow, Zs = gold federal band, banded = bird has color-bands but combination undetermined.
Color combinations are read as the bird's left leg and right leg, top to bottom; two letters designate every band; color-band designations for right and left legs are separated with a colon.

[3] Old combination included only if rebanded in 2004.

[4] **Age in 2004**: L = nestling, HY = hatch year, SY = 2 years, AHY = 2 years or older, 3Y = 3 years, A3Y = 3 years or older, 4Y = 4 years, A4Y = 4 years or older, etc.

[5] **Sex codes**: F = female, M = male, U = sex unknown.

[6] **Observation status codes**: N = new capture, R = recapture - followed by date recaptured, RS = resight.

[7] Original federal band number: 2140-66775.

[8] Color combination could not be determined due to a leg injury masking the band.

[9] Originally banded Y(HP)/R(HP):XX but recaptured without color-bands.

[10] Original federal band number: 2140-66517.

Table 3.7. Summary of Unpaired, Resident Willow Flycatchers and Individuals for which Residency and/or Breeding Status Could Not Be Confirmed, Mesquite, NV, in 2004

Site	Date Banded[1]	Federal Band #[1]	Color combination[2]	Age[3]	Sex[4]	Location[5]	Observation status[6]
West	4-Jul-01	2390-92433	XX:ZR(M)	4Y	M	T4	RS, unpaired, detected 7 May–27 Jul
West	5-Jun-04	2320-31551	EE:GO(M)	AHY	M	T6	N, unpaired, detected 3–25 Jun
West	7-Jul-00	2390-92365	RG(M):XX	5Y	M	T11	RS; unpaired, detected 15 May–29 Jul
West	5-Jul-04	2320-31627	WW(M):EE	SY	M	T41	N, unpaired, detected 3–13 Jul
West	N/A	N/A	UB:UB	AHY	U	F7	RS; detected 4 Jul
West	25-Jun-04	2320-31499	KO(M):EE	SY	M	F33	N, unpaired, detected 25 Jun, resighted at T4 on 2 Jul

[1] N/A = not applicable.

[2] **Color-band codes**: EE = electric yellow federal band, G = green, K = black, (M) = metal pin striped band, O = orange, R = red, UB = unbanded, W = white, XX = silver federal band, Z = gold. Color combinations are read as the bird's left leg and right leg, top to bottom; two letters designate every band; color-band designations for right and left legs are separated with a colon.

[3] **Age in 2004**: SY = 2 years, AHY = 2 years or older, 4Y = 4 years, 5Y = 5 years.

[4] **Sex codes**: M = male, U = sex unknown.

[5] **Location Codes**: T = territorial individual detected for at least 7 days, F = individual detected for less than 7 days.

[6] **Observation status codes**: N = new capture, RS = resight.

Table 3.8. Paired and Nestling Willow Flycatchers Banded and Resighted at Mormon Mesa, NV, in 2004

Site	Date Banded[1]	Federal Band #[1]	Color Combination[2]	Age[3]	Sex[4]	Territory	Observation Status[1,5]
North	N/A	N/A	UB:UB	AHY	F	1	RS
North	1-Jul-98	1710-20638	YR(M):XX	A8Y	M	1	RS
North	23-Jun-04	2320-31496	UB:EE	L	U	1	N
North	23-Jun-04	2320-31497	UB:EE	L	U	1	N
North	23-Jun-04	2320-31498	UB:EE	L	U	1	N
Delta West	INA	INA	undetermined	AHY	F	2	N/A
Delta West	21-May-04	2320-31651	EE:OD(M)	AHY	M	2	N

Table 3.8. Paired and Nestling Willow Flycatchers Banded and Resighted at Mormon Mesa, NV, in 2004, continued

Site	Date Banded[1]	Federal Band #[1]	Color Combination[2]	Age[3]	Sex[4]	Territory	Observation Status[1,5]
Virgin River #1 North	30-Jun-04	2320-31621	VV(M):EE	AHY	F	4	N
Virgin River #1 North	N/A	N/A	UB:UB	AHY	M	4	RS
Virgin River #1 North	10-Jul-04	2320-31619	UB:EE	L	U	4	N
Virgin River #1 North	10-Jul-04	2320-31620	UB:EE	L	U	4	N
Virgin River #1 North	2-Aug-03	2320-31440	OY(M):EE	SY	F	5	RS
Virgin River #1 North	7-Jun-04	2320-31552	EE:GR(M)	AHY	M	5	N
Virgin River #1 North	INA	INA	undetermined[6]	AHY	F	10	N/A
Virgin River #1 North	INA	INA	undetermined[6]	AHY	M	10	N/A
Virgin River #1 North	30-Jun-04	2320-31485	EE:WO(M)	AHY	F	32	N
Virgin River #1 North	4-Jul-04	2320-31572	YK(M):EE	SY	M	32	N
Virgin River #1 North	6-Jul-04	2320-31629	UB:EE	L	U	32	N
Delta West	4-Jul-04	2320-31625	EE:WG(M)	AHY	F	35	N
Delta West	27-May-04	2320-31653	WV(M):EE	SY	M	35	N
Delta West	4-Jul-04	2320-31623	UB:EE	L	U	35	N
Delta West	4-Jul-04	2320-31624	UB:EE	L	U	35	N

[1] N/A = not applicable, INA = information not available.

[2] **Color-band codes**: D = dark/navy blue, EE = electric yellow federal band, G = green, K = black, (M) = metal pin striped band, O = orange, R = red, UB = unbanded, V = violet, W = white, XX = silver federal band, Y = yellow, undetermined = presence of bands could not be determined. Color combinations are read as the bird's left leg and right leg, top to bottom; two letters designate every band; color-band designations for right and left legs are separated with a colon.

[3] **Age in 2004**: L = nestling, SY = 2 years old, AHY = 2 years or older, A8Y = 8 years or older.

[4] **Sex codes**: F = female, M = male, U = sex unknown.

[5] **Observation status codes**: N = new capture, RS = resight.

[6] One bird of pair is banded, other is unbanded.

Table 3.9. Summary of Unpaired, Resident Willow Flycatchers and Individuals for which Residency and/or Breeding Status Could Not Be Confirmed, Mormon Mesa, NV, in 2004

Site	Date Banded[1]	Federal Band #[1]	Color Combination[2]	Old color Combination[1,2,3]	Age[4]	Sex[5]	Location[6]	Observation Status[7]
Delta West	N/A	N/A	UB:UB	N/A	AHY	M	F3	RS, unpaired, detected 6-10 Jun
North	INA	INA	banded	N/A	AHY	U	F20	RS, detected 26–27 May
Mormon Mesa South	INA	INA	undetermined	N/A	AHY	U	F22	Detected 23 Jun
Mormon Mesa South	INA	INA	undetermined	N/A	AHY	U	F23	Detected 8 Jun, suspected migrant
North	N/A	N/A	UB:UB	N/A	AHY	U	F30	RS, detected 18 May, suspected migrant
Virgin River #1 North	INA	INA	undetermined	N/A	AHY	U	F31	Detected 18 May, suspected migrant
Virgin River #1 North	N/A	N/A	UB:UB	N/A	AHY	U	F33	RS, detected 19–25 May
Mormon Mesa South	N/A	N/A	UB:UB	N/A	AHY	M	F34	RS, detected 19 May, suspected migrant
Virgin River #1 North	6-Jul-04	2320-31628	EE:KZ(M)	N/A	SY	U	F36	N, captured in territory 5, not detected post capture
Virgin River #1 North	22-May-04	2320-31652	WG(M):EE	N/A	AHY	U	F61	N, detected 19–22 May
Virgin River #1 North	7-Jun-04	2320-31553	EE:GW(M)	N/A	SY	U	F62	N, captured in territory 5, not detected post capture
Virgin River #1 North	27-May-04	2320-31489	EE:OK(M)	N/A	AHY	U	F63	N, captured in territory 32, not detected post capture
Virgin River #1 North	12-Jun-03	2320-31428	EE:GZ(M)	EE:UB	SY	U	F64	R 4 Jul, captured in territory 32, not detected post capture

[1] N/A = not applicable; INA = information not available.

[2] **Color-band codes**: EE = electric yellow federal band, G = green, K = black, (M) = metal pin striped band, O = orange, UB = unbanded, W = white, Z = gold, banded = bird has color-bands but combination undetermined, undetermined = presence of bands could not be determined.
Color combinations are read as the bird's left leg and right leg, top to bottom; two letters designate every band; color-band designations for right and left legs are separated with a colon.

[3] Old combination included only if rebanded in 2004.

[4] **Age in 2004**: SY = 2 years, AHY = 2 years or older.

[5] **Sex codes**: M = male, U = sex unknown.

[6] **Location code**: F = individual detected for less than 7 days.

[7] **Observation status codes**: N = new capture, R = recapture - followed by date recaptured, RS = resight.

Table 3.10. Summary of Unpaired Willow Flycatchers at the Muddy River Delta, NV, in 2004

Site	Date Banded[1]	Federal Band #[1]	Color Combination[2]	Age[3]	Sex[4]	Location[5]	Observation Status[6]
Overton WMA	9-Jun-04	2320-31493	DO(M):EE	AHY	M	T1	N, unpaired, detected 20 May–11 Jun
Overton WMA	INA	INA	undetermined	AHY	U	F2	Detected 2–7 Jun
Overton WMA	INA	INA	undetermined	AHY	U	F3	Detected 12 July
Overton WMA	N/A	N/A	undetermined	AHY	U	F4	Detected 7–9 Jun

[1] INA = information not available.
[2] **Color-band codes**: D = dark/navy blue, EE = electric yellow federal band, (M) = metal pin striped band, O = orange, undetermined = presence of bands could not be determined. Color combinations are read as the bird's left leg and right leg, top to bottom; two letters designate every band; color-band designations for right and left legs are separated with a colon.
[3] **Age in 2004**: AHY = 2 years or older.
[4] **Sex codes**: M = male, U = sex unknown.
[5] **Location codes**: T territorial individual detected for at least 7 days, F = individual detected for less than 7 days.
[6] **Observation status codes**: N = new capture.

Table 3.11. Breeding and Nestling Willow Flycatchers Banded at Grand Canyon, AZ, in 2004

Site	Date Banded	Federal Band #	Color Combination[1]	Age[2]	Sex[3]	Territory	Observation Status[4]
RM 274.5	15-Jul-04	2320-31516	EE:RD(M)	SY	F	90	N
RM 274.5	15-Jul-04	2320-31517	EE:OR(M)	SY	M	90	N
RM 274.5	17-Jul-04	2360-59746	UB:EE	L	U	90	N
RM 274.5	17-Jul-04	2360-59771	UB:EE	L	U	90	N
RM 274.5	17-Jul-04	2360-59800	UB:EE	L	U	90	N

[1] **Color-band codes**: D = dark/navy blue, EE = electric yellow federal band, (M) = metal pin striped band, O = orange, R = red, UB = unbanded,. Color combinations are read as the bird's left leg and right leg, top to bottom; two letters designate every band; color-band designations for right and left legs are separated with a colon.
[2] **Age in 2004**: L = nestling, SY = 2 years.
[3] **Sex codes**: F = female, M = male, U = sex unknown.
[4] **Observation status codes**: N = new capture.

Table 3.12. Willow Flycatchers for which Residency and/or Breeding Status Could Not Be Confirmed, Grand Canyon, AZ, in 2004

Site	Date Banded[1]	Federal Band #[1]	Color Combination[2]	Age[3]	Sex[4]	Location[5]	Observation Status[6]
Burnt Springs	N/A	N/A	UB:UB	AHY	U	T91	RS, detected 8–24 June

[1] N/A = not applicable.

[2] **Color-band codes**: UB = unbanded.
Color combinations are read as the bird's left leg and right leg, top to bottom; two letters designate every band; color-band designations for right and left legs are separated with a colon.

[3] **Age in 2004**: AHY = 2 years or more.

[4] **Sex codes**: U = sex unknown.

[5] **Location Code**: T = territorial individual detected for at least 7 days.

[6] **Observation status codes**: RS = resight.

Topock – We detected 57 resident, adult willow flycatchers (color-banded and unbanded) from 34 territories at Topock. In addition to resident adults, we detected 10 individuals, 5 of which were most likely migrants, for which residency and/or breeding status could not be confirmed (Table 3.13 and 3.14). Of the 34 territories recorded at Topock, 29 consisted of paired individuals and 5 consisted of unpaired individuals. Of the breeding individuals, six males were polygynous. Field personnel captured and color-banded 16 new adults; recaptured 2 adult flycatchers, 1 of which was originally banded as nestling in 2003; and resighted 11 other returning banded individuals, 2 of which were originally banded as nestlings in 2003. We banded 31 nestlings from 14 nests and recaptured a 2004 fledgling that had been banded in the nest. Of the resident adults, 21 remained unbanded, and banding status could not be confirmed for 9 individuals. For migrants and individuals for which residency and/or breeding status could not be confirmed, three remained unbanded, and four were of unknown band status.

Bill Williams – We detected three resident willow flycatchers (color-banded and unbanded) from three territories at Bill Williams, all of which were composed of unpaired individuals. In addition to resident adults, we detected 21 individuals that were most likely migrants (Table 3.15). Field personnel captured and color-banded one new adult and resighted a returning individual. Banding status was undetermined for one resident. Of the migrants, 6 were unbanded, and band status for 15 could not be determined.

NON-MONITORING SITES

Key Pittman Wildlife Management Area – Field personnel captured and color-banded two new adults, recaptured an individual banded as a nestling in 2003, and banded six nestlings from three nests (Table 3.16).

Virgin River near Mesquite – Field personnel captured and color-banded four new adults and recaptured two adult flycatchers banded in previous years. Of the two recaptured adults, one was banded as a nestling in 2003 and the other was banded as a nestling in 2002 and not detected in 2003 (Table 3.17).

Table 3.13. Paired and Nestling Willow Flycatchers Banded and Resighted at Topock, Havasu NWR, AZ, in 2004

Site	Date Banded[1]	Federal Band #[1]	Color Combination[2]	Old Color Combination[1,2,3]	Age[4]	Sex[5]	Territory	Observation Status[1,6]
In Between	8-Jul-02	2110-78841	B(HP)/Y(HP):BEs	N/A	3Y	F	1	RS
In Between	19-May-03	2320-31576	KK(M):EE	N/A	A3Y	M	1, 73	RS
In Between	30-Jul-04	2320-31557	EE:UB	N/A	L	U	1	N
In Between	30-Jul-04	2320-31558	UB:EE	N/A	L	U	1	N
In Between	25-Jun-04	2320-31564	EE:UB	N/A	L	U	1	N
In Between	25-Jul-98	2390-92348	YY(P):XX	N/A	7Y	F	2	RS
In Between	3-Jun-04	2320-31538	EE:YR(M)	N/A	AHY	M	2, 22	N
In Between	1-Jun-03	2320-31577	GW(M):EE	N/A	A3Y	F	5	RS
In Between	17-May-04	2320-31414	RG(M):EE	N/A	AHY	M	5, 7	N
In Between	22-Jun-04	2320-31554	UB:EE	N/A	L	U	5	N
In Between	22-Jun-04	2320-31555	EE:UB	N/A	L	U	5	N
In Between	22-Jun-04	2320-31556	UB:EE	N/A	L	U	5	N
PC6-1	N/A	N/A	UB:UB	N/A	AHY	F	6	RS
PC6-1	N/A	N/A	UB:UB	N/A	AHY	M	6	RS
In Between	28-May-03	2320-31502	ZR(M):EE	N/A	A3Y	F	7	RS
PC6-1	8-Jul-04	2320-31515	EE:WY(M)	N/A	SY	F	8	N
PC6-1	N/A	N/A	UB:UB	N/A	AHY	M	8	RS
PC6-1	29-Jun-03	2320-31407	ZO(M):EE	UB:EE	SY	F	9	R 10 Jul
PC6-1	N/A	N/A	UB:UB	N/A	AHY	M	9	RS
PC6-1	16-Jul-04	2320-31510	UB:EE	N/A	L	U	9	N
PC6-1	16-Jul-04	2320-31511	UB:EE	N/A	L	U	9	N
Glory Hole	N/A	N/A	UB:UB	N/A	AHY	F	11	RS
Glory Hole	6-Jul-02	2110-78863	R(HP)/V(HP):BEs	N/A	3Y	M	11, 47	RS
Pierced Egg	6-Jun-04	2320-31415	OZ(M):EE	N/A	AHY	F	15	N
Pierced Egg	N/A	N/A	UB:UB	N/A	AHY	M	15	RS
Pierced Egg	5-Jul-04	2320-31421	UB:EE	N/A	L	U	15	N

Table 3.13. Paired and Nestling Willow Flycatchers Banded and Resighted at Topock, Havasu NWR, AZ, in 2004, continued

Site	Date Banded[1]	Federal Band #[1]	Color Combination[2]	Old Color Combination[1,2,3]	Age[4]	Sex[5]	Territory	Observation Status[1,6]
Pierced Egg	5-Jul-04	2320-31422	UB:EE	N/A	L	U	15	N
PC6-1	N/A	N/A	UB:UB	N/A	AHY	F	16	RS
PC6-1	N/A	N/A	UB:UB	N/A	AHY	M	16	RS
Hell Bird	N/A	N/A	UB:UB	N/A	AHY	F	18	RS
Hell Bird	INA	INA	undetermined	INA	AHY	M	18	N/A
800M	23-Jun-04	2320-31565	EE:KD(M)	N/A	AHY	F	20	N
800M	N/A	N/A	UB:UB	N/A	AHY	M	20	RS
800M	16-Jun-04	2320-31416	UB:EE	N/A	L	U	20	N
800M	16-Jun-04	2320-31417	UB:EE	N/A	L	U	20	N
In Between	6-Aug-04	2320-31521	EE:DY(M)	N/A	SY	F	22	N
In Between	2-Aug-04	2320-31542	UB:EE	N/A	L	U	22	N
In Between	2-Aug-04	2320-31543	UB:EE	N/A	L	U	22	N
In Between	2-Aug-04	2320-31544	EE:UB	N/A	L	U	22	N
Pipes 3	N/A	N/A	UB:UB	N/A	AHY	F	23	RS
Pipes 3	22-Jun-04	2320-31541	EE:KW(M)	N/A	SY	M	23, 24	N
Pipes 3	22-Jul-04	2320-31561	EE:UB	N/A	L	U	23	N
Pipes 3	22-Jul-04	2320-31562	KY(M):EE	UB:EE	HY	U	23	N, R 8 Aug
Pipes 3	22-Jul-04	2320-31563	EE:UB	N/A	L	U	23	N
Pipes 3	22-Jun-04	2320-31540	EE:KR(M)	N/A	SY	F	24	N
Pipes 3	INA	INA	undetermined	INA	AHY	F	25	N/A
Pipes 3	INA	INA	undetermined	INA	AHY	M	25	N/A
In Between	INA	INA	undetermined	INA	AHY	F	34	N/A
In Between	8-Jul-01	2140-66728	Bs:NN(P)	N/A	4Y	M	34, 72	RS
Hell Bird	INA	INA	UB:EE	N/A	SY	F	40	RS
Hell Bird	7-Jul-99	2140-66743	OG(M):Bs	VW(P):Bs	6Y	M	40	R 18 May
Hell Bird	7-Jul-04	2320-31424	EE:UB	N/A	L	U	40	N

Table 3.13. Paired and Nestling Willow Flycatchers Banded and Resighted at Topock, Havasu NWR, AZ, in 2004, continued

Site	Date Banded[1]	Federal Band #[1]	Color Combination[2]	Old Color Combination[1,2,3]	Age[4]	Sex[5]	Territory	Observation Status[1,6]
Hell Bird	7-Jul-04	2320-31425	EE:UB	N/A	L	U	40	N
Hell Bird	7-Jul-04	3500-68963	XX:UB	N/A	L	U	40	N
Pig Hole	N/A	N/A	UB:UB	N/A	AHY	F	41	RS
Pig Hole	28-May-04	2320-31598	DK(M):EE	N/A	AHY	M	41	N, R 29 Jun
Pig Hole	17-Jul-04	2320-31508	UB:EE	N/A	L	U	41	N
Pierced Egg	INA	INA	UB:EE	N/A	SY	F	42	RS
Pierced Egg	N/A	N/A	UB:UB	N/A	AHY	M	42	RS
Pierced Egg	4-Jul-04	2320-31419	UB:EE	N/A	L	U	42	N
Pierced Egg	4-Jul-04	2320-31420	UB:EE	N/A	L	U	42	N
Glory Hole	N/A	N/A	UB:UB	N/A	AHY	F	44	RS
Glory Hole	1-Jul-04	2320-31505	EE:DR(M)	N/A	SY	M	44	N
Glory Hole	22-Jul-04	2320-31506	UB:EE	N/A	L	U	44	N
Glory Hole	22-Jul-04	2320-31507	UB:EE	N/A	L	U	44	N
Glory Hole	N/A	N/A	UB:UB	N/A	AHY	F	45	RS
Glory Hole	1-Jul-04	2320-31567	YD(M):EE	N/A	SY	M	45	N
Glory Hole	16-Jul-04	2320-31513	UB:EE	N/A	L	U	45	N
Glory Hole	16-Jul-04	2320-31514	UB:EE	N/A	L	U	45	N
Glory Hole	N/A	N/A	UB:UB	N/A	AHY	F	47	RS
800M	2-Jun-03	2320-31526	OD(M):EE	N/A	A3Y	F	49	RS
800M	N/A	N/A	UB:UB	N/A	AHY	M	49	RS
800M	30-Jul-04	2320-31518	UB:EE	N/A	L	U	49	N
800M	30-Jul-04	2320-31519	UB:EE	N/A	L	U	49	N
800M	30-Jul-04	2320-31520	UB:EE	N/A	L	U	49	N
In Between	N/A	N/A	UB:UB	N/A	AHY	F	72	RS
In Between	3-Jul-03	2320-31584	EE:YK(M)	N/A	3Y	F	73	RS
250M	N/A	N/A	UB:UB	N/A	AHY	F	74	RS

Table 3.13. Paired and Nestling Willow Flycatchers Banded and Resighted at Topock, Havasu NWR, AZ, in 2004, continued

Site	Date Banded[1]	Federal Band #[1]	Color Combination[2]	Old Color Combination[1,2,3]	Age[4]	Sex[5]	Territory	Observation Status[1,6]
250M	17-Jun-04	2320-31418	EE:RR(M)	N/A	SY	M	74	N
250M	16-Jul-04	2320-31512	UB:EE	N/A	L	U	74	N
Glory Hole	INA	INA	undetermined	INA	AHY	F	76	N/A
Glory Hole	INA	INA	undetermined	INA	AHY	M	76	N/A
Hell Bird	INA	INA	undetermined	INA	AHY	F	77	N/A
Hell Bird	INA	INA	undetermined	INA	AHY	M	77	N/A

[1] N/A = not applicable; INA = information not available.

[2] **Color-band codes**: B = light blue, BEs = berry federal band, Bs = blue federal band, D = dark/navy blue, EE = electric yellow federal band, G = green, (HP) = half plastic bands/bands cut to half the height of a full plastic band, K = black, (M) = metal pin striped band, N = navy blue plastic band, O = orange, R = red, UB = unbanded, V = violet, W = white, XX = silver federal band, Y = yellow, Z = gold, undetermined = presence of bands could not be determined.
Color combinations are read as the bird's left leg and right leg, top to bottom; two letters designate every band; color-band designations for right and left legs are separated with a colon.

[3] Old combination included only if rebanded in 2004.

[4] **Age in 2004**: L = nestling, HY = hatch year, SY = 2 years, AHY = 2 years or older, 3Y = 3 years, A3Y = 3 years or older, 4Y = 4 years, A4Y = 4 years or older, etc.

[5] **Sex codes**: F = female, M = male, U = sex unknown.

[6] **Observation status codes**: N = new capture, R = recapture - followed by date recaptured, RS = resight.

Table 3.14. Summary of Unpaired, Resident Willow Flycatchers and Individuals for which Residency and/or Breeding Status Could Not Be Confirmed, Topock, Havasu NWR, AZ, in 2004

Site	Date Banded[1]	Federal Band #[1]	Color Combination[2]	Age[3]	Sex[4]	Location[5]	Observation Status[6]
Glory Hole	N/A	N/A	UB:UB	AHY	U	T10	RS, detected 11–29 May
Lost Lake	16-Jun-04	2320-31495	DY(M):EE	AHY	M	T17	N; detected 8–16 Jun
Swine Paradise	INA	INA	undetermined	AHY	U	T21	Detected 20 May–3 Jun
Pierced Egg	N/A	N/A	UB:UB	AHY	M	T33	RS, detected 22 Jun–4 Jul
Hell Bird	6-Jul-04	2320-31423	EE:RK(M)	AHY	U	T75	N; detected 30 Jun–14 Jul
Pipes 1	N/A	N/A	undetermined	AHY	U	F4	Detected 15–20 May, suspected migrant
PC6-1	N/A	N/A	UB:UB	AHY	M	F26	RS; detected 29–30 Jun
Platform	N/A	N/A	UB:UB	AHY	U	F30	RS; detected 7–11 May, suspected migrant
Barbed Wire	N/A	N/A	UB:UB	AHY	M	F31	RS, detected 25–29 May, suspected migrant
Swine Paradise	INA	INA	undetermined	AHY	U	F32	Detected 3 Jun, suspected migrant
Swine Paradise	INA	INA	undetermined	AHY	U	F35	Detected 3 Jun, suspected migrant
Hell Bird	25-Jul-04	2320-31560	EE:GY(M)	SY	M	F78	N; captured at 40 on 25 July, resighted at 74 on 26–27 July
Hell Bird	25-Jul-04	2320-31559	OK(M):EE	SY	U	F79	N; captured at 40 on 25 July, not detected post-capture
South Dike Road[7]	INA	INA	undetermined	AHY	M	F98	Detected 28 May
South Dike Road[7]	INA	INA	undetermined	AHY	M	F99	Detected 23 June

[1] N/A = not applicable; INA = information not available.

[2] **Color-band codes**: D = dark/navy blue, EE = electric yellow federal band, G = green, K = black, (M) = metal pin striped band, O = orange, R = red, UB = unbanded, Y = yellow, undetermined = presence of bands could not be determined.
Color combinations are read as the bird's left leg and right leg, top to bottom; two letters designate every band; color-band designations for right and left legs are separated with a colon.

[3] **Age in 2004**: SY = 2 years, AHY = 2 years or older.

[4] **Sex codes**: M = male, U = sex unknown.

[5] **Location codes**: T = territorial individual detected for at least 7 days, F = individual detected for less than 7 days.

[6] **Observation status codes**: N = new capture, RS = resight.

[7] Not a formal survey site, flycatchers detected en route.

Table 3.15. Summary of Unpaired, Resident Willow Flycatchers and Individuals for which Residency and/or Breeding Status Could Not Be Confirmed, Bill Williams NWR, AZ, in 2004

Site	Date Bbanded[1]	Federal Band #[1]	Color Combination[2]	Age[3]	Sex[4]	Location[5]	Observation Status[6]
Site 3	10-Jun-04	2320-31539	EE:YY(M)	SY	M	T3	N, unpaired, detected 3–10 June
Site 1	INA	INA	undetermined	AHY	M	T10	Unpaired, detected 27 May–9 June
Site 3	7-Jul-03	2320-31412	OW(M):EE	3Y	M	T20	RS, unpaired, detected 14 May–5 July
Site 8	INA	INA	undetermined	AHY	U	F1	Detected 28 May, suspected migrant
Site 5	INA	INA	undetermined	AHY	U	F2	Detected 30 May, suspected migrant
Site 2	INA	INA	undetermined	AHY	U	F21	Detected 19 May, suspected migrant
Beaver Pond	N/A	N/A	UB:UB	AHY	U	F22	Detected 21 May, suspected migrant
Beaver Pond	N/A	N/A	UB:UB	AHY	U	F23	Detected 21-23 May, suspected migrant
Site 2	INA	INA	undetermined	AHY	U	F24	Detected 9 June, suspected migrant
Site 11	INA	INA	undetermined	AHY	U	F25	Detected 15–16 June, suspected migrant
Site 3	N/A	N/A	UB:UB	AHY	U	F30	Detected 13–14 May, suspected migrant
Site 2	INA	INA	undetermined	AHY	U	F31	Detected 19 May, suspected migrant
Beaver Pond	INA	INA	undetermined	AHY	U	F32	Detected 23 May, suspected migrant
Beaver Pond	INA	INA	undetermined	AHY	U	F34	Detected 23 May, suspected migrant
Mineral Wash	INA	INA	undetermined	AHY	U	F35	Detected 23 May, suspected migrant
Beaver Pond	N/A	N/A	UB:UB	AHY	U	F36	Detected 10 June, suspected migrant
Beaver Pond	N/A	N/A	UB:UB	AHY	U	F37	Detected 10 June, suspected migrant
Site 4	N/A	N/A	UB:UB	AHY	U	F38	Detected 16 June, suspected migrant
Beaver Pond	INA	INA	undetermined	AHY	U	F39	Detected 21 May, suspected migrant
Beaver Pond	INA	INA	undetermined	AHY	U	F40	Detected 23 May, suspected migrant
Beaver Pond	INA	INA	undetermined	AHY	U	F41	Detected 30 May, suspected migrant
Beaver Pond	INA	INA	undetermined	AHY	U	F42	Detected 30 May, suspected migrant
Beaver Pond	INA	INA	undetermined	AHY	U	F43	Detected 23 May, suspected migrant
Beaver Pond	INA	INA	undetermined	AHY	U	F44	Detected 19 June, suspected migrant

[1] N/A = not applicable; INA = information not available.

[2] **Color-band codes**: EE = electric yellow federal band, (M) = metal pin striped band, O = orange, UB = unbanded, W = white, Y = yellow, undetermined = presence of bands could not be determined. Color combinations are read as the bird's left leg and right leg, top to bottom; two letters designate every band; color-band designations for right and left legs are separated with a colon.

[3] **Age in 2004**: SY = 2 years, AHY = 2 years or older. 3Y = 3 years.

[4] **Sex codes**: M = male, U = sex unknown.

[5] **Location codes**: T = territorial individual detected for at least 7 days, F = individual detected for less than 7 days.

[6] **Observation status codes**: N = new capture, RS = resight.

Table 3.16. Willow Flycatchers Color-Banded at Key Pittman Wildlife Management Area, NV, in 2004

Site	Date Banded	Federal Band #	Color Combination[1]	Age[2]	Sex[3]	Observation Status[4]
Key Pittman	25-Jun-03	2320-31457 [5]	EE:KG(M)	SY	M	R 3 Jul
Key Pittman	17-Jul-04	2320-31635	EE:YDY(M)	AHY	M	N
Key Pittman	17-Jul-04	2320-31636	UB:EE	L	U	N
Key Pittman	17-Jul-04	2320-31637	UB:EE	L	U	N
Key Pittman	17-Jul-04	2320-31638	UB:EE	L	U	N
Key Pittman	17-Jul-04	2360-59757	UB:EE	L	U	N
Key Pittman	11-Aug-04	2360-59767	UB:EE	L	U	N
Key Pittman	11-Aug-04	2360-59770	EE:UB	L	U	N
Key Pittman	12-Aug-04	2360-59772	YR(M):EE	AHY	F	N

[1] **Color-band codes**: D = dark/navy blue, EE = electric yellow federal band, G = green, K = black, (M) = metal pin striped band, UB = unbanded, Y = yellow.
Color combinations are read as the bird's left leg and right leg, top to bottom; two/three letters designate every band; color-band designations for right and left legs are separated with a colon.

[2] **Age in 2004**: L = nestling, SY = 2 years, AHY 2 years or older.

[3] **Sex codes**: F = female, M = male, U = sex unknown.

[4] **Observation status codes**: N = new capture, R = Recapture - followed by date recaptured.

[5] Recaptured 2003 nestling.

Table 3.17. Willow Flycatchers Color-Banded along the Virgin River near Mesquite, NV, in 2004

Site	Date Banded	Federal Band #	Color Combination[1]	Age[2]	Sex[3]	Observation Status[4]
Riverside West	19-Jun-04	2320-31494	EE:OG(M)	AHY	U	N
Bunker Farm	29-Jun-03	2320-31473[5]	EE:OKO(M)	SY	M	R 16 Jul
Bunker Farm	16-Jul-04	2320-31630	UB:EE	L	U	N
Bunker Farm	16-Jul-04	2320-31631	UB:EE	L	U	N
Bunker Farm	16-Jul-04	2320-31632	RZ(M):EE	SY	F	N
Electric Avenue	4-Jun-04	2320-31491	GK(M):EE	AHY	M	N
Electric Avenue	19-Jul-02	2320-31492	EE:RG(M)	3Y	F	R 4 June
Electric Avenue	4-Jun-04	2320-31654	EE:KY(M)	AHY	M	N

[1] **Color-band codes**: EE = electric yellow federal band, G = green, K = black, (M) = metal pin striped band, O = orange, R = red, UB = unbanded, Y = yellow, Z = gold. Color combinations are read as the bird's left leg and right leg, top to bottom; two letters designate every band; color-band designations for right and left legs are separated with a colon.

[2] **Age in 2004**: L = nestling, SY = 2 years, AHY = 2 years or older, 3Y = 3 years.

[3] **Sex codes**: F = female, M = male, U = sex unknown.

[4] **Observation status codes**: N = new capture, R = Recapture - followed by date recaptured.

[5] Recaptured 2003 nestling.

GILA RIVER AND COLORADO/GILA RIVER CONFLUENCE SOUTH TO MEXICO

From 10 to 30 June 2004, we recorded 40 willow flycatcher detections at eight sites along the Colorado River (Martinez Lake south to the Mexico border) and along the Gila River near Yuma (see Chapter 2 for details). Thirty-nine of these detections were recorded from 10 to 13 June, with a single flycatcher detected on 24 June. Field personnel captured and color-banded four new adults, all of which were second-year birds, near Martinez Lake on 10 and 11 June

(Table 3.18). Unsuccessful capture attempts were made at Martinez Lake and two other sites on 12 and 13 June. None of the color-banded individuals were detected post-capture, and other than a single detection at one site on 23 July, no flycatcher detections were recorded at any sites south of Bill Williams after 24 June, suggesting these individuals were northbound migrants.

Table 3.18. Willow Flycatchers Color-Banded along the Lower Colorado River South of the Bill Williams NWR to the Mexico Border, 2004

Site	Date Banded	Federal Band #	Color Combination[1]	Age[2]	Sex[3]	Observation Status[4]
Great Blue Heron	10-Jun-04	2320-31503	EE:GG(M)	SY	U	N
Great Blue Heron	11-Jun-04	2320-31504	EE:GG(M)	SY	U	N
Great Blue Heron	10-Jun-04	2320-31599	EE:GG(M)	SY	U	N
Great Blue Heron	10-Jun-04	2320-31600	EE:GG(M)	SY	U	N

[1] **Color-band codes**: EE = electric yellow federal band, G = green, (M) = metal pin striped band. Color combinations are read as the bird's left leg and right leg, top to bottom; two letters designate every band; color-band designations for right and left legs are separated with a colon.

[2] **Age in 2004**: SY = 2 years.

[3] **Sex codes**: U = sex unknown.

[4] **Observation status code**: N = new capture.

ADULT BETWEEN-YEAR RETURN AND DISPERSAL

In 2003 we identified 54 adult, resident willow flycatchers at the life history study areas and Bill Williams, of which 28 (52%) were detected in 2004 (Table 3.19). All returning adults returned to the same study area as detected in 2003. In addition, we detected one individual banded as an adult in 2000 and not detected in 2003. This individual was detected at the same study area where originally banded.

Table 3.19. Adult Willow Flycatcher Annual Return from 2003 to 2004

Study Area	# Identified in 2003	# of 2003 Birds Detected in 2004	% Return	% Return to Same Site
Pahranagat	11	6	55	100
Mesquite	24	12	50	100
Mormon Mesa	3	2	67	100
Topock	10	7	70	100
Bill Williams	6	1	17	100
Total	**54**	**28**	**52**	**100**

JUVENILE BETWEEN-YEAR RETURN AND DISPERSAL

In 2003, we banded 63 nestlings at the life history study areas and Bill Williams, of which two were known to have died before fledging. Of the 61 remaining juveniles, 13 (21%) were detected in 2004 (11 of known identity, 2 identified only as 2003 nestlings). Of the returning juveniles of known identity, six (55%) were detected at a different study area than where originally banded, and five (45%) were detected at the same study area (Table 3.20). In addition, we detected eight individuals that were banded as juveniles in 2002 or earlier and were not detected in 2003 (Table 3.21). Two (25%) of these individuals were detected at study areas other

than where originally banded; six (75%) returned to the same areas (Table 3.21). The median dispersal distance for all returning juvenile flycatchers exhibiting between-year movements in 2004 was 58 km (min = 20 km, max = 117 km).

Table 3.20. Summary of Juvenile Flycatcher Between-Year Movements for All Flycatchers Banded as Hatch Year Birds in 2003 and Recaptured or Resighted in 2004*

Study Area/ Site Banded 2003[1]	Year Hatched	Study Area/Site Detected 2004[1]	Distance Moved (km)	Federal Band #	Color Combination[2]	Sex[3]
PAHR/North	2003	KEPI[4]	30	2320-31457	EE:KG(M)	M
PAHR/North	2003	LIFI/North	117	2320-31475	EE:WR(M)	M
PAHR/South	2003	PAHR/North	--	2320-31459	EE:DK(M)	M
MESQ/West	2003	LIFI/North	20	2320-31486	YV(M):EE	F
MESQ/West	2003	MESQ/Bunker Farm[4]	--	2320-31473	EE:OKO(M)	M
MESQ/West	2003	MESQ/West	--	2320-31438	RK(M):EE	M
MESQ/West	2003	MESQ/West	--	2320-31471	EE:OW(M)	F
MESQ/West	2003	MESQ/West	--	2320-31480	WR(M):EE	F
MESQ/West	2003	MOME/Virgin River #1 N	40	2320-31428	EE:GZ(M)	U
MESQ/West	2003	MOME/Virgin River #1 N	40	2320-31440	OY(M):EE	U
BIWI/Site 3	2003	TOPO/PC6-1	72	2320-31407	ZO(M):EE	F

* Dispersal distances are given for flycatchers that moved between study areas.

[1] PAHR = Pahranagat National Wildlife Refuge, LIFI = Littlefield, MESQ = Mesquite, MOME = Mormon Mesa, TOPO = Topock Marsh, BIWI = Bill Williams National Wildlife Refuge, KEPI = Key Pittman Wildlife Management Area.

[2] **Color-band codes**: EE = electric yellow federal band, G = green, K = black, (M) = metal pin striped band, O = orange, R = red, V = violet, W = white, Y = yellow, Z = gold.
Color combinations are read as the bird's left leg and right leg, top to bottom; two letters designate every band; color-band designations for right and left legs are separated with a colon.

[3] **Sex codes**: F = female, M = male, U = sex unknown.

[4] Site surveyed and/or monitored by personnel from an unrelated flycatcher project.

Table 3.21. Summary of Flycatcher Between-Year Movements for All Flycatchers Banded as Hatch Year Birds Prior to 2003, Not Detected in 2003, and Detected in 2004*

Study Area/Site Originally Banded[1]	Year Hatched	Study Area/Site Detected 2004[1]	Distance Moved (km)	Federal Band #	Color Combination[2]	Sex[3]
TOPO/1000M	1998	TOPO/In Between	--	2390-92348	YY(P):XX	F
TOPO/800 M	1999	TOPO/Hell Bird	--	2140-66743	OG(M):Bs	M
MOME	1999	MESQ/West[4]	40	2390-92451	KW(M):XX	F
MESQ/West	2001	PAHR/North	108	2320-31592	GO(M):EE	U
TOPO/800M	2001	TOPO/In Between	--	2140-66728	Bs:NN(P)	M
MESQ/West	2001	MESQ/West	--	2390-92434	UB:XX	M
MESQ/West	2001	MESQ/West	--	2390-92470	KR(M):XX	F
MESQ/West	2002	MESQ/Electric Avenue[5]	--	2320-31492	EE:RG(M)	F

* With the exception of one bird noted in the table, information on any detections in years other than 2003 and 2004 is unavailable. Movement distances are given for individuals that moved between study areas.

[1] PAHR = Pahranagat National Wildlife Refuge, MESQ = Mesquite, MOME = Mormon Mesa, TOPO = Topock Marsh.

[2] **Color-band codes**: Bs = blue federal band, EE = electric yellow federal band, G = green, K = black, (M) = metal pin striped band, N = navy blue plastic band, O = orange, (P) = full plastic band, R = red, UB = unbanded, W = white, Y = yellow, XX = silver federal band.
Color combinations are read as the bird's left leg and right leg, top to bottom; two letters designate every band; color-band designations for right and left legs are separated with a colon.

[3] **Sex codes**: F = female, M = male, U = sex unknown.

[4] This individual detected at Mesquite West in 2002.

[5] Site surveyed and/or monitored by personnel from an unrelated flycatcher project.

DISCUSSION

Overall, 57 new adults and 89 juvenile Southwestern Willow Flycatchers were banded at the monitoring sites in 2004. Compared to 2003, we banded over double the number of new adults and 38% more juveniles. The greater number of new color-banded individuals in 2004 was largely due to the greater number of adults detected at Pahranagat (35 in 2004 vs. 21 in 2003), Mormon Mesa (27 in 2004 vs. 20 in 2003), and Topock (67 in 2004 vs. 25 in 2003). Also, three additional monitoring sites (Littlefield, Muddy River, and Grand Canyon) contributed to the greater number of adults and juveniles color-banded in 2004. In addition to the newly banded birds, 54 individuals banded in previous years were detected in 2004 through resighting and recapture. In total, 57% of all adult flycatchers detected at the monitoring sites were banded by the end of the 2004 season. This compares to 55% in 2003. Maintaining high overall percentages of banded birds is important because it increases the ability to detect site fidelity and movement, provides a more accurate calculation of survivorship, and provides the information needed for future fecundity studies. Also, a large number of color-banded flycatchers will be vital in detecting and tracking movements in the event of a stochastic occurrence (e.g., fire, drought, flood), natural or otherwise, at any of the flycatcher life history study areas. As target and passive capture techniques are continually being refined, we anticipate the percentages of color-banded willow flycatchers at sites to increase in subsequent years.

Breeding vs. Unpaired Territories – At the monitoring sites, we recorded a total of 82 willow flycatcher territories in 2004. Of these, 64 (78%) consisted of paired flycatchers and 18 (22%) consisted of unpaired individuals. The spacing of any territorial bird species in prime habitat, particularly species like the flycatcher in which its breeding habitat is relatively fragmented and rare on a landscape level, may exclude some individuals from the breeding population(s). As prime and sub-optimal breeding habitats are filled, the remaining non-breeding individuals must wait for vacancies in either habitat as unpaired individuals, commonly referred to as floaters (Brown 1964, Gill 1995). The observable fact is that detections of floater and resident, unpaired willow flycatchers at breeding sites is not uncommon, and unpaired individuals have been recorded at other breeding sites across the species' range (Stafford 1986; Kenwood and Paxton 2001; Smith et al. 2002; Koronkiewicz et al. 2002, 2004; Furtek and Tomlinson 2003; Whitfield 2003). Additionally, other research has shown that an unequivocal determination of breeding status for all willow flycatchers in a population often cannot be made. There are several reasons for this. Willow flycatchers may be detected only once during the breeding season (Kenwood and Paxton 2001; Koronkiewicz et al. 2002, 2004; this document). Some individuals are non-territorial floaters, which are individuals that are seen once or irregularly, are typically quiet, and do not display territorial behavior toward other flycatchers or respond aggressively to conspecific broadcasts (Kenwood and Paxton 2001; Koronkiewicz et al. 2002, 2004). In addition, willow flycatcher males frequently engage in extra pair copulations (Paxton et al. 1997, Pearson 2002) and are commonly polygynous (Whitfield et al. 1998, Davidson and Allison 2003, Koronkiewicz et al. 2004, this document). The documentation of unpaired resident and non-territorial floater flycatchers is important for demographic analyses and management and conservation of the species, as these individuals serve as population reservoirs and replace other individuals that move or die. The assumption that all flycatchers detected during the breeding season are paired, breeding individuals (Braden and McKernan 1998, unpubl. data) is unsubstantiated and violates the basic tenets of avian territorial social systems (see Brown 1964, Kaufmann 1983, Rappole 1995).

Adult and Juvenile Between-Year Return and Dispersal – Of the 28 adult willow flycatchers that returned from 2003, all returned to the same study area at which they were detected in 2003. Of 61 juvenile willow flycatchers banded in 2003, 11 (18%) of known identity were detected in 2004, of which 6 (55%) were detected at a different study area than where originally banded and 5 (45%) at the same area. Willow flycatcher dispersal data at the monitoring sites for two seasons (2003–2004) are consistent with range-wide data (Luff et al. 2000, Kenwood and Paxton 2001, Koronkiewicz et al. 2002) and results from previous years at the study areas (McKernan and Braden 2002), with adult flycatchers likely to exhibit strong site fidelity to breeding areas and juveniles likely to disperse away from natal areas. Given the small population sizes and geographic isolation of willow flycatcher breeding populations in the Southwest, juvenile dispersal is an important population variable in terms of both gene flow and the establishment of new flycatcher populations. Furthermore, the observed differential age patterns in willow flycatcher dispersal may contribute to an understanding of the observed patterns of high genetic diversity within and low reproductive isolation among Southwestern Willow Flycatcher populations (Busch et al. 2000 as cited in Koronkiewicz et al. 2002).

Adult and Juvenile Survivorship – Survivorship is defined as the number of individuals that survive from one year to the next, and accurate estimates depend on year-to-year detection of uniquely marked birds. In 2003 we identified 54 adult and 61 juvenile willow flycatchers at the monitoring sites, of which 28 (52%) and 13 (21%), respectively, were detected in 2004. Thus, minimum estimated adult and juvenile survival from 2003 to 2004 was 52 and 21%, respectively. These simple annual percent survivorship calculations assume that all living flycatchers are detected in a given year, and individuals not detected are assumed to have died, unless detected elsewhere. Previous research has shown that some adults and juveniles go undetected for up to three years after being banded (Koronkiewicz et al. 2002, McKernan and Braden 2002, this document), and simple annual percent survivorship thus underestimates survival. To provide more robust estimates of annual survival, software programs (e.g., Brownie et al. 1985, White 1996) incorporating both survival and detection probabilities have been developed in recent years. In subsequent years of this study, as more flycatcher demographic data are acquired at the life history study areas and other monitoring sites, we anticipate using this software in determining detection probabilities and annual adult and juvenile willow flycatcher survivorship.

GILA RIVER AND COLORADO/GILA RIVER CONFLUENCE SOUTH TO MEXICO

In 2004, we continued color-banding studies on the extreme southern stretches of the Colorado River to better determine flycatcher residency, breeding status, and movement patterns in this area. We captured and color-banded four individuals, none of which were detected post-capture. All four captured flycatchers were second year birds (born in 2003), based on the presence of retained flight feathers (per Kenwood and Paxton 2001 and Koronkiewicz et al. 2002). As in 2003, flycatcher behavioral observations in this area suggest strongly that the individuals detected at these sites were northbound migrants (see Chapter 2). Whether there are differential age patterns in willow flycatcher northbound migration along the lower Colorado River is in need of further study. Likewise, it is apparent that the lower Colorado and Gila River riparian corridors are important flyways and stopover habitat for numerous northbound willow flycatchers. The degree to which Southwestern Willow Flycatchers use these riparian corridors is unknown and requires further study.

CHANGE IN COLOR-BAND METHODOLOGY

As in 2003, field personnel experienced difficulty resighting and correctly identifying the color combinations of willow flycatchers previously banded with celluloid-plastic color-bands and epoxy-enamel colored federal bands. As has been shown by Lindsey et al. (1995), celluloid-plastic leg bands undergo fading and discoloration to such a degree that within two years primary colors cannot be recognized under field conditions. Adding to the difficulty we experienced resighting celluloid-plastic bands, field personnel recaptured a returning individual (2390-92451; originally banded with plastic bands as a nestling in 1999) whose plastic bands had fallen off leaving only the federal band. Upon recapturing flycatchers previously banded with epoxy-enamel colored federal bands used prior to 2003, we found that chipping of the enamel, which revealed the original silver band color underneath, caused difficulties in correct color identification through binoculars. Correct field identification over multiple years of the unique set of color-bands on a bird's legs is important in a long-term study such as this because it eliminates the need to recapture an individual flycatcher multiple times to determine identity. Moreover, the ability to correctly identify a color-band combination quickly and accurately with binoculars lessens the total amount of time spent in an individual's territory during monitoring.

To remedy the color-band problems noted above, we continued to use used metal pinstriped color-bands and color anodized federal bands, which have shown to be safe for willow flycatchers and colorfast for over six years (Koronkiewicz et al. in press.). These metal color-bands were used on all newly captured flycatchers and on recaptured flycatchers that wore faded and indistinguishable color-bands.

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CHAPTER 4

NEST MONITORING

INTRODUCTION

Documentation of nest success and productivity is critical to understanding local population status and demographic patterns of the Southwestern Willow Flycatcher. In 2004, at all sites where willow flycatcher breeding activity was suspected, we conducted intensive nest searches and nest monitoring. Specific objectives of nest monitoring included identifying breeding individuals (see Chapter 3, Color-banding and Resighting) for subsequent fecundity studies, calculating nest success and failure, documenting causes of nest failure (e.g., abandonment, desertion, depredation, and brood parasitism), and calculating nest productivity. Nest monitoring results from 2004 were compared with those at the study areas from 1996 to 2003 (McKernan 1997; McKernan and Braden 1998, 1999, 2001a, 2001b, 2002; Koronkiewicz et al. 2004; Braden and McKernan, unpubl. data). Although aspects of willow flycatcher breeding ecology can vary widely across its broad geographical and elevational ranges throughout the Southwest (Whitfield et al. 2003), we compared monitoring results with range-wide data to identify specific variables that may contribute to the characterization of flycatcher breeding ecology throughout the lower Colorado and Virgin River riparian systems.

METHODS

Upon locating territorial willow flycatchers, regardless of whether a possible mate was observed, we conducted intensive nest searches following the methods of Rourke et al. (1999). Nest monitoring followed the methods described by Rourke et al. (1999) and a modification of the Breeding Biology Research and Monitoring Database (BBIRD) protocol by Martin et al. (1997).

Nests were located primarily by observing adult flycatchers return to a nest or by systematically searching suspected nest sites. Nests were monitored every two to four days after nest building was complete and incubation was confirmed. During incubation and after hatching, nest contents were observed directly using a telescoping mirror pole to determine nest contents and transition dates. Nest monitoring during nest building and egg laying stages was limited to reduce the chance of abandonment during these periods. To reduce the risk of depredation (Martin et al. 1997), brood parasitism by the Brown-headed Cowbird, and premature fledging of young (Rourke et al. 1999), we observed nests from a distance with binoculars once the number and age of nestlings were confirmed. If no activity was observed at a previously occupied nest, the nest was checked directly to determine nest contents and cause of failure. If no activity was observed at a nest close to or on the estimated fledge date, we conducted a systematic search of the area to locate possible fledglings.

We considered a willow flycatcher nest successful only if fledglings were observed near the nest or in surrounding areas. The number of young fledged from each nest was counted based on the number of fledglings actually observed and thus is a conservative estimate. We considered a

nest to have failed if (1) the nest was abandoned prior to egg laying (abandoned); (2) the nest was deserted with flycatcher eggs or young remaining (deserted); (3) the nest was found empty or destroyed more than two days prior to the estimated fledge date (depredated); (4) the nest was destroyed due to weather (weather); or (5) the entire clutch was incubated for an excess of 20 days (infertile/addled). For nests containing flycatcher eggs, parasitism was considered the cause of nest failure if (1) cowbird young outlived any flycatcher eggs or young, or (2) the nest was parasitized during egg laying and the disappearance of flycatcher eggs coincided with the appearance of cowbird eggs.

During each nest check, we recorded date and time of the visit, observer initials, monitoring method (observation via binoculars or mirror pole), nesting stage, nest contents, and number and behavior of adults and/or fledges present onto standardized data forms (Appendix A) that included the nest or territory number and UTM coordinates. We calculated flycatcher nest success using both simple nesting success (number of successful nests/total number of nests) and the Mayfield method (Mayfield 1961, 1975), which calculates daily nest survival to account for nests that failed before they were found. We assumed one egg was laid per day, and incubation was considered to start the day the last egg was laid (per Martin et al. 1997). The nestling period was considered to start the day the first egg hatched and end the day the first nestling fledged. If exact transition dates or dates of depredation events were unknown, we estimated the transition date as halfway between observations. To calculate Mayfield survival probabilities (MSP), we used the average length of each nest stage (2.22, 12.65, and 13.65 days for laying, incubation, and nestling stages, respectively) as observed in this study in 2003 and 2004 for nests where transition dates were known. Nest productivity was calculated as the number of young fledged per nesting attempt. Only willow flycatcher nests that contained at least one flycatcher egg were used in calculating nest success and productivity. Fecundity was calculated as number of young produced per female over the breeding season.

RESULTS

NEST MONITORING

We documented 91 willow flycatcher nesting attempts at the four life history study areas, Littlefield, and Grand Canyon; 81 of these nests were known to contain flycatcher eggs and were used in calculating nest success and productivity. Thirty-eight (47%) nests were successful and fledged young, and 41 (51%) failed. The fates of two nests (2 %) were undetermined (Table 4.1). In these two cases, field personnel heard vocalizations suspected to be fledglings begging, but no fledglings could be visually confirmed. Nest success ranged from 24% at Mesquite to 76% at Pahranagat. For a comparison of nest success at all monitoring sites from 1998 to 2004, see Table 4.2.

Sixty-two nesting females were followed through all of their nesting attempts; sixty of these females produced at least one egg each. Two additional females were detected for which no nesting attempt could be confirmed. Of the 62 nesting females, 38 had one nesting attempt, 19 had two nesting attempts, and 5 had three nesting attempts. Of the 24 females who had multiple nesting attempts, 4 renested after successfully fledging young, and 20 renested after unsuccessful nests.

Table 4.1. Summary of Willow Flycatcher Nest Monitoring Results at the Four Life History Study Areas, Grand Canyon, AZ, and Littlefield, AZ, in 2004*

Study Area[1]	Site	# Pairs	# Nests	# Nests with 1+ WE[2]	# Successful Nests (%)	# Failed Nests (%)	# Nests with Unknown Fate[3]	# Parasitized Nests[4](%)
PAHR	Pahranagat North	13	15	15	12 (80%)	3 (20%)	0	0
	Pahranagat South	1	2	2	1 (50%)	1 (50%)	0	0
	Total	**14**	**17**	**17**	**13 (76%)**	**4 (24%)**	**0**	**0**
LIFI	North	1	3	2	1 (50%)	1 (50%)	0	0
	Total	**1**	**3**	**2**	**1 (50%)**	**1 (50%)**	**0**	**0**
MESQ	Mesquite West	12	20	17	4 (24%)	13 (76%)	0	8 (47%)
	Total	**12**	**20**	**17**	**4 (24%)**	**13 (76%)**	**0**	**8 (47%)**
MOME	Mormon Mesa North	1	1	1	1 (100%)	0	0	0
	Virgin River #1 North	4	5	4	1 (25%)	3 (75%)	0	1 (25%)
	Delta West	2	1	1	1 (100%)	0	0	0
	Total	**7**	**7**	**6**	**3 (50%)**	**3 (50%)**	**0**	**1 (17%)**
GRCA	RM 274.5	1	1	1	0	0	1 (100%)	0
	Total	**1**	**1**	**1**	**0**	**0**	**1 (100%)**	**0**
TOPO	Pipes 3	3	5	4	1 (25%)	3 (75%)	0	2 (50%)
	PC6-1	4	6	5	1 (20%)	4 (80%)	0	2 (40%)
	Pig Hole	1	1	1	1 (100%)	0	0	0
	In Between	8	15	14	6 (43%)	8 (57%)	0	4 (29%)
	800M	2	3	3	2 (67%)	1 (33%)	0	0
	Pierced Egg	2	2	2	2 (100%)	0	0	0
	250M	1	1	1	1 (100%)	0	0	1 (100%)
	Hell Bird	3	3	2	1 (67%)	1 (33%)	0	1 (50%)
	Glory Hole	5	7	6	2 (33%)	3 (50%)	1 (17%)	2 (33%)
	Total	**29**	**43**	**38**	**17 (45%)**	**20 (53%)**	**1 (2%)**	**12 (32%)**
Overall Total		**64**	**91**	**81**	**38 (47%)**	**41 (51%)**	**2 (2%)**	**21 (26%)**

* Only nests with at least one flycatcher egg were used in percentage calculations.

[1] PAHR = Pahranagat National Wildlife Refuge, LIFI = Littlefield, MESQ = Mesquite, MOME = Mormon Mesa, GRCA = Grand Canyon, TOPO = Topock Marsh.

[2] WE = willow flycatcher egg.

[3] No fledglings were visually located but nests are suspected to have fledged.

[4] Parasitized nests include all nests that contained at least one flycatcher egg and one cowbird egg, regardless of nest fate. Nests that contained at least one cowbird egg but no flycatcher eggs are addressed under Brood Parasitism later in this chapter.

Table 4.2. Willow Flycatcher Percent Nest Success Recorded at Breeding Sites along the Virgin and Lower Colorado Rivers from 1997 to 2004*

Year	Pahranagat (# nests)	Littlefield (# nests)	Mesquite[1] (# nests)	Mormon Mesa[2] (# nests)	Grand Canyon (# nests)	Topock (# nests)	Bill Williams (# nests)
1996	Nm[3]	Nm[3]	Nm[3]	Nm[3]	57 (7)	100 (1)	Nm[3]
1997	Nm[3]	Nd[4]	40 (5)	38 (16)	29 (14)	78 (9)	Nd[4]
1998	37 (19)	Nd[4]	0 (7)	58 (13)	Nd[4]	43 (21)	Nd[4]
1999	56 (16)	Ns[5]	Nm[3]	50 (12)	Nc[6]	35 (20)	Nd[4]
2000	52 (21)	Nd[4]	56 (9)	31 (16)	Nc[6]	28 (18)	100[7] (1)
2001	33 (27)	Nd[4]	47 (19)	35 (20)	nc[8]	25 (20)	60[7] (5)
2002	29 (21)	Nd[4]	53 (19)	0 (10)	Nd[4]	25 (12)	50[7] (11)
2003	91 (11)	Nd[4]	44 (18)	0 (10)	Nd[4]	78 (9)	100 (2)
2004	76 (17)	50 (2)	24 (17)	50 (6)	bc[9]	45 (38)	Nd[4]

* Data from 1997 to 2002 are from McKernan 1997, McKernan and Braden (2002), and Braden and McKernan (unpubl. data) unless noted otherwise; data from 2003 are from Koronkiewicz et al. (2004); data from 2004 can be found in this document. Total number of nests is indicated in parentheses.

[1] Study area includes both the Mesquite East and West sites.

[2] Study area includes the Virgin River Delta at Lake Mead.

[3] Study area not monitored.

[4] Study area surveyed, no breeding documented.

[5] Study area not surveyed.

[6] Breeding suspected, nest success not calculated.

[7] Nest success calculated by Paradzick et al. (2001), and Smith et al. (2002, 2003).

[8] Breeding confirmed, nest success not calculated.

[9] Breeding confirmed, undetermined if nestlings from a single nest fledged.

NEST FAILURE

Depredation was the major cause of nest failure, accounting for 47% (24 of 51) of all failed nests (Table 4.3) and 59% (24 of 41) of nests that failed after flycatcher eggs were laid.

Table 4.3. Summary of Causes of Willow Flycatcher Nest Failure at the Four Life History Study Areas, Grand Canyon, AZ, and Littlefield, AZ, in 2004*

Study Area[1]	Total # Nests	All Failed Nests	Abandoned (% failed nests)	Deserted (% failed nests)	Depredated (% failed nests)	Parasitized (% failed nests)	Unknown (% failed nests)
PAHR	17	4	0 (0%)	0 (0%)	3 (75%)	0 (0%)	1[2] (25%)
LIFI	3	2	1 (50%)	0 (0%)	1 (50%)	0 (0%)	0 (0%)
MESQ	20	16	2[3](13%)	4[4] (25%)	3 (19%)	5 (31%)	2[5](13%)
MOME	7	4	1[3] (25%)	0 (0%)	3 (75%)	0 (0%)	0 (0%)
GRCA	1	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
TOPO	43	25	5[3] (20%)	1[6] (4%)	14 (56%)	4 (16%)	1[7] (4%)
Total	**91**	**51**	**9 (18%)**	**5 (10)**	**24 (47%)**	**9 (18%)**	**4 (8%)**

* All nesting attempts (those with and without flycatcher eggs) are included.

[1] PAHR = Pahranagat National Wildlife Refuge, LIFI = Littlefield, MESQ = Mesquite, MOME = Mormon Mesa, GRCA = Grand Canyon, TOPO = Topock Marsh.

[2] Nest probably depredated during incubation, but nest was too high to mirror pole to confirm fate.

[3] One nest abandoned after being parasitized.

[4] One nest deserted with one flycatcher egg and one cowbird egg; one nest deserted with a flycatcher egg that appeared addled (discolored) and chipped; one nest deserted with nestlings in the nest, female not detected post desertion; one nest female built over eggs and reused nest structure after nest was parasitized.

[5] One nest found on ground with shell fragments nearby; unknown if cowbird or flycatcher egg fragments. One nest parasitized after 6 days of incubation; remaining flycatcher egg failed to hatch after 14 days of incubation, then disappeared; nest subsequently deserted with one cowbird egg remaining.

[6] Nest deserted with one flycatcher egg and one cowbird egg.

[7] Nest contained a dead nestling.

Nine nesting attempts (17% of all failed nests) were abandoned prior to willow flycatcher eggs being laid and five nests (10%) were deserted. Nine nests (18%) failed because of Brown-headed Cowbird parasitism (see below for more details on parasitism). Cause of failure could not be determined at four nests (8%). No nests failed because of weather or infertile/addled eggs.

BROOD PARASITISM

Twenty-one of 81 nests (26%) with flycatcher eggs were brood parasitized by Brown-headed Cowbirds. An additional three nests (one each at Mesquite, Mormon Mesa, and Topock) were parasitized prior to flycatcher eggs being laid and were subsequently abandoned (Tables 4.3 and 4.4). For nests containing flycatcher eggs, parasitism caused nest failure at nine nests. Five of these fledged cowbird young, and four instances of parasitism coincided with the disappearance of any flycatcher eggs in the nest. Three nesting attempts were deserted with flycatcher and cowbird eggs in the nest; in one of these instances, the female built over the eggs and reused the nest structure. Four nests were depredated with both flycatcher and cowbird eggs or young in the nest. Three parasitized nests fledged flycatchers but no cowbirds, and one nest fledged two flycatchers and one cowbird. The cause of failure at one nest was undetermined. Brood parasitism at all sites ranged from 0 to 47% and was highest at Mesquite (Table 4.1). Nests that contained flycatcher eggs and were brood parasitized were less likely to fledge flycatcher young than nests that were not parasitized (Chi-square = 8.87, $P = 0.003$).

Table 4.4. Fates of Willow Flycatcher Nests Parasitized by Brown-Headed Cowbirds, 2004*

Study Area[1]	Nest ID Code	Outcome
MESQ	1A	Fledged a cowbird
	1B	Parasitized (one flycatcher egg disappeared and cowbird egg appeared) after 6 days of incubation; remaining flycatcher egg failed to hatch after 14 days of incubation, then disappeared; nest subsequently deserted with one cowbird egg remaining
	2B	Fledged a cowbird
	3A	Deserted during egg laying with one flycatcher egg and one cowbird egg
	5A	Parasitized after one flycatcher egg was laid; flycatcher egg disappeared when cowbird egg appeared; nest abandoned
	5B	Abandoned with one cowbird egg before flycatcher eggs were laid
	9A	Parasitized after one flycatcher egg was laid; flycatcher egg found on ground when cowbird egg appeared; nest abandoned
	22A	Fledged a cowbird
	32A	Female built over one cowbird egg and one flycatcher egg and reused nest structure
MOME	10B	Abandoned with one cowbird egg before flycatcher eggs were laid
	32A	Fledged one flycatcher; cowbird nestling disappeared at approximately 7 days of age
TOPO	1A	Fledged one flycatcher; cowbird egg did not hatch
	9A	Fledged one cowbird and two flycatchers
	11C	Fledged a cowbird
	16A	One flycatcher egg disappeared from nest and another found on ground. Third egg disappeared when cowbird egg appeared.
	18A	Nest deserted with one flycatcher egg and one cowbird egg

Table 4.4. Fates of Willow Flycatcher Nests Parasitized by Brown-Headed Cowbirds, 2004*, continued

Study Area[1]	Nest ID Code	Outcome
TOPO	22B	Depredated with one cowbird egg and one flycatcher egg
	23A	Depredated with one cowbird egg and two flycatcher eggs
	24B	Parasitized after two flycatcher eggs were laid; both eggs disappeared when cowbird egg appeared
	34A	Fledged a cowbird
	44A	Depredated with one flycatcher egg and one cowbird egg
	72B	Depredated with one dead cowbird nestling, one flycatcher nestling, and one flycatcher egg
	74A	Fledged one flycatcher; cowbird egg did not hatch
	77A	Abandoned with one cowbird egg before flycatcher eggs were laid

* All nesting attempts are included.
[1] MESQ = Mesquite, MOME = Mormon Mesa, TOPO = Topock Marsh.

MAYFIELD NEST SUCCESS AND NEST PRODUCTIVITY

Mayfield survival probability (MSP) at the four life history study areas and Littlefield ranged from 0.24 to 0.73 and was 0.44 for all sites combined (Table 4.5). At all sites, 79 nestlings were confirmed to have fledged from 79 nests of known outcome (mean number of nestlings/nest = 1.00, SE = 0.14). Fecundity across study areas ranged from 0.92 to 2.5 young per female and averaged 1.32 (SE = 0.18) (Table 4.6).

Table 4.5. Daily Survival Rates and Mayfield Survival Probabilities (MSP) for Willow Flycatcher Nest Stages at the Four Life History Study Areas, Littlefield, AZ, and Grand Canyon, AZ, in 2004*

Study Area	Nest Stage[1]	Nest Losses/ Observation Days	Daily Survival Rate	Mayfield Survival Probability
Pahranagat	1	0/32	1.000	1.000
	2	2/165	0.988	0.857
	3	2/165.5	0.988	0.847
	MSP all stages = 0.73			
Littlefield	1	0/5	1.000	1.000
	2	1/16	0.938	0.442
	3	0/11	1.000	1.000
	MSP all stages = 0.44			
Mesquite	1	5/30	0.833	0.667
	2	2/139.5	0.986	0.833
	3	5/84	0.940	0.433
	MSP all stages = 0.24			
Mormon Mesa	1	1/12	0.917	0.824
	2	1/56	0.982	0.796
	3	1/51	0.980	0.736
	MSP all stages = 0.50			

Table 4.5. Daily Survival Rates and Mayfield Survival Probabilities (MSP) for Willow Flycatcher Nest Stages at the Four Life History Study Areas, Grand Canyon, AZ, and Littlefield, AZ, in 2004*, continued

Study Area	Nest Stage[1]	Nest Losses/ Observation Days	Daily Survival Rate	Mayfield Survival Probability
Grand Canyon[2]	1	0/2	1.000	1.000
	2	0/12	1.000	1.000
	3	--	--	--
Topock	1	4/39	0.897	0.786
	2	12/276.5	0.957	0.571
	3	4/259	0.985	0.809
	MSP all stages = 0.36			
TOTAL	1	10/120	0.917	0.824
	2	18/665	0.973	0.707
	3	12/570.5	0.979	0.748
	MSP all stages = 0.436			

* Mayfield survival probability was calculated using 2.22-day egg laying, 12.65-day incubation, and 13.65-day nestling stages.

[1] 1 = egg laying, 2 = incubation, 3 = nestling

[2] No values are given for the nestling stage or all stages combined because nest fate was undetermined.

Table 4.6. Willow Flycatcher Nest Productivity (Young Fledged per Nest) and Fecundity (Young Fledged per Female) at the Four Life History Study Areas and Littlefield, AZ, in 2004*

Study Area	# Young Fledged (# Nests)	Productivity Mean (SE)	Fecundity Mean (SE)
Pahranagat	35 (17)	2.06 (0.34)	2.50 (0.47)
Littlefield	2 (2)	1.00 (1.00)	2.00 (1.48)
Mesquite	11 (17)	0.65 (0.30)	0.92 (0.40)
Mormon Mesa	6 (6)	1.00 (0.52)	1.00 (0.52)
Topock	25 (37)	0.68 (0.14)	0.93 (0.17)
Total	**79 (79)**	**1.00 (0.14)**	**1.32 (0.18)**

* Calculations include nests that contained flycatcher eggs and had a known outcome.

DISCUSSION

In 2004, willow flycatcher nesting was documented at the four life history study areas, Littlefield, and Grand Canyon. In 2003, nesting was documented at the four life history study areas and Bill Williams, and although surveys were conducted at Littlefield and Grand Canyon, no nesting was documented at either study area (Koronkiewicz et al. 2004). Although resident willow flycatchers were detected at Bill Williams in 2004, all were unpaired, non-breeding individuals (see Chapter 3). Flycatcher nesting at Littlefield this year is the first to be documented since surveys began in 1997, and nesting at Grand Canyon has not been recorded since 2001 (McKernan and Braden 2002). We recorded the highest number of nests to be

documented at Topock Marsh since monitoring began in 1997. The high number of nesting flycatchers recorded at Topock in 2004 compared to 2003 is the result of both improved coverage of survey areas and the presence of breeding flycatchers in areas that were surveyed and found to be unoccupied in 2003. Given that southwestern riparian ecosystems experience dynamic change and are not ecologically static (Periman and Kelly 2000), willow flycatcher occupancy and nesting are likely to be affected by changes in habitat suitability, with breeding flycatchers detected in one year and not in another. Between-year variability in flycatcher occupancy and breeding is also likely to be exhibited more at relatively small sites, such as those found in Grand Canyon, which appear to be more subject to ecological change.

NEST SUCCESS

As in 2003, Pahranagat continued to exhibit high nest success in 2004, with 76% recorded in 2004 and 91% recorded in 2003 (see Table 4.2 for nest success at study areas from 1997–2004). Conversely, we recorded the lowest nest success at Mesquite since monitoring began in 1997, though success rate did not differ significantly from those recorded in 2000–2002 (Chi-square = 4.04, $P = 0.4$; small sample size in 1997–1998 precluded inclusion of these years in the analysis). At Mormon Mesa we observed few nesting attempts but the highest nest success (50%) since 1999. Nest success at Topock (45%) was in the middle of the range of success rates reported at the site since 1997. The increase in nest success at Mormon Mesa is of particular importance because no flycatchers have been reported to successfully fledge young at the site since 2001, and recent multi-year trends in low nest success and high emigration suggested that the site may be a population sink (Koronkiewicz et al. 2004). Nest success results at Mormon Mesa emphasize that the demographic patterns of passerine populations often vary year to year, and sometimes to a very large degree (Wiens 1989a). The different patterns of nest success observed at the study areas over many years reinforce the variability of the demographic traits of the willow flycatcher and further demonstrate the need for long-term data.

NEST FAILURE

Depredation was the major cause of willow flycatcher nest failure in 2004, accounting for 47% of all failed nests at the four life history study areas and Littlefield (Table 4.3). Depredation accounted for 75, 50, 19, 75, and 56% for all failed nests at Pahranagat, Littlefield, Mesquite, Mormon Mesa and Topock, respectively. These results are consistent with those reported at the life history study areas from 1998 to 2003 (McKernan and Braden 2002; Koronkiewicz et al. 2004; Braden and McKernan, unpubl. data) and with monitored sites across Arizona from 2000 to 2003 (Paradzick et al. 2001; Smith et al. 2002, 2003, 2004), which report depredation as accounting for the majority of all willow flycatcher nest failures. Factors influencing the increases and decreases in nest depredation at the life history study areas are inherently complex and at this time remain undetermined. However, the large variation in nest depredation rates observed among the study areas over time are not unusual for open cup nesting species. For open cup nesting passerines, it has been shown that nest depredation rates can vary year to year, and sometimes substantially, with depredation of eggs and young ultimately linked to fluctuations in predator densities, abundance, and richness (Wiens 1989b, Robinson 1992, Howlett and Stutchbury 1996).

BROOD PARASITISM

Brood parasitism by Brown-headed Cowbirds across all study areas ranged from 0 to 47% and averaged 26% (Table 4.1). These results are consistent with those reported at the study areas from 1998 to 2003 (McKernan and Braden 2002; Koronkiewicz et al. 2004; Braden and McKernan, unpubl. data; see Table 5.2 in Chapter 5). These parasitism rates are higher than those reported at monitored sites across Arizona, which averaged 4, 5, 11, and 2% in 2000, 2001, 2002, and 2003, respectively (Paradzick et al. 2001; Smith et al. 2002, 2003, 2004). We observed the second consecutive year of no brood parasitism at Pahranagat. Cowbird trapping and removal studies were initiated at all the life history studies in 2003, and we discuss trends in brood parasitism rates in detail in Chapter 5.

The effect of parasitism on nest fate was variable, but parasitism reduced the likelihood that a nest that contained flycatcher eggs would fledge flycatcher young. We observed seven nests in which the disappearance of flycatcher eggs coincided with the parasitism event. In these cases, cowbirds were suspected in ejecting the eggs. Female Brown-headed Cowbirds are known to physically attack willow flycatcher nestlings (Woodward and Stoleson 2002), remove single eggs, and occasionally destroy entire broods after laying is complete or after hatching (Lowther 1993 as cited in Woodward and Stoleson 2002). Therefore, it is also possible that some depredation events on eggs and nestlings are attributable to cowbirds. We also observed three nests that were parasitized prior to flycatcher eggs being laid and were subsequently abandoned. Thus, cowbird brood parasitism negatively affects overall flycatcher productivity by multiple mechanisms including interspecific nestling competition, depredation, and causing female flycatchers to expend energy renesting following parasitism events. Moreover, given that adult flycatchers exhibit high site fidelity to breeding areas (McKernan and Braden 2002, Koronkiewicz et al. 2004, this document) and renest most often after failed nests (Sedgwick 2000), females returning to sites with high brood parasitism are likely to reduce lifetime fecundity because they are expending energy on multiple failed nesting attempts over many years. Cowbird impacts to flycatcher populations may therefore be more severe than parasitism rates alone suggest. Because it is still unclear how brood parasitism rates affect flycatcher population sizes (Rothstein et al. 2003), baseline nesting studies in conjunction with cowbird control experiments need to be continued to determine whether brood parasitism presents a serious problem for populations at the life history study areas.

MAYFIELD NEST SUCCESS AND NEST PRODUCTIVITY

As presented in Koronkiewicz et al. (2004), comparing Mayfield survival probabilities (MSP) at the study areas with results from other studies may be somewhat problematic because of differences in the duration of nest stages (egg laying, incubation, and nestling stage) used in calculations. To determine the degree to which MSP comparisons can be made with other studies, we first calculated 2004 MSP at all study areas using the average flycatcher nest stages calculated by Rourke et al. (1999) and used by the Arizona Game and Fish Department (2.6, 12, and, 12.5 days for egg laying, incubation, and nestling stages, respectively). We then calculated 2004 MSP using the average flycatcher nest stages calculated at all study areas for 2003–2004 (2.22, 12.65, and 13.65 days for egg laying, incubation, and nestling stages, respectively), and compared the results. At each study area, the different methods resulted in differences in overall

MSP of less than two percent. Therefore, MSP comparisons between different study areas or across years in which different average nest stages are used can be used to evaluate broad trends in MSP.

Overall MSP (0.436) was similar to the overall MSP (0.383) reported at the life history study areas for 1997–2002 for the egg laying, incubation, and nestling stages (Braden and McKernan, unpubl. data). Overall MSP in 2004 was slightly lower than in 2003 (0.556) but was more consistent across study areas in 2004 than in 2003.

CHAPTER 5

BROWN-HEADED COWBIRD TRAPPING

INTRODUCTION

In 2003, we initiated intensive Brown-headed Cowbird trapping at all the life history study areas and continued the same effort in 2004. From 1997 to 2001, willow flycatcher nest success and brood parasitism rates were documented at the life history study areas (McKernan and Braden 2002), with no cowbird trapping conducted in the proximity of the breeding sites. In this study we compare willow flycatcher life history data under the influence of cowbird trapping (2003–2007) with data gathered at the life history study areas from 1997 to 2001 to determine if cowbird trapping and removal affects brood parasitism rates and willow flycatcher nest success and productivity.

METHODS

We conducted Brown-headed Cowbird trapping at each of the four life history study areas, with the number of traps set in each area determined by landscape characteristics and acreage of the site. Each trap had an effective trapping radius of 0.4 km (John Griffith, GWB, pers. comm., March 2002), and we deployed as many traps as needed at each site such that all the areas of occupied willow flycatcher habitat were under the influence of trapping. USBR biologists approved trap numbers and locations, and trapping methods followed those outlined in Griffith Wildlife Biology (1994a). To minimize the number of parasitism days (the number of days a host population is exposed to each female cowbird), cowbird traps were deployed at least two weeks prior to the initiation of flycatcher nesting (mid-May) and continually operated until all nests were at least past the egg laying and incubation stages (beginning of August).

We used a variation of the Australian crow trap (Figure 5.1) to capture Brown-headed Cowbirds. These portable, wood-framed traps were 4 feet high, 4 feet wide, and 8 feet long, with a door located on one end. The panels consisted of 2-inch by 2-inch wood supports covered with 0.5-inch wire mesh. A piece of plywood, with two 1.25-inch slots down the middle, was attached to the top of each trap for cowbird entry. Signs were posted on each trap door to inform the public of the nature and relevance of the trapping program. The signs were clearly marked and laminated to maintain legibility over the season. Padlocks were used on the doors to discourage vandalism. Each trap was situated in an accessible location and was visible from above with some natural tree cover. To attract cowbirds, a ratio of two male and three female live-decoy cowbirds were maintained in each trap each day. Each trap was leveled, and the wire mesh floor covered with a thin layer of soil to encourage natural foraging and social behavior among the decoy birds.

Six or more horizontal perches were provided in the trap corners, and shadecloth was attached to the outside of each trap to provide adequate shade. An abundant supply of wild birdseed (not containing sunflower seeds, which attract non-target species) and a 1-gallon guzzler of water were kept in each trap and replenished daily.

Figure 5.1. Brown-headed Cowbird trap used at life history study areas, 2004.

Each trap was checked every 24 hours, and findings were recorded on an individual daily data sheet (Appendix A). Each day we recorded the number of cowbirds captured and removed, including sex and age, the number of non-target birds captured and released, and any pertinent notes. Upon entering a trap, field personnel carefully flushed out any non-target birds noting species, sex, and, when possible, age. We clipped the wings of all cowbirds at the edge of the secondary and primary feathers, thus lowering the probability of injury in the trap and the likelihood that any escaped bird would be able to survive. Newly trapped cowbirds were removed, placed in a small holding cage, and then euthanized off-site using carbon monoxide.

Because relatively few cowbirds were captured and removed at Mormon Mesa and Mesquite in 2003, all traps at both study areas were moved to different locations, with an additional trap deployed at Mesquite (per verbal agreement with USBR biologists). At Mesquite, two traps were relocated to a riparian forest/agricultural field edge approximately 200 m from the breeding site; the third trap was relocated in riparian vegetation immediately adjacent to the breeding site.

At Mormon Mesa, three traps were relocated from the edge of a large wash to the interior of the riparian habitat less than 50 m from two breeding sites; the forth trap was relocated immediately adjacent to the Delta West breeding site (see Figures 5.2–5.5 for trap locations).

RESULTS

BROWN-HEADED COWBIRDS

From 15 May to 6 August 2004, we deployed and continuously operated two cowbird traps at Pahranagat, three at Mesquite, four at Mormon Mesa, and six at Topock. We captured and removed 77, 21, 25, and 45 Brown-headed Cowbirds, respectively, at each study area (Table 5.1).

Table 5.1. Summary of Brown-headed Cowbirds Trapped and Removed at Pahranagat NWR, Mesquite, and Mormon Mesa, NV, and Topock Marsh, AZ, 2004

Study area	Trap #	# Males	# Females	# Juveniles	Total # Brown-headed Cowbirds
Pahranagat	1	13	10	1	24
	2	32	19	2	53
	Total	**45**	**29**	**3**	**77**
Mesquite	1	0	0	0	0
	2	4	2	0	6
	3	7	7	1	15
	Total	**11**	**9**	**1**	**21**
Mormon Mesa	1	0	1	0	1
	2	0	4	1	5
	3	6	7	1	14
	4	2	3	0	5
	Total	**8**	**15**	**2**	**25**
Topock	1	6	2	0	8
	2	1	0	0	1
	3	4	2	1	7
	4	4	2	0	6
	5	1	3	0	4
	6	10	7	2	19
	Total	**26**	**16**	**3**	**45**

BROOD PARASITISM RATES

A comparison of the proportion of flycatcher nests parasitized at each of the life history study areas in the pretrapping (1997–2002) and trapping (2003–2004) periods shows a significantly (Chi-square = 4.9, $P = 0.03$) lower parasitism rate in the trapping period at Pahranagat. There was no change in parasitism rates at Mesquite, Mormon Mesa, or Topock (Table 5.2).

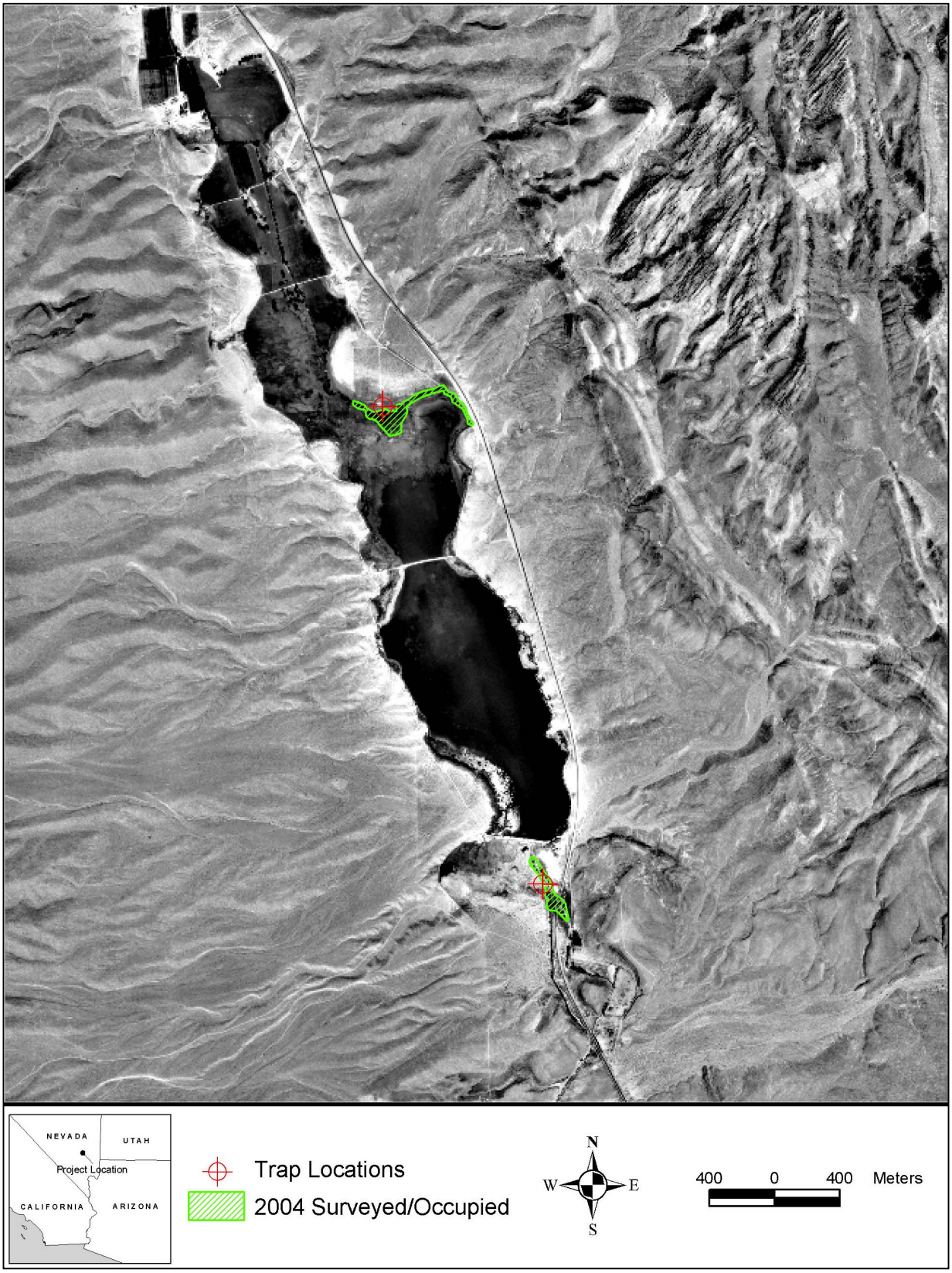

Figure 5.2. Cowbird trap locations at Pahranagat NWR, NV, 2004.

Figure 5.3. Cowbird trap locations at Mesquite, NV, 2004.

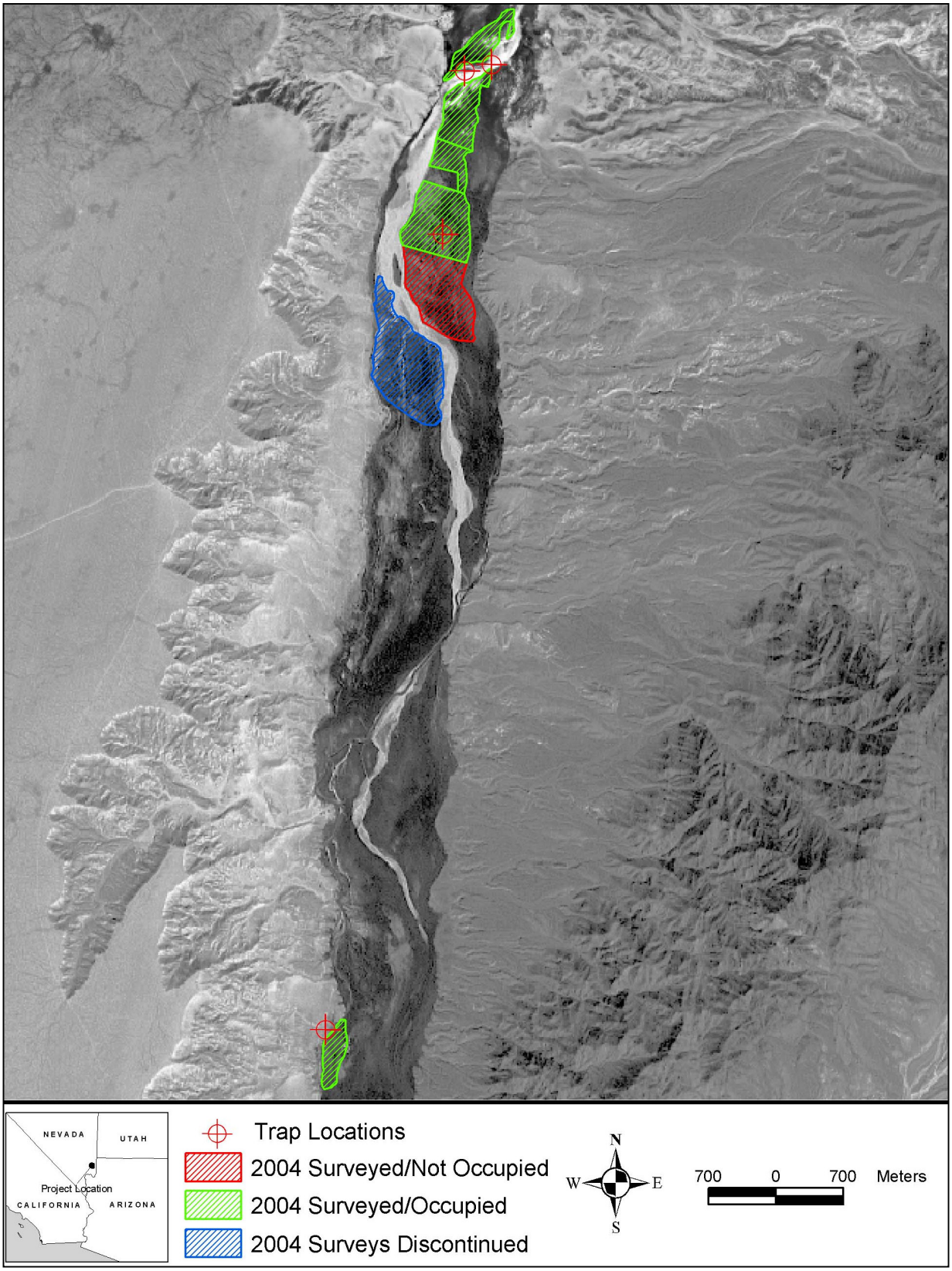

Figure 5.4. Cowbird trap locations at Mormon Mesa, NV, 2004.

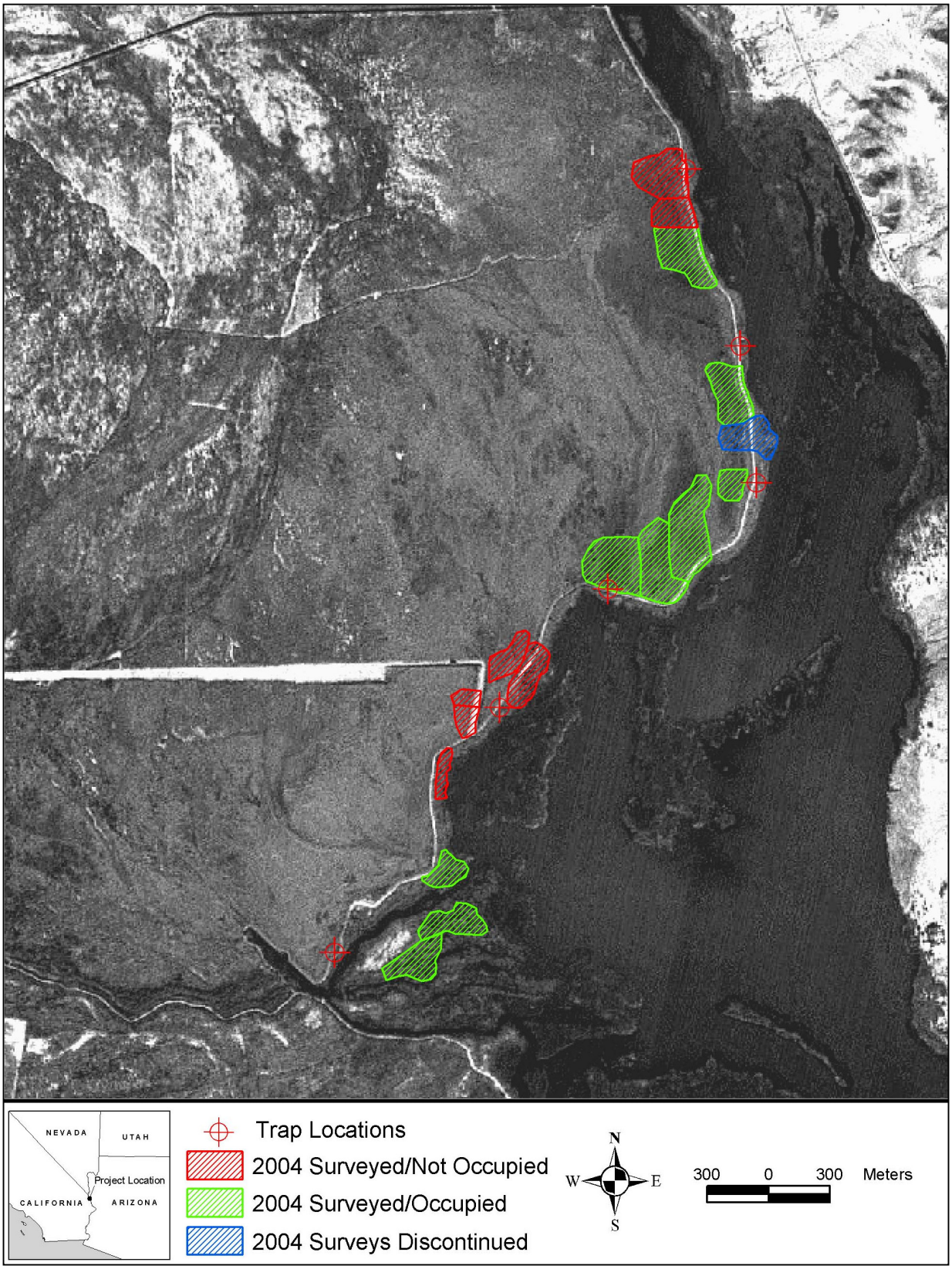

Figure 5.5. Cowbird trap locations at Topock Marsh, AZ, 2004.

Table 5.2. Brown-Headed Cowbird Brood Parasitism Rates at the Four Life History Study Areas, 1997–2004*

	Year	Pahranagat	Mesquite[1]	Mormon Mesa[2]	Topock
Pre-trapping periods	1997	nm[3]	60.0% (5)	18.8% (16)	11.1% (9)
	1998	0.0% (19)	57.1% (7)	15.4% (13)	28.6% (21)
	1999	12.5% (16)	nd[4]	0.0% (12)	30.0% (20)
	2000	14.3% (21)	22.2% (9)	25.0% (16)	16.7% (18)
	2001	14.8% (27)	15.8% (19)	20.0% (20)	25.0% (20)
	2002	33.3% (21)	31.6% (19)	0.0% (10)	16.7% (12)
Trapping periods	2003	0.0% (11)	22.2% (18)	10.0% (10)	22.2% (9)
	2004	0.0% (17)	47.1% (17)	16.7% (6)	31.6% (38)
% parasitism pretrapping periods (SE)		14.9% (5.3)	37.3% (9.0)	13.2% (4.4)	21.4% (3.1)
% parasitism trapping periods (SE)		0.0% (0.0)	34.7% (12.5)	13.4% (3.4)	26.9% (4.7)

* Total number of nests is indicated in parentheses for each year. Data for pre-trapping periods (1997–2002) are from McKernan and Braden (2002) and Braden and McKernan (unpubl. data); data for trapping periods (2003–2004) are from Koronkiewicz et al. (2004) and this document.

[1] Study area includes Mesquite East in 1997–1999 and Mesquite West in 2000–2004.

[2] Study area included Virgin River Delta sites.

[3] Study area not monitored.

[4] Study area monitored, no breeding documented.

NON-TARGET SPECIES

Eight non-target species were captured at all life history study areas during cowbird trapping (Table 5.3). Non-target species captures included House Sparrow (*Passer domesticus*), Blue Grosbeak (*Guiraca caerulea*), Red-winged Blackbird (*Agelaius phoeniceus*), Northern Mockingbird (*Mimus polyglottos),* Abert's Towhee (*Pipilo aberti*), Black-headed Grosbeak (*Pheucticus melanocephalus*), House Finch (*Carpodacus mexicanus*), and California Towhee (*Pipilo crissalis*). Because the same individual(s) may be captured and released on consecutive days, the total number of individuals of each species captured cannot be accurately determined. Mortalities included two individuals of two species (Northern Mockingbird, House Finch), with cause of death undetermined.

Table 5.3. Summary of Non-Target Species Captured during Brown-Headed Cowbird Trapping at the Life History Study Areas, 2004

Study Area	(Number Captured) Species (Sex - F, M, or?)	Capture Date(s)[1]
Pahranagat	(1) House Sparrow (F)	7 July
Mesquite	(1) Blue Grosbeak (juvenile)	18 June
	(1) Red-winged Blackbird (M)	19 June
	(1) Blue Grosbeak (?)	2 July
	(1) Northern Mockingbird (?)	9 July
	(1) Abert's Towhee (?)	12 July

Table 5.3. Summary of Non-Target Species Captured during Brown-Headed Cowbird Trapping at the Life History Study Areas, 2004, continued

Study Area	(Number Captured) Species (Sex - F, M, or?)	Capture Date(s)[1]
Mormon Mesa	(3) Northern Mockingbird (?)	30 June**
	(1) Black-headed Grosbeak (?)	30 June
	(1) Northern Mockingbird (?)	1–3 July
	(2) Northern Mockingbird (?)	30 July, 1 August
Topock	(1) House Finch (?)	3 June
	(3) House Finch (1M, 2F)	4 June
	(2) House Finch (F)	5 June
	(2) House Finch (1M, 1F)	6-9, 11–17 June
	(3) House Finch (2M, 1F)	18 June
	(1) House Finch (F)	19–21 June
	(2) House Finch (F)	22 June
	(8) House Finch (1M, 7F)	23 June
	(1) House Finch (F)	24–27 June
	(1) House Finch (?)	30 June**
	(1) California Towhee (?)	5,8,13 July
	(2) Northern Mockingbird (juvenile)	29 July
	(1) House Finch (?)	31 July

** = mortality

[1] Dates given indicate a separate capture on each date. Unless preceded by a mortality, it is not known whether a bird captured on a specific date is the same or a different individual from one captured on previous dates.

DISCUSSION

The frequency of Brown-headed Cowbird brood parasitism of willow flycatchers is known to be highly variable, ranging from less than 10% at some sites to over 60% at others (Sedgwick 2000). Cowbird brood parasitism of the flycatcher is of particular concern because parasitism usually results in reduced reproductive output (Sedgwick and Knopf 1988, Harris 1991, Whitfield and Sogge 1999, Rothstein et al. 2003). However, Brown-headed Cowbirds are native passerines, and willow flycatchers can raise offspring to fledging from a brood parasitized nest. Thus, cowbird management issues are complicated, particularly because it is still unclear how brood parasitism rates affect willow flycatcher population sizes (Rothstein et al. 2003).

Similar to 2003, the total number of Brown-headed Cowbirds captured at each of the four life history study areas in 2004 was variable, ranging from 21 to 77, with large numbers of captures recorded at Pahranagat (77) and Topock (45), and relatively few captures recorded at Mesquite (21) and Mormon Mesa (25). Reasons for this variability are undetermined; however, the total number of cowbird captures at each site appeared not to be directly related to the total number of traps per site. For example, and similar to 2003, Pahranagat had two traps and the greatest number of cowbirds captured, while Mormon Mesa had four traps and fewer cowbirds captured. Trends in subsequent years may suggest reasons for this variability.

In 2004, Mesquite and Mormon Mesa showed increases in the total number of captures compared to 2003 (21 vs. 6 at Mesquite, and 25 vs. 3 at Mormon Mesa). It is likely the relocation of all traps at both study areas and the addition of a third trap at Mesquite contributed to the increased numbers of cowbirds captured at both areas. Conversely, fewer cowbirds were captured at Pahranagat and Topock than in 2003 (77 vs. 115 at Pahranagat, and 45 vs. 113 at Topock). Reasons for this variability are undetermined; however, many more cowbirds are removed annually at Pahranagat than is reported for the traps alone. At the Pahranagat NWR headquarters, located less than 2 km from the nearest breeding site, up to 70 cowbirds are captured and removed annually for decoys at other trapping areas. Therefore, from 2003 to 2004 approximately 330 cowbirds were removed from the Pahranagat study area. Given that a relatively large number of cowbirds have been removed from an area that contains only approximately 7.5 ha of riparian flycatcher habitat surrounded by upland desert, we might expect cowbird numbers to decrease in the area in subsequent years. The reason for less than half the number of cowbirds captured and removed from Topock in 2004 compared to 2003 is undetermined. Overall, the total number captured at the Topock study area does not reflect total cowbird detections in the area, with cowbirds detected at the breeding sites daily. Trapping results in subsequent years may help to explain this variability.

Two years of trapping are insufficient to make an unequivocal determination on the effectiveness of cowbird trapping. Preliminary data, however, indicate a decline in the parasitism rate at Pahranagat since the implementation of trapping, with no brood parasitism documented at this study area in 2003 or 2004. As discussed above, large numbers of cowbirds have been removed from the study area, and cowbird numbers would be expected to decrease in the area as trapping continues in subsequent years. In addition, very few cowbirds were detected at the Pahranagat breeding sites during daily flycatcher monitoring in 2004. Trapping results and brood parasitism rates recorded in subsequent years will provide the information necessary to determine if cowbird trapping affects brood parasitism rate and willow flycatcher nest success and productivity at Pahranagat.

At Mesquite, cowbird brood parasitism rates have been high since flycatcher monitoring began in 1997 (Table 5.2). Moreover, a relatively large number of nest failures at Mesquite can be directly attributed to brood parasitism, with a number of abandonment and depredation events also possibly attributable to cowbirds (see Tables 4.3–4.4 and Discussion in Chapter 4). The flycatcher breeding site at Mesquite is bordered entirely by golf courses, human-made ponds and canals, fountains, and agricultural fields, and very large numbers of cowbirds are detected daily at the breeding sites during flycatcher monitoring. Overall, extensive human development immediately adjacent to the riparian forest at Mesquite has greatly enhanced cowbird habitat. Although cowbird trapping and removal has been conducted for only two years, which is likely an insufficient amount of time to influence flycatcher parasitism rates or reproductive success (Rothstein et al. 2003), further study is needed to investigate whether a more aggressive cowbird removal program is warranted at Mesquite.

At Mormon Mesa and Topock, cowbird brood parasitism rates have not changed since trapping was initiated. However, as noted previously, two years of trapping is likely an insufficient amount of time to influence flycatcher parasitism rates or reproductive success at sites. Trapping results and brood parasitism rates recorded in subsequent years will provide the information necessary to determine if cowbird trapping affects brood parasitism rate and willow flycatcher nest success and productivity at the study areas.

Eight non-target species were captured at Pahranagat, Mesquite, Mormon Mesa and Topock during cowbird trapping in 2004. Mortalities consisted of two individuals: one Northern Mockingbird and one House Finch. Capturing non-target species is of concern but is unavoidable. Griffith Wildlife Biology (1994b) reported over 8,400 captures of non-target species during a single season of cowbird trapping at Camp Pendleton, California. Species other than cowbirds have higher mortality rates in traps and may incur reduced breeding success because of time spent away from the nest (Rothstein et al. 2003). This emphasizes the need to check traps every 24 hours as specified in the above methods.

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CHAPTER 6

VEGETATION AND HABITAT CHARACTERISTICS

INTRODUCTION

During the 2004 field season, we measured vegetation and habitat characteristics at plots located throughout the four life history study areas to obtain an overall description of the whole habitat block. We also measured vegetation and habitat characteristics in Southwestern Willow Flycatcher nesting and non-use plots at the four life history study areas. For two areas, Grand Canyon and Littlefield, in which breeding was documented in 2004, we measured vegetation and habitat characteristics at flycatcher nest sites. Field methods for 2004 were identical to those used in 2003. Our specific objectives for vegetation sampling are to understand how habitat characteristics at sites used by nesting willow flycatchers differ from those at unused sites, and to identify specific variables that may contribute to the characterization of breeding habitat throughout the Virgin and lower Colorado River riparian systems. Data from nesting and non-use plots from 2003 and 2004 will be pooled with data acquired in subsequent years to contribute to an understanding of general habitat features that characterize Southwestern Willow Flycatcher breeding habitat.

METHODS

At each of the four life history study areas, we described and measured vegetation and habitat features following a modification of the methods of James and Shugart (1970). These methods were developed over several seasons by the Arizona Game and Fish Department (see data form, Appendix A). All vegetation characteristics were measured within an 11.3-m-radius (0.04 ha) circle. A plot this size centered on a nest is likely to be sufficient to describe variability within a flycatcher territory without measuring areas outside the territory (Sedgwick and Knopf 1992). We also chose a distance of 30 m from plot centers to record presence or absence of certain habitat features. An area of this size (0.28 ha) should represent an unbiased characterization of willow flycatcher habitat selection given that it encompasses approximately 25–50% of the home range of a breeding willow flycatcher (Paxton et al. 2003, Sedgwick 2000). To avoid disrupting flycatcher breeding activities, we measured vegetation in mid to late August when the nest, territory, and adjacent flycatcher territories were inactive.

We measured habitat characteristics at approximately 30 plots throughout each of the four life history study areas to obtain a description of the overall characteristics and the variability of habitat characteristics within the habitat block. We considered the habitat block to include all riparian areas that were potential nesting habitat or use areas (e.g., foraging, roosting, feeding young) for willow flycatchers. At Pahranagat and Mesquite, these areas were contiguous with nesting habitat that was occupied in 2004, while at Mormon Mesa and Topock, portions of the habitat block were separated from occupied habitat by roads, open water, dry washes, marshes, or dead vegetation. At the life history study areas that are separated into several noncontiguous sites, the number of plots measured in each site was proportional to the area of the site in relation

to the total area of all sites in the study area to obtain a representative sampling of the habitat. Nest and non-use plots (see below) were included in the habitat block measurements as long as they did not overlap with an adjacent plot and did not result in disproportionate representation of a site.

Plot center locations for habitat block points were selected by superimposing a 25 × 25–m grid on an ArcView® GIS 3.3 software shapefile of the study area boundary, numbering the grid blocks, selecting blocks by using a random number generator, and using the centroid of each selected block. Plot centers were located in the field by navigating to the given coordinates using a Rino 110 GPS unit.

At each plot, we laid out four 11.3-m-long ropes from plot center, one in each of the four cardinal directions. Each rope was marked at 1 m and 5 m from the center of the plot. At 1 m from the center of the plot in each cardinal direction, we measured vertical foliage density using a 7.5-m-tall survey rod. Working our way up the rod, we recorded the presence of vegetation, by species, within a 10-cm radius of the rod in 0.1-m intervals (presence of the species within the 0.1-m interval equaled one "hit" on the rod), and tallied all hits in 1-m intervals. Presence of dead vegetation (snags) was recorded in the same manner, but not identified to species. If canopy vegetation continued above 7.5 m, we estimated the number of hits as greater than or less than five hits per 1-m interval until the canopy vegetation stopped (modified from Rotenberry 1985). We measured total canopy and sub-canopy closure using a Model-A spherical densiometer at 1 m north and south of the center of each plot and averaged these measurements to obtain a single canopy closure value for each plot. We measured average canopy height within each 11.3-m plot by selecting a representative tree and using a survey rod or a clinometer and measuring tape to measure the height of the selected tree. We measured the distance, if less than 30 m, from plot center to the nearest native broadleaf tree (e.g., cottonwood, willow, or mesquite); canopy gap (at least 1-m square); and standing water or saturated soil. If any of the distances were >30 m, they were recorded as such.

We estimated percent woody ground cover, alive and dead, using a Daubenmire-type frame with the lower edge of the frame centered at 1 m north, south, east, and west of plot center. These percentages were averaged to obtain a single measure of percent woody ground cover for each plot. We tallied the number of live shrub and sapling stems for each species, by quadrant, within 5 m of the center of the plot and summed all species over all quadrants to obtain the total stem count for each plot. Shrub and sapling stems were tallied if they were at least 1.4-m tall and >2.5 cm in diameter at 10 cm above the ground. If a stem branched above 10 cm but below 1.4 m above the ground, only the largest stem was tallied. Stems were tallied by the following diameter at breast height (dbh) categories: <1 cm, 1–2.5 cm, 2.6–5.5 cm, and 5.6–8 cm. Dead stems were also tallied in these categories, but not identified to species. We tallied live trees (defined as dbh >8 cm) by species, in each quadrant of the 5-m-radius circle, in 8.1–10.5 cm and 10.5–15 cm dbh categories. Any trees greater than 15 cm dbh were measured and the exact dbh was recorded. Snags were also recorded in these categories, but not identified to species. Within each quadrant between 5 and 11.3 m of plot center, we tallied live trees >8 cm dbh by species but did not separate trees into size categories. Snags >8 cm dbh were also tallied, and tallies for each species and quadrant were summed to obtain a total tree count for the plot.

Additional information recorded at each plot included the date when the measurements were taken, observer initials, and UTM coordinates for each plot center.

We recorded these habitat and vegetation characteristics at each willow flycatcher nest located during the 2004 breeding season, including renests by the same female, in which at least one flycatcher egg had been laid. In addition to the variables described above, we recorded nest height and substrate species, dbh of substrate species, and height of the nesting substrate. If the distance to standing water or saturated soil was different during nesting than at the time of vegetation measurement, distance during nesting was estimated and recorded.

All habitat characteristics, excluding those specific to the nest, were also measured at non-use plots located 50–200 m from any willow flycatcher nest or territory center. Each non-use plot was surveyed multiple times throughout the season to confirm the absence of flycatchers. One non-use plot was selected for each willow flycatcher nest in which at least one flycatcher egg was laid. Non-use plot locations were randomly selected by superimposing a 25 × 25–m grid over an ArcView® GIS 3.3 software shapefile of the study area boundaries, including nest and territory locations, and clipping the grid to include areas between 50 and 200 m of known nests or territories, and within the study area boundaries. Each grid square was numbered, and grid squares were chosen using a random number generator. The centroid of each selected grid was the target location for the non-use plots. Non-use plots were located in the field by navigating to the given coordinates using a Rino 110 GPS unit and selecting the nearest woody plant at least 3-m tall. The plot was centered at a distance and direction from the bole of the tree determined by random number tables. Because randomly chosen non-use plots in clearly unsuitable habitat (e.g., desertscrub or open cattail or bulrush marsh) would have exaggerated differences between nesting and non-use plots, we only used non-use plots that contained at least one live, woody stem a minimum of 3 m in height (approximate average nest height in 2003 and 2004), per Allison et al. (2003).

DATA ANALYSES

We used JMP IN® Version 4 (SAS Institute Inc.) software for statistical analyses. A statistical significance level of $P \leq 0.05$ was chosen to reject null hypotheses. Data presented are means ± standard error (SE) unless otherwise stated.

Analyses of habitat blocks – Canopy closure, canopy height, percent woody ground cover, and total stem counts at habitat block plots were compared across study areas using one-way analysis of variance (ANOVA). If differences across study areas were indicated by the ANOVA, we used Tukey's multiple comparison test to determine which study areas differed.

Measures of distance to canopy gap, distance to broadleaf tree, and distance to water or saturated soil often contained both continuous and categorical (>30 m) data. If less than 5% of the measurements for a given variable were categorical, we converted all >30 m measurements to 31 m and analyzed distance using ANOVA. If greater than 5% of the measurements were categorical, we categorized all data as ≤30 m or >30 m and analyzed the data across sites using 4 × 2 contingency tables. If differences were indicated across sites, we used 2 × 2 contingency tables to determine which sites differed.

Vertical foliage density data in each habitat block were summarized graphically, but we did not make between-site comparisons. Vertical foliage density measurements above 7.5 m that were recorded as < or > 5 hits per meter were converted to 2.5 and 7.5 hits, respectively, to allow analyses of these data as continuous rather than categorical.

Analyses of nest characteristics – Characteristics specific to the nest (nest height, nest substrate species, nest substrate height, and nest substrate dbh) were compared between study areas using ANOVA and Tukey's multiple comparison test. Study areas where sample size was <5 were excluded from comparisons.

Analyses of nest vs. non-use sites – Canopy closure, canopy height, percent woody ground cover, total stem counts, and vertical foliage density within each meter interval were compared between nest and non-use sites at each life history study area using Student's *t*-tests. Distance to water, canopy gap, and broadleaf tree were analyzed as described above. We did not pool data across study areas because of significant differences in many variables between study areas.

RESULTS

At the four life history study areas, Littlefield, and Grand Canyon, we gathered data on vegetation and habitat characteristics at 79 nest plots and 75 non-use plots. We gathered data at an additional 37 habitat block plots at the life history study areas.

VEGETATION MEASUREMENTS OF ENTIRE HABITAT BLOCKS

Quantitative measurements of vegetation and habitat characteristics across habitat blocks at the four life history study areas varied within and between sites in canopy height and closure, percent woody ground cover, and number of shrub/sapling and tree stems (Table 6.1). Distance to canopy gap had 5% of the measurements recorded as >30 m. These values were converted to 31 m, and data were analyzed as continuous. Distance to broadleaf tree and water or saturated soil had greater than 5% of the measurements recorded as >30 m and were analyzed as categorical variables. All variables but distance to canopy gap differed significantly between sites. All sites except Pahranagat had the densest foliage within 4 m of the ground (Figures 6.1–6.4).

VEGETATION MEASUREMENTS AT THE NEST

Willow flycatcher nest height at the four life history study areas, Littlefield, and Grand Canyon ranged from 1.1 to 10.0 m, with a mean nest height of 3.2 m (SE = 0.2). Nest substrate included three woody species of trees, two native and one exotic, as well as dead trees. Flycatchers placed 63% of all nests at the study areas in tamarisk, 12% in coyote willow, 20% in Goodding willow, and 5% in snags. Nest substrate height at all sites ranged from 2.0 to 21.8 m, with a mean nest substrate height of 5.8 m (SE = 0.5). Nest substrate dbh was highly variable, ranging from 0.9 to 71.5 cm, with a mean nest substrate dbh of 9.5 cm (SE = 1.6). Nest height at Mesquite was lower than at Pahranagat and Topock, while nest substrate height and dbh were greater at Pahranagat than at the other study areas (Table 6.2). Nest height, substrate height, and substrate dbh at the life history study areas did not differ significantly between 2003 and 2004. Four of six

nests at Mormon Mesa in 2004 were placed in snags, whereas no nests were placed in snags in 2003; however, small sample size precluded statistical analysis of difference between years.

Table 6.1. Summary of Vegetation and Habitat Characteristics of Entire Habitat Blocks at the Four Life History Study Areas, 2004*

Parameter	Pahranagat (n = 29)	Mesquite (n = 30)	Mormon Mesa (n = 30)	Topock (n = 30)
Average canopy height (m)	17.5 (1.1) 5.7–26.1 A	4.4 (0.2) 2.0–7.4 B	3.8 (0.3) 2.0–9.7 B	5.5 (0.3) 1.5–9.5 B
% total canopy closure	91.9 (2.2) 49.0–100.0 A	82.1 (3.6) 27.1–99.5 A,B	73.2 (6.4) 0.0–100.0 B	82.2 (4.2) 0.0–100.0 A,B
% woody ground cover	37.4 (6.6) 0.0–100.0 A	27.8 (5.3) 0.0–100.0 A,B	10.2 (3.2) 1.1–99.5 B	16.7 (3.5) 0.9–86.5 B
% of plot centers within 30 m of standing water or saturated soil	20.7 A	60.0 B	0.0 C	20.0 A
Distance (m) to nearest canopy gap	6.1 (0.8) 0.0–15.0 A	5.3 (1.2) 0.0–21.0 A	8.1 (2.1) 0.0–31.0 A	7.1 (1.2) 0.0–31.0 A
% of plot centers within 30 m of a broadleaf tree	100.0 A	100.0 A	76.7 B	36.7 C
# shrubs/sapling stems within 5-m radius of plot center	6.0 (3.9) 0–111 A	110.9 (11.1) 30–221 B,C	78.5 (9.7) 8–248 B	116.1 (12.8) 3–380 C
# tree stems within 11.3-m radius of plot center	10.0 (2.4) 1–67 A	2.9 (1.4) 0–42 A	4.9 (1.5) 0–25 A	25.6 (2.5) 0–48 B

* Data presented for continuous variables are means, (standard error), and range. Significant differences (Tukey's test, α=0.05) between sites for a given continuous variable are indicated by alpha codes; sites with different letters differed from one another while sites with the same letter did not. Categorical variables were analyzed using Pearson chi-square.

Table 6.2. Summary of Nest Measurements at the Four Life History Study Areas, Littlefield, and Grand Canyon, 2004*

Parameter	Pahranagat (n = 16)	Mesquite (n = 16)	Mormon Mesa (n = 6)	Topock (n = 38)	Littlefield (n = 2)	Grand Canyon (n = 1)
Nest height (m)	3.7 (0.6) 1.2–10.0 A	2.1 (0.2) 1.1–3.2 B	2.1 (0.3) 1.4–3.4 A,B	3.6 (0.2) 2.0–6.7 A	2.2 (0.2) 2.0–2.4	2.8
Nest substrate[1]	6% SAEX 94% SAGO	63% TASP 37% SAEX	33% TASP 67% SNAG	100% TASP	100% SAEX	100% SAGO
Nest substrate height (m)	11.2 (1.6) 2.5–21.8 A	3.0 (0.2) 2.0–4.6 B	3.4 (0.7) 2.3–6.9 B	5.3 (0.2) 3.2–8.5 B	3.3 (0.5) 2.8–3.7	4.3
Nest substrate dbh (cm)	29.9 (5.3) 1.5–71.5 A	2.4 (0.4) 0.9–5.9 B	2.0 (0.6) 1.0–5.0 B	5.7 (0.6) 1.7–21.8 B	1.8 (0.5) 1.3–2.2	4.0

* Numerical data presented are means, (standard error), and range. Significant differences (Tukey's test, α = 0.05) between sites for a given continuous variable are indicated by alpha codes; sites with different letters differed from one another while sites with the same letter did not. Littlefield and Grand Canyon were excluded from between-site comparisons because of low sample sizes.

TASP = *Tamarix* sp. (tamarisk), SAEX = *Salix exigua* (coyote willow), SAGO = *Salix gooddingii* (Goodding willow), SNAG = standing dead tree; three were TASP, one was SAGO.

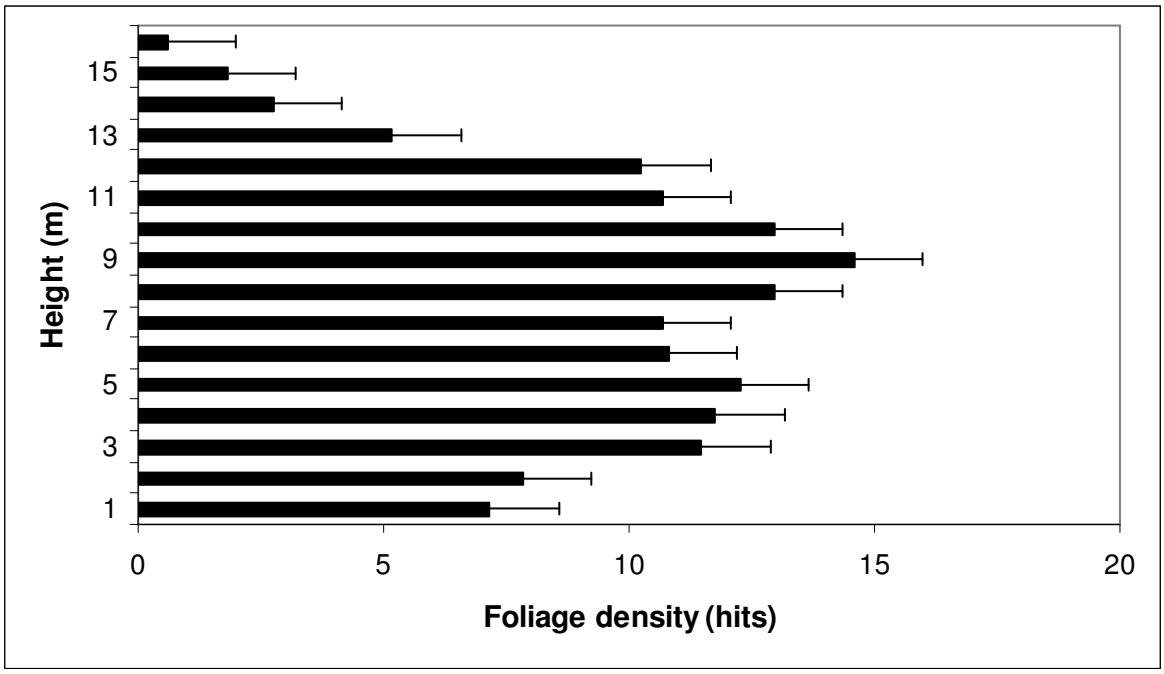

Figure 6.1. Vertical foliage density at habitat block points, Pahranagat NWR, NV, 2004. Values shown are mean and standard error of hits per meter interval. Standard error is pooled across all intervals.

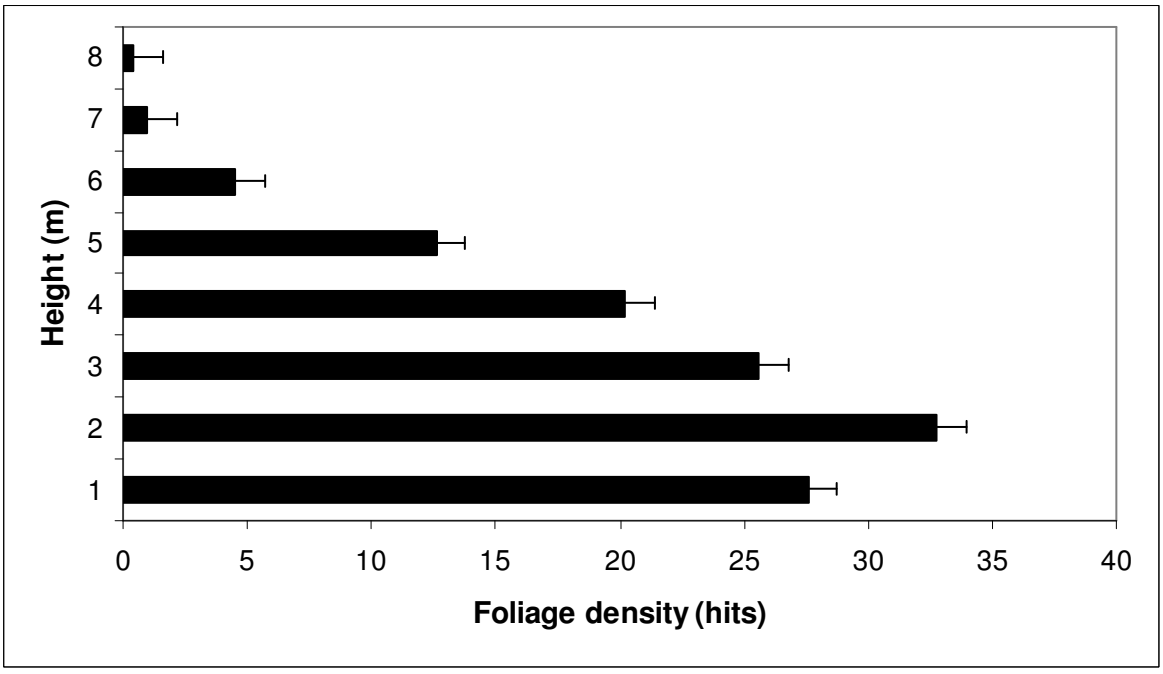

Figure 6.2. Vertical foliage density habitat block points, Mesquite, NV, 2004. Values shown are mean and standard error of hits per meter interval. Standard error is pooled across all intervals.

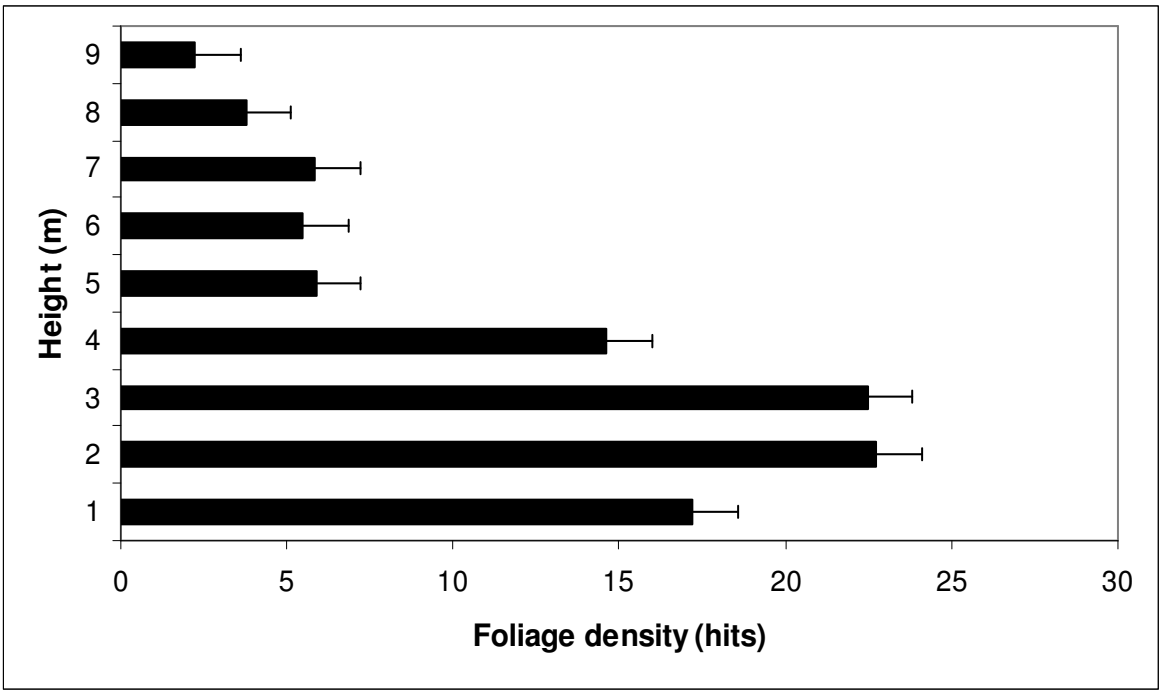

Figure 6.3. Vertical foliage density at habitat block points, Mormon Mesa, NV, 2004. Values shown are mean and standard error of hits per meter interval. Standard error is pooled across intervals.

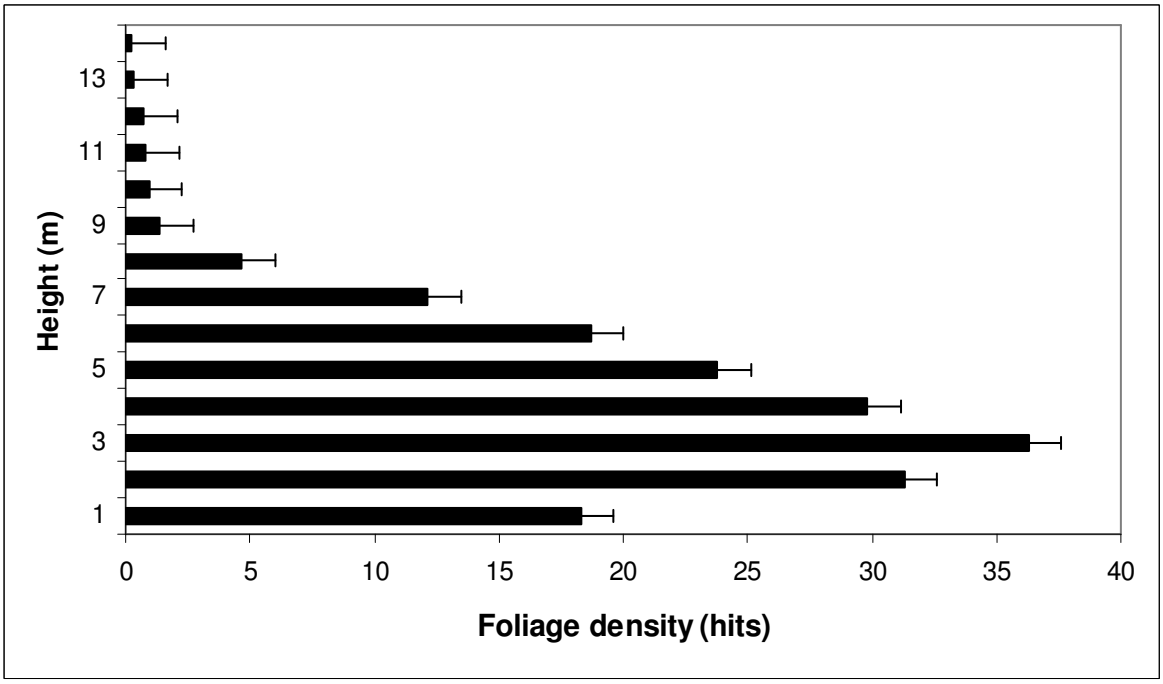

Figure 6.4. Vertical foliage density at habitat block points, Topock Marsh, AZ, 2004. Values shown are mean and standard error of hits per meter interval. Standard error is pooled across intervals.

VEGETATION MEASUREMENTS AT NEST PLOTS VS. NON-USE PLOTS

Woody ground cover was the only variable that did not differ between nest and non-use sites in at least one of the life history study areas (Table 6.3). Average canopy height was taller at nest sites than at non-use sites at Mesquite, Mormon Mesa, and Topock. Canopy closure was significantly higher at nest sites than at non-use sites at all life history study areas. Only at Mesquite was distance to canopy gap significantly greater at nest sites than at non-use sites.

Table 6.3. Comparison of Habitat Characteristics between Willow Flycatcher Nests and Non-Use Sites at the Four Life History Study Areas, Lower Colorado River, 2004[1]

Parameter	Pahranagat		Mesquite		Mormon Mesa		Topock	
	Nest n=16	Non-use n=16	Nest n=16	Non-use n=15	Nest n=6	Non-use n=6	Nest n=38	Non-use n=38
Canopy height (m)	15.8 (1.3)	19.4 (1.6)	5.2 (0.2)	3.8**** (0.1)	6.5 (1.1)	3.4* (0.4)	6.7 (0.2)	5.4**** (0.2)
% canopy closure	98.2 (0.3)	86.3** (4.1)	95.6 (1.4)	74.5*** (5.5)	98.4 (0.6)	83.9* (5.2)	89.6 (1.3)	80.0** (3.1)
% woody ground cover	40.8 (7.8)	24.5 (8.4)	23.9 (5.6)	18.5 (4.7)	7.1 (1.9)	12.1 (2.5)	14.6 (2.4)	12.9 (2.0)
% of plot centers <30 m from water or saturated soil	6.3	18.8	87.5	33.3**	0.0	0.0	31.6	5.4**
Distance (m) to nearest canopy gap	6.5 (1.0)	4.9 (1.1)	11.3 (2.1)	3.3** (1.5)	11.7 (4.4)	2.6 (0.6)	7.8 (1.0)	8.1 (1.4)
% of plot centers <30 m from a broadleaf tree	100.0	100.0	100.0	100.0	100.0	83.3	42.1	10.5**
# shrub/sapling stems within 5 m of plot center	7.4 (6.9)	2.5 (2.1)	159.3 (13.5)	67.7*** * (10.0)	69.5 (23.4)	111.8 (28.8)	111.3 (6.9)	143.8** (7.3)
# tree stems within 11.3 m of plot center	7.1 (1.3)	11.1 (4.3)	4.4 (2.5)	2.1 (0.9)	25.0 (6.9)	2.7* (1.7)	37.8 (2.7)	26.2** (2.6)

[1] Data are presented as means (SE). Significant differences (α = 0.05) between nest and non-use plots in a given study area are indicated by asterisks.

* $P < 0.05$

** $P < 0.01$

*** $P < 0.001$

**** $P < 0.0001$

At the time vegetation measurements were completed at Mesquite and Topock, significantly more nest sites than non-use sites were within 30 m of standing water or saturated soil. No nest or non-use sites at Mormon Mesa were within 30 m of standing water or saturated soil, and there was no significant difference in distance to water between nest and non-use sites at Pahranagat. At the time of nest initiation, 4 of 6 (67%) nests at Mormon Mesa and 14 of 16 (88%) of nests at Pahranagat were within 30 m of water.

Shrub/sapling stem count was significantly greater at nest sites than at non-use sites at Mesquite, while a significantly greater number of tree stems occurred at nest vs. non-use sites at Mormon Mesa and Topock. There was no difference in stem counts between nest and non-use sites at Pahranagat.

Vertical foliage density was greatest in the upper strata of the canopy at nest sites vs. non-use sites for all study areas except Pahranagat (Figures 6.5–6.8). At Pahranagat, significantly greater vertical foliage density occurred within 2–4 m of the canopy at nest sites vs. non-use sites.

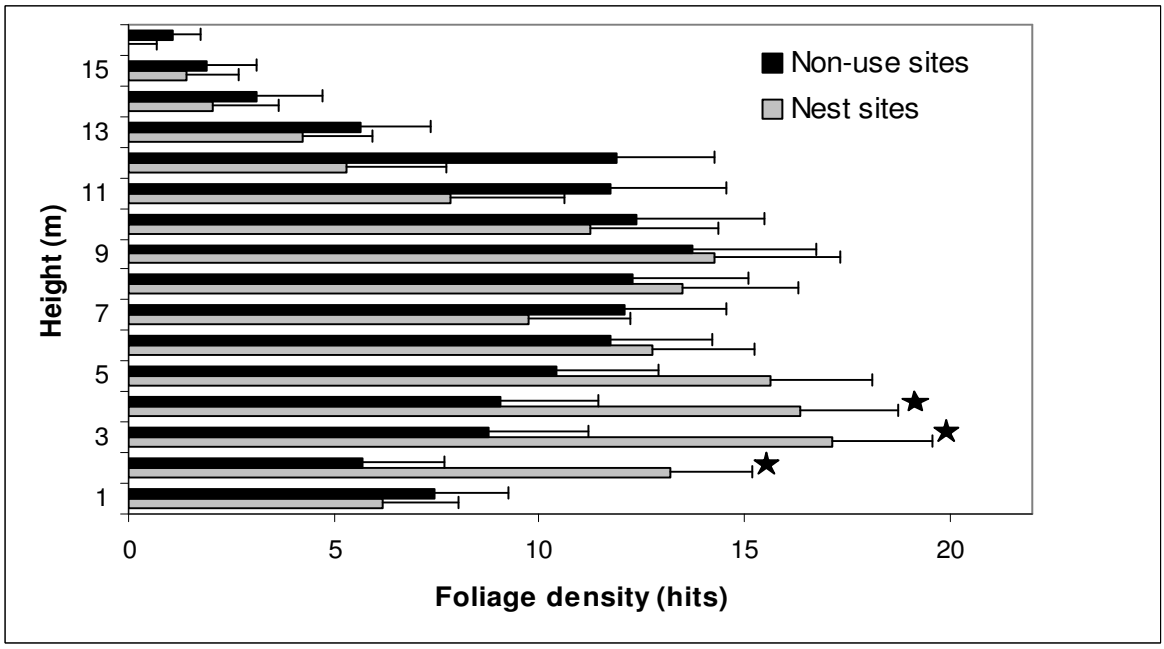

Figure 6.5. Vertical foliage density and standard error at willow flycatcher nest sites versus non-use sites at Pahranagat NWR, NV, 2004. Differences (Student's *t*-test, α=0.05) between nest and non-use sites within a given meter interval are indicated by asterisks.

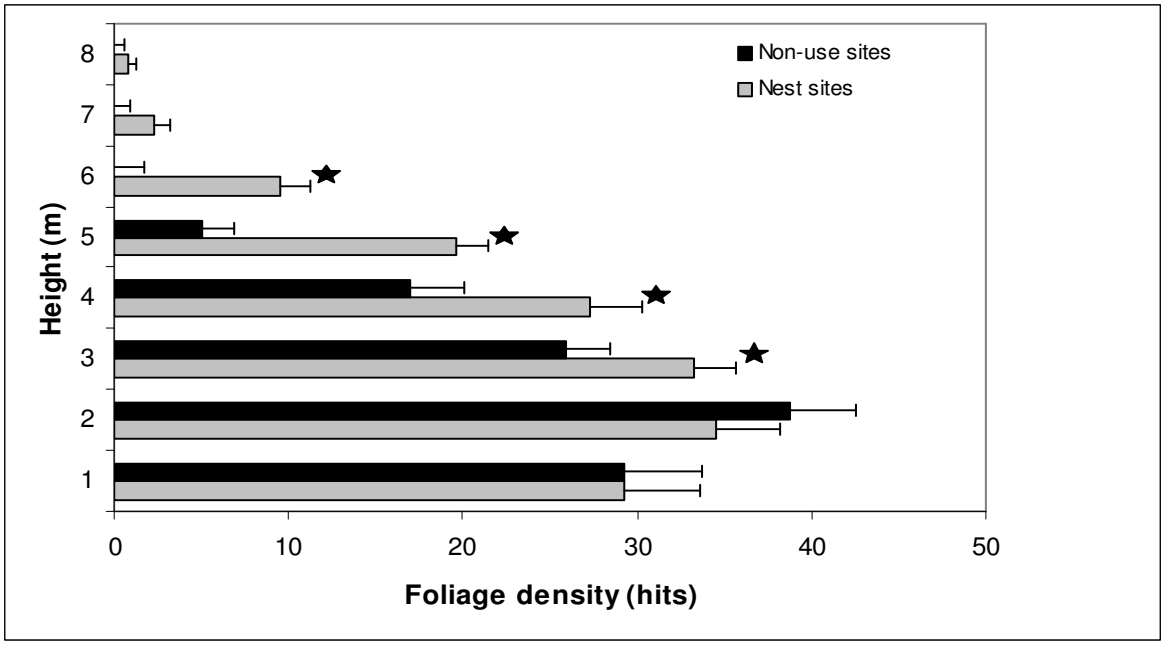

Figure 6.6. Foliage density and standard error at willow flycatcher nest sites vs. non-use sites at Mesquite, NV, 2004. Differences (Student's *t*-test, α=0.05) between nest and non-use sites within a given meter interval are indicated by asterisks.

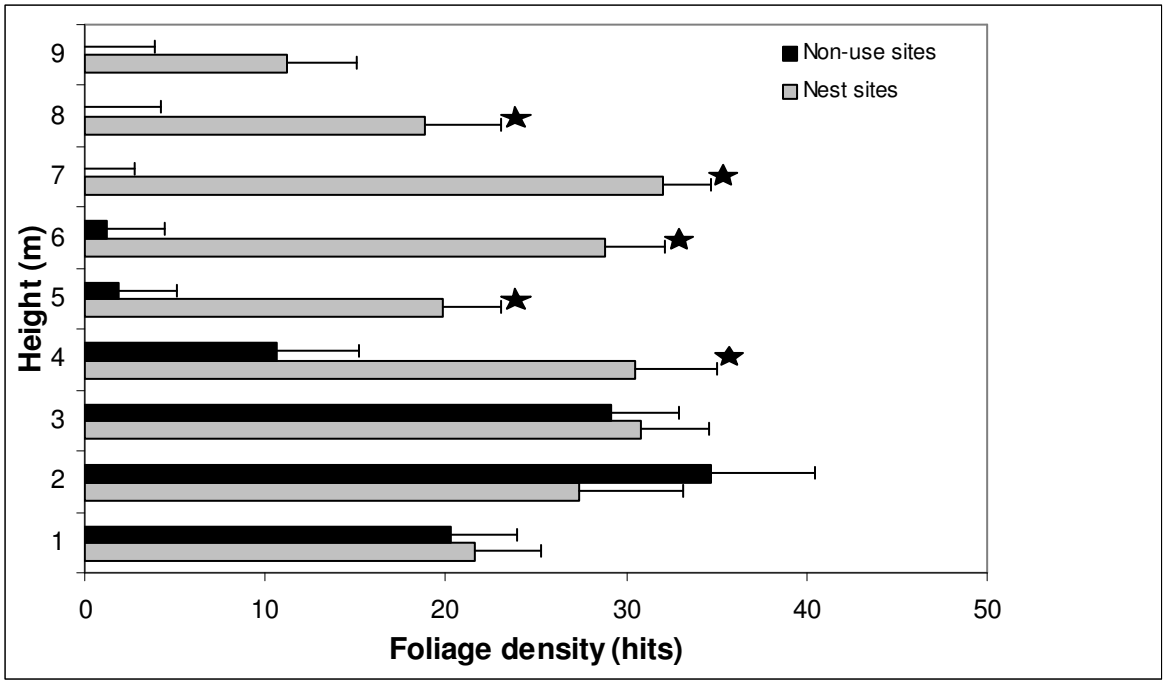

Figure 6.7. Foliage density and standard error at willow flycatcher nest sites vs. non-use sites at Mormon Mesa, NV, 2004. Differences (Student's *t*-test, α=0.05) between nest and non-use sites within a given meter interval are indicated by asterisks.

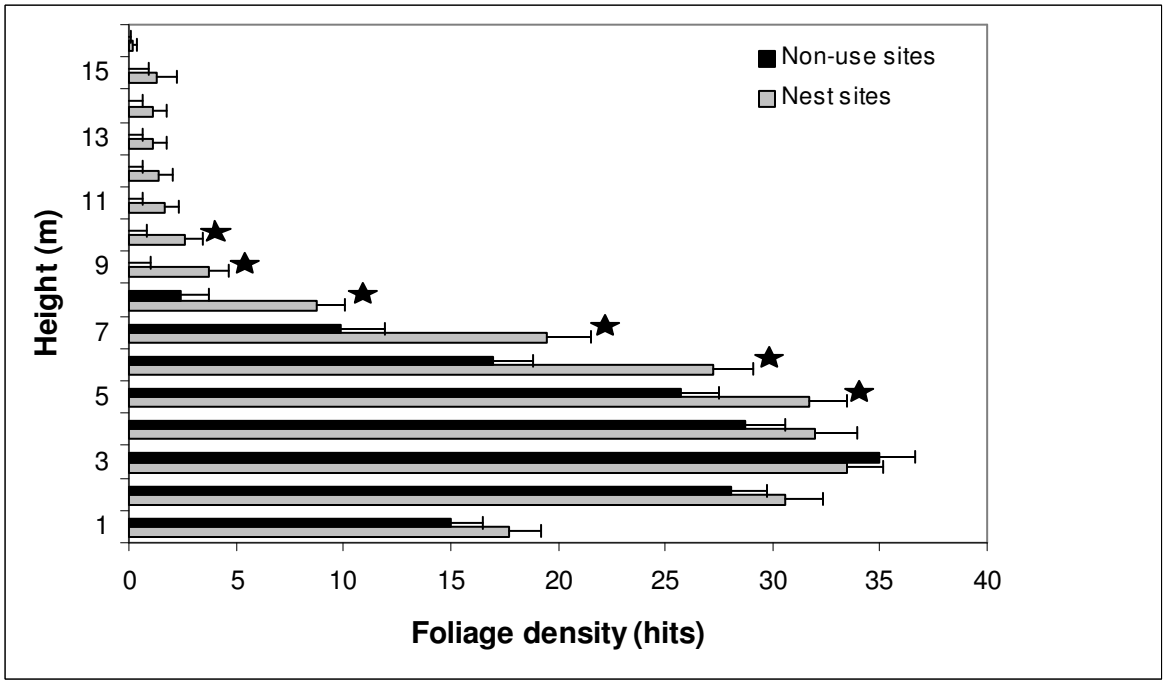

Figure 6.8. Foliage density and standard error at willow flycatcher nest sites versus non-use sites at Topock Marsh, AZ, 2004. Differences (Student's *t*-test, α=0.05) between nest and non-use sites within a given meter interval are indicated by asterisks.

DISCUSSION

Overall, the vegetation and habitat characteristics of entire habitat blocks at the four life history study areas show willow flycatchers breed in widely different types of riparian habitat throughout the Virgin and lower Colorado River regions. Although occupied flycatcher habitat at each of the four life history study areas consists of relatively homogeneous, contiguous stands of riparian vegetation, the sites differ from each other both structurally and compositionally. Pahranagat differs markedly in structure and vegetation species composition from Mesquite, Mormon Mesa, and Topock. The habitat block at Pahranagat consists of mature, native, large-diameter trees up to 20 m in height with relatively little shrub and sapling understory (Photo 1), while the habitat blocks at Mesquite, Mormon Mesa, and Topock are composed primarily of very dense stands of both mixed-native (Mesquite and Mormon Mesa) and exotic (Topock) woody vegetation 4–8 m in height (Photos 2–4). The very dense vegetation at Mesquite, Mormon Mesa, and Topock is reflected in higher shrub counts at these sites than at Pahranagat. The Topock habitat block also has a significantly greater number of tree stems than the other study areas. All study areas have relatively high canopy closure, with Pahranagat exhibiting significantly greater canopy closure than Mormon Mesa. At Mesquite, Mormon Mesa, and Topock, the greatest vertical foliage density occurs at 1–3 m above the ground. At Pahranagat, vertical foliage density within a given meter interval is generally less than at the other study areas but is relatively evenly distributed from 2–8 m above the ground, again illustrating the differences in vegetation structure between Pahranagat and the other study areas.

As in 2003, differences in nest characteristics between study areas reflected general differences in habitat structure, with nest substrates at Pahranagat being significantly taller and having larger dbh than substrates at other study areas. Average nest height at Mesquite, which has the youngest vegetation of the study areas, was once again lower than at Pahranagat and Topock; however, nest height at Mesquite did not differ from that at Mormon Mesa.

Comparisons between nest and non-use sites in 2004 demonstrated the same patterns that emerged in 2003. We found higher canopy closure at nest sites than at non-use sites in all study areas, and in three of the four life history study areas (Mesquite, Mormon Mesa, and Topock). At Pahranagat, canopy height at non-use sites tended to be taller than at nest sites because many non-use sites were in very tall stringers of cottonwoods on the periphery of the main habitat block, while nest sites were within a shorter stand of Goodding willow. As in 2003, nest sites contained more shrub/saplings than non-use sites at Mesquite, while more tree stems occurred at nest sites vs. non-use sites at Mormon Mesa. In 2004, nest sites at Topock had fewer shrubs but a higher tree count than non-use sites. At Pahranagat, vertical stems sprouting from live, fallen portions of canopy trees structurally represent the significantly greater vertical foliage recorded within 2–4 m of the ground at nest sites. Allison et al. (2003) also reported a trend for Southwestern Willow Flycatcher nest sites to have a higher percentage canopy closure and taller canopy than non-use sites, and Sedgwick and Knopf (1992) reported higher shrub density at nest sites vs. unused sites for a flycatcher population in north central Colorado.

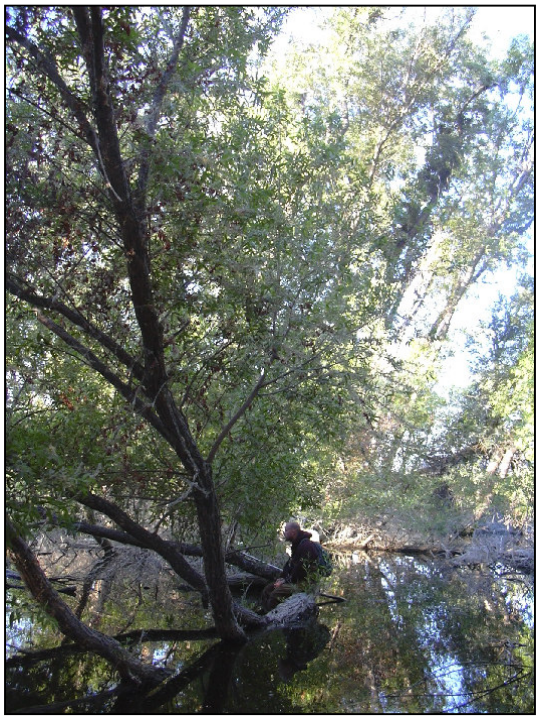

Photo 1. Southwestern Willow Flycatcher nesting habitat at Pahranagat NWR, NV, 2004.

Photo 2. Southwestern Willow Flycatcher nesting habitat at Mesquite, NV, 2004.

Photos 3 and 4. Southwestern Willow Flycatcher breeding habitat at Topock Marsh, AZ, 2004.

We concur with Allison et al. (2003) and Sogge and Marshall (2000) in that breeding riparian birds in the desert Southwest are exposed to extreme environmental conditions and that dense vegetation at the nest may be needed to provide a more suitable microclimate for raising offspring. In both 2003 and 2004, vertical foliage density at nest sites was greatest at and immediately above mean nest height. Allison et al. (2003) found the greatest foliage density to be at nest height at three large willow flycatcher breeding sites in Arizona. Greater canopy closure, taller canopy height, and dense foliage at nest height may facilitate a more favorable nesting microclimate and may be useful parameters in predicting preferred willow flycatcher riparian breeding habitat within the larger expanses of riparian vegetation along the Virgin and lower Colorado River. Given that standing water or saturated soil was present at most nest sites at the time of nest initiation, presence of water may also be a factor in providing a more suitable microclimate for raising offspring (Sogge and Marshall 2000; see Chapter 7).

Measures of distance to water differed between nest and non-use sites only at Mesquite and Topock; in both instances, more nest than non-use sites were within 30 m of standing water or saturated soil. However, vegetation measurements were conducted at the end of the breeding season so as to minimize disturbance to flycatchers, and water levels at Pahranagat, Mormon Mesa, and, to a lesser degree, Topock dropped throughout the breeding season (see Table 2.5 and site descriptions in Chapter 2). Mesquite is influenced by runoff from a golf course and is less subject to seasonal fluctuations in water level. Because of extreme seasonal changes in hydrology at the study areas, with most nest sites dry by August, distance to water as measured after the breeding season may not reflect hydrologic conditions during nest-site selection. Measuring presence of water early in the breeding season may be a better indicator of preferred flycatcher breeding habitat.

As in 2003, measures of distance to canopy gap were inconclusive. Allison et al. (2003) reported that, compared to the center of non-use plots, Southwestern Willow Flycatchers placed nests closer to canopy gaps, while Sedgwick and Knopf (1992) reported that a willow flycatcher population in northern Colorado placed nests farther from canopy gaps. Because of the variation in vegetation structure and species composition among the four life history study areas, presence of canopy gaps may not be a good predictor of flycatcher breeding habitat along the Virgin and lower Colorado Rivers.

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CHAPTER 7

NEST MICROCLIMATE

INTRODUCTION

Innate selection of beneficial nest-site microclimate by birds can moderate extreme environmental conditions and has the potential to improve reproductive success and increase fitness (Webb and King 1983, Walsberg 1985). Although nest microclimate may influence avian reproductive success, other factors such as habitat and food availability also are important (Cody 1985, Gloutney and Clark 1997). Potential covariance with other evolutionary forces such as predation further complicates any investigation of microclimatic nest-site selection (Martin 1995).

Most studies of microclimatic nest-site selection have concentrated on non-passerines. Waterfowl (Gloutney and Clark 1997), hummingbirds (Calder 1973), and woodpeckers (Connor 1975, Inouye 1976, Inouye et al. 1981) in particular have been evaluated with respect to various aspects of microclimatic regulation. Selected species from each of these groups have demonstrated a preference for specific physical attributes within their nesting habitat as strategies to maximize heat gain, minimize heat loss, or manipulate wind exposure, depending on the situation. Several species of woodpeckers excavate cavities whose entrance holes are oriented toward or away from the sun, again depending on the situation and the need to regulate nest microclimate.

Microclimatic selection by passerines has received less attention than that by non-passerines, with most investigations of passerines directed at either ground-nesters or those building covered nests. Horned Lark (*Eremophila alpestris*) is probably the most thoroughly studied ground-nesting passerine, and numerous studies indicate that it selects nest locations based on compass orientation as a way to manipulate wind exposure, solar insolation, and resulting nest microclimate (Cannings and Threlfall 1981, With and Webb 1993, Hartman and Oring 2003). Cactus Wren (*Campylorhynchus brunneicapillus*) and Verdin (*Auriparus flaviceps*) orient the entrances to their covered nests either away from or toward prevailing winds in different parts of the nesting season to moderate nest microclimate (Austin 1974, 1976).

Microclimatic nest-site selection has been investigated in only a few open-cup, shrub- or tree-nesting passerines. The Warbling Vireo (*Vireo gilvus*) is very sensitive to fluctuations in nest microclimate (Walsberg 1981), and the San Miguel Island Song Sparrow (*Melospiza melodia micronyx*) may benefit from microhabitats that maintain higher nest relative humidity (Kern et al. 1990).

Gloutney and Clark (1997) pointed out that nonrandom distribution of nests strongly supports the microhabitat (i.e., microclimate) selection hypothesis. For example, nest-site selection for thermal advantages has been offered as an explanation as to why nonrandom nest-site placement occurs in many species (Kern and van Riper 1984, Bekoff et al. 1987, van Riper et al. 1993).

Nests placed in dense vegetation have been suggested to be less susceptible to predation (Cody 1985), and may also benefit from protection from wind, nocturnal heat loss, and diurnal heat gain (Walsberg 1981, 1985). Because the microhabitat of an individual can influence energy expenditure (Warkentin and West 1990), calories conserved through beneficial nest-site selection can aid reproductive efforts and improve fitness (Gloutney and Clark 1997).

Air temperature alone cannot portray the microclimate of an incubating bird (Gloutney and Clark 1997). Solar insolation, vapor pressure (i.e., relative humidity), and wind speed interact in a complex manner with temperature to define microclimate (McArthur 1990), so that many physiological investigators instead calculate *operative temperature* in a complex formula that integrates all of the above factors (Gloutney and Clark 1997).

The purpose of this microclimate investigation was to document temperature, relative humidity, and soil moisture at nests of Southwestern Willow Flycatchers, an open-cup nesting passerine. We tested the null hypothesis that no difference existed between (1) a flycatcher nest site, (2) a randomly located adjacent site within that flycatcher territory, and (3) unoccupied riparian habitat outside of that territory. Air temperature, relative humidity, and soil moisture were used as indices to microclimate, although it was recognized that substantial interaction likely occurred between those three variables.

METHODS

OVERVIEW

We located active flycatcher nests at four life history study areas (Pahranagat, Mesquite, Mormon Mesa, and Topock) between May and July 2004. Temperature, relative humidity, and soil moisture were measured at three locations relative to each nest for the purpose of examining microclimate at three levels of potentially increasing differences in flycatcher nesting habitat use, as follows:

1. Within 2 m of a nest (i.e., the nest site).
2. Within the territory associated with that nest (but 5–10 m from the nest; i.e., within-territory site).
3. Within unoccupied riparian habitat 50–200 m from the nearest known nest or territory (i.e., non-use site).

We began collecting microclimate data simultaneously at nest, within-territory, and non-use sites within 48–72 hours of the time an active nest was vacated. A nest was defined as vacated if it met one of the following criteria: (1) it had been abandoned for any reason (including brood parasitism) at any stage of the nesting cycle after the first flycatcher egg was laid, (2) it had fledged young and was no longer active, or (3) it had been depredated after an egg was laid. This technique minimized disturbance due to equipment placement or increased human activity near the nest as recommended by Hartman and Oring (2003), while still allowing for quantitative post-use comparisons of microclimate.

Temperature and relative humidity data were collected over a period of at least 14 full days (midnight to midnight), after which time we transferred the equipment and effort used to collect microclimate data to the nest, within-territory, and non-use sites for another recently vacated nest (i.e., including a second brood or second nesting attempt). The 14-day study period for each nest became the focus of all final analyses. Renests, or second nests of a known pair, were treated as independent data points because nests were the unit of analysis of this study and not individuals or pairs. All equipment used to collect microclimate data was removed after 14 full days from the time the last active nest had been vacated.

TEMPERATURE AND RELATIVE HUMIDITY MEASUREMENTS

Measurements of temperature and relative humidity (T/RH) were recorded automatically every 15 minutes using a HOBO H8 Pro (Onset Computer Corporation, Pocasset, MA) that combines a thermometer (degrees Celsius), relative humidity monitor, and digital data logger (hereafter referred to as a sensor array). We camouflaged all HOBO sensor arrays by placing them in an inverted small, plastic bowl coated with spray adhesive and local vegetation. The opening at the bottom was covered with shadecloth, allowing free air circulation around the sensor array. The HOBO sensor arrays were placed in four different location types in a manner consistent with an overall randomization design, as follows:

(1) Seasonal-variation (SV) sensor arrays: When field personnel arrived at the four life history study areas in early May, they placed SV sensor arrays at representative locations within the riparian and adjacent desertscrub habitat. The riparian SV sensor arrays were designed to monitor T/RH fluctuations throughout the nesting season within the riparian zone to document ambient environmental conditions throughout the study period. Riparian SV sensor arrays were placed in the nearest tree or woody shrub at their representative sites using a prearranged random number selection sequence (see 3C–3E below). The desertscrub SV sensor arrays at each study area were placed in desert habitat outside the riparian zone to document local extremes in T/RH.

(2) Nest site (NS) sensor arrays: Once a known nest was vacated, an NS sensor array was placed less than 1 m from the nest, preferably hanging directly below it. Sensor arrays were camouflaged so as not to disturb birds that may have returned to the nest to recycle nesting material. Canopy closure was visually estimated as < 25%, 25–75%, or >75% at all nest, within-territory, and non-use sites, and habitat type was identified as native (cottonwood/willow), exotic (tamarisk), mixed native, or mixed exotic (see data forms in Appendix A).

(3) Within-territory (WT) sensor arrays: A WT sensor array was placed at a location within the territory of the pair that attended the corresponding nest. The WT sensor array sites were determined by means of the following instructions and the use of random number sequences:

A. The compass direction to walk from the nest, given in degrees from north, was determined from a random number sequence.
B. The distance (between 5 and 10 m) to walk in the designated direction was determined from a random number sequence. Once that distance was traveled, the closest woody tree or shrub was selected for sensor array placement. If several trees were tied for closest, one of the field crew tossed a rock over his or her shoulder and the woody tree or shrub closest to its resting place was the one in which the sensor array was placed.

C. The sensor array was placed within the documented range of flycatcher nest heights (Sogge et al. 1997), and maximum height depended upon local tree or shrub maximum height at each of the four life history study areas. Sensor arrays were placed at a height between 1.5 and 5.0 m, as determined from a random number sequence, at Mesquite, Mormon Mesa, and Topock, and between 1.5 and 10.0 m (or as high as reasonably possible) at Pahranagat. If the random number at Pahranagat was greater than approximately 7 m, the sensor array was placed as close to the random height as reasonably possible. If the tree or shrub chosen for a sensor array location was of insufficient height to accept the height from the random number sequence, then field personnel placed the sensor array at the first height in the sequence that was less than the height of the tree or shrub.

D. The distance (0–3 m) at which the sensor array was placed from the bole of the tree or center of the shrub was determined from a random number sequence. If the tree or shrub was of insufficient radius to accept the distance from the random number sequence, then field personnel placed the sensor array at the first number in the sequence that was less than the radius of the tree or shrub.

E. The compass direction, given in degrees from north, at which the sensor array was placed from the bole of the tree or center of the shrub was determined from a random number sequence. If there was no branch in this compass direction that would support the sensor array at the height and distance specified in (C) and (D), field personnel proceeded clockwise around the tree or shrub until a suitable branch was located.

If, as presented in C and D, a number from a subsequent random number sequence (sequence meaning a row in the random number table) was used because the number in the initial sequence was too high, then both sequences were considered used and no longer available for future use. If these directions took field personnel outside of the riparian zone or to a site without trees or shrubs, they returned to the nest site and used the next sequence of random numbers.

(4) Non-use (NU) habitat sensor arrays: At all life history study areas, we identified NU habitat after the first territories and nests were located. We used ArcView® GIS 3.3 software to generate two circles that were centered on each nest site or territory center, one 50 m in radius and one 200 m in radius. The area between the two circles that was within the study area boundaries and was at least 50 m from all other nests or territory centers was classified as NU. Specific locations for non-use sensor were selected by superimposing a 25 × 25–m grid on the NU habitat, numbering the grid blocks, selecting blocks by using a random number generator, and using the centroid of each selected block. The NU site was located in the field using the UTM coordinates and a Rino 110 GPS unit. The exact location of the sensor array was determined by selecting the closest woody tree or shrub and using the procedures in 3C–3E above. If the NU site was inaccessible (e.g., impenetrable vegetation or deep water) or was in clearly unsuitable habitat (e.g., open marsh), the next UTM coordinate for a random NU site was used.

SOIL MOISTURE MEASUREMENTS

We recorded soil moisture (SM) measurements using two methods: (1) SV SM sensor arrays were placed at representative locations throughout the four study areas at the same sites as the SV T/RH arrays in riparian habitat to document daily range and rate of change, and (2) hand-held probes were used to document soil moisture at NS, WT, and NU sites at the time the T/RH

sensor arrays were placed, and at the time the T/RH sensor arrays were removed 14 days later. No SV SM sensor arrays were placed in desertscrub habitat because soil moisture at those locations was assumed to be at or near zero.

(1) In mid-May, field personnel placed SV sensor arrays at representative sites within the riparian zone at each of the four life history study areas. If the locations for any of the SV SM sensor arrays were inundated or exhibited completely saturated soils, field personnel placed the sensor array 5 m beyond the edge of the inundated or saturated area in a compass direction determined by a random number sequence. The decision rule for completely saturated soil was as follows: a 1-cm-deep trench (created with a stick) filled with water or unstable mud in less than one minute.

The SM data were collected at 1-hour intervals using a Smart Soil Moisture Sensor connected to a 4-channel HOBO Micro Station data logger (both by Onset Computer Corp., Pocasset, MA). All SM sensor arrays were buried horizontally with the flat side perpendicular to the ground surface and the top edge of the sensor 1 cm beneath the soil surface. A trench slightly narrower than the probe was excavated with a putty knife to ensure good soil-to-probe contact.

(2) Hand-held probes, the ThetaProbe ML2x coupled to an HH2 Moisture Meter Readout (Macaulay Land Use Research Institute, Aberdeen, UK, and Delta-T Devices, Cambridge, UK, respectively) were used to gather volumetric water content data at NS, WT, and NU sites during the 14-day period after nests were vacated. Measurements were taken between 0700 to 1000 hours to eliminate the potential bias of time-of-day changes in the soil capillary fringe. The SM readings (17 per site) were recorded at the plot center and at estimated 0.5-m intervals from 0.5 to 2.0 m in each cardinal direction for each NS, WT, and NU site. If the soil was too wet (above ~50% volumetric water content, which represents saturated soil) or too dry (below ~0.5%) to obtain a volumetric SM reading, the logger read "above" or "under," respectively. If soil was completely saturated or inundated, "sat" was recorded. Readings of "above" and "sat" occurred for approximately 2% of the data points; readings of "under" occurred for approximately 3%. These results were converted to continuous values for the final analysis: 50% for "above" and "sat" values and 0% for "under" values. For the final analysis, the SM readings were combined into two comparison groups: plot center to 1.0 m, and greater than1.0 m to 2.0 m.

Soil samples were collected at each SM site (SV, NS, WT, NU sites) when sensor arrays were initially set up. Samples were approximately the size of a medium apple, collected from the surface down to and including a depth of 5 cm, and placed in a heavy zip-lock plastic bag labeled with the site designation. Because soil texture strongly influences capillary action and therefore overall soil moisture (Sumner 2000), analysis of soil composition may be conducted in future years as time and funding allow.

STATISTICAL ANALYSES

We downloaded data from the T/RH and SM sensor arrays at SV, NS, WT, and NU sites into databases at the end of the field season. We merged all data to create one dataset for further analysis, with the exception of the SV dataset, which was summarized separately for descriptive purposes and was not included in any of the analyses. We calculated the following variables for each sensor array by overall study period:

- Mean soil moisture from plot center to 1.0 m from plot center
- Mean soil moisture from greater than 1.0 m to 2.0 m from plot center
- Mean distance to saturated/inundated soil
- Mean diurnal temperature
- Mean maximum diurnal temperature
- Mean diurnal relative humidity
- Mean nocturnal temperature
- Mean minimum nocturnal temperature
- Mean nocturnal relative humidity
- Mean daily temperature range (diurnal maximum minus nocturnal minimum)

The overall study period constituted the entire season for SV sensor arrays and the 14 days of monitoring for sites (NS, WT, and NU) associated with nests. We determined diurnal and nocturnal periods by using the actual daily sunrise and sunset times reported for the region by the National Weather Service (2004).

We used Tukey's multiple comparison test with a one-way Analysis-of-Variance (ANOVA) to determine whether placing the sensor arrays *after* the nest had been vacated was appropriate, by testing the mean weekly diurnal temperature and mean soil moisture of the SV sensor arrays at each study area. Any consecutive weeks at a study area that were significantly different would be an indication that placing the sensor arrays after nests had been vacated was inappropriate.

We used probability plots and other distribution tests to test the response variables for normality. Chi-square (X^2) and one-way ANOVA tests were used to test the single effects of the three location types (NS, WT, NU) and other predictor variables for all response variables. If significant differences were found ($P<0.05$), we used Tukey's multiple comparison test to determine pairwise differences.

We used multiple factor ANOVA (MANOVA) analyses with and without interaction terms to determine significant differences in means between location types for all temperature, humidity, and soil moisture variables. MANOVA tests for a difference in means, while controlling for the variance by study area, habitat, and canopy closure. The full model is:

> Response Variable = Location Type + Study Area + Habitat + Canopy + Significant Interaction Term(s)

The R^2 value for the MANOVA analyses identifies the extent of the variation in the response variable that was explained by the predictor variables in each analysis. Tukey's multiple comparison test was used to determine pairwise differences for significant predictor variables. The *P* values presented in the MANOVA analyses were for type III sum of squares.

Correlated values were determined using the Pearson correlation coefficient (R). Analyses were conducted using SAS® Version 9.1 (SAS Institute 2003) and Stata® Version 8.2 (StataCorp LP 2004).

RESULTS

SEASONAL VARIATION

Twenty SV T/RH sensor arrays and 16 SV SM sensor arrays were placed at the four life history study areas beginning May 11 and remained in place until late August. One T/RH sensor in desertscrub at Mormon Mesa failed to function. The results from all SV sensor arrays indicated desertscrub sites were substantially hotter and drier than riparian sites (Tables 7.1 and 7.2).

Table 7.1. Seasonal Variation in Riparian Habitat by Study Area for Southwestern Willow Flycatcher Microclimate Data from along the Virgin and Lower Colorado Rivers, May–August, 2004*

Descriptive Statistics	Pahranagat	Mesquite	Mormon Mesa	Topock
N (Temperature/Humidity)	3	3	3	3
N (Soil Moisture)	4	4	4	4
Mean soil moisture (% volume)	20.9 (3.8)	18.9 (3.2)	16.9 (3.2)	30.3 (3.8)
Mean diurnal temperature (°C)	25.5 (1.7)	29.5 (1.6)	32.9 (2.5)	27.1 (1.2)
Mean maximum diurnal temperature (°C)	32.4 (2.1)	39.5 (2.3)	45.8 (3.3)	33.6 (1.2)
Mean diurnal relative humidity (%)	32.5 (6.8)	40.4 (5.1)	33.5 (4.3)	62.9 (6.7)
Mean nocturnal temperature (°C)	20.2 (1.7)	23.0 (2.0)	20.0 (2.4)	22.7 (1.7)
Mean minimum nocturnal temperature (°C)	15.3 (2.0)	17.4 (2.3)	14.7 (2.5)	19.0 (2.2)
Mean nocturnal relative humidity (%)	38.0 (6.2)	51.8 (8.1)	59.2 (7.0)	68.8 (5.3)
Mean daily temperature range (°C)	17.2 (2.3)	22.1 (2.8)	31.1 (3.9)	14.6 (2.3)

*All values are means (standard error in parentheses).

Table 7.2. Seasonal Variation in Desertscrub Habitat by Study Area for Southwestern Willow Flycatcher Microclimate Data along the Virgin and Lower Colorado Rivers, May–August, 2004*

Descriptive Statistics	Pahranagat	Mesquite	Mormon Mesa	Topock
N (Temperature/Humidity)	2	2	1	2
Mean diurnal temperature (°C)	33.0 (2.4)	38.9 (2.7)	38.6 (5.1)	38.6 (2.9)
Mean maximum diurnal temperature (°C)	48.2 (3.4)	48.3 (3.5)	52.0 (7.7)	49.3 (3.7)
Mean diurnal relative humidity (%)	21.7 (7.6)	10.9 (4.0)	14.5 (5.4)	23.3 (7.4)
Mean nocturnal temperature (°C)	19.8 (2.5)	28.3 (2.5)	25.6 (4.2)	26.3 (2.9)
Mean minimum nocturnal temperature (°C)	14.3 (2.9)	22.0 (2.9)	19.7 (4.7)	20.2 (3.4)
Mean nocturnal relative humidity (%)	34.6 (10.3)	17.4 (7.1)	27.1 (6.6)	42.7 (11.0)
Mean daily temperature range (°C)	33.9 (3.9)	26.4 (3.5)	32.3 (8.3)	29.2 (3.4)

*All values are means (standard error in parentheses). No SM data were gathered in desertscrub habitat.

DATA COLLECTION AFTER NESTS WERE VACATED

Mean diurnal temperature differed significantly ($P<0.05$) during four pairs of weeks: the first and second week in August at Mormon Mesa and, at Pahranagat, the last week in May and the first week in June, the first and second weeks in June, and the second and third weeks in August. Mean soil moisture differed at Topock between the second and third weeks in June.

LOCATION TYPES: DESCRIPTIVE STATISTICS AND SINGLE EFFECTS ANALYSIS

Data on T/RH were successfully collected for 70 NS, 70 WT, and 63 NU sites (Tables 7.3–7.6). Sample sizes for the three location types were unequal because of the random failure of some data loggers. The location type data were normally distributed for all response variables, so no transformations or elimination of outliers were needed.

The single effects analyses indicate that the NS, WT, and NU sites were significantly different at all four study locations for the three diurnal temperature values: mean diurnal temperature, mean maximum diurnal temperature, and mean daily temperature range. The pairwise differences demonstrated that NU sites on average were significantly hotter during the day than either NS or WT sites. Figures 7.1 through 7.4 show box plots comparing mean diurnal temperature and other response variables for NS, WT, and NU sites by study area.

Mean soil moisture was significantly lower at NU sites compared to NS or WT sites at plot center to 1.0 m from the plot center and from 1.5 to 2.0 m from plot center at Pahranagat and Topock. Mean diurnal relative humidity was significantly higher at NS sites compared to NU sites at Pahranagat and Mesquite. Mesquite and Mormon Mesa had more native habitat at NS and WT sites than at NU sites. Mesquite had greater canopy cover at NS and WT sites than at NU sites, and Topock exhibited a greater mean distance to water from NU sites than from either NS or WT sites.

INDIVIDUAL EFFECT OF PREDICTOR VALUES

The single effects analyses (Tables 7.7 through 7.10) illustrate the individual effect that each predictor had on response variables across study areas. The NU sites were significantly different from both NS and WT sites for both soil moisture measures, mean distance to water, the three diurnal temperature values, and mean diurnal relative humidity. The WT and NS sites differed for only the three diurnal temperature values.

All response variables differed significantly among study areas. In 2003, Topock exhibited the highest diurnal and nocturnal temperatures, but Mormon Mesa was consistently the hottest and driest study area in 2004. Pahranagat in 2004, like 2003, consistently exhibited the lowest diurnal and nocturnal temperatures and the highest soil moisture values.

Table 7.3. Descriptive Statistics (Chi-square) and Single Effects (ANOVA) for Southwestern Willow Flycatcher Microclimate Data by Location Type at Pahranagat NWR, June–August, 2004*

Response Variable	Nest Site	Within Territory	Non-Use	*P*	Significant Pairwise Differences	
					2004	2003
N (Temperature/Humidity Sensor Arrays)	16	14	15	N/A	N/A	N/A
Habitat						
Native (cottonwood or willow)	16 (100.0)	14 (100.0)	15 (100.0)	N/A	N/A	N/A
Exotic (tamarisk)	0 (0.0)	0 (0.0)	0 (0.0)			
Mixed (native and exotic)	0 (0.0)	0 (0.0)	0 (0.0)			
Canopy Cover						
Less than 25%	0 (0.0)	1 (7.14)	3 (20.0)	0.187	N/A	N/A
25–75%	9 (56.3)	8 (57.1)	10 (66.7)			
More than 75%	7 (43.8)	5 (35.7)	2 (13.3)			
Soil Moisture						
Mean soil moisture (% volume) plot center to 1.0 m	40.0 (3.0)	40.0 (2.2)	24.7 (4.2)	0.002	WT>NU, NS>NU	N/A
Mean soil moisture (% volume) 1.5–2.0 m from plot center	40.8 (2.3)	39.5 (2.4)	24.5 (3.9)	0.001	WT>NU, NS>NU	N/A
Mean distance to saturated/ inundated soil	35.0 (8.3)	41.3 (10.3)	86.9 (19.9)	0.030	NU>NS	N/A
Temperature/Humidity						
Mean diurnal temperature (°C)	26.1 (0.2)	27.6 (0.5)	28.6 (0.5)	<0.001	NU>NS, WT>NS	NU>NS
Mean maximum diurnal temperature (°C)	35.8 (0.5)	40.9 (1.5)	41.2 (1.4)	0.003	NU>NS, WT>NS	N/A
Mean diurnal relative humidity (%)	43.4 (2.2)	39.1 (1.8)	33.8 (2.5)	0.013	NS>NU	NS>WT>NU
Mean nocturnal temperature (°C)	21.8 (0.3)	22.0 (0.4)	22.6 (0.6)	0.410	N/A	N/A
Mean minimum nocturnal temperature (°C)	12.8 (0.4)	12.3 (0.4)	13.3 (0.6)	0.291	N/A	N/A
Mean nocturnal relative humidity (%)	46.2 (2.1)	42.7 (1.4)	40.4 (2.7)	0.150	N/A	N/A
Mean daily temperature range (°C)	16.3 (0.7)	20.7 (1.4)	19.2 (0.9)	0.014	WT>NS	N/A

*Results of pairwise comparisons for similar data in 2003 are included. Habitat and canopy cover variables are presented as N followed by % of column totals (in parentheses), while soil moisture and temperature/humidity values are means (standard error in parentheses). N/A = data not available or not applicable.

Table 7.4. Descriptive Statistics (Chi-square) and Single Effects (ANOVA) for Southwestern Willow Flycatcher Microclimate Data by Location Type at Mesquite, June–August, 2004*

Response variable	Nest Site	Within Territory	Non-Use	*P*	Significant Pairwise Differences	
					2004	2003
N (Temperature/Humidity Sensor Arrays)	14	15	11	N/A	N/A	N/A
Habitat						
Native (cottonwood or willow)	10 (71.4)	9 (60.0)	1 (9.1)	0.019	NS>NU, WT>NU (more native)	N/A
Exotic (tamarisk)	3 (21.4)	3 (20.0)	4 (36.36)			
Mixed (native and exotic)	1 (7.14)	3 (20.0)	6 (54.6)			
Canopy Cover						
Less than 25%	0 (0.0)	1 (6.7)	7 (63.6)	<0.001	NS>NU, WT>NU	NS>NU, WT>NU
25–75%	11 (78.6)	13 (86.7)	4 (36.4)			
More than 75%	3 (21.4)	1 (6.7)	0 (0.0)			
Soil Moisture						
Mean soil moisture (% volume) plot center to 1.0 m	40.7 (3.2)	39.8 (3.2)	37.0 (3.2)	0.714	N/A	N/A
Mean soil moisture (% volume) 1.5–2.0 m from plot center	40.2 (3.0)	39.6 (3.0)	32.3 (4.8)	0.259	N/A	N/A
Mean distance to saturated/ inundated soil	7.0 (2.3)	8.4 (2.3)	18.5 (4.7)	0.030	NU>NS	N/A
Temperature/Humidity						
Mean diurnal temperature (°C)	29.0 (0.4)	30.7 (0.5)	33.4 (1.1)	<0.001	NU>NS, NU>WT	NU>NS, NU>WT
Mean maximum diurnal temperature (°C)	39.1 (0.7)	44.0 (1.0)	52.2 (1.6)	<0.001	NU>WT> NS	NU>NS, NU>WT
Mean diurnal relative humidity (%)	52.0 (1.8)	47.9 (2.2)	42.2 (1.8)	0.006	NS>NU	NS>NU, WT>NU
Mean nocturnal temperature (°C)	22.7 (0.5)	22.8 (0.5)	22.3 (0.6)	0.786	N/A	N/A
Mean minimum nocturnal temperature (°C)	14.8 (0.6)	14.4 (0.6)	13.8 (1.1)	0.699	N/A	N/A
Mean nocturnal relative humidity (%)	63.1 (2.1)	61.8 (2.0)	64.2 (3.4)	0.786	N/A	N/A
Mean daily temperature range (°C)	18.4 (0.6)	22.9 (0.8)	28.7 (2.5)	<0.001	NU>NS, NU>WT	NU>NS, NU>WT

*Results of pairwise comparisons for similar data in 2003 are included. Habitat and canopy cover variables are presented as N followed by % of column totals (in parentheses), while soil moisture and temperature/humidity values are means (standard error in parentheses). N/A = data not available or not applicable.

Table 7.5. Descriptive Statistics (Chi-square) and Single Effects (ANOVA) for Southwestern Willow Flycatcher Microclimate Data by Location Type at Mormon Mesa, June–August, 2004*

Response Variable	Nest Site	Within Territory	Non-Use	*P*	Significant Pairwise Differences	
					2004	2003
N (Temperature/Humidity Sensor Arrays)	6	6	5	N/A	N/A	N/A
Habitat						
Native (cottonwood or willow) – 2 missing Habitat values	3 (75.0)	3 (50.0)	0 (0.0)	0.016	NS>NU, WT>NU (more native)	N/A
Exotic (tamarisk)	0 (0.0)	0 (0.0)	4 (80.0)			
Mixed (native and exotic)	1 (25.0)	3 (50.0)	1 (20.0)			
Canopy Cover – 1 missing canopy value						
Less than 25%	0 (0.0)	0 (0.0)	2 (40.0)	0.128	N/A	WT>NU
25–75%	4 (80.0)	6 (100.0)	3 (60.0)			
More than 75%	1 (20.0)	0 (0.0)	0 (0.0)			
Soil Moisture						
Mean soil moisture (% volume) plot center to 1.0 m	25.5 (5.6)	26.0 (8.6)	6.2 (5.2)	0.262	N/A	N/A
Mean soil moisture (% volume) 1.5–2.0 m from plot center	20.3 (7.7)	21.8 (9.0)	5.7 (5.1)	0.497	N/A	N/A
Mean distance to saturated/ inundated soil	48.0 (8.5)	50.6 (7.5)	68.1 (19.2)	0.488	N/A	N/A
Temperature/Humidity						
Mean diurnal temperature (°C)	33.5 (0.7)	34.8 (1.0)	37.0 (0.5)	0.027	NU>NS	N/A
Mean maximum diurnal temperature (°C)	45.2 (1.3)	51.4 (1.9)	53.9 (1.6)	0.006	NU>NS, WT>NS	N/A
Mean diurnal relative humidity (%)	37.6 (1.6)	36.0 (2.1)	30.1 (3.1)	0.095	N/A	N/A
Mean nocturnal temperature (°C)	24.9 (1.0)	24.6 (1.0)	23.4 (1.1)	0.588	N/A	N/A
Mean minimum nocturnal temperature (°C)	17.2 (1.0)	16.8 (0.9)	14.4 (1.2)	0.147	N/A	N/A
Mean nocturnal relative humidity (%)	60.2 (1.6)	60.3 (1.3)	55.2 (4.0)	0.276	N/A	N/A
Mean daily temperature range (°C)	21.4 (1.0)	27.3 (1.3)	31.6 (1.4)	<0.001	NU>NS, WT>NS	N/A

*Results of pairwise comparisons for similar data in 2003 are included. Habitat and canopy cover variables are presented as N followed by % of column totals (in parentheses), while soil moisture and temperature/humidity values are means (standard error in parentheses). N/A = data not available or not applicable.

Table 7.6. Descriptive Statistics (Chi-square) and Single Effects (ANOVA) for Southwestern Willow Flycatcher Microclimate Data by Location type Topock, June–August, 2004*

Response Variable	Nest Site	Within Territory	Non-use	*P*	Significant pairwise differences	
					2004	2003
N (Temperature/Humidity Sensor Arrays)	34	35	32	N/A	N/A	N/A
Habitat						
Native (cottonwood or willow)	0 (0.0)	1 (2.9)	0 (0.0)			
Exotic (tamarisk)	33 (97.1)	31 (88.6)	30 (93.8)	0.566	N/A	N/A
Mixed (native and exotic)	1 (2.9)	3 (8.6)	2 (6.3)			
Canopy Cover – 1 missing canopy value						
Less than 25%	1 (2.9)	3 (8.6)	7 (22.6)			
25–75%	26 (76.5)	26 (74.3)	21 (67.7)	0.116	N/A	WT>NU
More than 75%	7 (20.6)	6 (17.1)	3 (9.7)			
Soil Moisture						
Mean soil moisture (% volume) plot center to 1.0 m	41.9 (1.1)	39.2 (1.5)	28.8 (2.3)	<0.001	NS>NU, WT>NU	N/A
Mean soil moisture (% volume) 1.5–2.0 m from plot center	41.9 (1.3)	38.9 (1.7)	28.1 (2.4)	<0.001	NS>NU, WT>NU	N/A
Mean distance to saturated/ inundated soil	22.6 (2.2)	23.7 (1.9)	36.0 (2.2)	<0.001	NU>NS, NU>WT	N/A
Temperature/Humidity						
Mean diurnal temperature (°C)	30.3 (0.3)	30.9 (0.3)	32.0 (0.7)	0.025	NU>NS	N/A
Mean maximum diurnal temperature (°C)	41.4 (0.7)	42.1 (0.8)	44.9 (1.1)	0.012	NU>NS	N/A
Mean diurnal relative humidity (%)	59.2 (1.6)	57.5 (1.6)	56.1 (1.9)	0.439	N/A	N/A
Mean nocturnal temperature (°C)	24.6 (0.3)	24.4 (1.6)	23.7 (0.4)	0.219	N/A	N/A
Mean minimum nocturnal temperature (°C)	17.2 (0.5)	16.9 (0.4)	15.8 (0.5)	0.095	N/A	N/A
Mean nocturnal relative humidity (%)	69.3 (1.6)	69.9 (1.3)	73.5 (1.3)	0.089	N/A	N/A
Mean daily temperature range (°C)	17.4 (0.7)	18.8 (0.7)	21.9 (0.8)	<0.001	NU>NS, NU>WT	N/A

*Results of pairwise comparisons for similar data in 2003 are included. Habitat and canopy cover variables are presented as N followed by % of column totals (in parentheses), while soil moisture and temperature/humidity values are means (standard error in parentheses). N/A = data not available or not applicable.

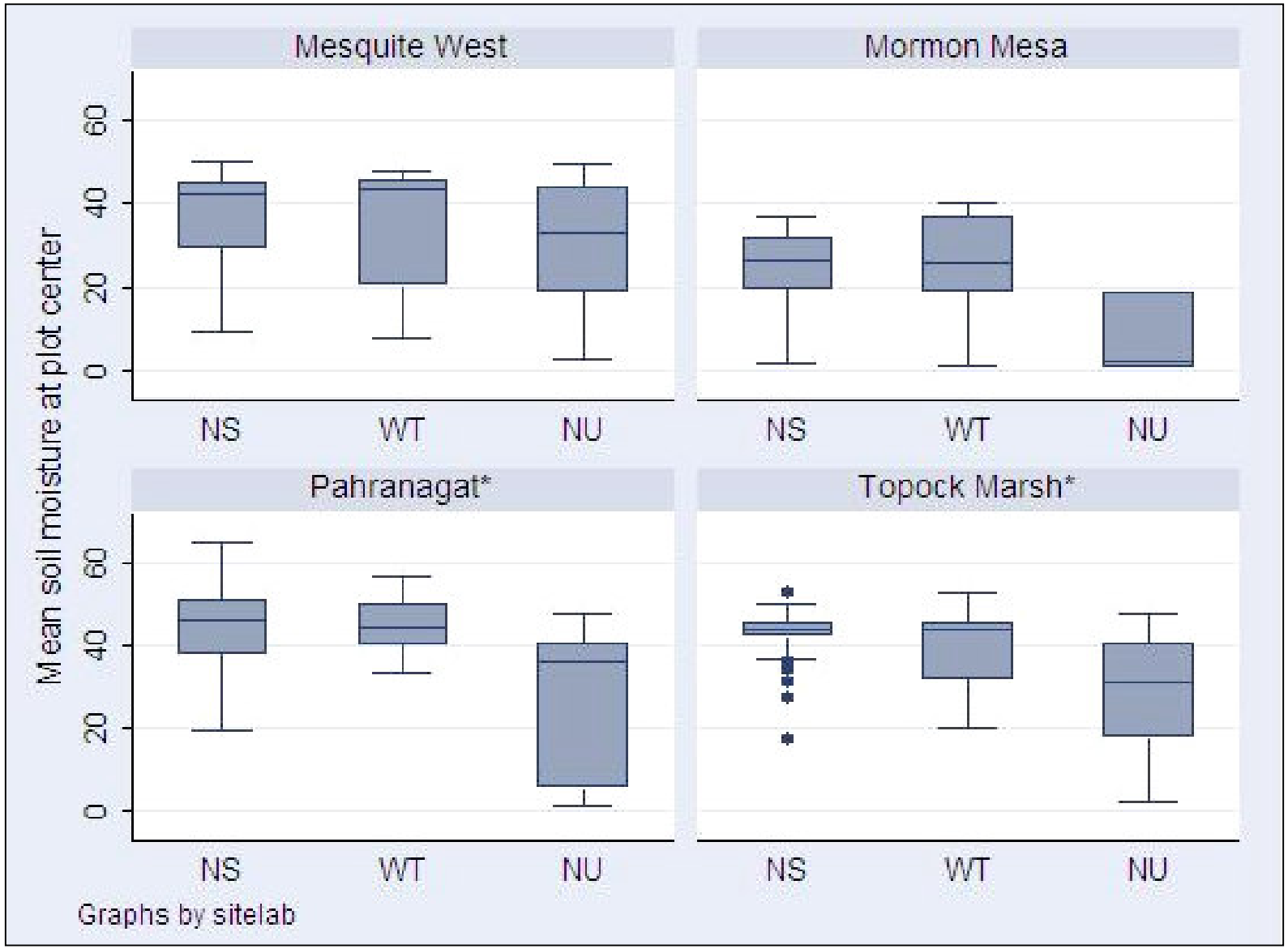

Figure 7.1. Box plots for the mean percent soil moisture plot center to 1.0 m from plot center by study area and location type for Southwestern Willow Flycatcher microclimate data along the Virgin and lower Colorado River regions, June–August, 2004. (Lines = minimum and maximum values; Box = 25th to 75th quartiles; Dots = outliers; and Center line = Median; * = P<0.05.)

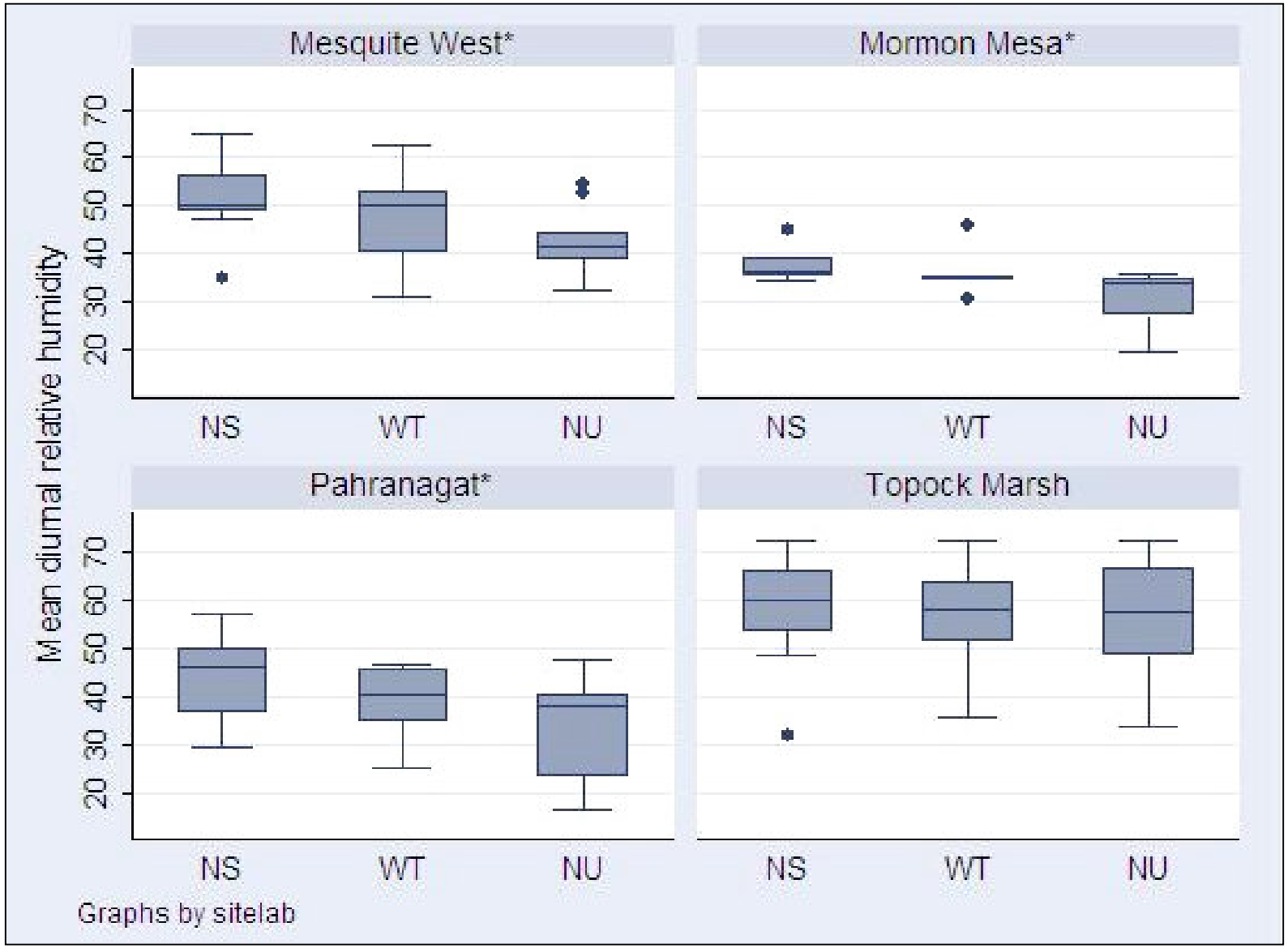

Figure 7.2. Box plots of the mean diurnal relative humidity by study area and location type for Southwestern Willow Flycatcher microclimate data along the Virgin and lower Colorado River regions, June–August, 2004. (Lines = minimum and maximum values; Box = 25th to 75th quartiles; Dots = outliers; and Center line = Median; *=P<0.05.)

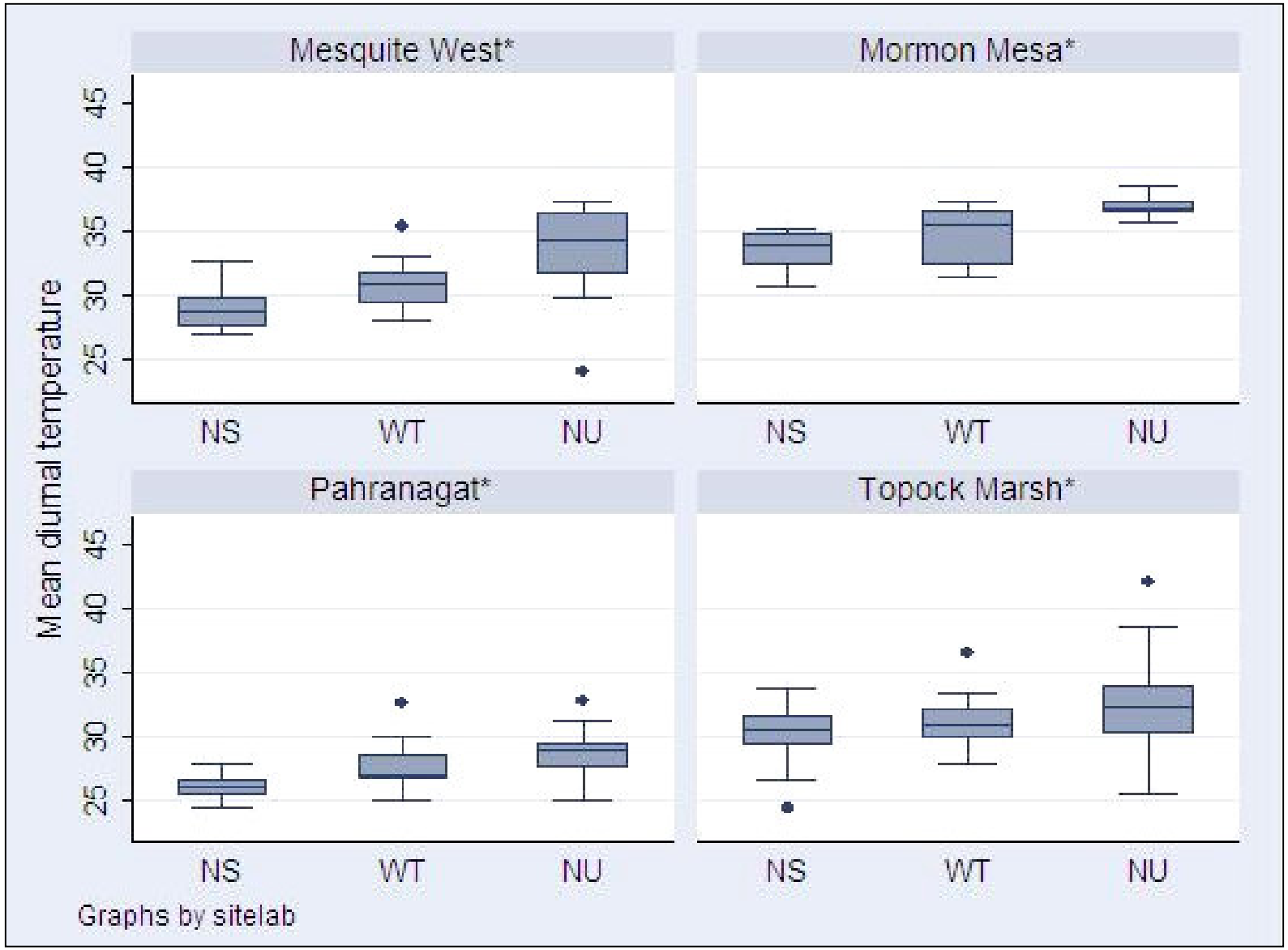

Figure 7.3. Box plots of the mean diurnal temperature by study area and location type for Southwestern Willow Flycatcher microclimate data along the Virgin and lower Colorado River regions, June–August, 2004. (Lines = minimum and maximum values; Box = 25th to 75th quartiles; Dots = outliers; and Center line = Median; *=P<0.05.)

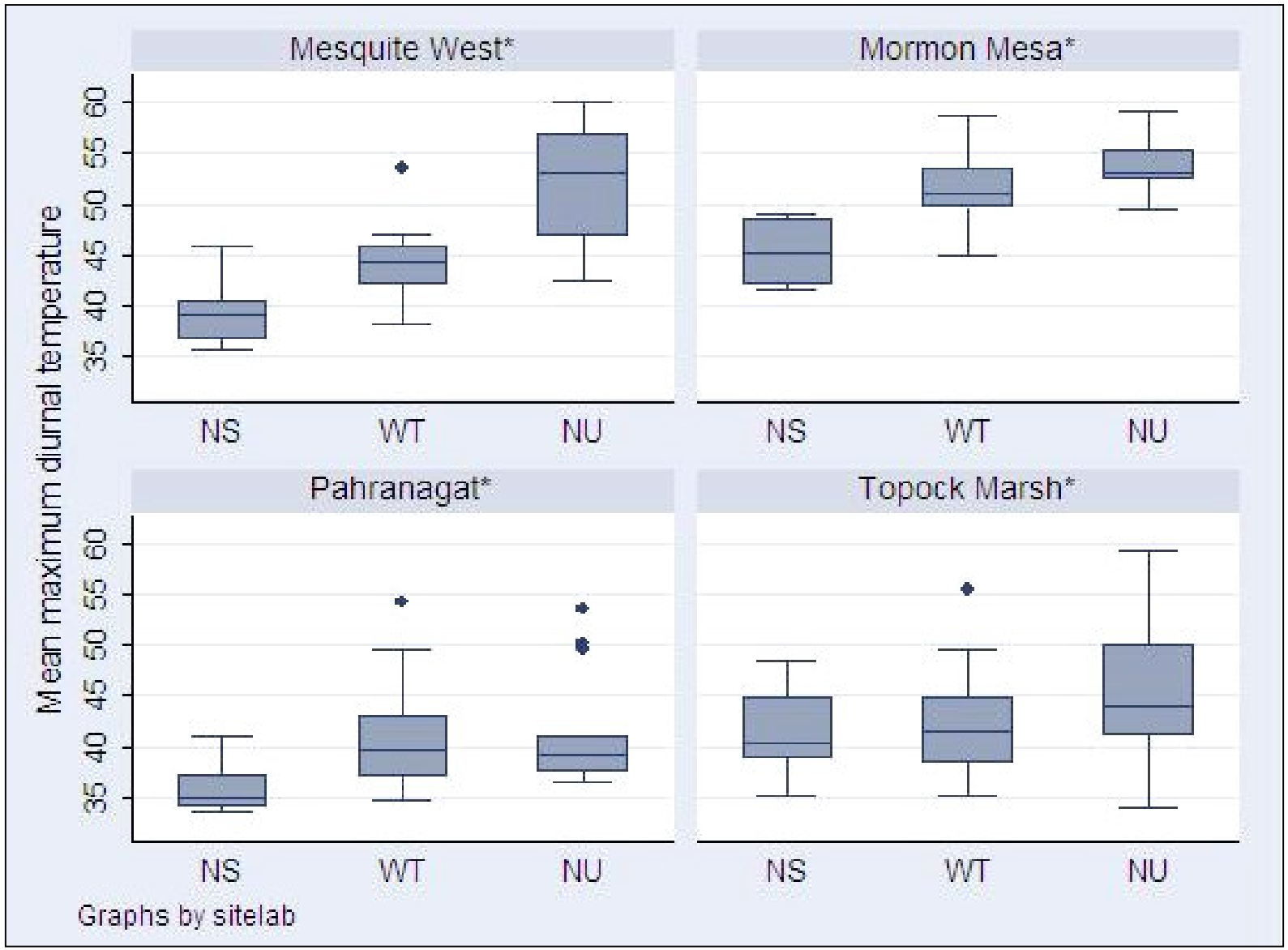

Figure 7.4. Box plots of the mean maximum diurnal temperature by study area and location type for Southwestern Willow Flycatcher microclimate data along the Virgin and lower Colorado River regions, June–August, 2004. (Lines = minimum and maximum values; Box = 25th to 75th quartiles; Dots = outliers; and Center line = Median; *=P<0.05.)

Table 7.7. Single Effects ANOVA Response Variables by Location Type for Southwestern Willow Flycatcher Microclimate Data along the Virgin and Lower Colorado River Regions, June–August, 2004*

Response Variable	Location Type			*P*	Significant Pairwise Differences	
	Nest Site	Within Territory	Non-Use		2004	2003
Soil Moisture						
Mean soil moisture (% volume) plot center to 1.0 m	40.2 (1.2)	38.7 (1.2)	28.1 (1.9)	<0.001	NS>NU, WT>NU	N/A
Mean soil moisture (% volume) 1.5–2.0 m from plot center	40.0 (1.3)	38.1 (1.4)	27.1 (1.9)	<0.001	NS>NU, WT>NU	N/A
Mean distance to saturated/ inundated soil	23.7 (2.6)	25.0 (2.7)	47.8 (6.3)	<0.001	NU>WT, NU>NS	N/A
Temperature/Humidity						
Mean diurnal temperature (°C)	29.3 (0.3)	30.5 (0.3)	31.9 (0.5)	<0.001	NU>WT>NS	NU>WT>NS
Mean maximum diurnal temperature (°C)	39.9 (0.5)	43.1 (0.6)	46.1 (0.9)	<0.001	NU>WT>NS	NU>WT>NS
Mean diurnal relative humidity (%)	52.2 (1.3)	49.9 (1.4)	46.2 (1.8)	0.021	NS>NU	NS>WT>NU
Mean nocturnal temperature (°C)	23.5 (0.3)	23.6 (0.3)	23.1 (0.3)	0.417	N/A	N/A
Mean minimum nocturnal temperature (°C)	15.7 (0.4)	15.4 (0.4)	14.7 (0.4)	0.175	N/A	N/A
Mean nocturnal relative humidity (%)	61.9 (1.5)	61.9 (1.5)	62.6 (2.0)	0.953	N/A	N/A
Mean daily temperature range (°C)	17.7 (0.4)	20.8 (0.6)	23.3 (0.8)	<0.001	NU>WT>NS	NU>WT>NS

*Results of pairwise comparisons for similar data in 2003 are included. All values are means (standard error in parentheses); N/A = data not available or not applicable.

Table 7.8. Single Effects ANOVA Response Variables by Study Area for Southwestern Willow Flycatcher Microclimate Data along the Virgin and Lower Colorado River Regions, June–August, 2004*

Response Variable	Study Area				*P*	Significant Pairwise Differences	
	Pahranagat (PA)	Mesquite (MW)	Mormon Mesa (MM)	Topock (TM)		2004	2003
Soil Moisture							
Mean soil moisture (% volume) plot center to 1.0 m	35.1 (2.1)	39.3 (1.8)	21.9 (4.6)	36.9 (1.1)	<0.001	PA>MM, TM>MM, MW>MM	N/A
Mean soil moisture (% volume) 1.5–2.0 m from plot center	35.2 (2.0)	37.6 (2.1)	18.0 (4.8)	36.6 (1.2)	<0.001	PA>MM, TM>MM, MW>MM	N/A
Mean distance to saturated/ inundated soil	56.3 (9.2)	10.7 (1.9)	55.0 (7.0)	27.2 (1.4)	<0.001	PA>TM, PA>MW, MM>TM, MM>MW, TM>MW	N/A
Temperature/Humidity							
Mean diurnal temperature (°C)	27.4 (0.3)	30.9 (0.5)	35.0 (0.5)	31.0 (0.3)	<0.001	MM>TM, MM>MW, MM>PA, TM>PA, MW>PA	MM>PA, MW>PA, TM>PA
Mean maximum diurnal temperature (°C)	39.2 (0.8)	44.6 (1.0)	50.0 (1.3)	42.7 (0.5)	<0.001	MM>MW, MM>TM, MM>PA, MW>PA, TM>PA	MM>PA, MW>PA
Mean diurnal relative humidity (%)	38.9 (1.4)	47.8 (1.3)	34.8 (1.5)	57.6 (1.0)	<0.001	TM>PA, TM>MW, TM>MM, MW>PA, MW>MM	TM>MW, TM>PA, TM>MM, MW>MM
Mean nocturnal temperature (°C)	22.1 (0.2)	22.6 (0.3)	24.3 (0.6)	24.2 (0.2)	<0.001	MM>MW, MM>PA, TM>MW, TM>PA	TM>MW, TM>PA, TM>MM, PA>MM

Table 7.8. Single Effects ANOVA Response Variables by Study Area for Southwestern Willow Flycatcher Microclimate Data along the Virgin and Lower Colorado River Regions, June–August, 2004*, continued

Response Variable	Study Area				*P*	Significant Pairwise Differences	
	Pahranagat (PA)	Mesquite (MW)	Mormon Mesa (MM)	Topock (TM)		2004	2003
Mean minimum nocturnal temperature (°C)	12.8 (0.3)	14.4 (0.4)	16.2 (0.6)	16.6 (0.3)	<0.001	TM>MW, TM>PA, MM>PA, MW>PA	TM>MW, TM>PA, TM>MM
Mean nocturnal relative humidity (%)	43.2 (1.3)	62.9 (1.4)	58.8 (1.4)	70.9 (0.8)	<0.001	TM>MW, TM>PA, TM>MM, MW>PA, MM>PA	TM>MW, TM>PA, TM>MM, MW>PA, MM>PA
Mean daily temperature range (°C)	18.6 (0.6)	23.0 (1.0)	26.5 (1.2)	19.3 (0.5)	<0.001	MM>TM, MM>PA, MW>TM, MW>PA	MM>TM, MM>PA, MW>PA, MW>TM

*Results of pairwise comparisons for similar data in 2003 are included. All values are means (standard error in parentheses); N/A = data not available or not applicable.

Table 7.9. Single Effects ANOVA Response Variables by Habitat Type for Southwestern Willow Flycatcher Microclimate Data along the Virgin and Lower Colorado River Regions, June–August, 2004*

Response variable	Habitat Type			*P*	Significant Pairwise Differences	
	Native (Cottonwood or Willow)	Exotic (Tamarisk)	Mixed (Native and Exotic)		2004	2003
Soil Moisture						
Mean soil moisture (% volume) plot center to 1.0 m	36.2 (1.6)	35.5 (1.2)	40.4 (1.7)	0.397	N/A	N/A
Mean soil moisture (% volume) 1.5–2.0 m from plot center	35.4 (1.6)	35.2 (1.3)	40.3 (1.9)	0.384	N/A	N/A
Mean distance to saturated/ inundated soil	38.7 (6.4)	28.3 (1.7)	28.4 (6.0)	0.152	N/A	N/A
Temperature/Humidity						
Mean diurnal temperature (°C)	28.7 (0.3)	31.3 (0.3)	32.2 (0.5)	<0.001	Mix>Nat, Tam>Nat	Mix>Nat, Tam>Nat
Mean maximum diurnal temperature (°C)	40.7 (0.7)	43.4 (0.6)	47.5 (1.3)	<0.001	Mix>Tam>Nat	Mix>Nat
Mean diurnal relative humidity (%)	42.2 (1.2)	55.0 (1.2)	49.0 (2.4)	<0.001	Mix>Nat, Tam>Nat	Tam>Nat> Mix
Mean nocturnal temperature (°C)	22.5 (0.2)	24.1 (0.2)	23.3 (0.5)	<0.001	Tam>Nat	Tam>Mix, Tam>Nat
Mean minimum nocturnal temperature (°C)	13.7 (0.3)	16.3 (0.3)	15.2 (0.8)	<0.001	Tam>Nat	Tam>Mix, Tam>Nat
Mean nocturnal relative humidity (%)	50.7 (1.5)	69.0 (1.0)	66.7 (1.7)	<0.001	Tam>Nat, Mix>Nat	Tam>Mix, Tam>Nat
Mean daily temperature range (°C)	19.9 (0.6)	20.0 (0.6)	24.4 (1.2)	0.002	Mix>Tam, Mix>Nat	Mix>Tam, Mix>Nat

*Results of pairwise comparisons for similar data in 2003 are included. All values are means (standard error in parentheses); N/A = data not available or not applicable.

Table 7.10. Single Effects ANOVA Response Variables by Canopy Closure for Southwestern Willow Flycatcher Microclimate Data along the Virgin and Lower Colorado River Regions, June–August, 2004*

Response Variable	Canopy Closure Categories			*P*	Significant Pairwise Differences	
	< 25%	25–75%	> 75%		2004	2003
Soil Moisture						
Mean soil moisture (% volume) plot center to 1.0 m	31.9 (2.9)	35.8 (1.1)	39.4 (1.9)	0.095	N/A	N/A
Mean soil moisture (% volume) 1.5–2.0 m from plot center	31.3 (2.9)	35.1 (1.1)	40.3 (1.9)	0.029	GT75>LT25	N/A
Mean distance to saturated/ inundated soil	35.8 (5.9)	33.2 (3.4)	23.7 (3.9)	0.345	N/A	N/A
Temperature/Humidity						
Mean diurnal temperature (°C)	33.6 (0.7)	30.4 (0.3)	28.6 (0.4)	<0.001	LT25>25-75>GT75	LT25>25-75>GT75
Mean maximum diurnal temperature (°C)	50.2 (1.2)	42.4 (0.4)	39.4 (0.8)	<0.001	LT25>25-75>GT75	LT25>25-75>GT75
Mean diurnal relative humidity (%)	43.7 (2.2)	50.3 (1.1)	50.8 (2.3)	0.046	25-75>LT25	N/A
Mean nocturnal temperature (°C)	22.8 (0.5)	23.6 (0.2)	23.0 (0.3)	0.113	N/A	N/A
Mean minimum nocturnal temperature (°C)	13.9 (0.6)	15.7 (0.3)	14.4 (0.4)	0.005	25-75>LT25	N/A
Mean nocturnal relative humidity (%)	64.5 (2.7)	62.4 (1.1)	58.6 (2.7)	0.212	N/A	LT5>GT75, 25-75>GT75
Mean daily temperature range (°C)	27.8 (1.1)	19.8 (0.4)	18.0 (0.6)	<0.001	LT25>25-75, LT25>GT75	LT25>25-75>GT75

*Results of pairwise comparisons for similar data in 2003 are included. All values are means (standard error in parentheses); N/A = data not available or not applicable.

All temperature and humidity response variables differed significantly among habitat types. There was no significant difference in soil moisture or mean distance to water between habitat types. Native habitats consistently exhibited the lowest diurnal and nocturnal temperature and humidity, and the lowest mean daily temperature range as compared to exotic or mixed habitats. However, the majority of sites with native habitat occur at Pahranagat, which has the highest latitude and elevation of the sites and exhibited the lowest diurnal and nocturnal temperatures. Thus, habitat type and study area are likely confounded.

The following variables differed significantly among canopy closure levels: soil moisture at plot center to 1.0 m from the plot center and from 1.5 to 2.0 m from plot center, mean diurnal temperature, mean maximum diurnal temperature, mean diurnal relative humidity, mean minimum nocturnal temperature, and mean daily temperature range. These results are similar to those obtained in 2003.

MANOVA MODEL

Location type remained a significant predictor for soil moisture at plot center to 1.0 m from the plot center and from 1.5 to 2.0 m from plot center, mean distance to water, the three diurnal temperature measures, and mean diurnal relative humidity, even after adjusting for study area, habitat, and canopy closure (Table 7.11). No significant interaction terms remained in the stepwise analyses, so the models with these terms, which were shown for the 2003 analysis, have not been included here.

Because NU sites were the source of much of the significant difference in the single effects of location, NU sites were removed from the models to make a discrete comparison between only NS and WT sites at all study areas (Table 7.12). This MANOVA showed that NS sites remained significant predictors of mean diurnal temperature, mean maximum diurnal temperature, and mean daily temperature range. In 2003, only mean maximum diurnal temperature remained significantly different between NS and WT sites.

The response variables were often correlated (Table 7.13). For example, higher soil moisture at plot center to 1.0 m was significantly correlated with the following: higher soil moisture from 1.5 to 2.0 m, lower distance to water/saturated soil, lower mean diurnal temperatures, lower mean maximum diurnal temperatures, higher mean diurnal and nocturnal relative humidity, and lower mean diurnal temperature range. However, soil moisture at plot center was not significantly correlated with nocturnal temperature or minimum nocturnal temperature. Of note is that all three measures of diurnal temperature were directly and significantly correlated.

DISCUSSION

SEASONAL VARIATION

The 2004 finding that riparian habitat was cooler and more humid than adjacent desertscrub habitat was consistent with data collected in 2003 and with what would be expected.

Table 7.11. MANOVA Response Variables by Location Type, Adjusting for Study Area, Habitat, and Canopy Closure for Southwestern Willow Flycatcher Microclimate Data along the Virgin and Lower Colorado River regions, June–August, 2004*

Response Variable	*P* for Overall Model	R^2 (%)	*P* for Location Type		Other Significant Predictors 2004	Significant Pairwise Differences	
			2004	2003		2004	2003
Soil Moisture							
Mean soil moisture (% m^3/m^3) plot center to 1.0 m	<0.001	31.7	<0.001	N/A	Study area, Habitat	NS>NU, WT>NU, MW>MM, PA>MM, TM>MM, Mix>Tam	N/A
Mean soil moisture (% volume) 1.5–2.0 m from plot center	<0.001	35.1	<0.001	N/A	Study area, Habitat	NS>NU, WT>NU, MW>MM, PA>MM, TM>MM, Nat>Mix, Mix>Tam	N/A
Mean distance to saturated/ inundated soil	<0.001	37.3	<0.001	N/A	Study area	NU>NS, NU>WT, MW>MM, PA>MW, TM>MM, PA>TM	N/A
Temperature/Humidity							
Mean diurnal temperature (°C)	<0.001	55.4	0.001	0.008	Study area, Canopy	NU>NS, WT>NS, MM>MW, MM>PA, MM>TM, TM>PA, MW>PA, 25-75-LT25, GT75-LT25	NU>NS, Mix>Nat, LT25>25-75>GT75
Mean maximum diurnal temperature (°C)	<0.001	49.0	<0.001	0.008	Study area, Canopy	NU>NS, WT>NS, MM>MW, MM>PA, MM>TM, TM>PA, LT25>25-75, LT25>GT75	NU>NS, LT25>25-75>GT75
Mean diurnal relative humidity (%)	<0.001	54.5	0.020	0.002	Study area, Habitat, Canopy	NS>NU, MW>MM, TM>MM, MW>PA, TM>MW, TM>PA, Mix>Tam, 25-75>LT25, GT75>LT25	NS>NU, WT>NU, MW>MM, TM>MM, MW>PA, TM>PA, Nat>Mix
Mean nocturnal temperature (°C)	<0.001	20.4	0.597	0.354	Study area	TM>MW, TM>PA	PA>MM, TM>MM
Mean minimum nocturnal temperature (°C)	<0.001	32.4	0.351	0.188	Study area	MM>PA, TM>MW, TM>PA	TM>MM, TM>MW, TM>PA
Mean nocturnal relative humidity (%)	<0.001	65.4	0.601	0.484	Study area	MM>PA, TM>MM, MW>PA, TM>MW, TM>PA	MM>PA, MW>PA, TM>PA, Mix>Nat, Tam>Mix
Mean daily temperature range (°C)	<0.001	48.1	<0.001	<0.001	Study area, Canopy	NU>NS, WT>NS, MM>MW, MM>PA, MM>TM, MW>PA, MW>TM, LT25>25-75, LT25> GT75	NU>NS, NU>WT, MM>PA, MM>TM, MW>TM, LT25>25-75, LT25>GT75

*Results of pairwise comparisons for similar data in 2003 are included. N/A = data not available or not applicable.

Table 7.12. MANOVA Response Variables by Location Type (NS and WT only), Adjusting for Study Area, Habitat, and Canopy Closure for Southwestern Willow Flycatcher Microclimate Data along the Virgin and Lower Colorado River Regions, June–August, 2004*

Response Variable	*P* for Overall Model	R^2 (%)	*P* for Location Type		Other Significant Predictors 2004	Significant Pairwise Differences	
			2004	2003		2004	2003
Soil Moisture							
Mean soil moisture (% volume) plot center to 1.0 m	<0.001	16.5	0.246	N/A	Study area, Habitat	MW>MM, PA>MM, TM>MM, Mix>Tam	N/A
Mean soil moisture (% volume) 1.5–2.0 m from plot center	<0.001	25.9	0.187	N/A	Study area, Habitat	MW>MM, PA>MM, TM>MM, Mix>Tam	N/A
Mean distance to saturated/ inundated soil	<0.001	44.8	0.569	N/A	Study area, Canopy	MM>MW, MM>TM, PA>MW, PA>TM, 25-75>GT75	N/A
Temperature/Humidity							
Mean diurnal temperature (°C)	<0.001	58.3	0.001	0.060	Study area	WT>NS, MM>MW, MM>PA, MM>TM, MW>PA, TM>PA	N/A
Mean maximum diurnal temperature (°C)	<0.001	36.5	<0.001	0.017	Study area	WT>NS, MM>MW, MM>PA, MM>TM, MW>PA	MM>TM, Mix>Nat, Tam>Nat
Mean diurnal relative humidity (%)	<0.001	50.3	0.053	0.127	Study area	MW>MM, TM>MM, MW>PA, TM>MW, TM>PA	MW>MM, TM>MM, MW>PA, TM>PA, Nat>Mix
Mean nocturnal temperature (°C)	<0.001	33.0	0.701	0.951	Study area, Canopy	TM>MW, TM>PA, 25-75>LT25	N/A
Mean minimum nocturnal temperature (°C)	<0.001	44.2	0.424	0.335	Study area, Canopy	MM>PA, MW>PA, TM>MW, TM>PA, 25-75>LT25, GT75>LT25	TM>MM, TM>MW, TM>PA
Mean nocturnal relative humidity (%)	<0.001	63.2	0.407	0.236	Study area	MM>PA, TM>MM, MW>PA, TM>MW, TM>PA	N/A
Mean daily temperature range (°C)	<0.001	35.1	<0.001	0.771	Study area, Canopy	WT>NS, MM>MW, MM>PA, MM>TM, LT25>25-75, LT25>GT75	N/A

*Results of pairwise comparisons for similar data in 2003 are included. N/A = data not available or not applicable.

Table 7.13. Correlations (R) among response variables for Southwestern Willow Flycatcher microclimate data along the Virgin and lower Colorado River regions, June–August, 2004[1]

Predictor Variables	SM Plot Center	SM 2.0 m	Distance to Water	Mean Day Temp	Mean Max Day Temp	Mean Day Rel. Hum.	Mean Night Temp	Mean Min Night Temp	Mean Night Rel. Hum.	Mean Day Temp Range
Mean soil moisture (% volume) plot center to 1.0 m	1.0	0.96*	-0.16*	-0.35*	-0.28*	0.33*	-0.13	-0.04	0.16*	-0.21*
Mean soil moisture (% volume) 1.5–2.0 m from plot center	-	1.0	-0.17*	-0.38*	-0.32*	0.33*	-0.13	-0.03	0.14	-0.25*
Mean distance to saturated/ inundated soil at setup	-	-	1.0	-0.04	-0.02	-0.25*	-0.04	-0.09	-0.27*	0.01
Mean diurnal temperature (°C)	-	-	-	1.0	0.80*	-0.18*	0.51*	0.38*	0.28*	0.65*
Mean maximum diurnal temperature (°C)	-	-	-	-	1.0	-0.27*	0.20*	0.12	0.16*	0.81*
Mean diurnal relative humidity (%)	-	-	-	-	-	1.0	0.19*	0.33*	0.79*	-0.40*
Mean nocturnal temperature (°C)	-	-	-	-	-	-	1.0	0.87*	0.13	-0.24*
Mean minimum nocturnal temperature (°C)	-	-	-	-	-	-	-	1.0	0.26*	-0.32*
Mean nocturnal relative humidity (%)	-	-	-	-	-	-	-	-	1.0	0.08
Mean daily temperature range (°C)	-	-	-	-	-	-	-	-	-	1.0

[1]Positive numbers = direct correlation; negative numbers = inverse correlation; * = $P<0.05$)

DATA COLLECTION AFTER NESTS WERE VACATED

Because so few differences were found in 2004 (as in 2003) between consecutive weeks for T/RH and SM measurements, we were again confident in the validity of measuring nest microclimate after nests were vacated. A total of 88 pairs of weeks were possible: 11 weeks from mid-May to mid-August, in the four study areas, with two measures each. Of these, only five pairs of weeks (or 6%) differed significantly for SV measurements of mean diurnal temperature and mean soil moisture; three were at the peak of the nesting season (June); and two were outside the peak.

LOCATION TYPES: DESCRIPTIVE STATISTICS AND SINGLE EFFECTS ANALYSIS

Soil moisture at NS and WT sites was higher than at NU sites at Pahranagat and Topock. Canopy cover at this level of analysis was generally not a significant factor in the 2004 data as it had appeared to be in the 2003 data. The three measures of diurnal temperature differed among location types in 2004, with NU sites consistently hotter than NS sites, NU sites usually hotter than WT sites, and WT sites sometimes hotter than NS sites. Diurnal relative humidity was higher at NS sites than at NU sites at Pahranagat and Mesquite, as it was in 2003. As in 2003, nocturnal variables generally did not differ between location types.

INDIVIDUAL EFFECT OF PREDICTOR VALUES

Results of single effects analyses in 2004 were generally similar to those from 2003, with the exception that reliable soil moisture data were available in 2004. The NS and WT sites exhibited higher soil moisture, were closer to open water, and were cooler and more humid during the day than NU sites. The finding that study areas differed significantly for all variables was identical to findings from 2003. Again, as in 2003, most temperature and humidity variables differed among habitat types. Soil moisture variables, however, did not differ. Those sites with greater canopy closure exhibited a pattern similar to that detected in 2003 by being cooler during daytime and exhibiting greater soil moisture.

MANOVA MODEL

The first MANOVA analysis for all three location types for the 2004 data validated the results from 2003 by showing the same pattern of significance: NS sites during the daytime were cooler, had smaller temperature fluctuations, and were more humid than NU sites. In addition, the 2004 data revealed that NS and WT sites exhibited greater soil moisture and were closer to water than NU sites. These findings indicate that Southwestern Willow Flycatchers established territories and built their nests at sites with significantly cooler, more humid, and wetter microclimates.

The second MANOVA analysis comparing only NS and WT sites revealed that Southwestern Willow Flycatchers were building nests at sites within their territories that were cooler and exhibited smaller temperature fluctuations. Soil moisture, diurnal relative humidity, and all nocturnal T/RH variables were similar among NS and WT sites.

Our findings indicate that Southwestern Willow Flycatchers nest in habitats exhibiting lower mean diurnal temperatures, lower mean maximum diurnal temperatures, and lower mean daily temperature ranges. These three measures were highly correlated and likely incorporate different perspectives on the same question: how hot does it get at the nest site? These results corroborate the 2003 findings that the largest difference between nest sites and non-nest sites is mean maximum diurnal temperature.

For this analysis, we split the soil moisture measurements into those measurements closest to plot center and those farther away. The results were essentially the same for both measures, suggesting that it might be more efficient and make the analysis less complicated by combining them into one measure in future analyses.

COMPARISON WITH OTHER FINDINGS

Allison et al. (2003) reported that habitat within Southwestern Willow Flycatcher nesting territories exhibited greater canopy closure than non-nesting plots in Arizona, a relationship they suggested might provide a more favorable (i.e., more moderate) microclimate at nests. Our finding that NS and WT sites had greater canopy closure than NU sites at two study areas was consistent with Allison et al. (2003). Our vegetation analyses (see previous chapter), which used a quantitative, continuous measure rather than a categorical measure of canopy closure, parallel this, in that canopy closure was greater at NS sites than at NU sites in all study areas.

At the four life history study areas, McKernan and Braden (2001a, 2001b) reported that mean daily temperature range (they used the term "variation in temperature") was significantly greater at NU sites than at either NS or WT sites, but that NS and WT sites were similar. However, their difference between NU and NS sites was small, which was apparently the reason they discounted the difference as biologically insignificant and reported the following: "Selection of nest sites or territories by the…flycatcher was not found to be affected by specific requirements in temperature, relative humidity, or stability in these microclimate variables. Therefore, the microclimate variables are unlikely to limit habitat suitability for the species" (McKernan and Braden 2001b:78). They also reported that "…microclimate variables between native and non-native habitat types, under the same hydrological conditions, do not limit habitat suitability for the …flycatcher" (McKernan and Braden 1999:58, McKernan and Braden 2001b:81).

The 2004 findings supported our earlier assertion (Koronkiewicz et al. 2004) that the differences among our mean diurnal temperature measures at the three location types, although small (only 2.6 degrees C), appear to be biologically meaningful since they paralleled significant vegetative differences identified in the previous chapter and reported by Allison et al. (2003). Therefore, it continues to appear that microclimate limits nesting habitat suitability, territory location, and nest placement. This key difference between our findings and those of McKernan and Braden (2001b) should be interpreted with caution as we were unable to replicate their field methods, and we used a different approach to statistical analysis. Additional microclimate data collected in subsequent years will continue to show whether the patterns observed to date are consistent across years and will help clarify whether suitable nesting habitat for willow flycatchers is limited by microclimate.

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APPENDIX A

Field Data Forms

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SWFL SURVEY AND DETECTION FORM

Site Name (specific to patch)_________________________________ **Date** ________________

Observer(s) ____ **UTM Zone** ________

Start	**Stop**
Time ____________	Time ____________
UTM E 0 __ __ __ __ __ __ N __ __ __ __ __ __ __	UTM E 0 __ __ __ __ __ __ N __ __ __ __ __ __ __

Intermediate Waypoints

UTM E 0 __ __ __ __ __ __ N __ __ __ __ __ __ __	UTM E 0 __ __ __ __ __ __ N __ __ __ __ __ __ __
UTM E 0 __ __ __ __ __ __ N __ __ __ __ __ __ __	UTM E 0 __ __ __ __ __ __ N __ __ __ __ __ __ __
UTM E 0 __ __ __ __ __ __ N __ __ __ __ __ __ __	UTM E 0 __ __ __ __ __ __ N __ __ __ __ __ __ __
UTM E 0 __ __ __ __ __ __ N __ __ __ __ __ __ __	UTM E 0 __ __ __ __ __ __ N __ __ __ __ __ __ __
UTM E 0 __ __ __ __ __ __ N __ __ __ __ __ __ __	UTM E 0 __ __ __ __ __ __ N __ __ __ __ __ __ __
UTM E 0 __ __ __ __ __ __ N __ __ __ __ __ __ __	UTM E 0 __ __ __ __ __ __ N __ __ __ __ __ __ __
UTM E 0 __ __ __ __ __ __ N __ __ __ __ __ __ __	UTM E 0 __ __ __ __ __ __ N __ __ __ __ __ __ __
UTM E 0 __ __ __ __ __ __ N __ __ __ __ __ __ __	UTM E 0 __ __ __ __ __ __ N __ __ __ __ __ __ __

SWFL Detections

UTM E 0 __ __ __ __ __ __ N __ __ __ __ __ __ __ Banded? Y N U Pair? Y N Nest Found? Y N
Comments ____
____

UTM E 0 __ __ __ __ __ __ N __ __ __ __ __ __ __ Banded? Y N U Pair? Y N Nest Found? Y N
Comments ____
____

UTM E 0 __ __ __ __ __ __ N __ __ __ __ __ __ __ Banded? Y N U Pair? Y N Nest Found? Y N
Comments ____
____

UTM E 0 __ __ __ __ __ __ N __ __ __ __ __ __ __ Banded? Y N U Pair? Y N Nest Found? Y N
Comments ____
____

Survey Summary

Total survey hours ______ # SWFLS found _______ Est. # Pairs ________ Est. # Territories _______

Playbacks used? Y or N Cowbirds Detected? Y or N If Y, approx # ______________________

Sign of Livestock? Y or N If yes, explain ____

Additional Comments ____
____
____
____
____
____

LCR SWFL SURVEY AND DETECTION FORM 2004 – Additional Detections

Site Name (specific to patch)_________________________________ **Date** _________________

SWFL Detections

UTM E ______________ N _________________ Pair? Y or N Nest Found? Y or N
Comments ____
____

UTM E ______________ N _________________ Pair? Y or N Nest Found? Y or N
Comments ____
____

UTM E ______________ N _________________ Pair? Y or N Nest Found? Y or N
Comments ____
____

UTM E ______________ N _________________ Pair? Y or N Nest Found? Y or N
Comments ____
____

UTM E ______________ N _________________ Pair? Y or N Nest Found? Y or N
Comments ____
____

UTM E ______________ N _________________ Pair? Y or N Nest Found? Y or N
Comments ____
____

UTM E ______________ N _________________ Pair? Y or N Nest Found? Y or N
Comments ____
____

UTM E ______________ N _________________ Pair? Y or N Nest Found? Y or N
Comments ____
____

UTM E ______________ N _________________ Pair? Y or N Nest Found? Y or N
Comments ____
____

UTM E ______________ N _________________ Pair? Y or N Nest Found? Y or N
Comments ____
____

UTM E ______________ N _________________ Pair? Y or N Nest Found? Y or N
Comments ____

SWFL General Site Description

(Complete at least 3 times during season: early (15–25 May), mid-season (10–25 June), and late season (10–25 July)

Site name:_____ **Date (MM/DD/YY):** _____

Observer(s):_____ **early**_____ **mid**_____ **late** _____ **other**_____

Vegetation at site: >90% native 50-90% native 50-90% exotic >90% exotic

Canopy closure: <25% 25-50% 50-70% 70-90% >90%

Dominant overstory species: TASP SAGO SAEX POFR Other _____

Overstory height (m): _____

Dominant understory species: TASP SAGO SAEX PLSE Other _____

Understory height (m): _____

Other vegetation types present (e.g., cattail)? Yes No

If yes, type of vegetation: _____ **percentage of site:**_____
type of vegetation: _____ **percentage of site:**_____
type of vegetation: _____ **percentage of site:**_____

% of site inundated: _____

Depth of surface water: toes (<5cm) ankles (5-15 cm) calves (15-40 cm) knees (40-60 cm)
thighs (60-80 cm) waist (100 cm) too deep to wade (>100 cm)

% of site with saturated soils: _____

If not inundated, distance to standing water or saturated soil (m):_____

Give a narrative description of the site, including adjacent habitats:

_____
_____
_____
_____
_____
_____
_____
_____
_____

Additional comments:_____
_____
_____
_____
_____
_____
_____

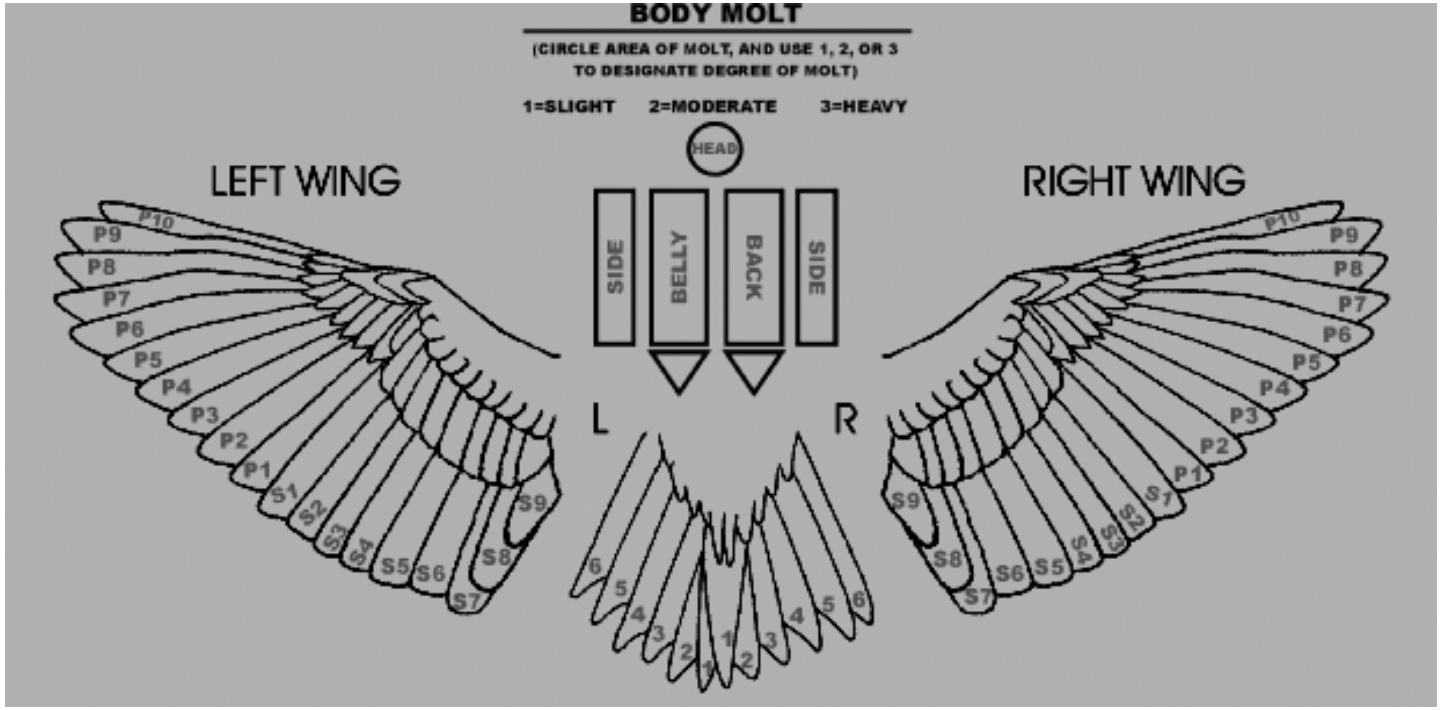
SITE: _____ **BANDER:** _____ **DATE**: _____ **TIME**: _____ **TERR AND NEST #**: _____ **NBN:** ____ of ____ nestlings banded.
NOTES:_____
_____
_____

FEDERAL BAND #	COLOR COMBO		STATUS	SEX	CP	BP	AGE AHY, SY, L, or HY	FECAL SAMPLE? (Y or N)	BLOOD SAMPLES? (G and/or S)	FEATHER SAMPLE? (Y or N)	WING CHORD	TAIL	CULMEN LENGTH	CULMEN WIDTH	FAT	MASS
	L	R														

Retained Feathers Present: Yes or No (circle) – if Yes use diagram below
Active Molt: Yes or No (circle) – if Yes use diagram below
Tail older (more worn) than PPs and SSs? Yes or No (Circle)

Colorimeter sample: Yes or No (circle)
Blood Samples: G=genetics, S=slide

STATUS: NCP (new cap passive), NCT (new cap target), RCP (recap passive), RCT (recap target). NBN (nestling banded)
SEX: U=unknown, F=female, M=male
CP: 0=non-breeding, S=partial breeding, M=full breeding
BP: 0= none, 1=smooth, 2=vascularized and filled with fluid, 3 =wrinkled, 4=molting



DETAIL ALL MOLTS AND RETAINED FEATHERS ONTO DIAGRAM AND DETAIL IN NOTES

COLORIMETER DATA FORM – 2004

SITE (e.g. Gadsden Bend, AZ): _____ **DATE (e.g. 11 June 2004):** _____

OBSERVER (e.g. M.A. McLeod): _____ **FED BAND # :** _____

CROWN MEASUREMENTS
PAGE (e.g. P12): _____

	L *	a *	b *
MAX			
MIN			
AVG			
SD			

BACK MEASUREMENTS
PAGE (e.g. P13): _____

	L *	a *	b *
MAX			
MIN			
AVG			
SD			

NOTES:_____
_____
_____
_____
_____
_____
_____
_____
_____

RESIGHT DATA FORM

				COLOR COMBO							
OBS Use 3 initials	SITE 4 Letter Code	TERRITORY	NEST	LEFT LEG (Top/ Bottom)	RIGHT LEG (Top/ Bottom)	CONF LEVL A, B, C, N, P	ASSOC WITH A NEST?	CAPTURE?	# WIFLS PRESENT	SEX (M/F/ U)	OBSERVATIONS AND COMMENTS: discuss observations & activities. **Include % confidence of N resights, including when only one leg was observed – or if unsure what band was on what leg.**
	-	-	-		-	-					Service Band Number =
	-	-	-		-	-					Service Band Number =
-	-	-	-		-	-					Service Band Number =
-	-	-	-		-	-					Service Band Number =
-	-	-	-		-	-					Service Band Number =
-	-	-	-		-	-					Service Band Number =
-	-	-	-		-	-					Service Band Number =
-	-	-	-		-	-					Service Band Number =
-	-	-	-		-	-					Service Band Number =
-	-	-	-		-	-					Service Band Number =
-	-	-	-		-	-					Service Band Number =

Willow Flycatcher Nest Record Form (2004)

Site name:_____ Patch Name:_____ Nest no.:_____

Nest Location: NAD:_____

Zone:_____

UTM's:
Easting:_____

Northing:_____

Nest Height:_____m (approximate)

Nest Substrate:_____(e.g. TASP=tamarisk, SAGO=Gooding willow, POFR=cottonwood, SAGE=Geyer willow, etc.)

Distance to water when nest found: _____(m)

Depth of surface water (please circle how wet you got when nest was found): toes (<5cm), ankles (5-15 cm), calves (15-40 cm), knees (40-60 cm), thighs (60-80 cm), waist (100 cm), too deep to wade (>100 cm)

PLEASE DO NOT FILL OUT ANYTHING BELOW

Bird 1: Color band combination:_____ **Band Number:**_____ Female

Bird 2: Color band combination:_____ **Band Number:**_____ Male

Willow Flycatcher

Trans dates	B D (T/F)	
		Found
		First egg
		Clutch completion
		Hatching
		Fledged or Failed

Willow Flycatcher

No. Presumed	No. Confirmed	
		Eggs
		Nestlings
		Fledglings

Cowbird

Trans dates	B D (T/F)	
		First egg
		Hatching
		Fledged

Cowbird

No.	Complete? (T/F)	
		Eggs
		Nestlings
		Fledgling

Outcome (Record code & describe)**:**_____**:**_____

_____

_____

_____

Outcome codes:
UN= unknown; **FY=** fledged young, with at least one young seen leaving or in the vicinity of nest; **FP=** fledged young, as determined by parents behaving as if dependent fledgling(s) nearby; **FU=** suspected fledging of at least one young; **FC=** fledged at least one host young with cowbird parasitism; **FD=** Nest partially depredated with confirmed fledging of at least one young; **PO=** predation observed; **PE=** probable predation, nest empty and intact; **PD=** probable predation, damage to nest structure; **AB=** nest abandoned prior to egg(s) being laid; **DE=** deserted with egg(s) or young; **PA=** parasitized, host attempted to raise cowbird young. No host young were fledged from the nest**;** **WE=** failure due to weather; **AD=** failure, entire clutch addled/infertile; **OT=** failure due to other, or unknown, causes.

Mayfield Success

(WIFL) Period	# Exposure days	Success
Egg Laying		
Incubation		
Nestling		

Mayfield success codes: **S=** successful; **D=** depredated; **U=** status unknown/nest occupied- fate unknown; **M=** mortality other than predation; **A=** abandoned with host egg(s) or young; **Z=** abandoned, no (zero) eggs laid.

Willow Flycatcher Nest Record Form (continued)

Site name:____________________________________Patch name:____________________ Nest no.: ________

Date	Time	Obs	Mon Type	Stage	Adult pres.	# WF Egg	# CB Egg	# WF Nstl	# CB Nstl	#WF Fldg	Age Yng	Comments

COWBIRD TRAPPING DATA FORM

Name: _____ **Date:** _____

Start Time: _____

Location: _____ **End Time:** _____

Trap #

COWBIRDS																		
	M	F	J	M	F	J	M	F	J	M	F	J	M	F	J	M	F	J
Newly Trapped																		
Previous Decoys																		
Removed																		
Added																		
Total left in Trap																		
Non-Target Species																		

Comments _____

LCR Southwestern Willow Flycatcher Project - Vegetation Datasheet 2004

Date:	Obs:	Site:	Plot type:	ID#:	UTM: E N

Nest site only	Substr.:	**All plot centers**	Dist water: m	**Woody Ground Cover**		**Total Canopy**
Substr. DBH: cm	Substr. Ht.: m	Dist canopy gap: m	Dist. Broadleaf: m	N:	E:	N:
Nest Ht.: m or %- % X m		Top Can.: m or %- % X m		S:	W:	S:

Species		**TASP**	**SAGO**	**SAEX**	**POFR**	SNAG	**OTSP1**:_____	**OTSP2**:_____	**OTSP3**:____
Shrub/Sapling Count In 5m Plot < or = 8 cm dbh	<1								
	1-2.5								
	2.6-5.5								
	5.6-8								
	Sum								

Species		**TASP**	**SAGO**	**SAEX**	**POFR**	SNAG	**OTSP1**:_____	**OTSP2**:_____	**OTSP3**:____
Tree Count In 5m Plot > 8 cm dbh	8.1-10.5								
	10.5-15								
	Measured Trees >15 cm dbh								

Species	**TASP**	**SAGO**	**SAEX**	**POFR**	SNAG	**OTSP1**:_____	**OTSP2**:_____	**OTSP3**:____
Tree Count in 5m to 11.3m Plot >8 cm dbh								

NOTES

*** If, at ankle height or above, shrub/sapling/tree splits into multiple branches, count it as one stem and measure the biggest stem. If splits below ankle height, count all stems**

**** If shrub/sapling/tree is not at least breast height, do not count**

Vertical Foliage Sampling (i.e. "Hits on the pole") : Microplot Vegetation

CENTER PLOT						
	Hits/Species					
Height (m)	Tasp	Sago	Saex	Pofr	Snag	Otsp **
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						

Record number of decimeters with hits on pole (within 10 cm radius) per 1-m interval up to 8 m; above 8 m, estimate > or < 5 hits per meter interval.

**** Other species (common name) _____**

Vertical Foliage Sampling (i.e., "Hits on the pole") Data Form : Microplot Vegetation

Date:	Obs.:	Site:	Plot type:	ID#:

Vertical Foliage Volume

NORTH	Hits/Species						EAST	Hits/Species					
Height (m)	Tasp	Sago	Saex	Pofr	Snag	Otsp **	Height (m)	Tasp	Sago	Saex	Pofr	Snag	Otsp **
1							1						
2							2						
3							3						
4							4						
5							5						
6							6						
7							7						
8							8						
9							9						
10							10						
11							11						
12							12						
13							13						
14							14						
15							15						
16							16						
17							17						
18							18						
19							19						
20							20						
21							21						
22							22						
23							23						
24							24						
25							25						

SIDE 2

SOUTH	Tasp	Sago	Saex	Pofr	Snag	Otsp **	WEST	Tasp	Sago	Saex	Pofr	Snag	Otsp **
1							1						
2							2						
3							3						
4							4						
5							5						
6							6						
7							7						
8							8						
9							9						
10							10						
11							11						
12							12						
13							13						
14							14						
15							15						
16							16						
17							17						
18							18						
19							19						
20							20						
21							21						
22							22						
23							23						
24							24						
25							25						

Record hits on pole (within 10 cm radius) per 0.1 m intervals up to 8 m; above 8 m, estimate > or < 5 hits per interval.

**** Other species (common name)** _____

SWFL Microclimate Data Sheet **LOCATION IDENTIFIER** _____–_____–_____

UTM coordinates: Easting (x) 0__ __ __ __ __ __ __ **Northing (y)** __ __ __ __ __ __ __ __
Dominant habitat within 10 m: Cottonwood/Willow Tamarisk Mixed Native/Exotic Other (specify:)
Estimated canopy cover at the sensor array: Less than 25% 25%-75% More than 75%

Temperature/Relative Humidity (T/RH)

Set-up: Date (MM/DD/YY):_____ Time (military):_____ Crew member(s)_____
Logger 6-digit serial number (e.g., #630863):_____ Was red LED checked at set-up? Y or N
If NOT a nest site, what is the randomization sequence used? Sequence #: _____
Column 1: _____ Column 2: _____ Column 3:_____ Column 4:_____ Column 5: _____
If nest site, when was nest vacated (known or estimated; MM/DD/YY)? _____
Logger location: Tree Shrub Est. overall height of tree or shrub? _____ m Est. height of logger _____ m

Take-down: Date (MM/DD/YY):_____ Time (military):_____ Crew member(s):_____
Did any events occur that might have interfered with accuracy of data gathered by this logger (e.g., array blown out of tree, etc.)? No Yes If yes, explain:

Soil Moisture (SM) – Seasonal Variation (SV)

Set-up: Date (MM/DD/YY):_____ Time (military):_____ Crew member(s)_____
6-digit sensor serial number: _____ 6-digit logger serial number: _____
Soil sample taken (at set-up only)? Yes No If no, explain:

Dates sensor function was checked (approx. 10-day intervals): _____ _____ _____ _____
_____ _____ _____ _____ _____ _____ _____ _____

Take-down: Date (MM/DD/YY):_____ Time (military):_____ Crew member(s):_____
Did any event (e.g., unexpected flood, dug up by animal, vandalism) occur that might have influenced the accuracy of the soil moisture data gathered by this sensor? Yes No If yes, explain:

Was site inundated/saturated at time when soil moisture array was taken down? Yes No
If yes, indicate depth of water: SAT <5 cm 5-15 cm 15-50 cm >50 cm

Soil Moisture (SM) – Nest Site (NS), Within Territory (WT), and Non-use (NU)

Set-up: Date (MM/DD/YY):_____ Time (military):_____ Crew member(s)_____
6-digit sensor serial number: _____ logger number: _____
Soil sample taken (at set-up only)? Yes No If no, explain:
SM readings: Plot center _____
North: 0.5 m _____ 1.0 m _____ 1.5 m _____ 2.0 m _____
East: 0.5 m _____ 1.0 m _____ 1.5 m _____ 2.0 m _____
South: 0.5 m _____ 1.0 m _____ 1.5 m _____ 2.0 m _____
West: 0.5 m _____ 1.0 m _____ 1.5 m _____ 2.0 m _____
Distance to saturated/inundated soil: _____ m

Take-down: Date (MM/DD/YY):_____ Time (military):_____ Crew member(s):_____
6-digit sensor serial number: _____ logger number: _____
SM readings: Plot center _____
North: 0.5 m _____ 1.0 m _____ 1.5 m _____ 2.0 m _____
East: 0.5 m _____ 1.0 m _____ 1.5 m _____ 2.0 m _____
South: 0.5 m _____ 1.0 m _____ 1.5 m _____ 2.0 m _____
West: 0.5 m _____ 1.0 m _____ 1.5 m _____ 2.0 m _____
Distance to saturated/inundated soil: _____ m

Location identifier format: Study area code (MW, MM, PA, TM) – Location code (NS, WT, SU, SVR, SVD) – Nest number (for NS, WT, SU locations) or Seasonal Variation number; e.g., TM-SU-9A or MM-SVD-2
SAT decision rule: A 1-cm-deep trench created with a stick fills with water or unstable mud in less than one minute.

APPENDIX B

Orthophotos Showing Study Sites

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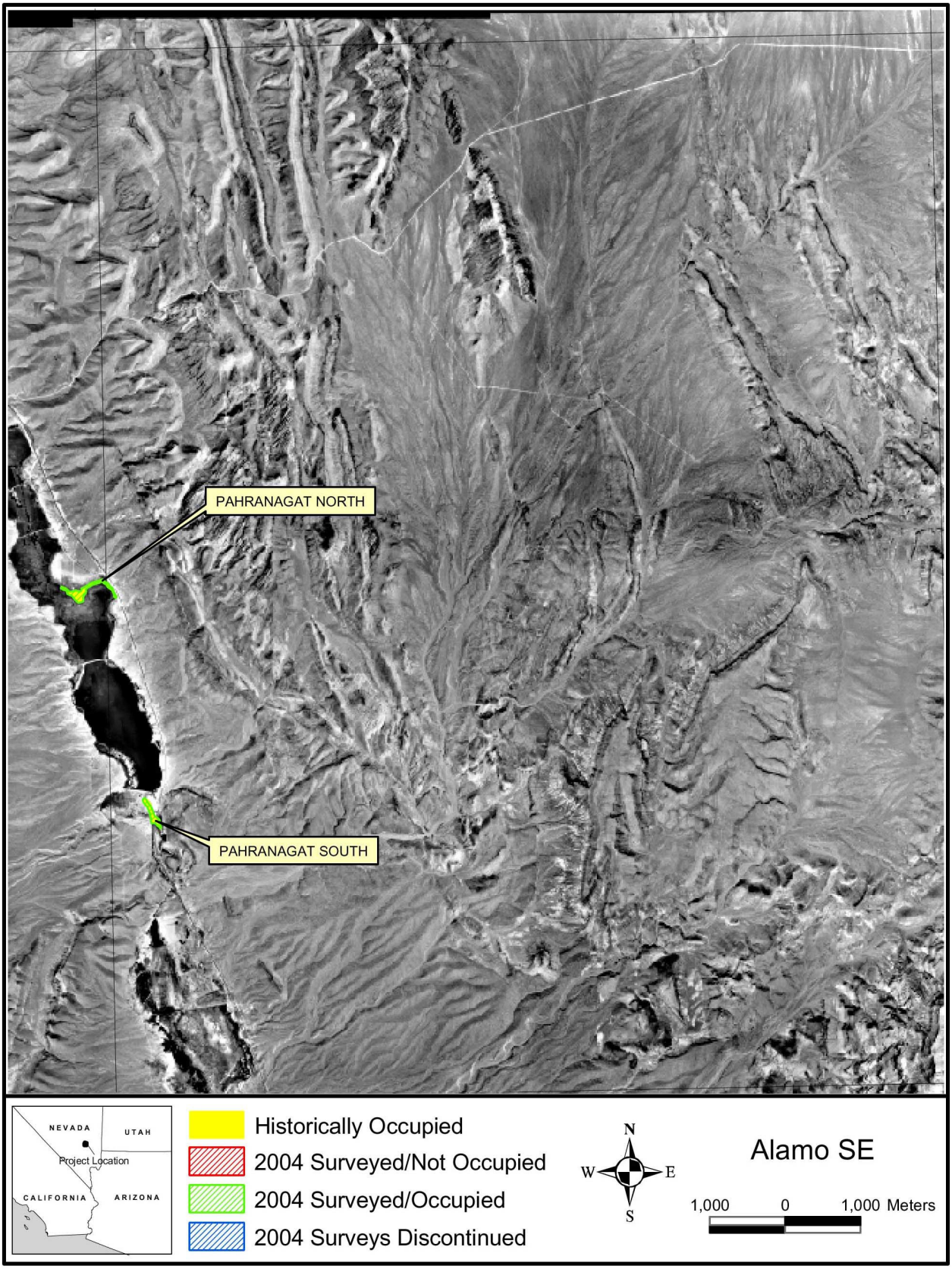
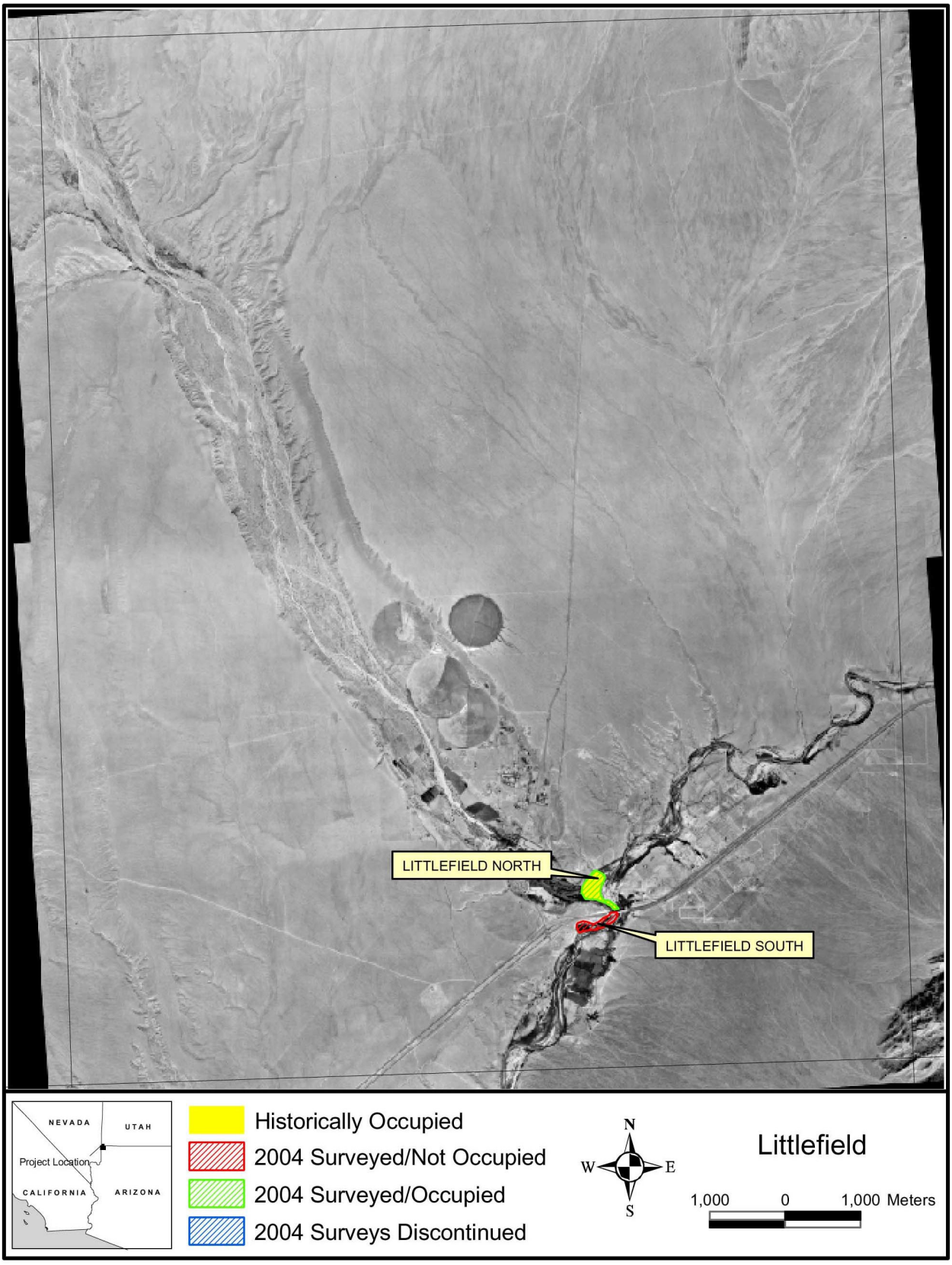
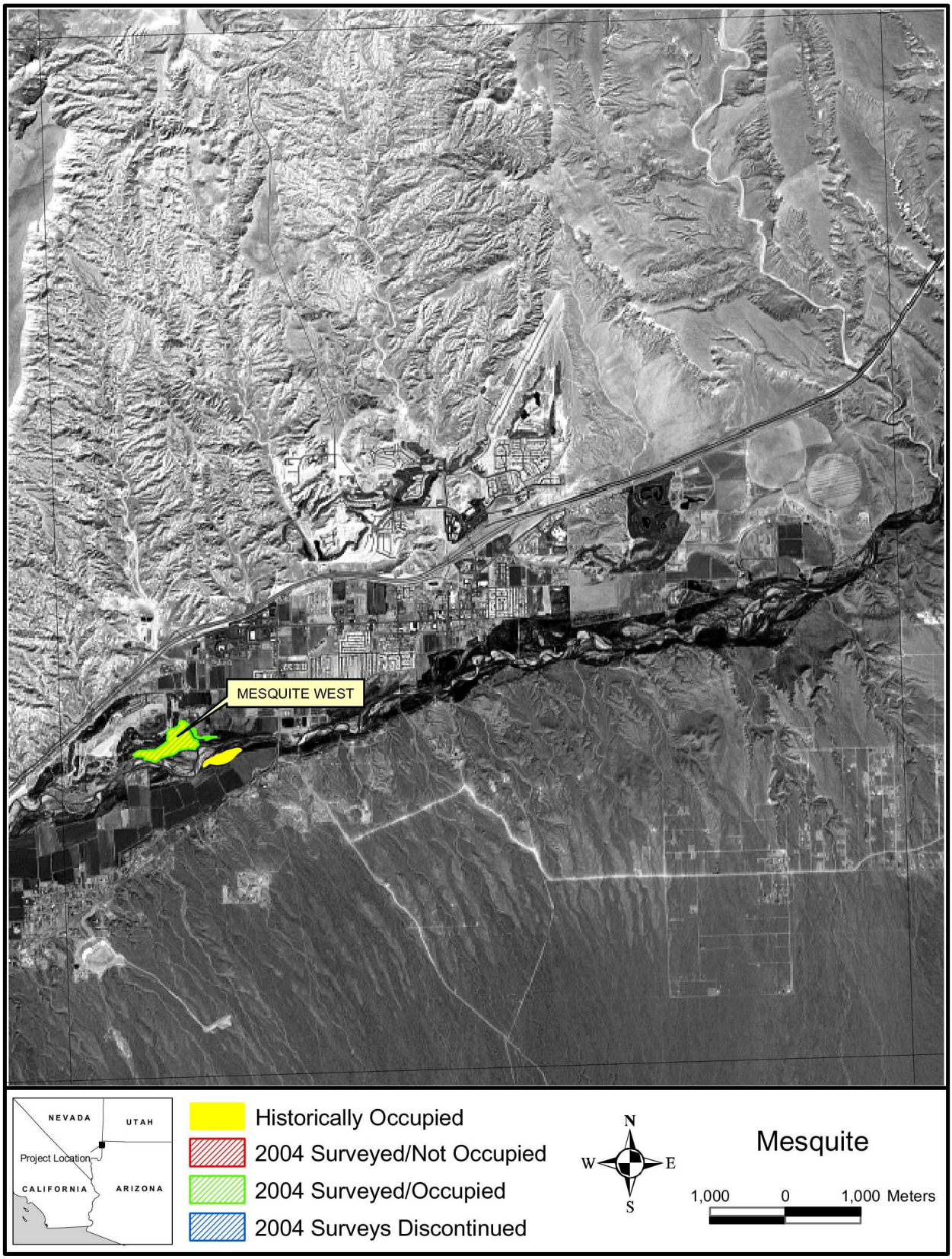
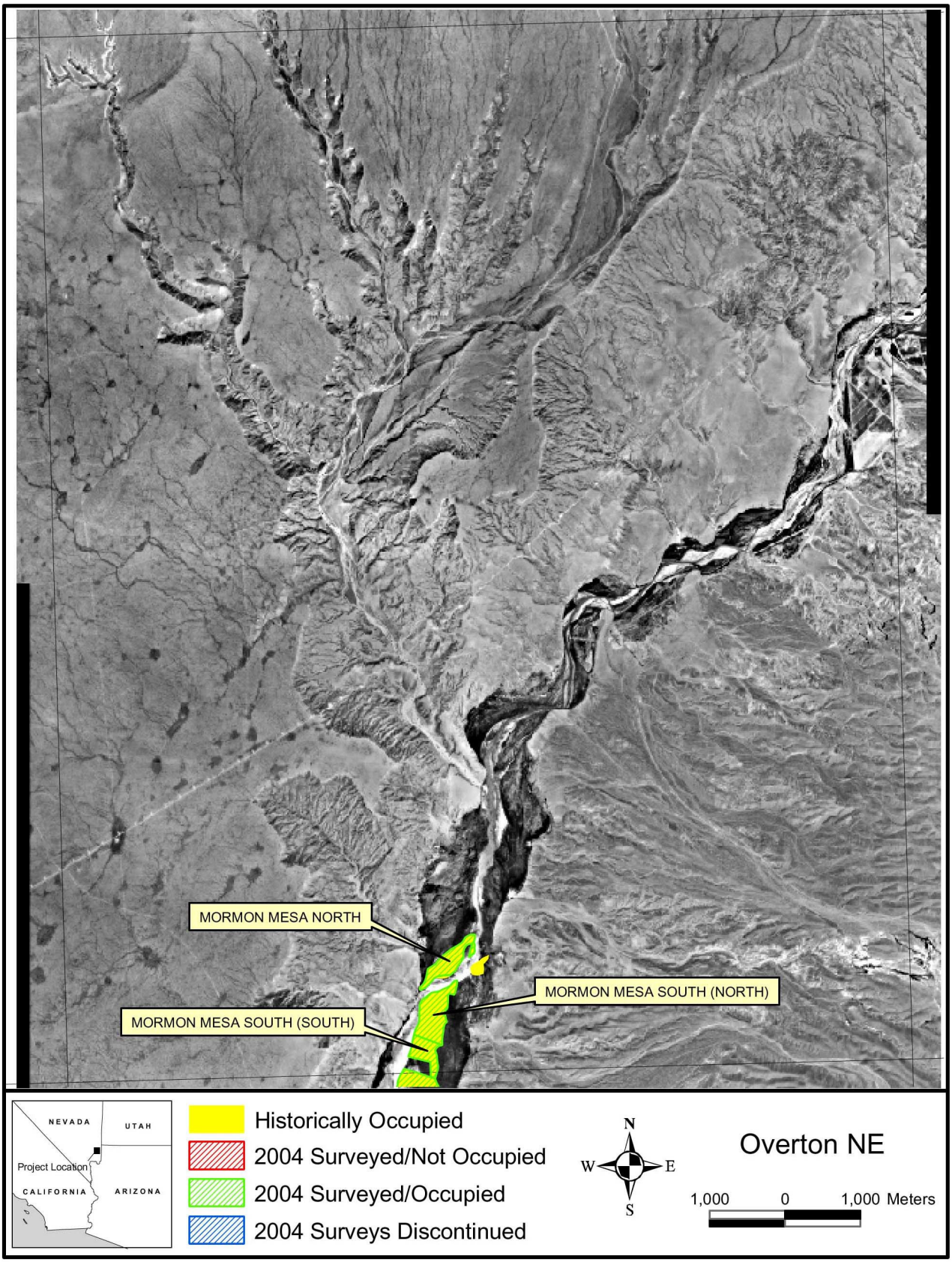
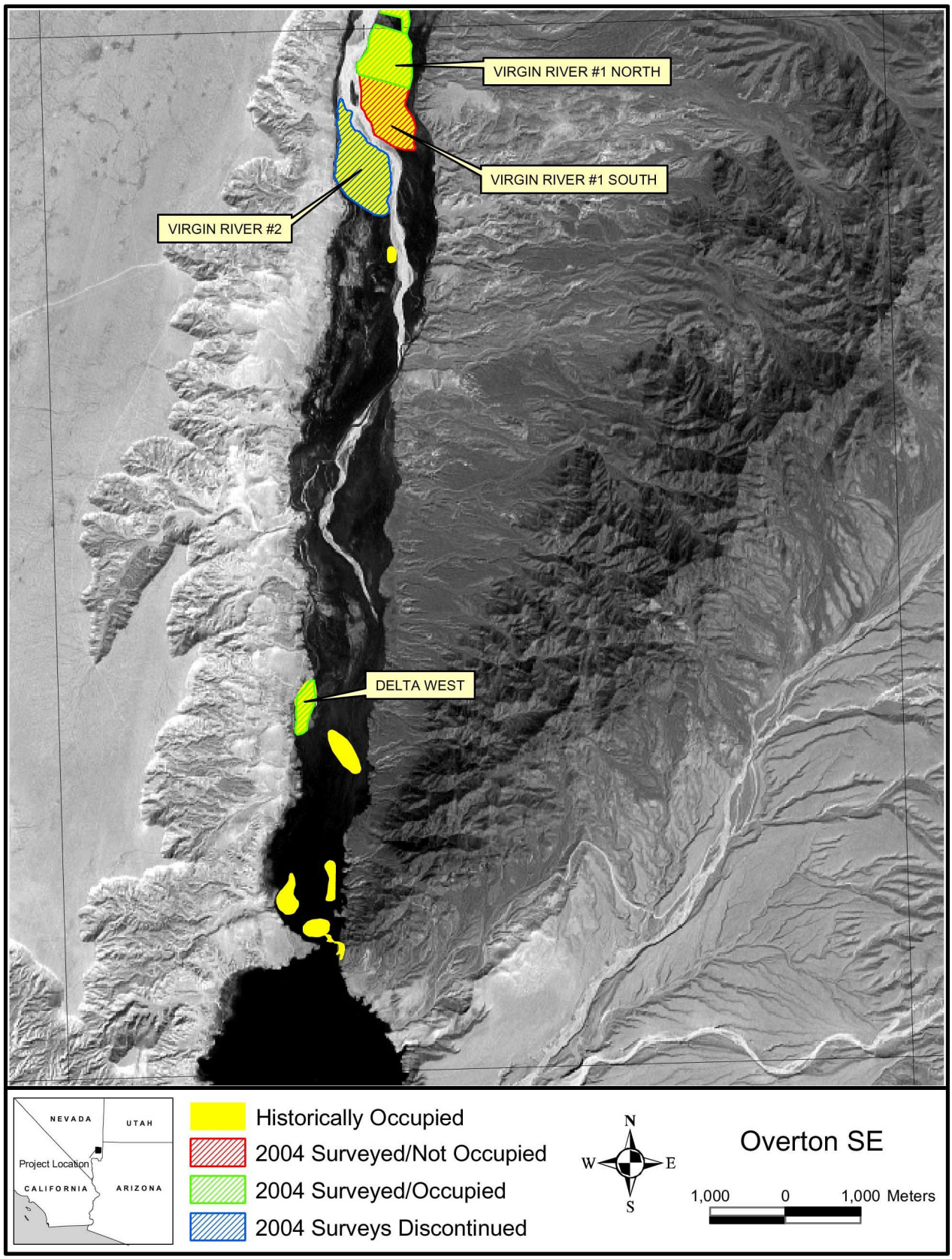
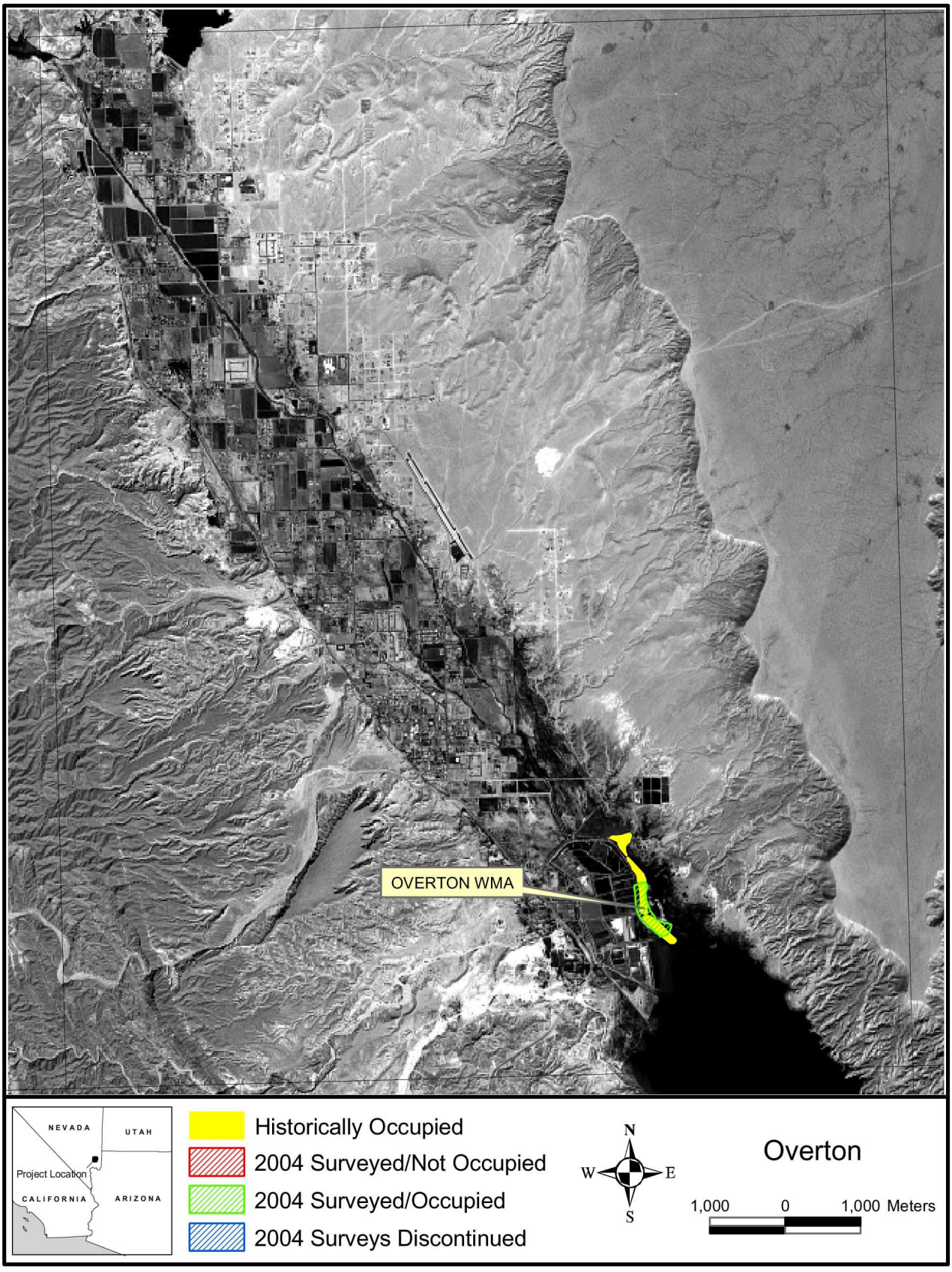

PAHRANAGAT NORTH
PAHRANAGAT SOUTH
NEVADA
UTAH
Project Location
CALIFORNIA
ARIZONA
Historically Occupied
2004 Surveyed/Not Occupied
2004 Surveyed/Occupied
2004 Surveys Discontinued
N
W
E
S
Alamo SE
1,000
0
1,000 Meters

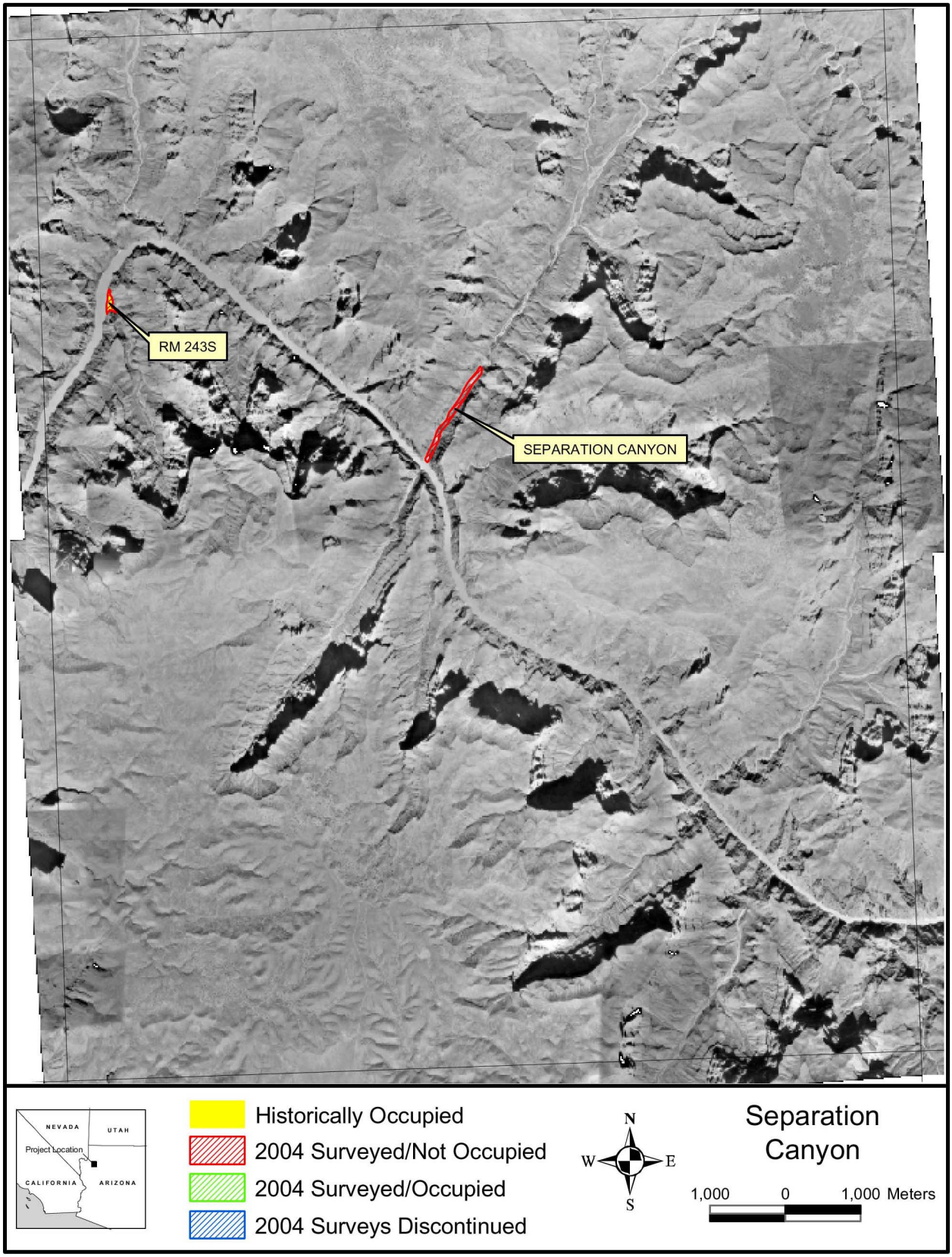

LITTLEFIELD NORTH
LITTLEFIELD SOUTH
NEVADA
UTAH
Project Location
CALIFORNIA
ARIZONA
Historically Occupied
2004 Surveyed/Not Occupied
2004 Surveyed/Occupied
2004 Surveys Discontinued
N
W
E
S
Littlefield
1,000
0
1,000 Meters

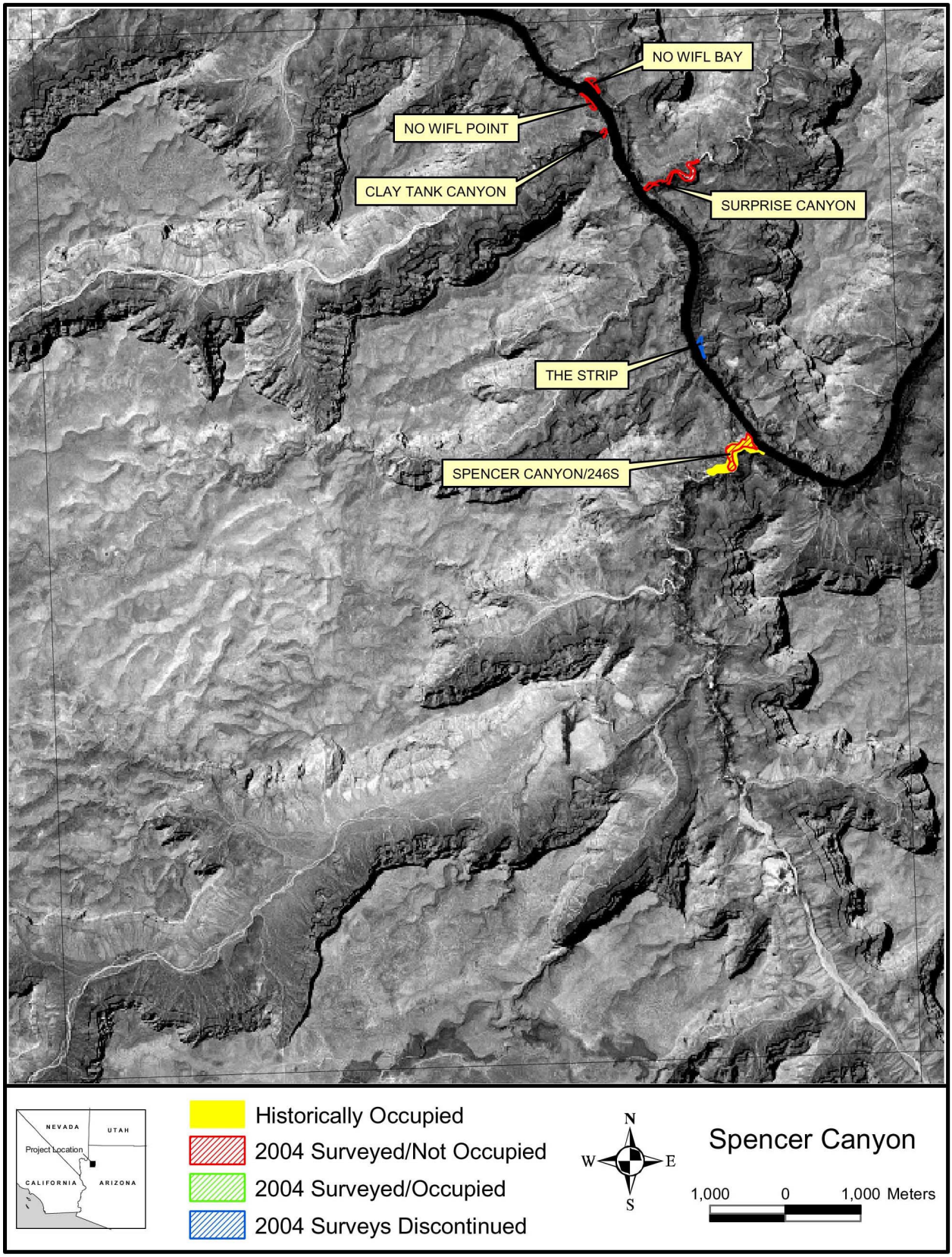

MESQUITE WEST
NEVADA
UTAH
Project Location
CALIFORNIA
ARIZONA
Historically Occupied
2004 Surveyed/Not Occupied
2004 Surveyed/Occupied
2004 Surveys Discontinued
N
W
E
S
Mesquite
1,000
0
1,000 Meters

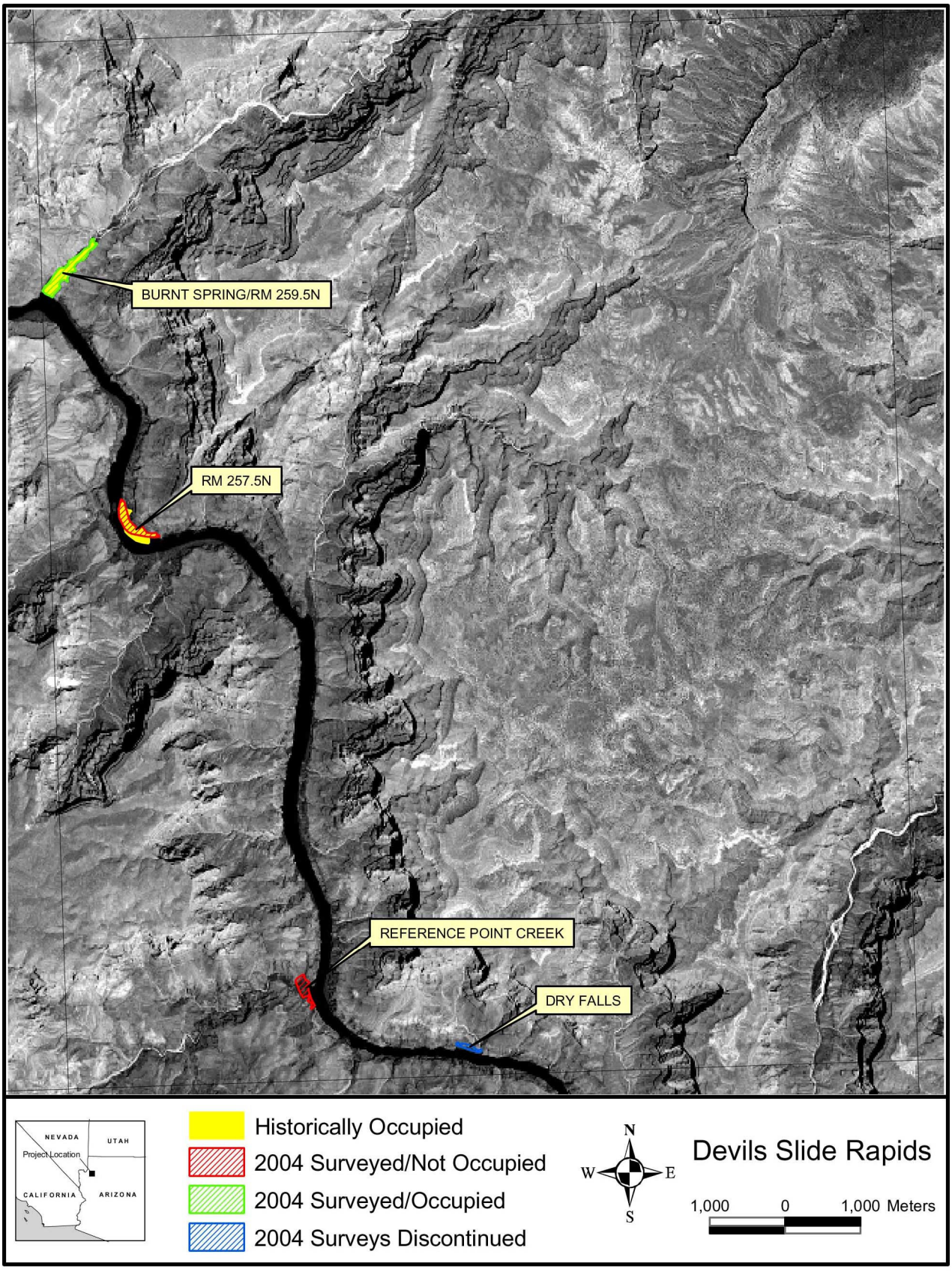

MORMON MESA NORTH
MORMON MESA SOUTH (NORTH)
MORMON MESA SOUTH (SOUTH)
NEVADA
UTAH
Project Location
CALIFORNIA
ARIZONA
Historically Occupied
2004 Surveyed/Not Occupied
2004 Surveyed/Occupied
2004 Surveys Discontinued
N
W
E
S
Overton NE
1,000 0 1,000 Meters

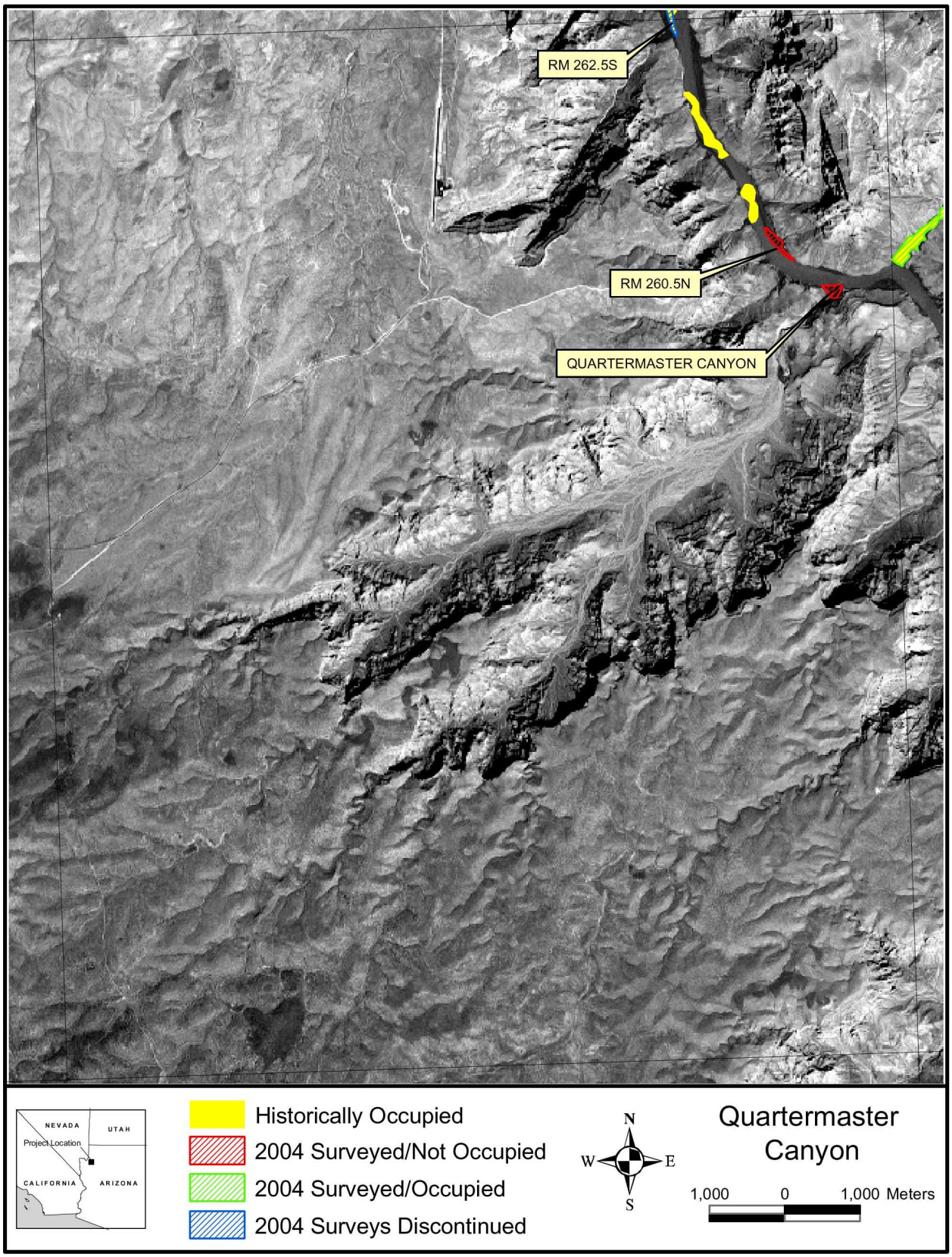

VIRGIN RIVER #1 NORTH
VIRGIN RIVER #1 SOUTH
VIRGIN RIVER #2
DELTA WEST
NEVADA
UTAH
Project Location
CALIFORNIA
ARIZONA
Historically Occupied
2004 Surveyed/Not Occupied
2004 Surveyed/Occupied
2004 Surveys Discontinued
N
W
E
S
Overton SE
1,000 0 1,000 Meters

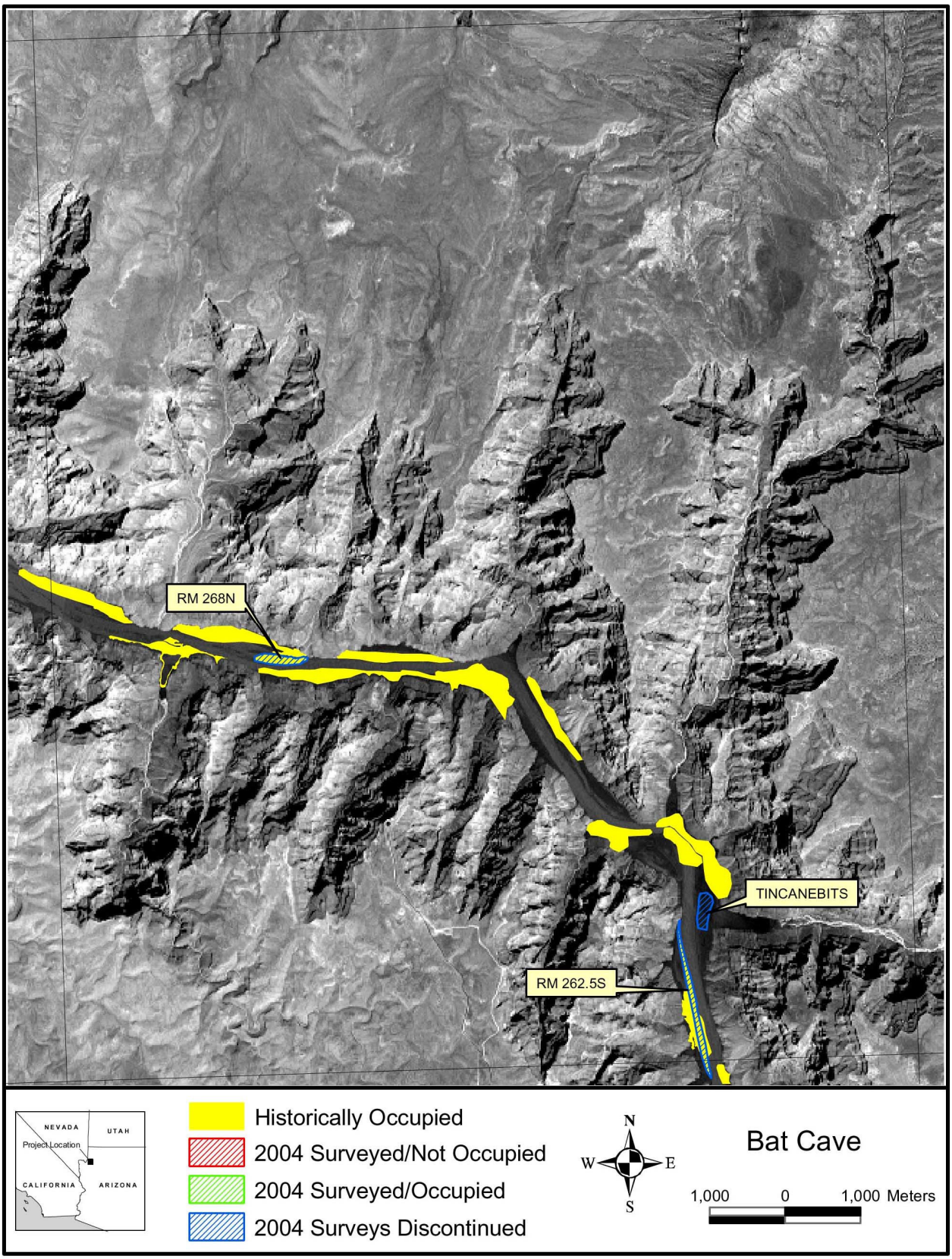

OVERTON WMA
NEVADA
UTAH
Project Location
CALIFORNIA
ARIZONA
Historically Occupied
2004 Surveyed/Not Occupied
2004 Surveyed/Occupied
2004 Surveys Discontinued
N
W
E
S
Overton
1,000
0
1,000 Meters

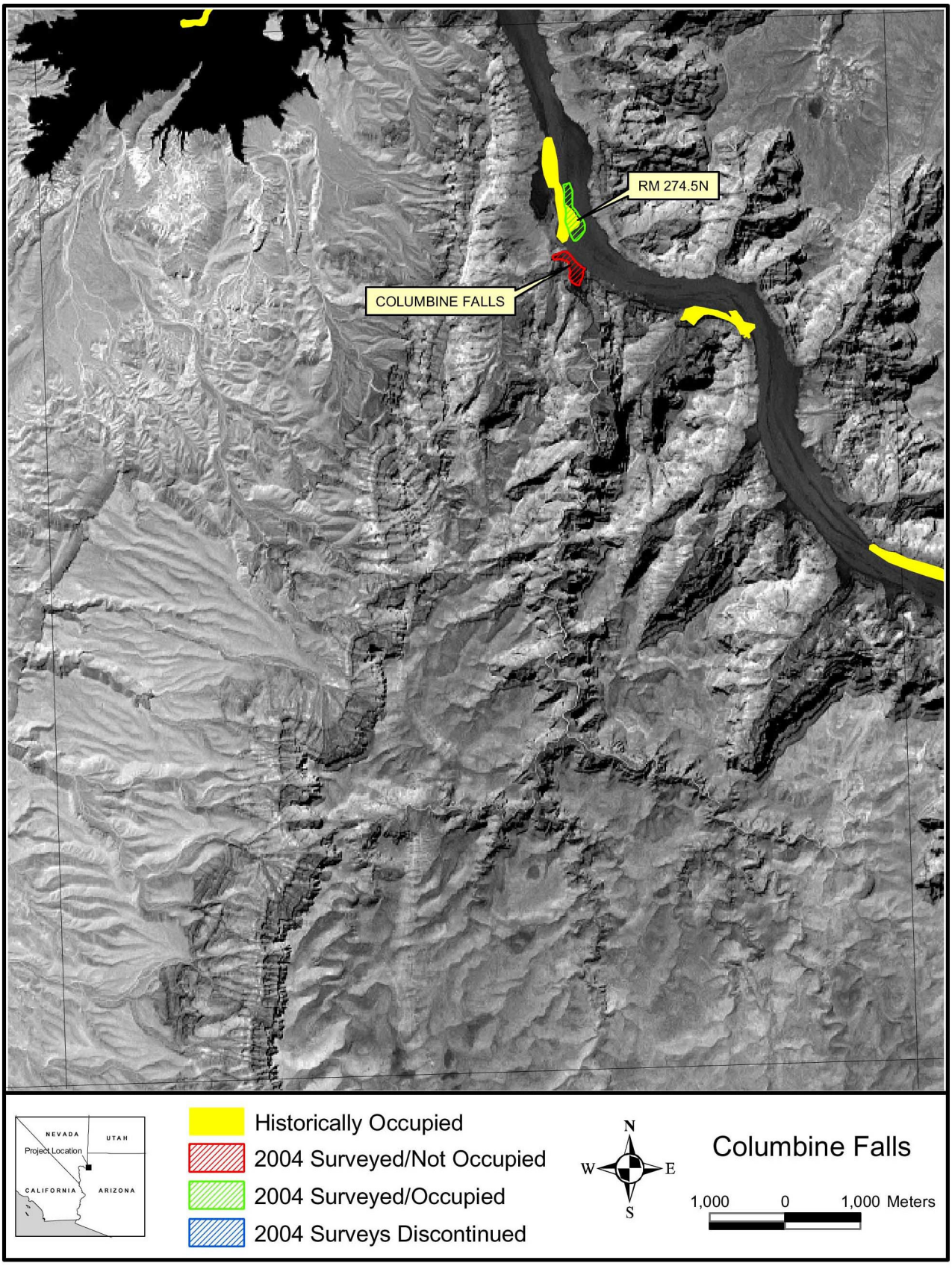

RM 243S
SEPARATION CANYON
NEVADA
UTAH
Project Location
CALIFORNIA
ARIZONA
Historically Occupied
2004 Surveyed/Not Occupied
2004 Surveyed/Occupied
2004 Surveys Discontinued
N
W
E
S
Separation Canyon
1,000 0 1,000 Meters

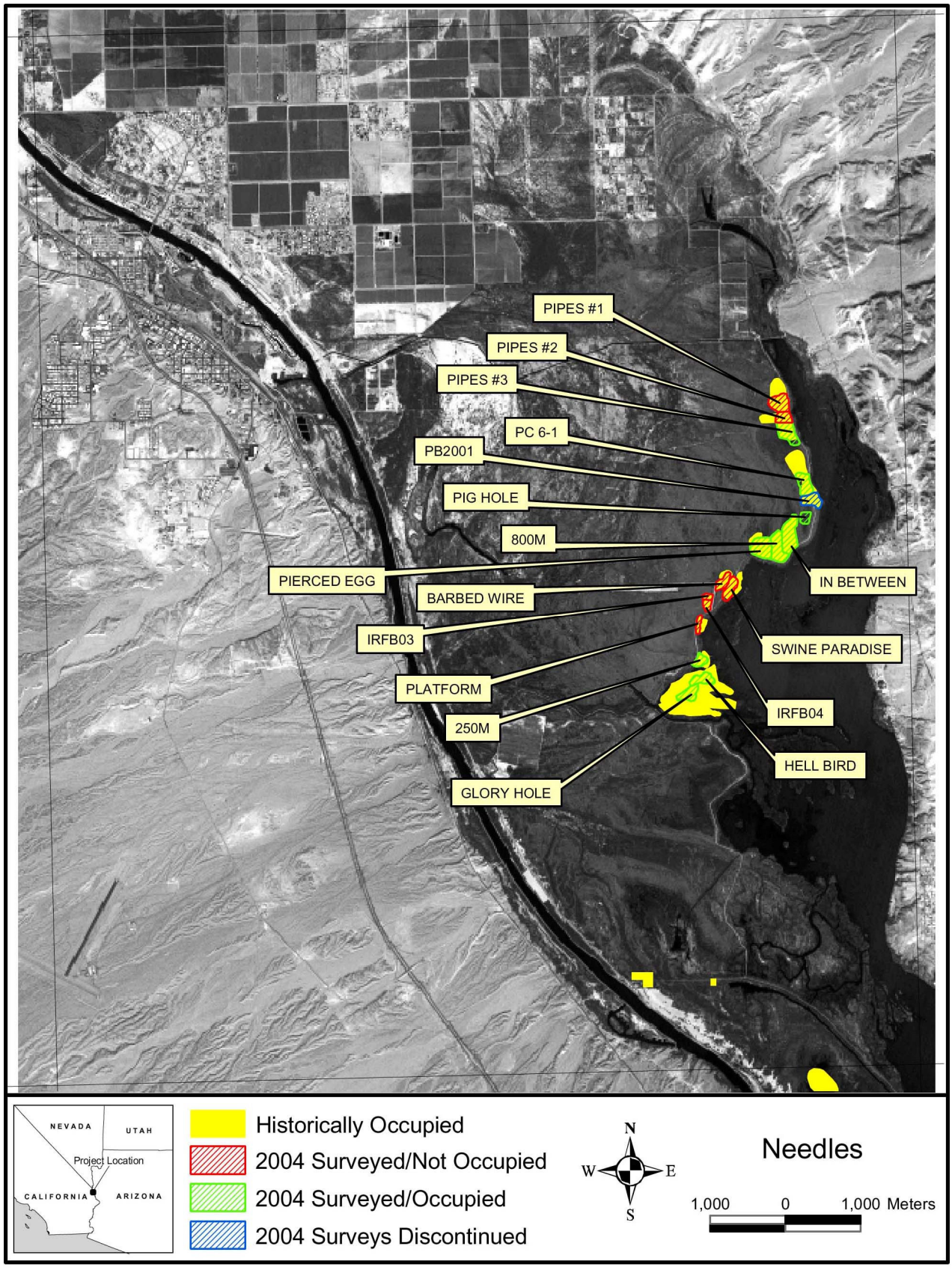

NO WIFL BAY
NO WIFL POINT
CLAY TANK CANYON
SURPRISE CANYON
THE STRIP
SPENCER CANYON/246S
NEVADA
UTAH
Project Location
CALIFORNIA
ARIZONA
Historically Occupied
2004 Surveyed/Not Occupied
2004 Surveyed/Occupied
2004 Surveys Discontinued
N
W
E
S
Spencer Canyon
1,000
0
1,000 Meters

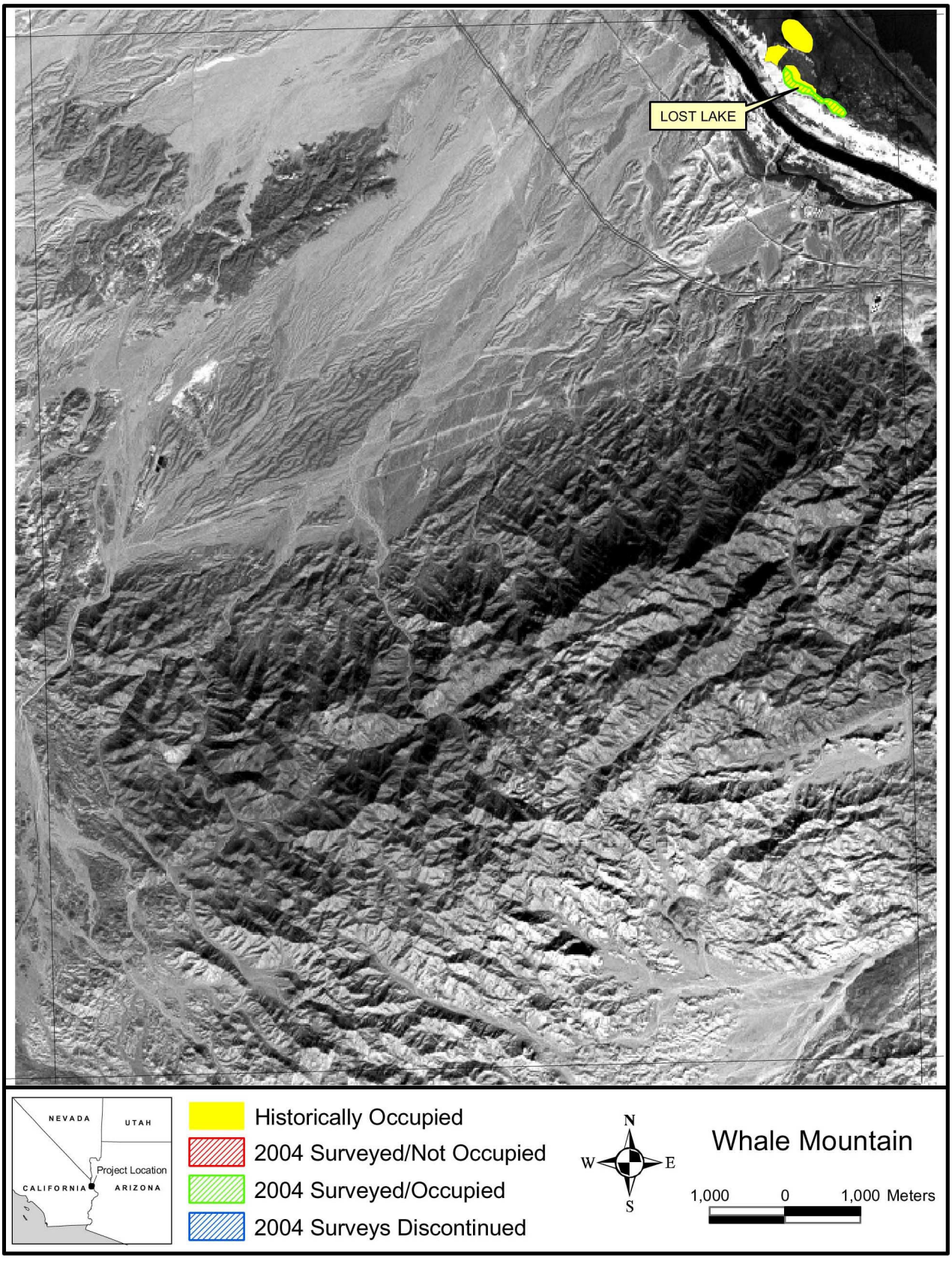

BURNT SPRING/RM 259.5N
RM 257.5N
REFERENCE POINT CREEK
DRY FALLS
NEVADA
UTAH
Project Location
CALIFORNIA
ARIZONA
Historically Occupied
2004 Surveyed/Not Occupied
2004 Surveyed/Occupied
2004 Surveys Discontinued
N
W
E
S
Devils Slide Rapids
1,000
0
1,000 Meters

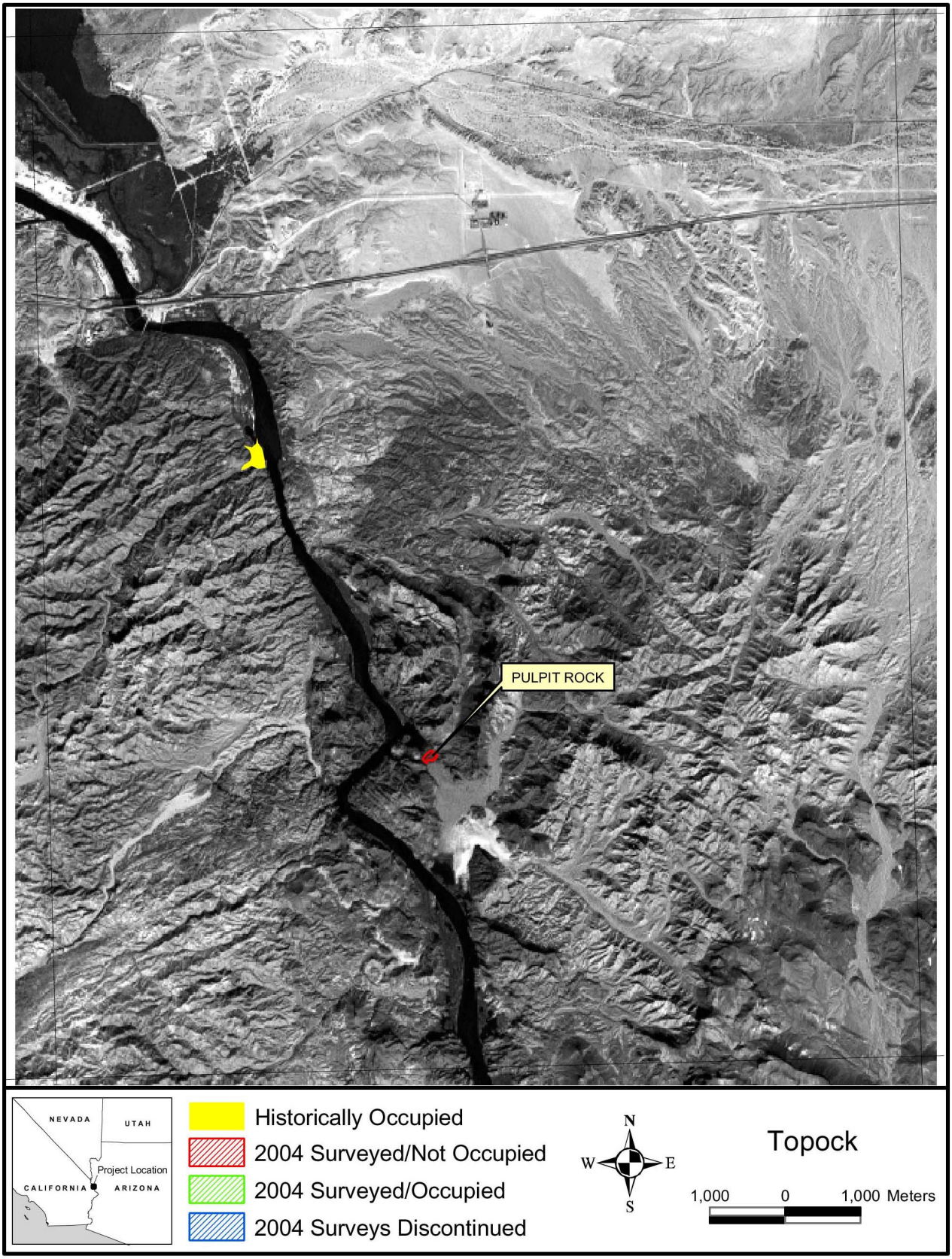

RM 262.5S
RM 260.5N
QUARTERMASTER CANYON
NEVADA
UTAH
Project Location
CALIFORNIA
ARIZONA
Historically Occupied
2004 Surveyed/Not Occupied
2004 Surveyed/Occupied
2004 Surveys Discontinued
N
W
E
S
Quartermaster Canyon
1,000 0 1,000 Meters

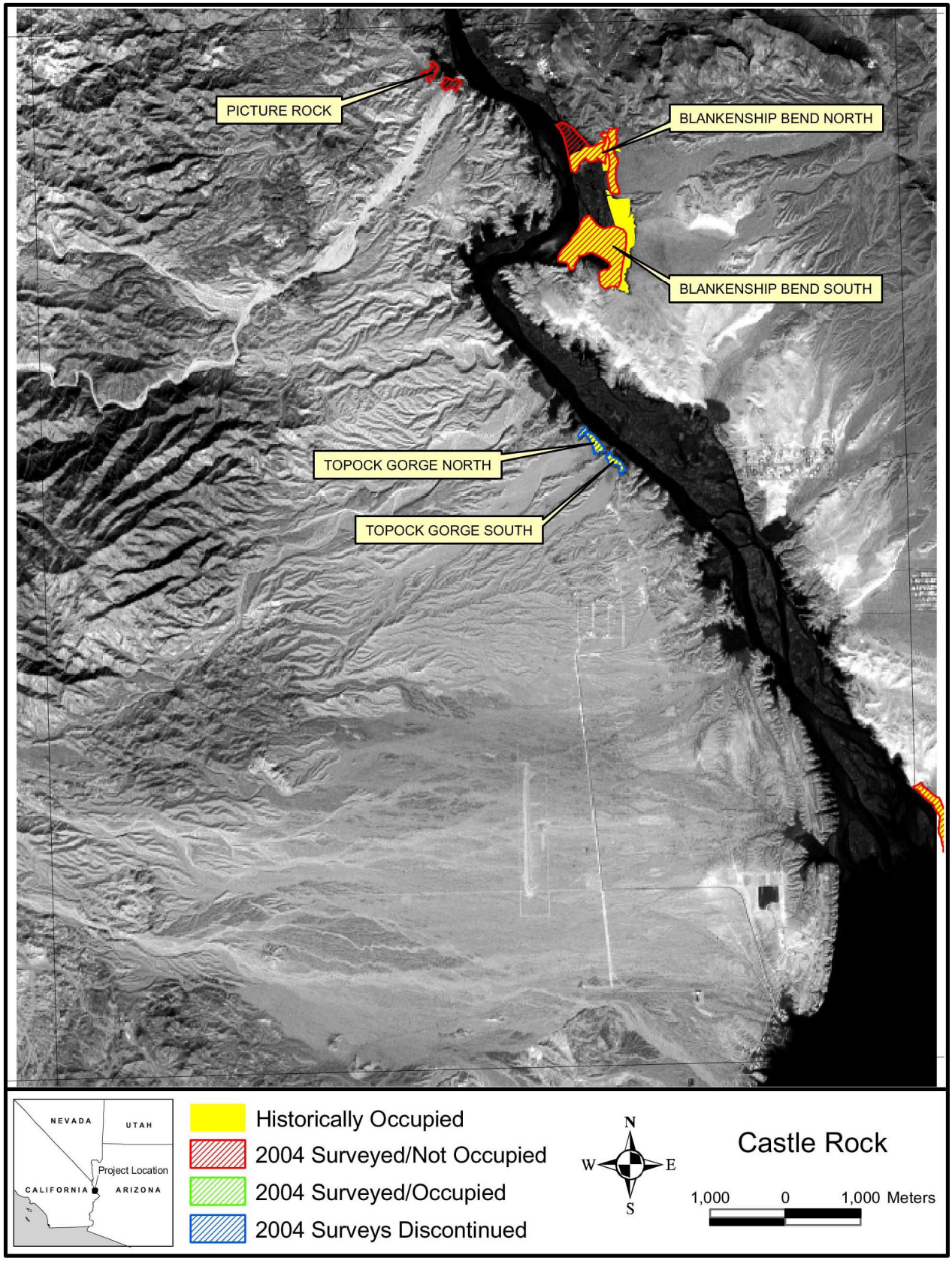

RM 268N
TINCANEBITS
RM 262.5S
NEVADA
UTAH
Project Location
CALIFORNIA
ARIZONA
Historically Occupied
2004 Surveyed/Not Occupied
2004 Surveyed/Occupied
2004 Surveys Discontinued
N
W
E
S
Bat Cave
1,000
0
1,000 Meters

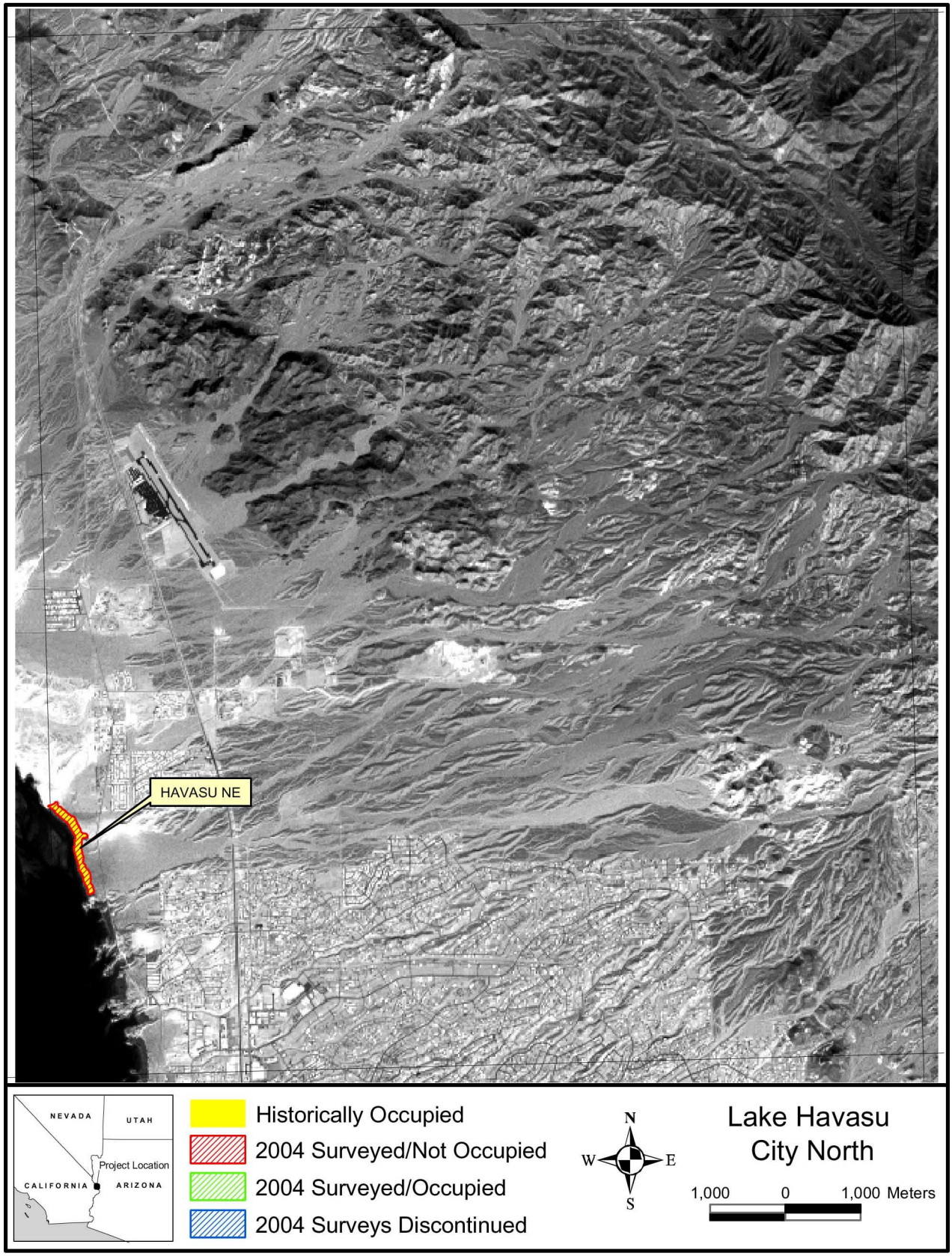

RM 274.5N
COLUMBINE FALLS
NEVADA
UTAH
Project Location
CALIFORNIA
ARIZONA
Historically Occupied
2004 Surveyed/Not Occupied
2004 Surveyed/Occupied
2004 Surveys Discontinued
N
W
E
S
Columbine Falls
1,000
0
1,000 Meters

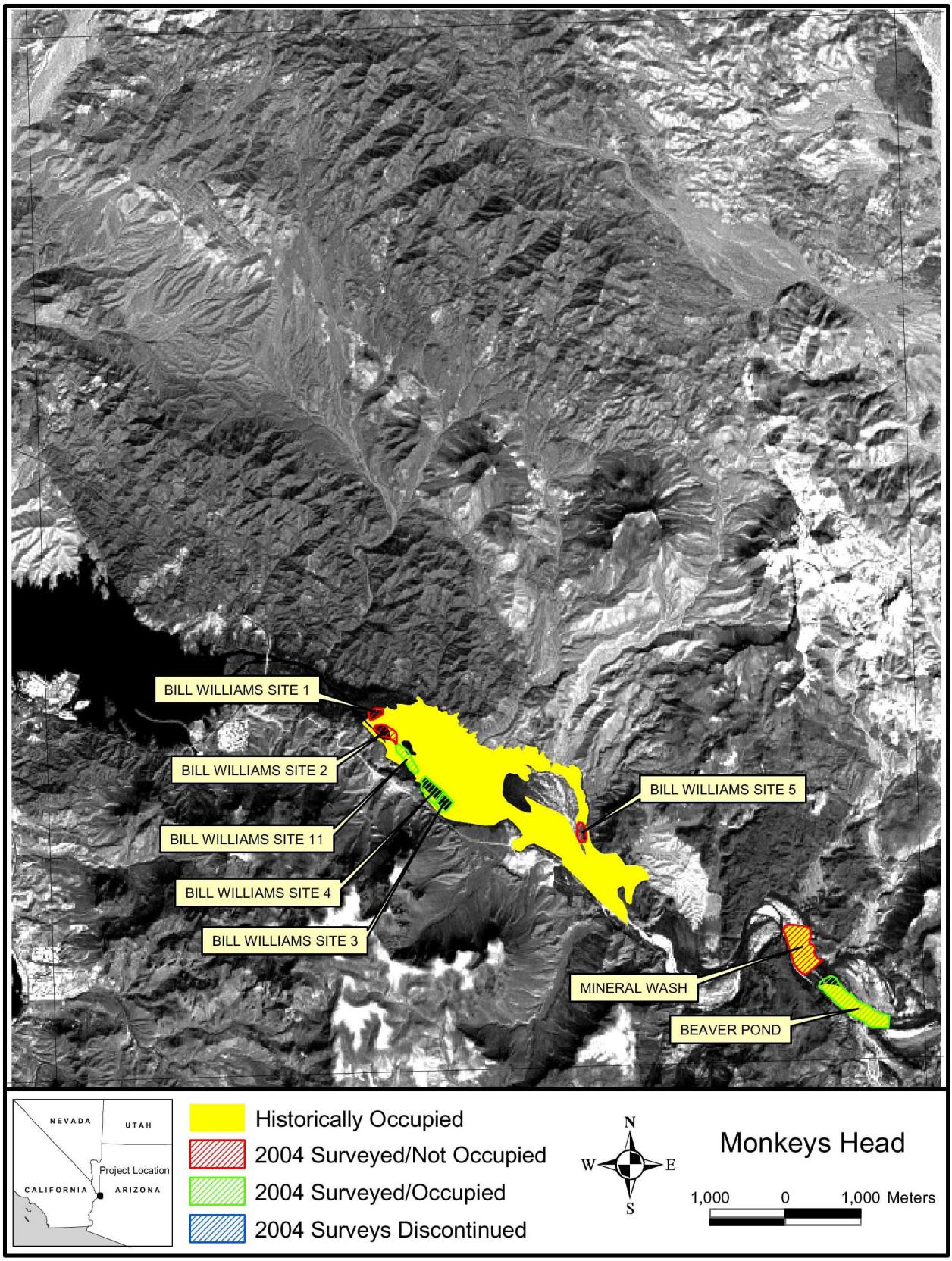

PIPES #1
PIPES #2
PIPES #3
PC 6-1
PB2001
PIG HOLE
800M
PIERCED EGG
BARBED WIRE
IRFB03
PLATFORM
250M
GLORY HOLE
IN BETWEEN
SWINE PARADISE
IRFB04
HELL BIRD
NEVADA
UTAH
Project Location
CALIFORNIA
ARIZONA
Historically Occupied
2004 Surveyed/Not Occupied
2004 Surveyed/Occupied
2004 Surveys Discontinued
N
W
E
S
Needles
1,000
0
1,000 Meters

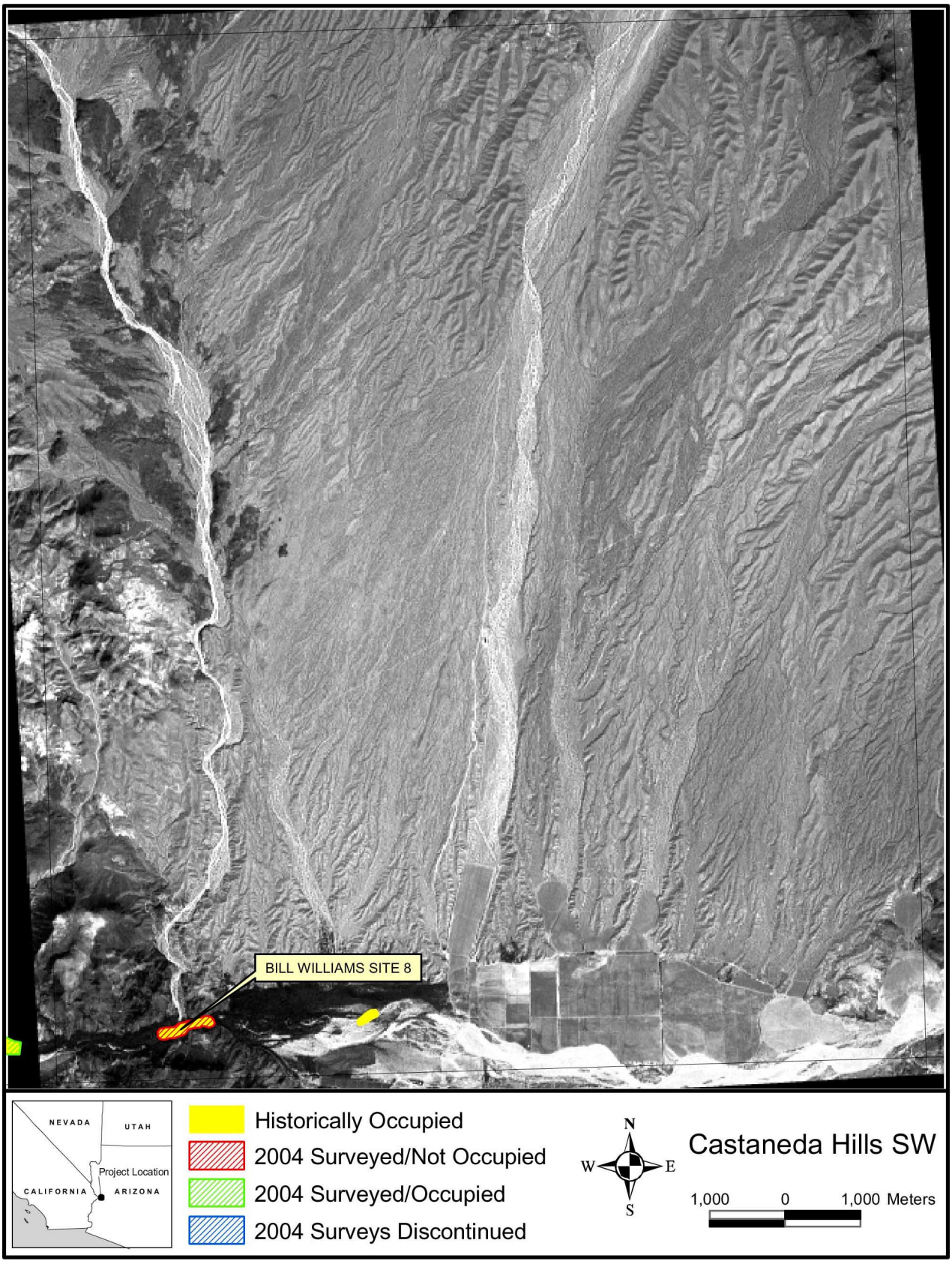

LOST LAKE
NEVADA
UTAH
Project Location
CALIFORNIA
ARIZONA
Historically Occupied
2004 Surveyed/Not Occupied
2004 Surveyed/Occupied
2004 Surveys Discontinued
N
W
E
S
Whale Mountain
1,000
0
1,000 Meters


PULPIT ROCK
NEVADA
UTAH
Project Location
CALIFORNIA
ARIZONA
Historically Occupied
2004 Surveyed/Not Occupied
2004 Surveyed/Occupied
2004 Surveys Discontinued
N
W
E
S
Topock
1,000
0
1,000 Meters

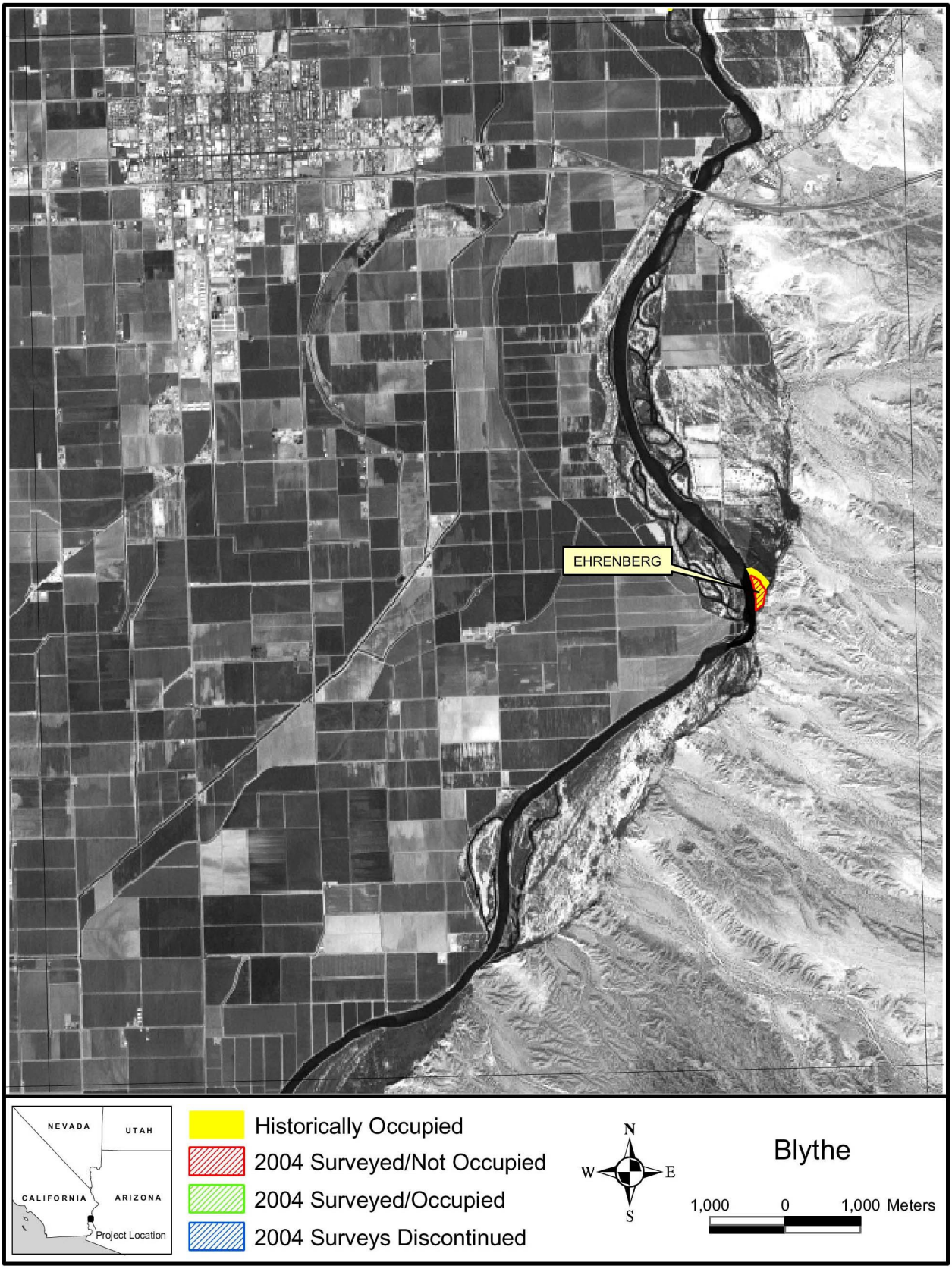

PICTURE ROCK
BLANKENSHIP BEND NORTH
BLANKENSHIP BEND SOUTH
TOPOCK GORGE NORTH
TOPOCK GORGE SOUTH
NEVADA
UTAH
Project Location
CALIFORNIA
ARIZONA
Historically Occupied
2004 Surveyed/Not Occupied
2004 Surveyed/Occupied
2004 Surveys Discontinued
N
W
E
S
Castle Rock
1,000
0
1,000 Meters

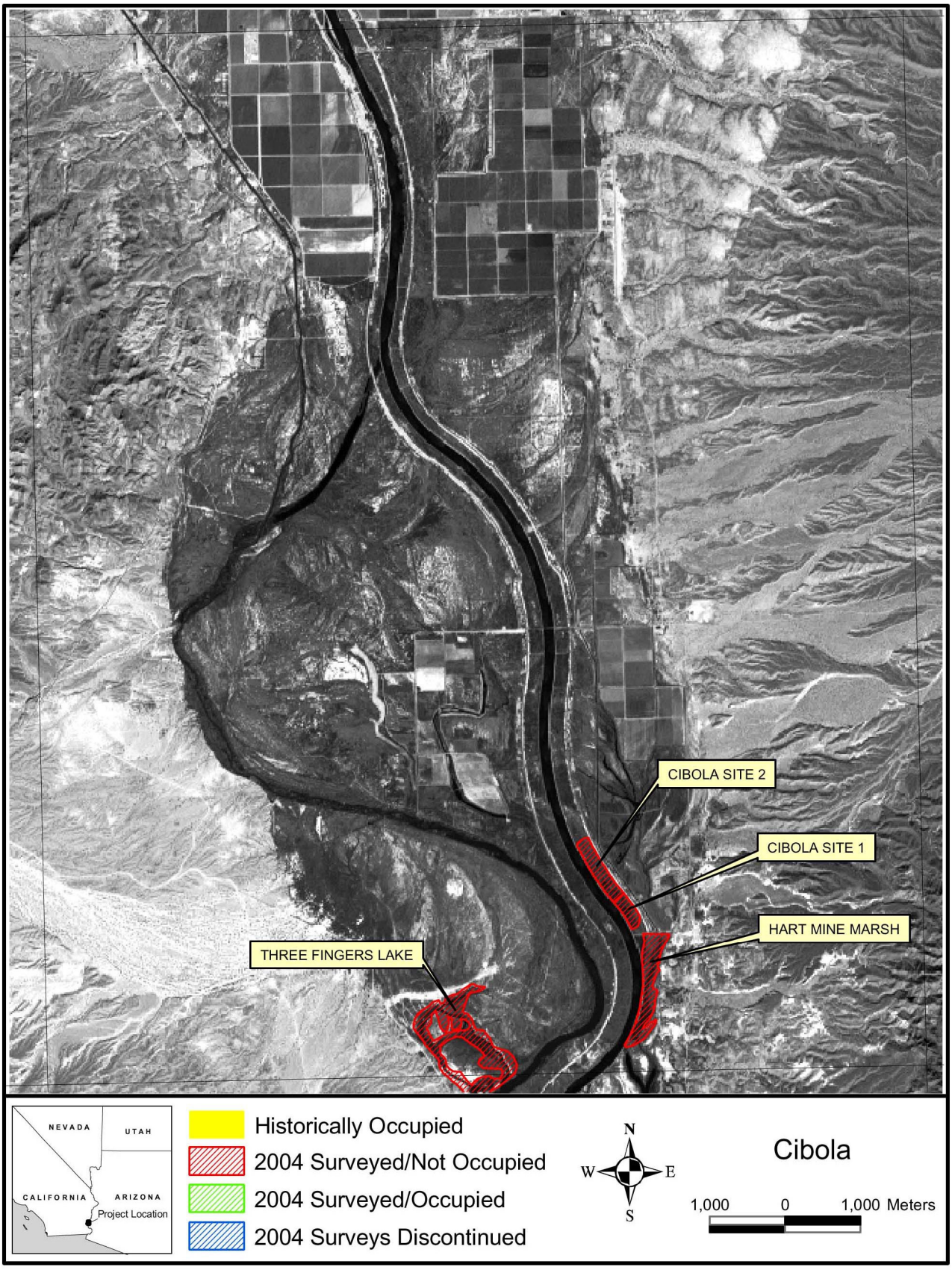

HAVASU NE
NEVADA
UTAH
Project Location
CALIFORNIA
ARIZONA
Historically Occupied
2004 Surveyed/Not Occupied
2004 Surveyed/Occupied
2004 Surveys Discontinued
N
W
E
S
Lake Havasu
City North
1,000
0
1,000 Meters

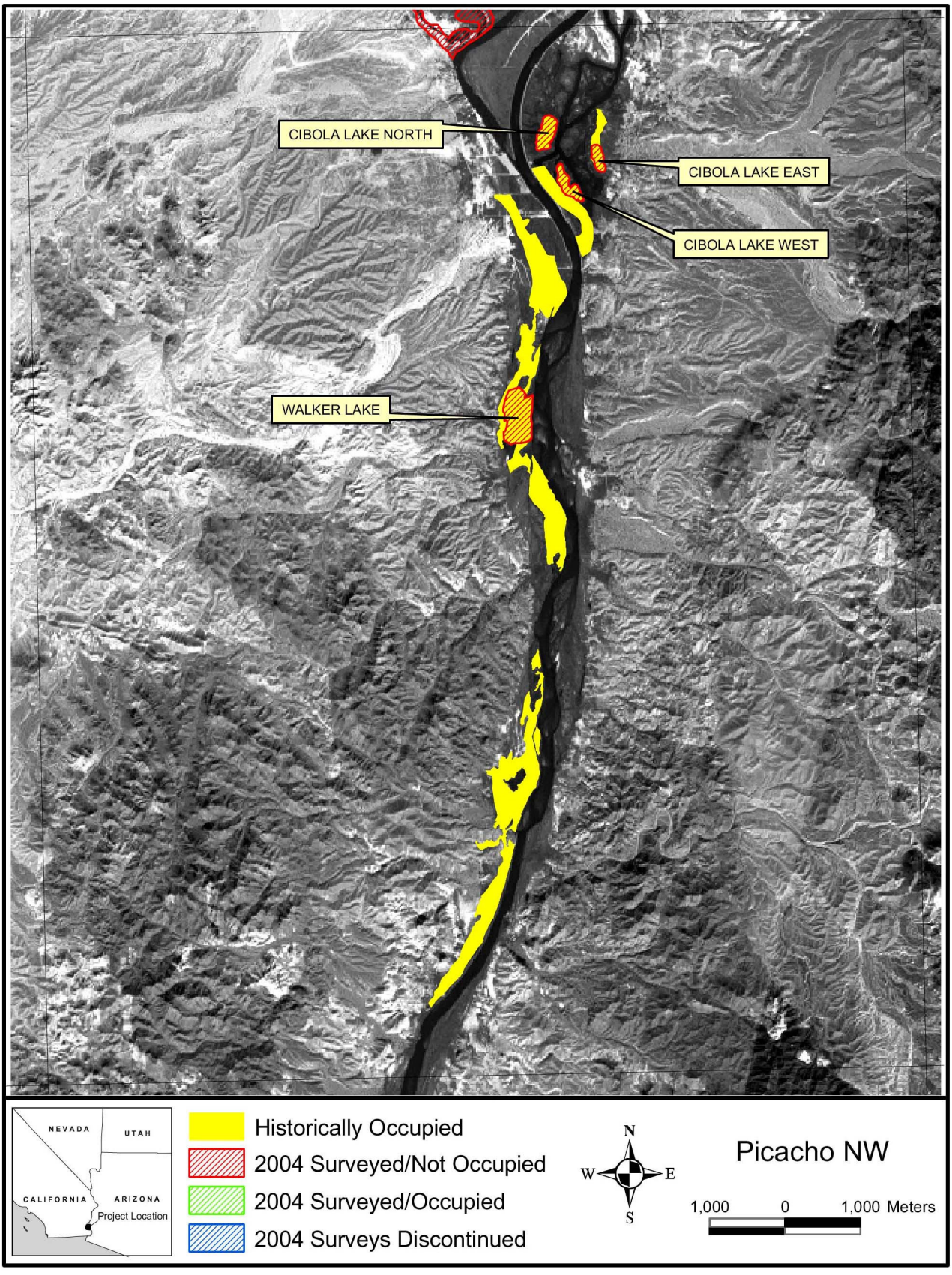

BILL WILLIAMS SITE 1
BILL WILLIAMS SITE 2
BILL WILLIAMS SITE 11
BILL WILLIAMS SITE 4
BILL WILLIAMS SITE 3
BILL WILLIAMS SITE 5
MINERAL WASH
BEAVER POND
NEVADA
UTAH
Project Location
CALIFORNIA
ARIZONA
Historically Occupied
2004 Surveyed/Not Occupied
2004 Surveyed/Occupied
2004 Surveys Discontinued
N
W
E
S
Monkeys Head
1,000
0
1,000 Meters

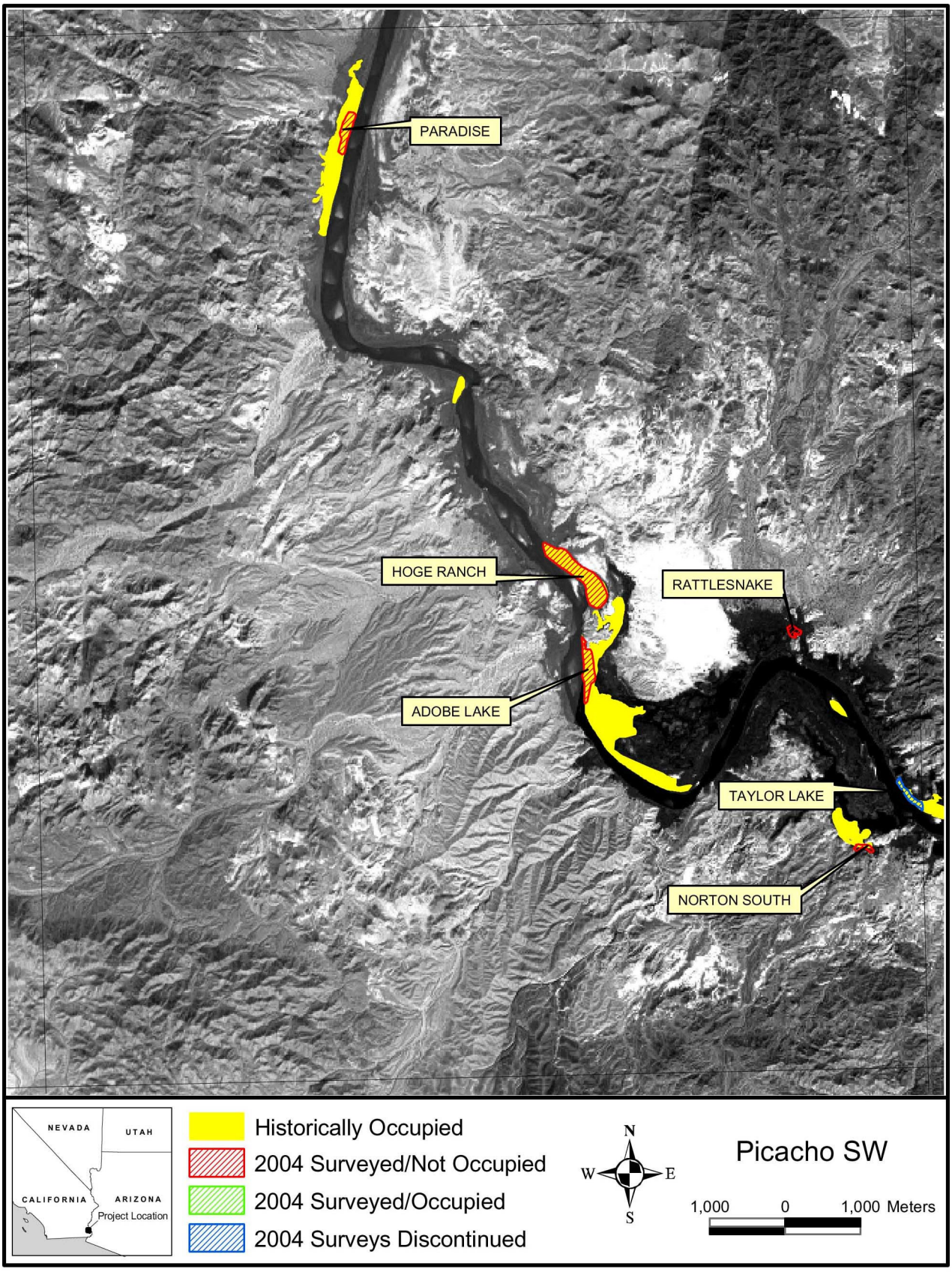

BILL WILLIAMS SITE 8
NEVADA
UTAH
Project Location
CALIFORNIA
ARIZONA
Historically Occupied
2004 Surveyed/Not Occupied
2004 Surveyed/Occupied
2004 Surveys Discontinued
N
W
E
S
Castaneda Hills SW
1,000 0 1,000 Meters

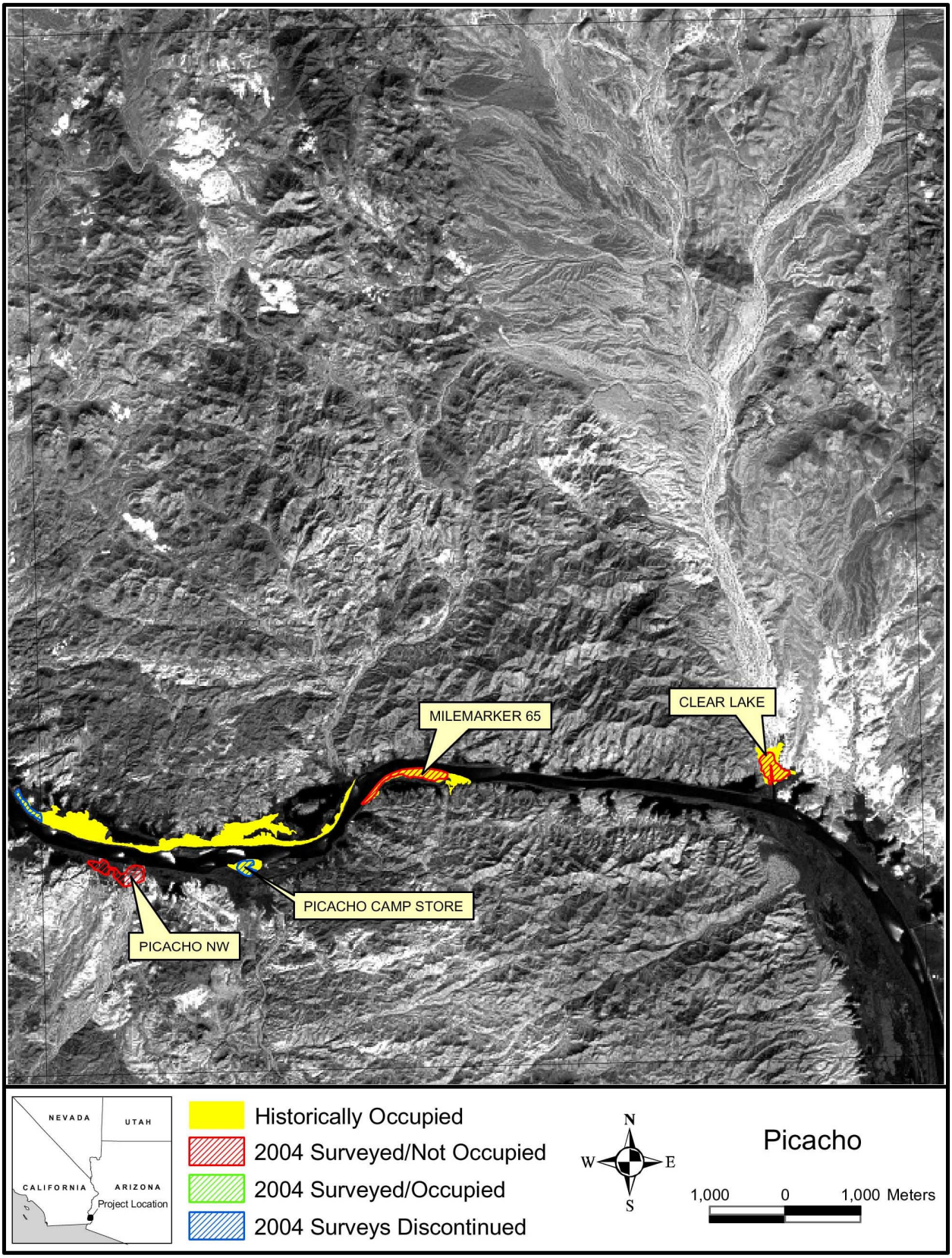

BIG HOLE SLOUGH
NEVADA
UTAH
CALIFORNIA
ARIZONA
Project Location
Historically Occupied
2004 Surveyed/Not Occupied
2004 Surveyed/Occupied
2004 Surveys Discontinued
N
W
E
S
Blythe NE
1,000
0
1,000 Meters

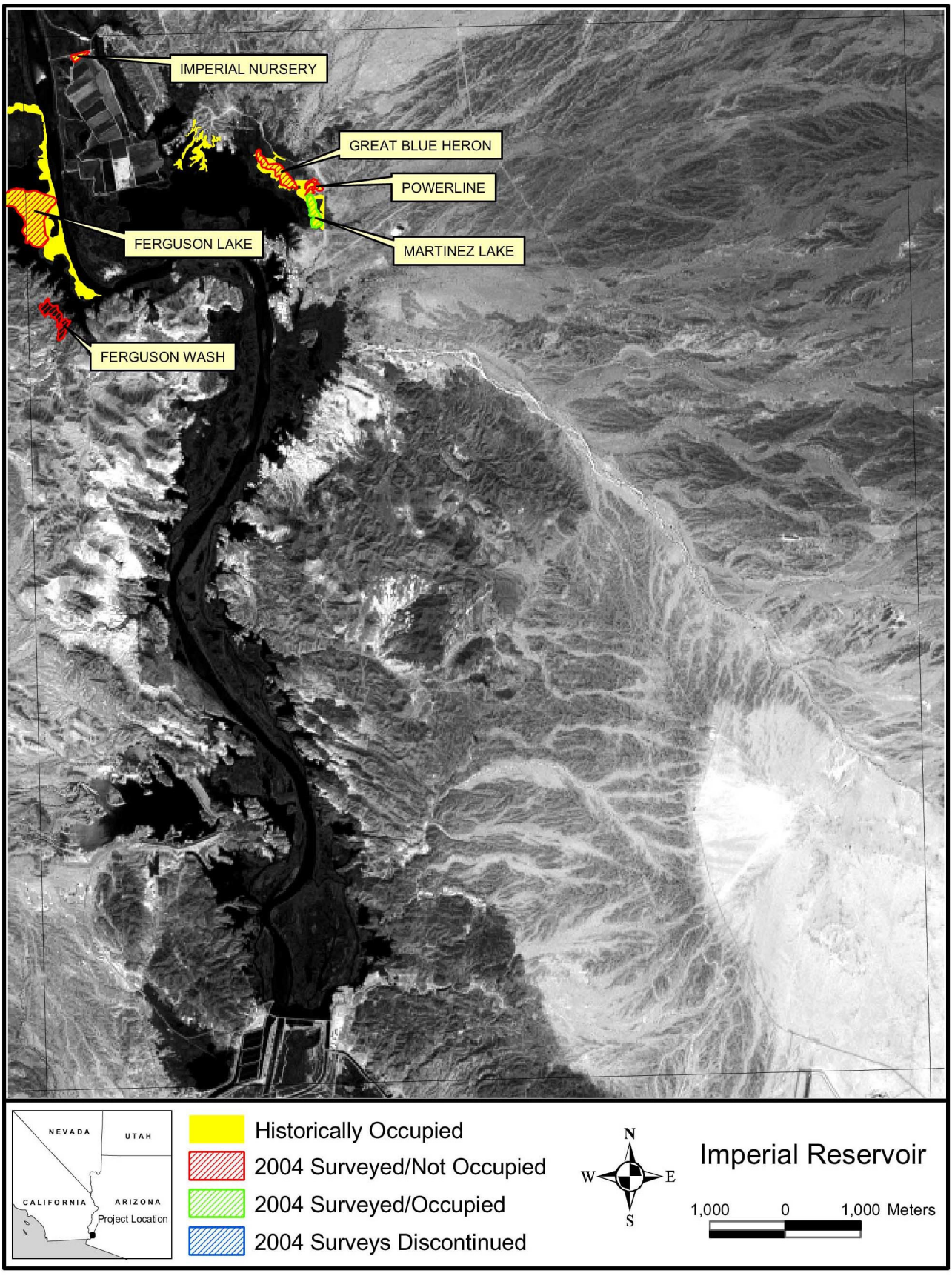

EHRENBERG
NEVADA
UTAH
CALIFORNIA
ARIZONA
Project Location
Historically Occupied
2004 Surveyed/Not Occupied
2004 Surveyed/Occupied
2004 Surveys Discontinued
N
W
E
S
Blythe
1,000
0
1,000 Meters

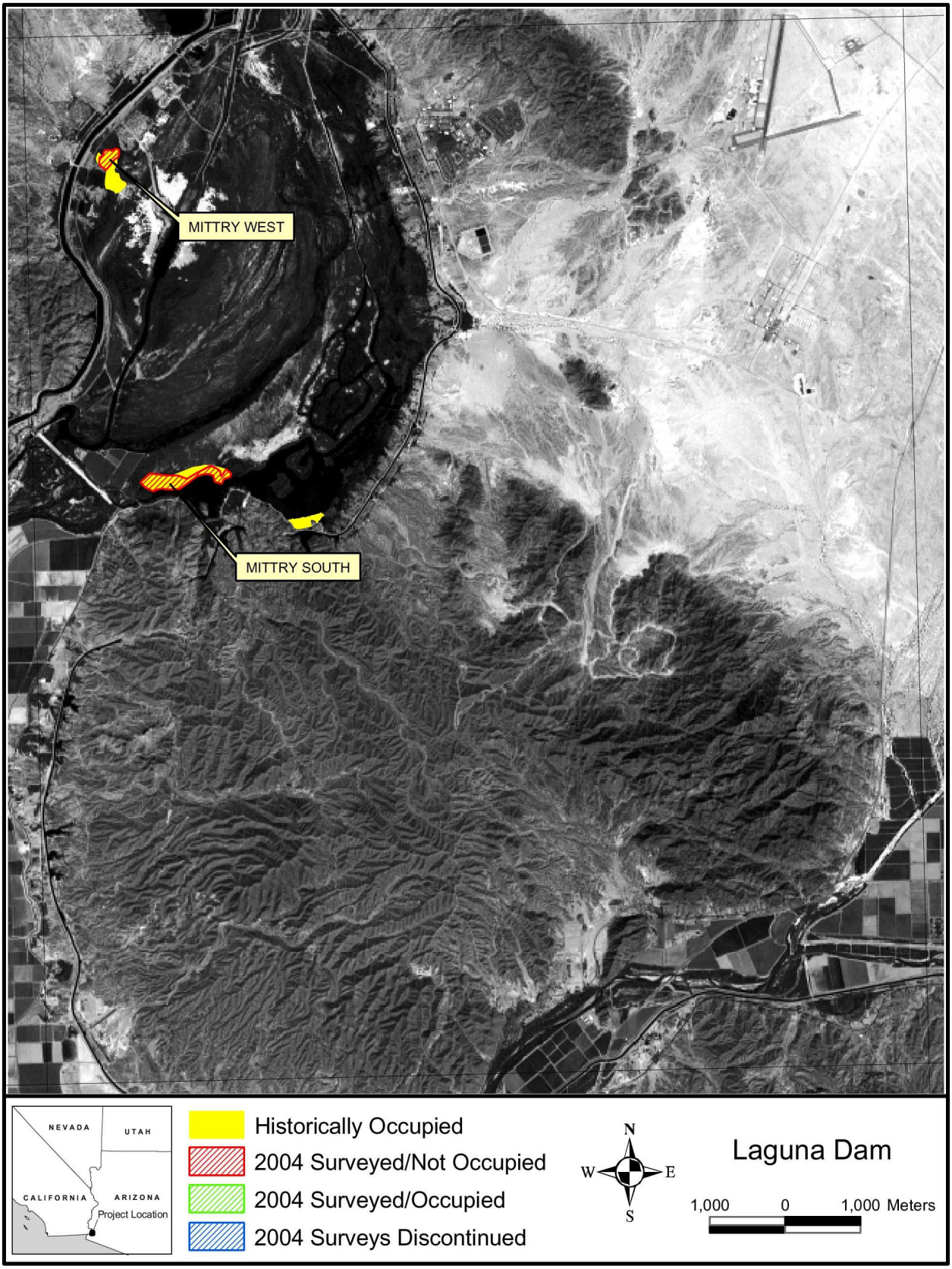

CIBOLA SITE 2
CIBOLA SITE 1
HART MINE MARSH
THREE FINGERS LAKE
NEVADA
UTAH
CALIFORNIA
ARIZONA
Project Location
Historically Occupied
2004 Surveyed/Not Occupied
2004 Surveyed/Occupied
2004 Surveys Discontinued
N
W
E
S
Cibola
1,000
0
1,000 Meters


CIBOLA LAKE NORTH
CIBOLA LAKE EAST
CIBOLA LAKE WEST
WALKER LAKE
NEVADA
UTAH
CALIFORNIA
ARIZONA
Project Location
Historically Occupied
2004 Surveyed/Not Occupied
2004 Surveyed/Occupied
2004 Surveys Discontinued
N
W
E
S
Picacho NW
1,000
0
1,000 Meters

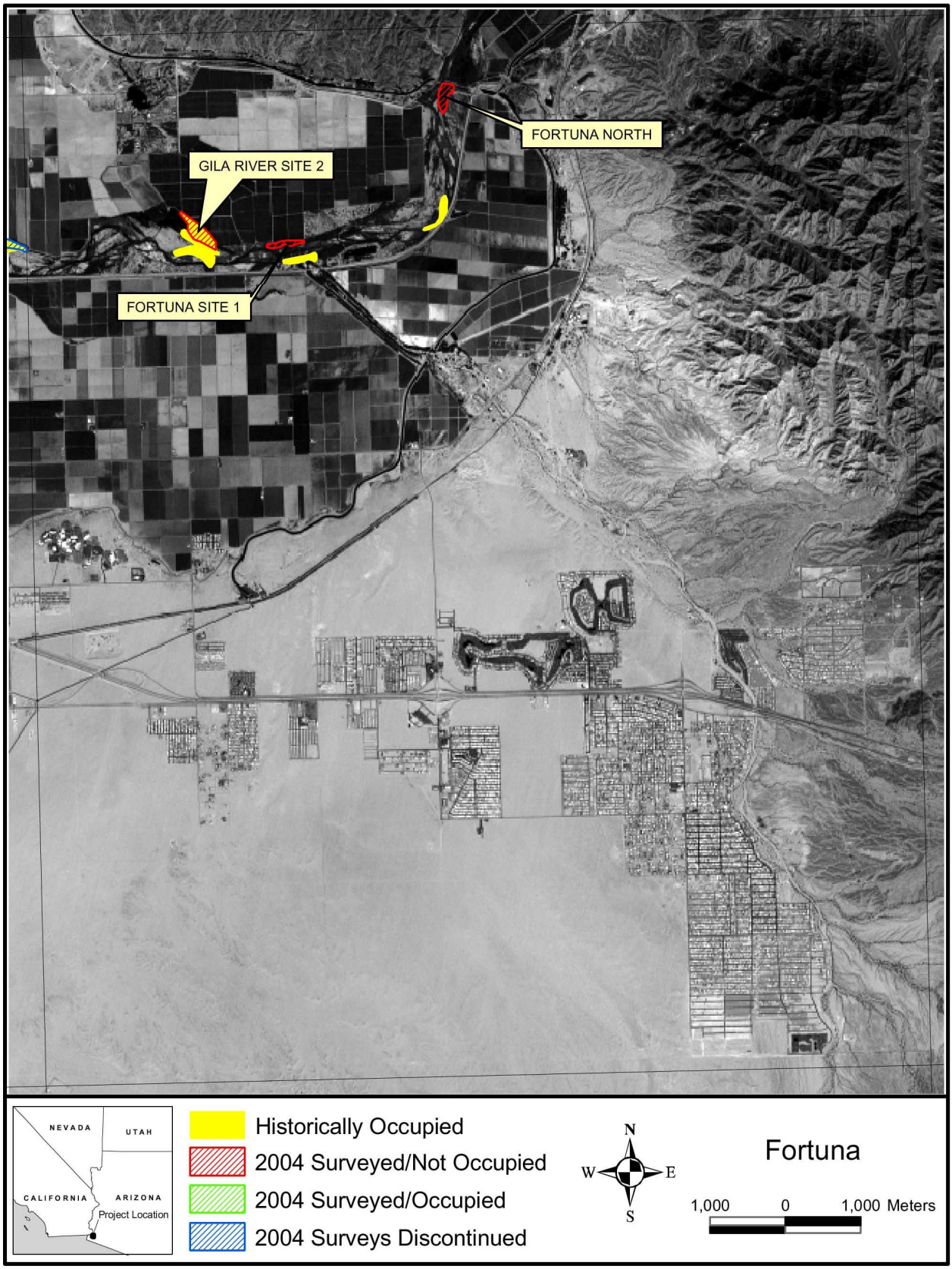

PARADISE
HOGE RANCH
RATTLESNAKE
ADOBE LAKE
TAYLOR LAKE
NORTON SOUTH
NEVADA
UTAH
CALIFORNIA
ARIZONA
Project Location
Historically Occupied
2004 Surveyed/Not Occupied
2004 Surveyed/Occupied
2004 Surveys Discontinued
N
W
E
S
Picacho SW
1,000 0 1,000 Meters

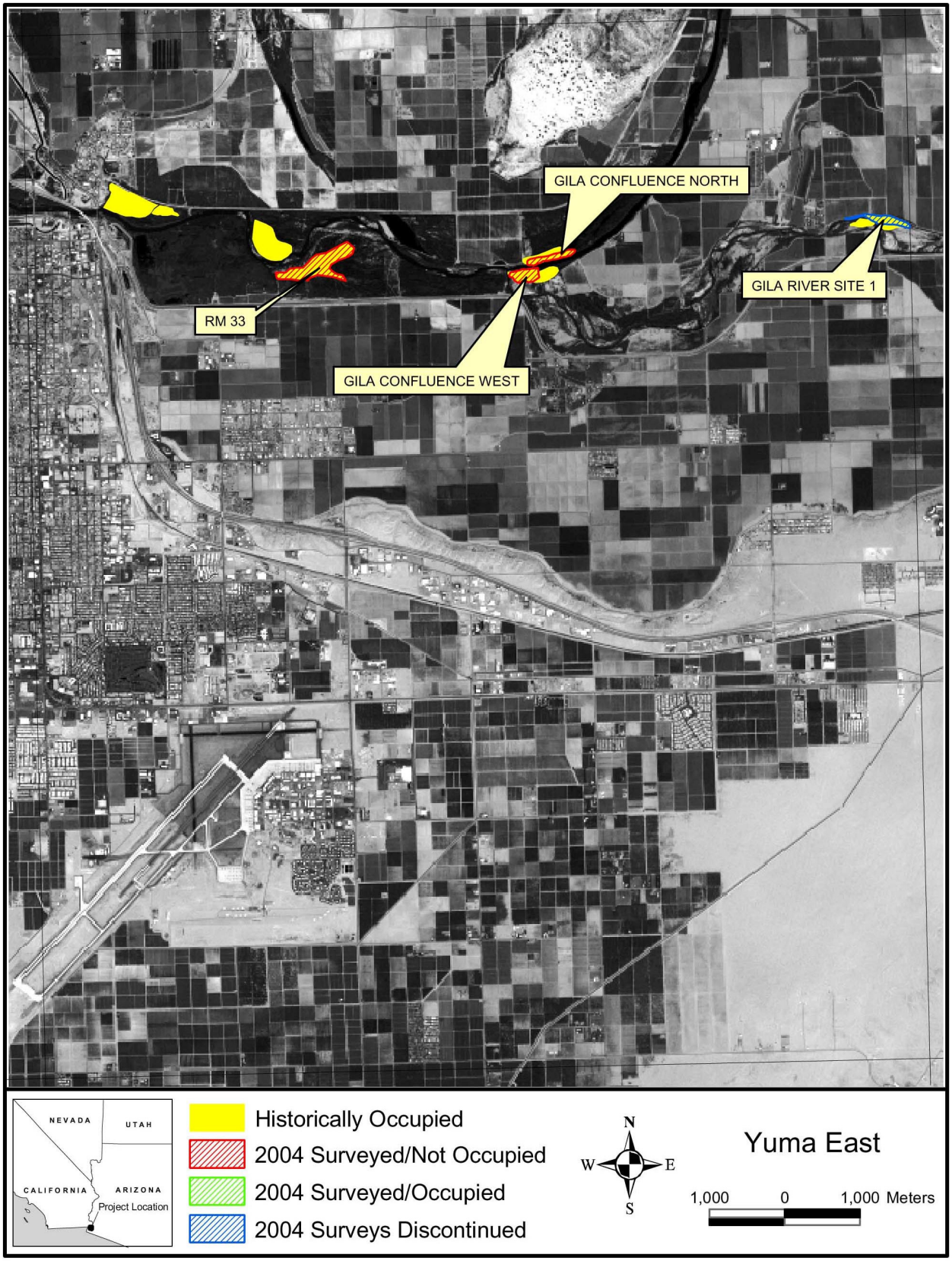

MILEMARKER 65
CLEAR LAKE
PICACHO CAMP STORE
PICACHO NW
NEVADA
UTAH
CALIFORNIA
ARIZONA
Project Location
Historically Occupied
2004 Surveyed/Not Occupied
2004 Surveyed/Occupied
2004 Surveys Discontinued
N
W
E
S
Picacho
1,000 0 1,000 Meters

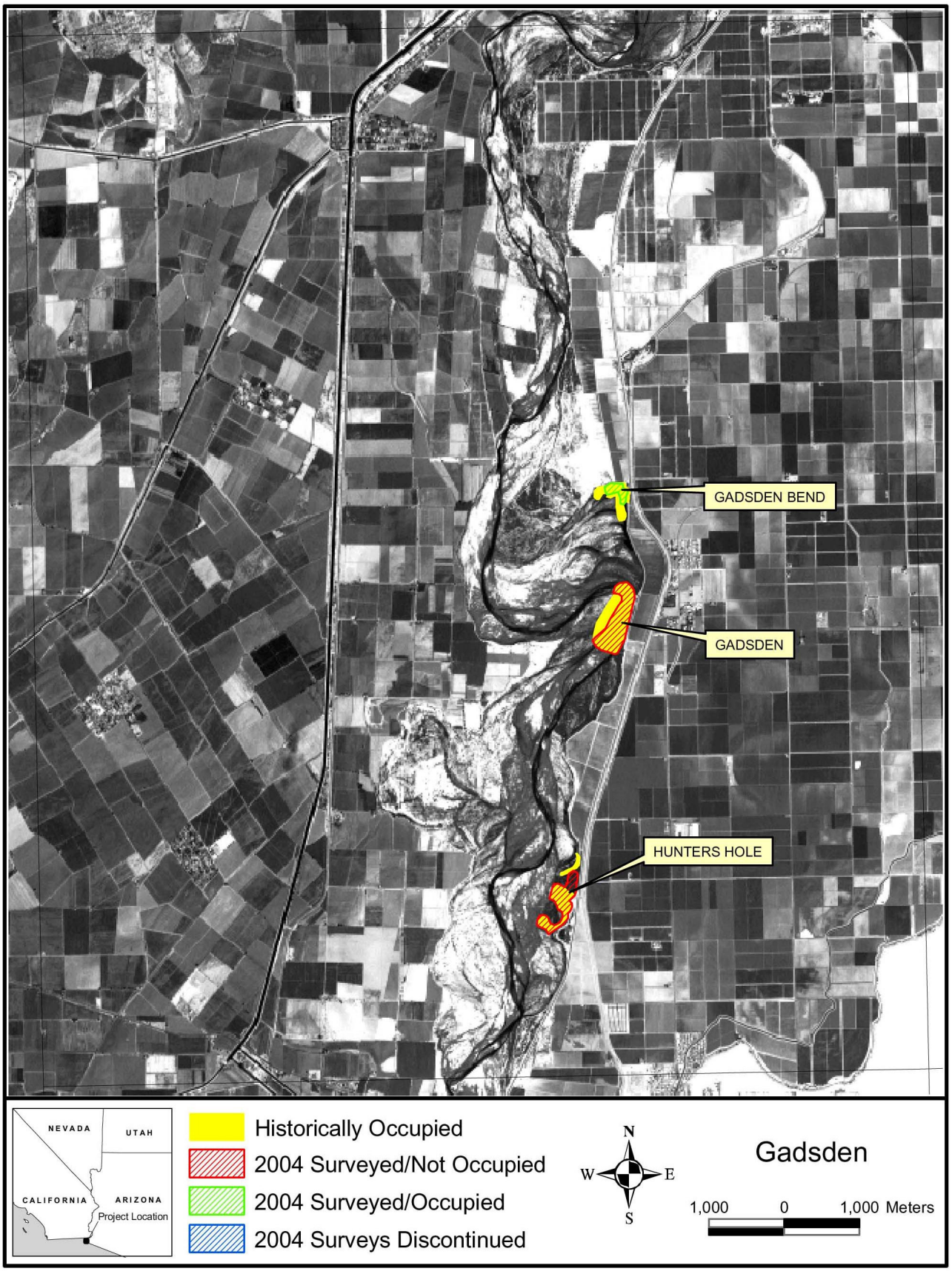

IMPERIAL NURSERY
GREAT BLUE HERON
POWERLINE
FERGUSON LAKE
MARTINEZ LAKE
FERGUSON WASH
NEVADA
UTAH
CALIFORNIA
ARIZONA
Project Location
Historically Occupied
2004 Surveyed/Not Occupied
2004 Surveyed/Occupied
2004 Surveys Discontinued
N
W
E
S
Imperial Reservoir
1,000
0
1,000 Meters


MITTRY WEST
MITTRY SOUTH
NEVADA
UTAH
CALIFORNIA
ARIZONA
Project Location
Historically Occupied
2004 Surveyed/Not Occupied
2004 Surveyed/Occupied
2004 Surveys Discontinued
N
W
E
S
Laguna Dam
1,000 0 1,000 Meters


POTHOLES WEST
POTHOLES EAST
NEVADA
UTAH
CALIFORNIA
ARIZONA
Project Location
Historically Occupied
2004 Surveyed/Not Occupied
2004 Surveyed/Occupied
2004 Surveys Discontinued
N
W
E
S
Bard
1,000 0 1,000 Meters


FORTUNA NORTH
GILA RIVER SITE 2
FORTUNA SITE 1
NEVADA
UTAH
CALIFORNIA
ARIZONA
Project Location
Historically Occupied
2004 Surveyed/Not Occupied
2004 Surveyed/Occupied
2004 Surveys Discontinued
N
W
E
S
Fortuna
1,000
0
1,000 Meters


GILA CONFLUENCE NORTH
GILA RIVER SITE 1
RM 33
GILA CONFLUENCE WEST
NEVADA
UTAH
CALIFORNIA
ARIZONA
Project Location
Historically Occupied
2004 Surveyed/Not Occupied
2004 Surveyed/Occupied
2004 Surveys Discontinued
N
W
E
S
Yuma East
1,000
0
1,000 Meters


GADSDEN BEND
GADSDEN
HUNTERS HOLE
NEVADA
UTAH
CALIFORNIA
ARIZONA
Project Location
Historically Occupied
2004 Surveyed/Not Occupied
2004 Surveyed/Occupied
2004 Surveys Discontinued
N
W
E
S
Gadsden
1,000
0
1,000 Meters

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APPENDIX C

All Willow Flycatchers Color-banded and/or Resighted 2003–2004

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Appendix C. Willow flycatchers banded and resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2004. Table includes individuals banded at sites prior to 2003 (Braden and McKernan, unpubl. data) and recaptured or resighted by SWCA. The table is sorted by federal band number, and includes color combination, study area and site originally banded, age when banded, sex, date originally banded, and the year(s) detected (including the year banded). A numerical footnote in the "Years Detected" column indicates the individual moved that year to a different study area than it occupied the prior year, with the footnote number indicating the new location (see legend at end of table).

Current Federal Band Number	Current Color Combination[A]	Study Area Originally Banded[B]	Site Originally Banded	Age When Banded[C]	Sex[D]	Date Originally Banded	Years Detected		
							Year(s) Detected Pre-2003[E]	2003	2004
1590-97338	OG(M):XX	PAHR	NORTH	AHY	M	16-Jun-97	1997, 2001	X	X
1710-20638	YR(M):XX	GRCA	RM 267.0	AHY	M	1-Jul-98	1998	X[1]	X[1]
2090-42022	GG(P):XX	MOME	UNKNOWN	L	F	1-Jul-98	1998	X[2]	
2110-78841	B(HP)/Y(HP):BEs	TOPO	800M	HY	F	8-Jul-02	2002	X[3]	X[3]
2110-78842	OB(P):BEs	MESQ	WEST	AHY	M	31-Jul-02	2002	X	X
2110-78855	RK(M):BEs	TOPO	800M	HY	M	7-Jul-02	2002	X[3]	
2110-78861	BEs:VK(M)	TOPO	INBETWEEN	L	M	6-Jul-02	2002	X[4]	X[2]
2110-78863	R(HP)/V(HP):BEs	TOPO	INBETWEEN	L	M	6-Jul-02	2002	X[5]	X[5]
2140-66564	RR(P):Zs	PAHR	UNKNOWN	L	F	4-Jul-02	2002	X[6]	
2140-66568	BR(P):Zs	PAHR	UNKNOWN	AHY	M	23-Jul-02	2002	X[6]	
2140-66606	KY(M):Rs	MOME	UNKNOWN	L	M	17-Jul-98	1998, 2000,2001	X[2]	
none[F]	WR(M):UB	PAHR	UNKNOWN	AHY	F	18-Jul-00	2000	X[6]	X[6]
2140-66693	Rs:OK(M)	MOME	DELTA WEST	L	M	2-Aug-01	2001, 2002[G]	X[2]	
2140-66696	Rs:R(HP)/O(HP)	MESQ	WEST	L	F	3-Aug-01	2001	X	
2140-66709	Bs:GW(M)	MESQ	WEST	AHY	M	22-Jul-02	2002	X	X
2140-66728	Bs:NN(P)	TOPO	800M	L	M	8-Jul-01	2001		X[3]
2140-66743	OG(M):Bs	TOPO	800M	L	M	7-Jul-99	1999		X[7]
2320-31401	OO(M):EE	BIWI	SITE 4	AHY	M	29-May-03		X	
2320-31402	EE:VG(M)	BIWI	SITE 4	AHY	M	10-Jun-03		X	
2320-31403	EE:VK(M)	YUMA	GILA 1.5[H]	SY	M	12-Jun-03		X	
2320-31404	RD(M):EE	BIWI	SITE 3	AHY	F	27-Jun-03		X	
2320-31405	EE:RW(M)	BIWI	SITE 3	SY	F	28-Jun-03		X	
2320-31406	UB:EE	BIWI	SITE 3	L	U	29-Jun-03		X	
2320-31407	ZO(M):EE	BIWI	SITE 3	L	F	29-Jun-03		X	X[8]
2320-31408	UB:EE	BIWI	SITE 3	L	U	29-Jun-03		X	
2320-31409	UB:EE	BIWI	SITE 3	L	U	2-Jul-03		X	
2320-31410	UB:EE	BIWI	SITE 3	L	U	2-Jul-03		X	

Current Federal Band Number	Current Color Combination[A]	Study Area Originally Banded[B]	Site Originally Banded	Age When Banded[C]	Sex[D]	Date Originally Banded	Years Detected		
							Year(s) Detected Pre-2003[E]	2003	2004
2320-31411	UB:EE	BIWI	SITE 3	L	U	2-Jul-03		X	
2320-31412	OW(M):EE	BIWI	SITE 3	SY	M	7-Jul-03		X	X
2320-31413	EE:RY(M)	MESQ	WEST	SY	U	5-Aug-03		X	
2320-31414	RG(M):EE	TOPO	INBETWEEN	AHY	M	17-May-04			X
2320-31415	OZ(M):EE	TOPO	PIERCED EGG	AHY	F	6-Jun-04			X
2320-31416	UB:EE	TOPO	800M	L	U	16-Jun-04			X
2320-31417	UB:EE	TOPO	800M	L	U	16-Jun-04			X
2320-31418	EE:RR(M)	TOPO	250M	SY	M	17-Jun-04			X
2320-31419	UB:EE	TOPO	PIERCED EGG	L	U	4-Jul-04			X
2320-31420	UB:EE	TOPO	PIERCED EGG	L	U	4-Jul-04			X
2320-31421	UB:EE	TOPO	PIERCED EGG	L	U	5-Jul-04			X
2320-31422	UB:EE	TOPO	PIERCED EGG	L	U	5-Jul-04			X
2320-31423	EE:RK(M)	TOPO	HELLBIRD	AHY	U	6-Jul-04			X
2320-31424	EE:UB	TOPO	HELLBIRD	L	U	7-Jul-04			X
2320-31425	EE:UB	TOPO	HELLBIRD	L	U	7-Jul-04			X
2320-31426	EE:VV(M)	MOME	VIRGIN RIVER #1 N	AHY	F	8-Jun-03		X	
2320-31427	VG(M):EE	MOME	DELTA WEST	AHY	M	22-Jun-03		X	
2320-31428	EE:GZ(M)	MESQ	WEST	L	U	12-Jun-03		X	X[9]
2320-31429	UB:EE	MESQ	WEST	L	U	12-Jun-03		X	
2320-31430	EE:UB	PAHR	NORTH	L	U	1-Jul-03		X	
2320-31431	EE:UB	MESQ	WEST	L	U	26-Jul-03		X	
2320-31432	EE:UB	PAHR	NORTH	L	U	1-Jul-03		X	
2320-31433	EE:UB	MESQ	WEST	L	U	26-Jul-03		X	
2320-31434	EE:UB	MESQ	WEST	L	U	26-Jul-03		X	
2320-31435	EE:UB	PAHR	NORTH	L	U	3-Jul-03		X	
2320-31436	UB:EE	PAHR	NORTH	L	U	3-Jul-03		X	
2320-31437	UB:EE	PAHR	NORTH	L	U	3-Jul-03		X	
2320-31438	RK(M):EE	MESQ	WEST	L	M	5-Jul-03		X	X
2320-31439	RO(M):EE	MESQ	WEST	L	U	5-Jul-03		X	
2320-31440	OY(M):EE	MESQ	WEST	L	U	5-Jul-03		X	X[9]
2320-31441[J]	UB:EE	MOME	DELTA WEST	L	U	9-Jul-03		X	
2320-31442	EE:WD(M)	MESQ	WEST	L	M	19-Jul-02	2002	X	
2320-31443	EE:UB	MESQ	WEST	L	U	29-Jul-03		X	
2320-31444	RW(M):EE	MESQ	WEST	AHY	F	31-Jul-03		X	X

Current Federal Band Number	Current Color Combination[A]	Study Area Originally Banded[B]	Site Originally Banded	Age When Banded[C]	Sex[D]	Date Originally Banded	Years Detected		
							Year(s) Detected Pre-2003[E]	2003	2004
2320-31445	EE:WK(M)	MESQ	WEST	AHY	F	1-Aug-03		X	X
2320-31446	UB:EE	PAHR	NORTH	L	U	29-Jun-04			X
2320-31447[J]	UB:EE	PAHR	NORTH	L	U	25-Jul-04			X
2320-31448	UB:EE	PAHR	NORTH	L	U	29-Jun-04			X
2320-31449[J]	UB:EE	PAHR	NORTH	L	U	25-Jul-04			X
2320-31450[J]	UB:EE	PAHR	NORTH	L	U	25-Jul-04			X
2320-31452	EE:KO(M)	PAHR	NORTH	AHY	M	20-May-03		X	
2320-31453	EE:WW(M)	PAHR	NORTH	AHY	M	28-May-03		X	X
2320-31454	EE:DO(M)	PAHR	NORTH	AHY	M	1-Jun-03		X	X
2320-31455	EE:KV(M)	PAHR	NORTH	SY	M	3-Jun-03		X	
2320-31456	EE:UB	PAHR	NORTH	L	U	25-Jun-03		X	
2320-31457	EE:KG(M)	PAHR	NORTH	L	M	25-Jun-03		X	X[10]
2320-31458	EE:UB	PAHR	SOUTH	L	U	25-Jun-03		X	
2320-31459	EE:DK(M)	PAHR	SOUTH	L	M	25-Jun-03		X	X[6]
2320-31460	EE:UB	PAHR	SOUTH	L	U	25-Jun-03		X	
2320-31461	EE:UB	PAHR	SOUTH	L	U	25-Jun-03		X	
2320-31462	EE:UB	PAHR	NORTH	L	U	26-Jun-03		X	
2320-31463	EE:UB	PAHR	NORTH	L	U	26-Jun-03		X	
2320-31464	EE:UB	PAHR	NORTH	L	U	26-Jun-03		X	
2320-31465	EE:UB	PAHR	NORTH	L	U	26-Jun-03		X	
2320-31466	EE:KW(M)	PAHR	NORTH	AHY	F	26-Jun-03		X	
2320-31467	EE:UB	PAHR	NORTH	L	U	27-Jun-03		X	
2320-31468	EE:UB	PAHR	NORTH	L	U	27-Jun-03		X	
2320-31469	EE:UB	PAHR	NORTH	L	U	27-Jun-03		X	
2320-31470	EE:UB	PAHR	NORTH	L	U	27-Jun-03		X	
2320-31471	EE:OW(M)	MESQ	WEST	L	F	29-Jun-03		X	X
2320-31472	EE:UB	MESQ	WEST	L	U	29-Jun-03		X	
2320-31473	EE:OKO(M)	MESQ	WEST	L	M	29-Jun-03		X	X[11]
2320-31474[J]	EE:UB	MESQ	WEST	L	U	29-Jun-03		X	
2320-31475	EE:WR(M)	PAHR	NORTH	L	M	1-Jul-03		X	X[12]
2320-31476	DD(M):EE	MESQ	WEST	SY	F	17-Jun-03		X	
2320-31477	EE:UB	MESQ	WEST	L	U	25-Jun-03		X	
2320-31478	DW(M):EE	MESQ	WEST	AHY	M	25-Jul-02	2002	X	
2320-31479	GG(M):EE	MESQ	WEST	SY	F	26-Jun-03		X	X

Current Federal Band Number	Current Color Combination[A]	Study Area Originally Banded[B]	Site Originally Banded	Age When Banded[C]	Sex[D]	Date Originally Banded	Years Detected		
							Year(s) Detected Pre-2003[E]	2003	2004
2320-31480	WR(M):EE	MESQ	WEST	L	F	27-Jun-03		X	X
2320-31481	UB:EE	PAHR	NORTH	L	U	30-Jul-03		X	
2320-31482	UB:EE	PAHR	NORTH	L	U	30-Jul-03		X	
2320-31483	RR(M):EE	MESQ	WEST	L	U	21-Jun-04			X
2320-31484	UB:EE	PAHR	NORTH	L	U	23-Jun-04			X
2320-31485	EE:WO(M)	MOME	VIRGIN RIVER #1 N	AHY	F	30-Jun-04			X
2320-31486	YV(M):EE	MESQ	WEST	L	F	23-Jul-03		X	X[12]
2320-31487	EE:UB	MESQ	WEST	L	U	23-Jul-03		X	
2320-31488	EE:UB	MESQ	WEST	L	U	23-Jul-03		X	
2320-31489	EE:OK(M)	MOME	VIRGIN RIVER #1 N	AHY	U	27-May-04			X
2320-31490	EE:OO(M)	LIFI	NORTH	AHY	M	3-Jun-04			X
2320-31491	GK(M):EE	MESQ	ELECTRIC AVE	AHY	M	4-Jun-04			X
2320-31492	EE:RG(M)	MESQ	WEST	L	F	19-Jul-02	2002		X[13]
2320-31493	DO(M):EE	MUDD	OVERTON WMA	AHY	M	9-Jun-04			X
2320-31494	EE:OG(M)	MESQ	RIVERSIDE WEST	AHY	U	19-Jun-04			X
2320-31495	DY(M):EE	TOPO	LOST LAKE	AHY	M	16-Jun-04			X
2320-31496	UB:EE	MOME	MORMON MESA N	L	U	23-Jun-04			X
2320-31497	UB:EE	MOME	MORMON MESA N	L	U	23-Jun-04			X
2320-31498	UB:EE	MOME	MORMON MESA N	L	U	23-Jun-04			X
2320-31499	KO(M):EE	MESQ	WEST	SY	M	25-Jun-04			X
2320-31500[J]	EE:UB	MESQ	WEST	L	U	25-Jun-04			X
2320-31501	EE:DD(M)	BIWI	SITE 3	AHY	M	7-May-03		X	
2320-31502	ZR(M):EE	TOPO	INBETWEEN	AHY	F	28-May-03		X	X
2320-31503	EE:GG(M)	IMPE	GREAT BLUE HERON	SY	U	10-Jun-04			X
2320-31504	EE:GG(M)	IMPE	GREAT BLUE HERON	SY	U	11-Jun-04			X
2320-31505	EE:DR(M)	TOPO	GLORY HOLE	SY	M	1-Jul-04			X
2320-31506	UB:EE	TOPO	GLORY HOLE	L	U	22-Jul-04			X
2320-31507	UB:EE	TOPO	GLORY HOLE	L	U	22-Jul-04			X
2320-31508	UB:EE	TOPO	PIG HOLE	L	U	17-Jul-04			X
2320-31510	UB:EE	TOPO	PC6-1	L	U	16-Jul-04			X
2320-31511	UB:EE	TOPO	PC6-1	L	U	16-Jul-04			X
2320-31512	UB:EE	TOPO	250M	L	U	16-Jul-04			X
2320-31513	UB:EE	TOPO	GLORY HOLE	L	U	16-Jul-04			X
2320-31514	UB:EE	TOPO	GLORY HOLE	L	U	16-Jul-04			X

Current Federal Band Number	Current Color Combination[A]	Study Area Originally Banded[B]	Site Originally Banded	Age When Banded[C]	Sex[D]	Date Originally Banded	Years Detected		
							Year(s) Detected Pre-2003[E]	2003	2004
2320-31515	EE:WY(M)	TOPO	PC6-1	SY	F	8-Jul-04			X
2320-31516	EE:RD(M)	GRCA	RM 274.5	SY	F	15-Jul-04			X
2320-31517	EE:OR(M)	GRCA	RM 274.5	SY	M	15-Jul-04			X
2320-31518	UB:EE	TOPO	800M	L	U	30-Jul-04			X
2320-31519	UB:EE	TOPO	800M	L	U	30-Jul-04			X
2320-31520	UB:EE	TOPO	800M	L	U	30-Jul-04			X
2320-31521	EE:DY(M)	TOPO	INBETWEEN	SY	F	6-Aug-04			X
2320-31526	OD(M):EE	TOPO	800M	AHY	F	2-Jun-03		X	X
2320-31527	KZ(M):EE	TOPO	INBETWEEN	AHY	F	21-Jun-03		X	
2320-31528	EE:YV(M)	TOPO	INBETWEEN	AHY	M	24-Jun-03		X	
2320-31529	UB:EE	TOPO	800M	L	U	26-Jun-03		X	
2320-31530	UB:EE	TOPO	800M	L	U	26-Jun-03		X	
2320-31531	UB:EE	TOPO	800M	L	U	26-Jun-03		X	
2320-31532	UB:EE	TOPO	INBETWEEN	L	U	27-Jun-03		X	
2320-31533	UB:EE	TOPO	INBETWEEN	L	U	27-Jun-03		X	
2320-31534	UB:EE	TOPO	INBETWEEN	L	U	27-Jun-03		X	
2320-31535	UB:EE	TOPO	800M	L	U	2-Jul-03		X	
2320-31536	UB:EE	TOPO	800M	L	U	2-Jul-03		X	
2320-31537	UB:EE	TOPO	800M	L	U	2-Jul-03		X	
2320-31538	EE:YR(M)	TOPO	INBETWEEN	AHY	M	3-Jun-04			X
2320-31539	EE:YY(M)	BIWI	SITE 3	SY	M	10-Jun-04			X
2320-31540	EE:KR(M)	TOPO	PIPES 3	SY	F	22-Jun-04			X
2320-31541	EE:KW(M)	TOPO	PIPES 3	SY	M	22-Jun-04			X
2320-31542	UB:EE	TOPO	INBETWEEN	L	U	2-Aug-04			X
2320-31543	UB:EE	TOPO	INBETWEEN	L	U	2-Aug-04			X
2320-31544	EE:UB	TOPO	INBETWEEN	L	U	2-Aug-04			X
2320-31551	EE:GO(M)	MESQ	WEST	AHY	M	5-Jun-04			X
2320-31552	EE:GR(M)	MOME	VIRGIN RIVER #1 N	AHY	M	7-Jun-04			X
2320-31553	EE:GW(M)	MOME	VIRGIN RIVER #1 N	SY	U	7-Jun-04			X
2320-31554	UB:EE	TOPO	INBETWEEN	L	U	22-Jun-04			X
2320-31555	EE:UB	TOPO	INBETWEEN	L	U	22-Jun-04			X
2320-31556	UB:EE	TOPO	INBETWEEN	L	U	22-Jun-04			X
2320-31557[J]	EE:UB	TOPO	INBETWEEN	L	U	30-Jul-04			X
2320-31558	UB:EE	TOPO	INBETWEEN	L	U	30-Jul-04			X

Current Federal Band Number	Current Color Combination[A]	Study Area Originally Banded[B]	Site Originally Banded	Age When Banded[C]	Sex[D]	Date Originally Banded	Years Detected		
							Year(s) Detected Pre-2003[E]	2003	2004
2320-31559	OK(M):EE	TOPO	HELLBIRD	SY	U	25-Jul-04			X
2320-31560	EE:GY(M)	TOPO	HELLBIRD	SY	M	25-Jul-04			X
2320-31561	EE:UB	TOPO	PIPES 3	L	U	22-Jul-04			X
2320-31562	KY(M):EE	TOPO	PIPES 3	L	U	22-Jul-04			X
2320-31563	EE:UB	TOPO	PIPES 3	L	U	22-Jul-04			X
2320-31564	EE:UB	TOPO	INBETWEEN	L	U	25-Jun-04			X
2320-31565	EE:KD(M)	TOPO	800M	AHY	F	23-Jun-04			X
2320-31567	YD(M):EE	TOPO	GLORY HOLE	SY	M	1-Jul-04			X
2320-31568	YG(M):EE	PAHR	NORTH	AHY	F	2-Jul-04			X
2320-31569	UB:EE	PAHR	NORTH	L	U	2-Jul-04			X
2320-31570	EE:UB	PAHR	NORTH	L	U	2-Jul-04			X
2320-31571	UB:EE	PAHR	NORTH	L	U	2-Jul-04			X
2320-31572	YK(M):EE	MOME	VIRGIN RIVER #1 N	SY	M	4-Jul-04			X
2320-31573	WY(M):EE	MESQ	WEST	AHY	F	6-Jul-04			X
2320-31576	KK(M):EE	TOPO	INBETWEEN	AHY	M	19-May-03		X	X
2320-31577	GW(M):EE	TOPO	INBETWEEN	AHY	F	1-Jun-03		X	X
2320-31578	KG(M):EE	GADS	HUNTER'S HOLE	SY	U	15-Jun-03		X	
2320-31579	KD(M):EE	GADS	RIVER MILE 33	SY	U	18-Jun-03		X	
2320-31580	GZ(M):EE	GADS	RIVER MILE 33	SY	U	18-Jun-03		X	
2320-31581	UB:EE	TOPO	INBETWEEN	L	U	3-Jul-03		X	
2320-31582	UB:EE	TOPO	INBETWEEN	L	U	3-Jul-03		X	
2320-31583	UB:EE	TOPO	INBETWEEN	L	U	3-Jul-03		X	
2320-31584	EE:YK(M)	TOPO	INBETWEEN	SY	F	3-Jul-03		X	X
2320-31585	UB:EE	TOPO	INBETWEEN	L	U	3-Jul-03		X	
2320-31586	UB:EE	TOPO	INBETWEEN	L	U	3-Jul-03		X	
2320-31587	UB:EE	TOPO	INBETWEEN	L	U	3-Jul-03		X	
2320-31588	UB:EE	TOPO	GLORY HOLE	L	U	17-Jul-03		X	
2320-31589	EE:YD(M)	PAHR	NORTH	AHY	M	14-May-04			X
2320-31590	GR(M):EE	PAHR	NORTH	AHY	M	15-May-04			X
2320-31591	GY(M):EE	PAHR	NORTH	AHY	M	15-May-04			X
2320-31592	GO(M):EE	MESQ	WEST	L	U	6-Aug-01	2001		X[6]
2320-31593	EE:WV(M)	PAHR	NORTH	AHY	M	18-May-04			X
2320-31594	EE:YO(M)	PAHR	NORTH	AHY	M	18-May-04			X
2320-31595	GV(M):EE	PAHR	NORTH	AHY	U	18-May-04			X

Current Federal Band Number	Current Color Combination[A]	Study Area Originally Banded[B]	Site Originally Banded	Age When Banded[C]	Sex[D]	Date Originally Banded	Years Detected		
							Year(s) Detected Pre-2003[E]	2003	2004
2320-31596	EE:YG(M)	PAHR	NORTH	SY	M	19-May-04			X
2320-31597[I]	EE:UB	9 E OF ALAMO	UNKNOWN	AHY	M	14-Jul-01	2001	X[6]	X[6]
2320-31598	DK(M):EE	TOPO	PIG HOLE	AHY	M	28-May-04			X
2320-31599	EE:GG(M)	IMPE	GREAT BLUE HERON	SY	U	10-Jun-04			X
2320-31600	EE:GG(M)	IMPE	GREAT BLUE HERON	SY	U	10-Jun-04			X
2320-31601	UB:EE	PAHR	NORTH	L	U	25-Jun-04			X
2320-31602	UB:EE	PAHR	NORTH	L	U	25-Jun-04			X
2320-31603	UB:EE	PAHR	NORTH	L	U	25-Jun-04			X
2320-31604	UB:EE	PAHR	NORTH	L	U	25-Jun-04			X
2320-31605	UB:EE	PAHR	NORTH	L	U	25-Jun-04			X
2320-31606	UB:EE	PAHR	NORTH	L	U	25-Jun-04			X
2320-31607	UB:EE	PAHR	NORTH	L	U	26-Jun-04			X
2320-31608	EE:UB	PAHR	NORTH	L	U	26-Jun-04			X
2320-31609	UB:EE	PAHR	NORTH	L	U	26-Jun-04			X
2320-31610	EE:UB	PAHR	NORTH	L	U	26-Jun-04			X
2320-31611[J]	EE:UB	MESQ	WEST	L	U	25-Jun-04			X
2320-31612[J]	EE:UB	MESQ	WEST	L	U	25-Jun-04			X
2320-31613[K]	DR(M):EE	MESQ	WEST	AHY	F	24-Jul-02	2002	X	X
2320-31614[L]	VY(M):EE	TOPO	800M	L	M	4-Aug-00	2000	X[2]	X[2]
2320-31615	EE:OY(M)	MESQ	WEST	L	U	21-Jun-04			X
2320-31616	EE:UB	MESQ	WEST	L	U	8-Jul-04			X
2320-31617	UB:EE	MESQ	WEST	L	U	8-Jul-04			X
2320-31618	EE:UB	MESQ	WEST	L	U	8-Jul-04			X
2320-31619[J]	UB:EE	MOME	VIRGIN RIVER #1 N	L	U	10-Jul-04			X
2320-31620[J]	UB:EE	MOME	VIRGIN RIVER #1 N	L	U	10-Jul-04			X
2320-31621	VV(M):EE	MOME	VIRGIN RIVER #1 N	AHY	F	30-Jun-04			X
2320-31622	VK(M):EE	MESQ	WEST	AHY	M	3-Jul-04			X
2320-31623	UB:EE	MOME	DELTA WEST	L	U	4-Jul-04			X
2320-31624	UB:EE	MOME	DELTA WEST	L	U	4-Jul-04			X
2320-31625	EE:WG(M)	MOME	DELTA WEST	AHY	F	4-Jul-04			X
2320-31627	WW(M):EE	MESQ	WEST	SY	M	5-Jul-04			X
2320-31628	EE:KZ(M)	MOME	VIRGIN RIVER #1 N	SY	U	6-Jul-04			X
2320-31629	UB:EE	MOME	VIRGIN RIVER #1 N	L	U	6-Jul-04			X
2320-31630	UB:EE	MESQ	BUNKER FARM	L	U	16-Jul-04			X

Current Federal Band Number	Current Color Combination[A]	Study Area Originally Banded[B]	Site Originally Banded	Age When Banded[C]	Sex[D]	Date Originally Banded	Years Detected		
							Year(s) Detected Pre-2003[E]	2003	2004
2320-31631	UB:EE	MESQ	BUNKER FARM	L	U	16-Jul-04			X
2320-31632	RZ(M):EE	MESQ	BUNKER FARM	SY	F	16-Jul-04			X
2320-31633	UB:EE	MESQ	WEST	L	U	16-Jul-04			X
2320-31634	UB:EE	MESQ	WEST	L	U	16-Jul-04			X
2320-31635	EE:YDY(M)	KEPI	KEPI	AHY	M	17-Jul-04			X
2320-31636	UB:EE	KEPI	KEPI	L	U	17-Jul-04			X
2320-31637	UB:EE	KEPI	KEPI	L	U	17-Jul-04			X
2320-31638	UB:EE	KEPI	KEPI	L	U	17-Jul-04			X
2320-31651	EE:OD(M)	MOME	DELTA WEST	AHY	M	21-May-04			X
2320-31652	WG(M):EE	MOME	VIRGIN RIVER #1 N	AHY	M	22-May-04			X
2320-31653	WV(M):EE	MOME	DELTA WEST	SY	M	27-May-04			X
2320-31654	EE:KY(M)	MESQ	ELECTRIC AVE	AHY	M	4-Jun-04			X
2320-31655	VW(M):EE	MESQ	WEST	SY	F	14-Jun-04			X
2320-31656	WD(M):EE	PAHR	NORTH	AHY	F	19-Jun-04			X
2320-31657	WO(M):EE	PAHR	NORTH	AHY	F	20-Jun-04			X
2320-31658	WK(M):EE	PAHR	NORTH	AHY	F	20-Jun-04			X
2320-31660	UB:EE	MESQ	WEST	L	U	21-Jun-04			X
2320-31661	EE:DW(M)	PAHR	NORTH	SY	F	17-Jun-04			X
2320-31662	YY(M):EE	PAHR	NORTH	SY	F	17-Jun-04			X
2320-31663	EE:GK(M)	PAHR	NORTH	AHY	F	18-Jun-04			X
2320-31664	YW(M):EE	PAHR	NORTH	AHY	F	18-Jun-04			X
2320-31665	UB:EE	PAHR	NORTH	L	U	22-Jun-04			X
2320-31666	UB:EE	PAHR	NORTH	L	U	22-Jun-04			X
2320-31667	UB:EE	PAHR	PAHR	L	U	22-Jun-04			X
2320-31668	ZG(M):EE	PAHR	NORTH	AHY	F	22-Jun-04			X
2320-31669	ZK(M):EE	PAHR	SOUTH	AHY	F	6-Aug-04			X
2360-59717	RY(M):EE	MESQ	WEST	AHY	M	18-Jul-04			X
2360-59721	UB:EE	PAHR	NORTH	L	U	1-Aug-04			X
2360-59723	UB:EE	PAHR	NORTH	L	U	1-Aug-04			X
2360-59724	UB:EE	PAHR	NORTH	L	U	1-Aug-04			X
2360-59746	UB:EE	GRCA	RIVER MILE 274.5	L	U	17-Jul-04			X
2360-59757	UB:EE	KEPI	KEPI	L	U	17-Jul-04			X
2360-59760	UB:EE	LIFI	NORTH	L	U	29-Jul-04			X
2360-59761	UB:EE	LIFI	NORTH	L	U	29-Jul-04			X

Current Federal Band Number	Current Color Combination[A]	Study Area Originally Banded[B]	Site Originally Banded	Age When Banded[C]	Sex[D]	Date Originally Banded	Years Detected		
							Year(s) Detected Pre-2003[E]	2003	2004
2360-59762	EE:UB	MESQ	WEST	L	U	7-Aug-04			X
2360-59763	EE:UB	MESQ	WEST	L	U	7-Aug-04			X
2360-59766	EE:UB	MESQ	WEST	L	U	7-Aug-04			X
2360-59767	UB:EE	KEPI	KEPI	L	U	11-Aug-04			X
2360-59770	EE:UB	KEPI	KEPI	L	U	11-Aug-04			X
2360-59771	UB:EE	GRCA	RIVER MILE 274.5	L	U	17-Jul-04			X
2360-59772	YR(M):EE	KEPI	KEPI	AHY	F	12-Aug-04			X
2360-59800	UB:EE	GRCA	RIVER MILE 274.5	L	U	17-Jul-04			X
2370-39901	OO(M):XX	PAHR	NORTH	AHY	U	12-Aug-04			X
2370-39902	XX:KY(M)	PAHR	NORTH	HY	U	12-Aug-04			X
2370-39903	DD(M):XX	PAHR	UNKNOWN	AHY	F	10-Aug-00	2000		X[6]
2370-39904	YV(M):XX	PAHR	NORTH	HY	U	12-Aug-04			X
2390-92348	YY(P):XX	TOPO	1000m	L	F	25-Jul-98	1998		X[3]
2390-92350	XX:DY(M)	MOME	UNKNOWN	AHY	M	17-May-00	2000	X[2]	X[2]
2390-92365	RG(M):XX	MUDD	OWMA	L	M	7-Jul-00	2000	X[2]	X[2]
2390-92410	XX:DD(P)	MESQ	WEST	AHY	M	29-May-01	2001	X	
2390-92420	XX:ZK(M)	MESQ	WEST	L	M	27-Jun-01	2001, 2002	X	
2390-92421	XX:WR(M)	MESQ	WEST	L	M	27-Jun-01	2001	X	X
2390-92427	XX:OW(HP)	MOME	UNKNOWN	L	F	29-Jun-01	2001	X[2]	
2390-92433	XX:ZR(M)	MESQ	WEST	L	M	4-Jul-01	2001	X	X
2390-92434	UB:XX	MESQ	WEST	L	M	4-Jul-01	2001		X
2390-92451	KW(M):XX	MOME	UNKNOWN	L	F	2-Jul-99	1999, 2002[G]		X[2]
2390-92470	KR(M):XX	MESQ	WEST	L	F	24-Jul-01	2001		X
2390-92475	XX:WY(M)	MOME	DELTA WEST	L	M	26-Jul-01	2001, 2002[G]	X[2]	X[2]
3500-68963	XX:UB	TOPO	HELLBIRD	L	U	7-Jul-04			X
3500-68968	DW(M):XX	PAHR	SOUTH	HY	U	6-Aug-04			X
3500-68969	XX:GG(M)	PAHR	SOUTH	HY	U	6-Aug-04			X
3500-68971[M]	XX:DD(M)	PAHR	SOUTH	AHY	M	17-May-03		X	X
3500-68972	GG(M):XX	PAHR	SOUTH	HY	U	6-Aug-04			X
INA	Rs:UB	Detected PAHR S 2003	UNKNOWN	AHY	F	INA		X	
INA	UB:XX	Detected MOME N 2003	UNKNOWN	INA	F	INA		X	
INA	KY(HP):XX	Detected MOME VR #1 N 2003	UNKNOWN	INA	F	INA		X	

Current Federal Band Number	Current Color Combination[A]	Study Area Originally Banded[B]	Site Originally Banded	Age When Banded[C]	Sex[D]	Date Originally Banded	Years Detected		
							Year(s) Detected Pre-2003[E]	2003	2004
INA	Bs:undetermined[N]	Detected TOPO Inbetween 2003	UNKNOWN	INA	M	INA		X	
INA	?? banded:EE[N]	Detected MESQ West 2004	UNKNOWN	INA	F	INA			X

[A] **Current Color Combo**: B(HP) = light blue half plastic band, B(P) = light blue full plastic band, BEs = berry epoxy enameled federal band, Bs = blue epoxy enameled federal band, D(M) = blue metal pinstriped band, EE = electric yellow federal band, G(HP) = green half plastic band, G(M) = green metal pin striped band, G(P) = green full plastic band, K(HP) = black half plastic band, K(M) = black metal pin striped band, K(P) = black full plastic band, N(HP) = dark/navy blue half plastic band, N(P) = navy/dark blue full plastic band, O(HP) = orange half plastic band, O(M) = orange metal pinstriped band, O(P) = orange full plastic band, P(HP) = hot pink half plastic band, P(P) = hot pink full plastic band, R(HP) = red half plastic band, R(M) = red metal pin striped band, R(P) = red full plastic band, Rs = red epoxy enameled federal band, UB = unbanded, V(HP) = violet half plastic band, V(M) = violet metal pin striped band, V(P) = violet full plastic band, W(HP) = white half plastic band, W(M) = white metal pin striped band, W(P) = white full plastic band, XX = standard issue federal band, Y(HP) = yellow half plastic band, Y(M) = yellow metal pin striped band, Y(P) = yellow full plastic band, Z(M) = gold metal pinstriped band, Zs = gold epoxy enameled federal band.
Color combinations are read as the bird's left leg and right leg, top to bottom; two or three letters designate every band; color band designations for right and left legs are separated with a colon; bands stacked one over the over are separated with a slash (/).

[B] **Study Area Originally Banded**: PAHR = Pahranagat National Wildlife Refuge, NV; LIFI = Virgin River/Beaver Dam Wash confluence, Littlefield, AZ; MESQ = Mesquite, NV; MOME = Mormon Mesa, NV; MUDD = Muddy River Delta at Lake Mead, Overton Wildlife Management Area, NV; GRCA = Grand Canyon National Park, AZ; TOPO = Topock Marsh, Havasu National Wildlife Refuge, AZ; BIWI = Bill Williams River National Wildlife Refuge, AZ; YUMA = Yuma, AZ; GADS = Gadsden Bend area along CO River, AZ; 9 E OF ALAMO = bird captured and banded 9 miles east of Alamo, NV (per Federal Bird Banding Laboratory); KEPI = Key Pittman Wildlife Management Area, NV.

[C] **Age When Banded**: AHY = 2 years or older, SY = 2 years old, HY = hatch year, born that year, L = nestling, born that year.

[D] **Sex**: F = female, M = male, U = unknown.

[E] Location for each year detected pre-2003 is the "Study Area Originally Banded" unless otherwise noted.

[F] Original federal band (2140-66621) removed due to a leg injury; no federal band on right leg.

[G] Detected at Mesquite West in 2002.

[H] Site is located between Gila River Site 2 and Gila River Site 1.

[I] Original federal band (2190-76604) replaced.

[J] Individual known to have died before fledging.

[K] Original federal band (2140-66517) replaced.

[L] Original federal band (2140-66775) replaced.

[M] Original federal band (2320-31451) replaced.

[N] Color combination could not be determined due to a leg injury masking the band.

INA = information not available.

[1] Mormon Mesa North

[2] Mesquite West

[3] Topock Inbetween

[4] exhibited within season movement in 2003, Mormon Mesa then to Mesquite West

[5] Topock Glory Hole

[6] Pahranagat North

[7] Topock Hellbird

[8] Topock PC6-1

[9] Mormon Mesa Virgin River #1 North

[10] Key Pittman Wildlife Management Area

[11] MESQ Bunker Farm

[12] Littlefield North

[13] MESQ Electric Avenue

APPENDIX D

Contributing Personnel

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Contributor	Role
Steven W. Carothers, Ph.D.	Principal-in-Charge
Mary Anne McLeod, M.S.	Project Manager/Scientist/Field Supervisor
Thomas J. Koronkiewicz, M.S.	Senior Scientist/Field Supervisor
Bryan T. Brown, Ph.D.	Microclimate/Habitat Specialist
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Glenn A. Dunno, M.A.	GIS Specialist
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Dorothy A. House, M.A.	Technical Editor
Denise A. Johnson	Project Coordinator
Cheyenne Laczek-Johnson	Field Coordinator
Clifford B. Cordy, Ph.D.	Field Coordinator
Jessica Blickley	Bander/Nest Monitor
Jennifer Brown	Bander/Nest Monitor
Nora Camberos	Bander/Nest Monitor
Stacia A. Hetrick	Bander/Nest Monitor
Shirley E. Bartz	Bander/Nest Monitor
Bree Beveridge	Surveyor/Nest Monitor
Scarlett Howell	Surveyor/Nest Monitor
Alison Peterson	Surveyor/Nest Monitor
Pauline Ridings	Surveyor/Nest Monitor
Todd L. Schipper	Surveyor/Nest Monitor
Elizabeth (Beth) Summers	Surveyor/Nest Monitor
Aaron Walpole	Surveyor/Nest Monitor
Javan Bauder	Surveyor
Robyn Fyles	Surveyor
Andrew (Andy) Doll	Surveyor
Chris Chutter	Surveyor
Katie Eaton	Surveyor
Corina Burkhart	Surveyor
Nicholas Block	Surveyor
Ana Cerro	Surveyor

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APPENDIX E

Errata from 2003 Annual Report

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Appendix E. Errata from Koronkiewicz et al. 2004.

Page	Line	Old text	Correct text
52, Table 3.2	1st line of table, Color Combination column	BEs:XX	Rs:XX
52, Table 3.2	4th line of table, Age column	A3Y	A4Y
53, Table 3.4	14th line of table, Observation status column	N; R 7 July	N; R 30 July
54, Table 3.4	11th line of table, Territory column	6	4
54, Table 3.4	15th line of table, Territory column	12, 22	12
55, Table 3.5	6th line of table, Date banded column	31-JUL-02	27-JUN-01
68	Paragraph 1, line 1	…ranged from 0 to 100%…	…ranged from 6 to 100%…
68, Table 4.4	Nest losses/observation days for Mormon Mesa, egg laying stage	0/16	0/18
68, Table 4.4	Daily survival rate for all sites, egg laying stage	0.957	0.977