Lower Colorado River Multi-Species Conservation Program

Balancing Resource Use and Conservation

Southwestern Willow Flycatcher Monitoring Along the Lower Colorado River and Tributaries

2018 Annual Report

June 2019

Work conducted under LCR MSCP Work Task D02

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Lower Colorado River Multi-Species Conservation Program

Southwestern Willow Flycatcher Monitoring Along the Lower Colorado River and Tributaries

2018 Annual Report

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Multi-Species Conservation Program
Bureau of Reclamation
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ACRONYMS AND ABBREVIATIONS

ALAM	Alamo Lake study area
BA	biological assessment
BBIRD	Breeding Biology Research and Monitoring Database
BIWI	Bill Williams study area
BO	biological opinion
cfs	cubic foot/feet per second
CIBO	Cibola study area
cm	centimeter(s)
cottonwood-willow	Fremont cottonwood-Goodding's willow (*Populus fremontii-Salix gooddingii*)
cowbird	brown-headed cowbird(s) (*Molothrus ater*)
CVCA	Cibola Valley Conservation Area
FR	Federal Register
ha	hectare(s)
HCP	Habitat Conservation Plan
IMPE	Imperial study area
km	kilometer(s)
LCR	lower Colorado River
LCR MSCP	Lower Colorado River Multi-Species Conservation Program
LDCA	Laguna Division Conservation Area
m	meter(s)
MITT	Mittry Lake study area
Pa	Pascal(s)
PVER	Palo Verde Ecological Reserve
Reclamation	Bureau of Reclamation
RH	relative humidity
sp.	single unidentified species
spp.	unidentified multiple species in a genus
SWCA	SWCA Environmental Consultants
T	temperature
TES	threatened, endangered, and sensitive
TOGO	Topock Gorge study area
TOPO	Topock Marsh study area
U.S.	United States
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VP	vapor pressure
wet soils	inundated or saturated soils
YUMA	Yuma study area

Symbols

≈	approximately
x	by
°	degrees
°C	degrees Celsius
=	equal to
>	greater than
≥	greater than or equal to
<	less than
≤	less than or equal to
#	number
%	percent
®	registered trademark
–	to
^	to the power of

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EXECUTIVE SUMMARY

SWCA Environmental Consultants (SWCA) was contracted by the Bureau of Reclamation (Reclamation) to continue surveys, monitoring, and ecological studies of southwestern willow flycatchers (*Empidonax traillii extimus*),[1] in suitable and/or historical riparian and wetland habitats throughout the lower Colorado River (LCR) region and along its tributaries in 2018.

Prior to 2018, Reclamation's flycatcher studies included several breeding areas in southern Nevada, and color banding and intensive territory and nest monitoring was completed wherever territorial flycatchers were detected. Beginning in 2018, the geographic scope of the project was reduced to include only the LCR and portions of its major tributaries downstream from Hoover Dam, banding was largely discontinued, and intensive territory and nest monitoring was completed only in specific portions of the project area. Approximately 100 sites are included in the study of flycatchers along the LCR, but starting in 2013, a portion of the sites were surveyed triennially rather than annually. Sites on the triennial schedule were surveyed in 2018. SWCA completed territory monitoring at the Alamo Lake study area (ALAM) and within Lower Colorado River Multi-Species Conservation Program (LCR MSCP) conservation areas to determine the number of resident and paired flycatchers. More intensive territory monitoring, with the intention of locating flycatcher nests, was completed at the Topock Marsh (TOPO) and Bill Williams (BIWI) study areas outside of conservation areas to document nest fate, brood parasitism, and causes of nest failure.

Recorded broadcasts of flycatcher song and calls were used to elicit willow flycatcher responses at 87 sites, ranging in size from < 1 to 41 hectares, along the LCR and its tributaries from Topock Marsh, Arizona, south to Yuma, Arizona, between May 15 and July 17, 2018. Four of these sites were surveyed opportunistically during reconnaissance efforts. Surveys were discontinued during the season at two sites because of poor habitat quality. In addition to the 87 sites that were surveyed, 1 site could not be formally surveyed or assessed because deep water and dense marsh vegetation made the site inaccessible, and no broadcast surveys were completed at another site because it was completely occupied by territorial flycatchers throughout the breeding season. In addition to the surveys completed by SWCA, Reclamation completed broadcast surveys at Hunters Hole.

A total of 333 adult flycatchers and willow flycatchers were detected in the project area in 2018. Of these, 124 flycatchers from 72 territories were recorded at 11 sites within the following study areas: TOPO, BIWI, and ALAM, Arizona. An additional 209 willow flycatchers that did not occupy territories

[1] Throughout this document, when residency status for an individual is undetermined and the subspecies is unknown, the term "willow flycatcher" is used to refer to *E. traillii*. The term "flycatcher" refers to *E. t. extimus*.

were detected across all study areas. A total of 157 of these were recorded south of Parker Dam between May 15 and June 14. Subsequent surveys and behavioral observations suggest these willow flycatchers were not resident individuals but were most likely spring migrants.

Binoculars were used to determine the identity of previously color-banded flycatchers by observing, from a distance, the unique color combinations on their legs. Field personnel also used digital cameras to take pictures of flycatchers; these photos supplemented any resight data. Of the 333 adult flycatchers and willow flycatchers detected in 2018, 15 (5%) were known to be banded, and 10 of the 15 were individually identified. A total of 127 adults were known to be unbanded, and band status was undetermined for 191 adults. Of the adults that were identified in 2018, two were identified for the first time since they were banded in their hatch year. Both of these were males that fledged at ALAM, one at Burro Wash 02 in 2015 and the other at Middle Earth 02 in 2016, and returned to ALAM Burro Wash 02 as adults. Dispersal distances were 0.01 and 0.81 kilometer, respectively.

In 2017, 26 adult, resident flycatchers were individually identified at study areas that were monitored by SWCA in both 2017 and 2018. Of these 26 flycatchers, 8 were detected in 2018, with all but 1 returning flycatcher being initially detected at the same study area where they were resident in 2017. One male flycatcher moved 48.5 kilometers from BIWI Site 01 to ALAM Burro Wash 01.

Across all sites in TOPO and BIWI where intensive territory monitoring was conducted, two flycatcher nesting attempts were found at TOPO; no flycatcher pairs were documented at BIWI. Neither nest was parasitized by brown-headed cowbirds (*Molothrus ater*), and both were depredated during the nestling period. Apparent nest success was 0%.

Soil moisture conditions were described up to four times during the season at each flycatcher nest at TOPO. Descriptions included conditions of soil moisture at the nest (inundated, saturated, damp, or dry), depth of water (if any) at the nest, distance to water from the nest, and the percent of the area within 20 and 50 meters (m) of the nest that contained inundated or saturated soils (hereafter wet soils). Soils beneath both nests were damp when each estimate of soil condition was recorded. The distance to wet soils tended to increase during the season but never exceeded 12 m. Flycatchers are known for their propensity to nest near surface water, which affects vegetation density, food availability, and microclimate.

The species of tree or shrub in which a nest was placed, as well as a visual estimate of the percentage of vegetation volume that consisted of tamarisk (*Tamarix* spp.) within 2 and 5 m of the nest, was recorded at both flycatcher nests at TOPO. The purpose of quantifying the amount of tamarisk near each nest is to determine the potential impact of defoliation due to tamarisk beetles (*Diorhabda*

spp.), which have been present at TOPO since 2017 and were documented in the study area throughout the breeding season in 2018. Both nests were in an area with a Goodding's willow (*Salix gooddingii*) overstory and a tamarisk understory, and both nests were placed in tamarisk, at 3.1 and 4.7 m above the ground. Between 20 and 40% of the vegetation within 2 and 5 m of each nest consisted of tamarisk. The tamarisk within 5 m of each nest were affected by tamarisk beetles throughout the nesting cycle, with up to half of the tamarisk leaves being brown while the remainder were green. The tamarisk in the immediate vicinity of the nests were not as severely affected by beetles as the tamarisk in the remainder of the site, which exhibited extensive browning and defoliation throughout the breeding season.

An iButton data logger was deployed at each flycatcher nest after the nest was confirmed to be in the incubation phase. These loggers recorded temperature and humidity data every 30 minutes and remained in place until the end of the breeding season. The small sample size precluded meaningful comparisons between microclimate conditions observed in 2018 and those observed in other years.

Chapter 1 – Introduction

SPECIES INTRODUCTION

The southwestern willow flycatcher (*Empidonax traillii extimus*) is one of four currently recognized subspecies of willow flycatcher (Unitt 1987). It 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 and western Texas (figure 1-1) (Unitt 1987).

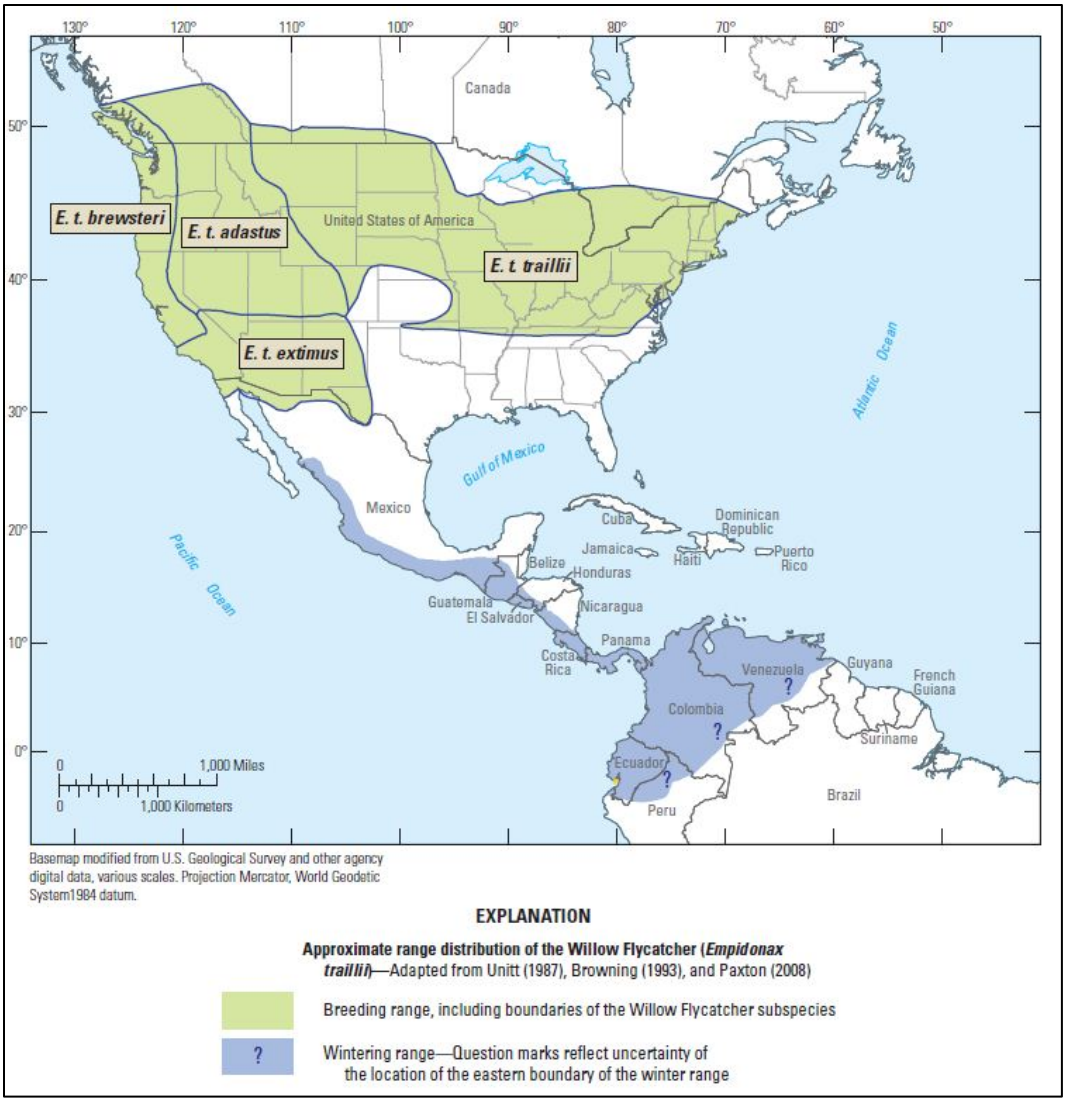

Figure 1-1.—Breeding range distribution of the subspecies of the willow flycatcher (*Empidonax traillii*).
From Sogge et al. (2010).

In the Southwest, most flycatcher[1] breeding territories are found within small breeding sites containing five or fewer territories (Durst et al. 2006). One of the last long-distance neotropical migrants to arrive in North America in spring, the flycatcher has a short, approximately 100-day breeding season, with individuals typically arriving in May or June and departing in August (Sogge et al. 2010). All four subspecies of the willow flycatcher spend the non-breeding season in portions of southern Mexico, Central America, and northwestern South America (Howell and Webb 1995; Ridgely and Tudor 1994; Stiles and Skutch 1989; Unitt 1997), with wintering ground habitat being similar to habitat on the breeding grounds (Lynn et al. 2003). Willow flycatchers have been recorded on their wintering grounds from central Mexico to southern Central America as early as mid-August (Howell and Webb 1995; Stiles and Skutch 1989), and wintering, resident individuals have been recorded in southern Central America as late as the end of May (Koronkiewicz et al. 2006).

Historical breeding records and museum collections indicate that a sizable population of flycatchers may have existed along the most southerly stretches of the lower Colorado River (LCR) (Unitt 1987). The most recent collection of a breeding flycatcher along the LCR south of the Bill Williams River, Arizona, was in 1938, and no nests have been found in this area since before 1970 (Unitt 1987), though northbound and southbound migrant willow flycatchers use the riparian corridor (Brown et al. 1987; McKernan and Braden 2002; McLeod and Pellegrini 2013; McLeod et al. 2008, 2018a; Phillips et al. 1964; this document). Factors contributing to the decline of flycatchers on their breeding grounds include loss, degradation, and/or fragmentation of riparian habitat; invasion of riparian habitat by non-native plants; and brood parasitism by brown-headed cowbirds (*Molothrus ater*) (hereafter cowbirds) (Marshall and Stoleson 2000; U.S. Fish and Wildlife Service [USFWS] 1995). Because of low population numbers range-wide, identifying and conserving flycatcher breeding sites is thought to be crucial to the recovery of the subspecies (USFWS 2002).

Tamarisk beetles (*Diorhabda* spp.) pose an additional threat to flycatchers. Tamarisk beetles defoliate tamarisk (*Tamarix* spp.) plants during the flycatcher breeding season, likely exposing flycatcher nests to adverse microclimate conditions and increased risks of depredation and parasitism. Northern tamarisk beetles (*D. carinulata*) were released in St. George, Utah, in 2006, and widespread defoliation was first observed in St. George in 2008. The area of defoliation on the Virgin River expanded downstream annually, encompassing the entire stretch of the Virgin River to Lake Mead, Nevada, by the end of the breeding season in 2011. Tamarisk beetles continued spreading downstream along the LCR in 2012, and by the end of the 2012 breeding season, they were found as far downstream as the lower end of Lake Mohave (Arizona

[1] Throughout this document, when residency status for an individual is undetermined and the subspecies is unknown, the term "willow flycatcher" is used to refer to *E. traillii*. The term "flycatcher" refers to *E. t. extimus*.

and California) (T. Dudley 2012, personal communication). By fall 2013, tamarisk beetles were detected approximately 11 kilometers (km) south of Lake Mohave at Big Bend State Park, Nevada (B. Bloodworth 2014, personal communication). No substantial southerly movement was recorded in 2014 (T. Dudley 2014, personal communication), but by August 2015, beetles were detected approximately 11 km south of Big Bend (T. Dudley 2015, personal communication). Beetles expanded their range an additional 110 km downstream on the LCR in 2016 and by the end of the summer were found at Topock Marsh, in Topock Gorge, along the shores of Lake Havasu (Arizona and California), on the Parker Strip, and on the Bill Williams River as far upstream as Kohen Ranch (L. Harter 2016, personal communication; M.A. McLeod, personal observation; S. Ketcham 2016, personal communication). Beetles continued to spread in 2017, arriving at Blythe, California, on the LCR (B. Bloodworth 2017, personal communication) and at Alamo Lake (McLeod et al. 2018b). Beetles were detected approximately 65 km south of Blythe at the Imperial National Wildlife Refuge in October 2018 (E. Munes 2018, personal communication). Tamarisk beetles (*D. carinulata* and *D. sublineata*) are also present on the Rio Grande in Texas and New Mexico, and in 2016, beetles arrived at breeding areas that support large numbers of flycatchers at Elephant Butte Reservoir, New Mexico (D. Moore 2016, personal communication).

BUREAU OF RECLAMATION PROJECT HISTORY

In 1995, the Bureau of Reclamation (Reclamation); other Federal, State, and Tribal agencies; and environmental and recreational interests agreed to form a partnership to develop and implement the Lower Colorado River Multi-Species Conservation Program (LCR MSCP) for long-term endangered species compliance and management in the historical floodplain of the LCR. As a step in developing the LCR MSCP, Reclamation prepared a biological assessment (BA) in August 1996, evaluating the effects of dam operations and maintenance activities on threatened, endangered, and sensitive (TES) species. These species included the flycatcher, which was listed by the USFWS as endangered in 1995 (60 FR 10694–10715). In response to the BA, the USFWS issued a biological opinion (BO) in April 1997, which outlined several terms and conditions Reclamation must implement in order not to jeopardize these species. Among these terms and conditions was the requirement to survey and monitor occupied and potential habitat for flycatchers along the LCR for a period of 5 years. The studies were intended to determine the number of flycatcher territories, status of breeding pairs, nest success, the biotic and abiotic characteristics of occupied flycatcher sites, and cowbird brood parasitism rates. In 2002, Reclamation reinitiated consultation with the USFWS on the effects of continued dam operations and maintenance of TES species along the LCR. The USFWS responded with a BO in April 2002, requiring continued flycatcher studies along the LCR through April 2005.

The LCR MSCP is a 50-year program that seeks to protect 27 TES species and their habitats along the LCR while maintaining river regulation and water management required by law. The LCR MSCP was approved in April 2005 with the signing of a Record of Decision by the Secretary of the U.S. Department of the Interior, and implementation of the program began in October 2005. Documentation for the LCR MSCP includes a Habitat Conservation Plan (HCP), a BA/BO, and an environmental impact statement. The HCP specifies monitoring and research measures that call for surveys and research to better define habitat requirements for the flycatcher and studies to determine the effects of cowbird nest parasitism on flycatcher reproduction. The HCP also calls for the creation of a system of conservation areas, where habitat would be created for the benefit of many species, including the flycatcher.

Reclamation initiated flycatcher studies along the LCR in 1996 in anticipation of the requirements outlined in the BOs that were part of LCR MSCP development. These studies have been conducted annually since 1996 and were completed in 1996–2002 by the San Bernardino County Museum and in 2003–18 by SWCA Environmental Consultants (SWCA). Prior to 2017, Reclamation's flycatcher studies included several breeding areas in southern Nevada, and color banding and intensive territory and nest monitoring were completed wherever territorial flycatchers were detected. Beginning in 2018, the geographic scope of the project was reduced to include only the LCR and portions of its major tributaries downstream from Hoover Dam, banding was largely discontinued, and intensive territory and nest monitoring was completed only in specific portions of the project area.

Throughout the history of this project, SWCA has designated "survey sites" (an area of riparian habitat that can generally be covered via presence/absence surveys by one person in a single morning) and grouped those survey sites geographically into "study areas." In 2013, a three-tiered geographic naming convention was instituted by the LCR MSCP that designates area, site, and section, with area covering the largest extent and section the smallest. SWCA's designation of "survey site" is equivalent to section. A study area does not always correspond to an LCR MSCP area; in some cases, a study area encompasses multiple areas, and in others, an area encompasses multiple study areas. The relationship of the LCR MSCP area and site classifications to the designations of survey site and study area is shown in attachment 1. Throughout this report, the terminology of survey site and study area is used for ease of comparison with earlier reports.

DESCRIPTION OF STUDIES

Study areas included in the project in 2018 (figure 1-2) are: (1) Topock Marsh (TOPO) and (2) Topock Gorge (TOGO), on the LCR, Havasu National Wildlife Refuge, Arizona; (3) Bill Williams (BIWI), along the Bill Williams River,

Figure 1-2.—Locations of southwestern willow flycatcher study areas along the LCR and its tributaries, 2018.
(Note: Study area labels represent the approximate center of multiple sites within that region.)

Arizona; (4) Alamo Lake (ALAM), Arizona; (5) Palo Verde Ecological Reserve (PVER), within the PVER Conservation Area north of Blythe, California; (6) Cibola (CIBO), along the LCR in and around the Cibola National Wildlife Refuge, Arizona and California; (7) Imperial (IMPE), along the LCR in and around the Imperial National Wildlife Refuge, Arizona and California; (8) Mittry Lake (MITT), along the LCR around Mittry Lake, Arizona and California; and (9) Yuma (YUMA), along the LCR between Yuma and the Southerly International Boundary with Mexico and along the Gila River between Yuma and Dome, Arizona.

Specific components of the 2018 study, and the chapters in which they are addressed, are as follows:

Chapter 2 – Site Descriptions. A general site description, including major types of vegetation and hydrological conditions, was completed for each survey site at least three times during the survey season. This chapter gives a general description of each survey site and discusses habitat quality and changes in habitat quality.

Chapter 3 – Presence/Absence Surveys and Territory Monitoring. Presence/absence surveys, following a five-survey protocol (per Sogge et al. 2010), were conducted at pre-selected survey sites. A portion of the sites are surveyed every 3 years, and these were surveyed in 2018. Territory monitoring (visiting locations of flycatcher detections with the intention of determining whether a territory was present and if it consisted of a single flycatcher or a pair) was completed at ALAM and within LCR MSCP conservation areas. More intensive territory monitoring, with the intention of locating flycatcher nests, was completed at TOPO and BIWI outside of conservation areas. This chapter presents the methodology and results of surveys and territory monitoring.

Chapter 4 – Resighting. Flycatchers were resighted during surveys and territory and nest monitoring activities. This chapter summarizes the number of banded and unbanded flycatchers detected, lists banded flycatchers that could be individually identified, and discusses between-year movements and dispersal.

Chapter 5 – Nest Monitoring and Nest Site Characteristics. Any flycatcher nests that were found at TOPO or BIWI outside of LCR MSCP conservation areas were monitored to determine nest fates. Data on surface hydrology, vegetation type, and microclimate were collected at these nest locations. This chapter summarizes nesting attempts, nest fates, and productivity for monitored flycatcher nests and reports the conditions of vegetation type, soil moisture, temperature, and humidity recorded at these nest sites.

Chapter 6 – Summary of Study Design Discussions. For ease of reference, this chapter summarizes all study design discussions from previous chapters.

Chapter 2 – Site Descriptions

INTRODUCTION

During each year of the flycatcher study, SWCA has formulated qualitative descriptions of the vegetation and soil moisture characteristics of each site surveyed for flycatchers or evaluated as a potential survey site. These descriptions make it possible to track changes in habitat conditions and quality over time.

METHODS

Site Selection

Survey sites were selected based on locations surveyed during previous years of flycatcher studies along the LCR (McLeod et al. 2018a) and reconnaissance on foot during the 2018 survey period. Reclamation biologist Chris Dodge guided and approved survey site selection. Survey sites in TOGO and those located south of Parker Dam but outside LCR MSCP conservation areas are currently surveyed every 3 years; these were surveyed in 2018. Some sites in BIWI were surveyed irregularly, but these were returned to the annual schedule starting in 2018 when they were included in the Middle Bill Williams National Wildlife Refuge as creditable acreage under the LCR MSCP. All sites that were surveyed irregularly were ones at which no territorial flycatchers had been detected in recent years and at which vegetation and hydrology were unlikely to change without a major flood event.

During the survey season, on-the-ground habitat reconnaissance and evaluation were conducted to locate additional potentially suitable flycatcher habitat and to re-evaluate areas visited in previous years and noted as having the potential to become suitable habitat. Personnel focused habitat reconnaissance and evaluation in areas that matched the criteria for suitable habitat (see “Habitat Suitability Criteria” below). If the reconnaissance site met the criteria for suitable habitat, the site was added to the survey site list and scheduled for surveys for the remainder of the season. If the reconnaissance site did not meet the criteria for suitable habitat, but field personnel judged that it could potentially mature and develop missing criteria in future years, the site was scheduled for re-evaluation in future seasons.

Field personnel were provided with high-resolution digital aerial photographs of all survey sites and potential survey sites. Aerial imagery was georeferenced and

overlain with an outline of the proposed survey area. Boundaries of a survey site were sometimes refined during the season based on conditions observed on the ground.

Habitat Suitability Criteria

Habitat suitability criteria (table 2-1) were developed to guide the evaluation of each site in terms of its suitability for flycatchers. The criteria were based upon habitat conditions documented in flycatcher territories along the LCR (McLeod and Pellegrini 2013; McLeod et al. 2008) as well as descriptions of suitable habitat in Sogge et al. (2010). Criteria were defined for both minimally suitable habitat and preferred nesting habitat. Any survey site could include both suitable and unsuitable habitat because boundaries were drawn to encompass the maximum known extent of suitable habitat, and unsuitable riparian vegetation contiguous with suitable habitat was often included as part of the survey areas. The presence of the various components of suitable and preferred habitat was evaluated based on data recorded during site descriptions.

Table 2-1.—Southwestern willow flycatcher habitat suitability criteria for suitable and preferred habitat along the LCR and tributaries

Habitat metrics and components		Suitable habitat	Preferred nesting habitat
Metric	Patch width	≥ 10 meters	≥ 20 meters
	Canopy height	≥ 4.5 meters	≥ 5.5 meters
	Canopy closure	≥ 85%	≥ 90%
Component	Midstory structural components[1]	Dense layer of vegetation to provide cover for nests	Dense layer of vegetation to provide cover for nests
		Dense twig structure for nest placement	Dense twig structure for nest placement
		Flight paths present within the midstory	Flight paths present within the midstory
	Surface water or saturated soil[2]	Present or absent	Present within or adjacent to woody vegetation in at least May and June

[1] Structural components are those that have been observed in the field but that have not been quantitatively measured as part of this project. Components are recognizable even though they are not measured.

[2] Standing water or saturated soil is required to maintain suitable vegetation structure. Suitable vegetation structure may persist for a few years without nearby wet soils.

Site Descriptions

Because vegetation structure and surface soil moisture conditions within riparian habitats are seasonally dynamic, field personnel completed site description forms (attachment 2) for each flycatcher survey site at least three times throughout the survey season: early season (mid-May), mid-season (mid-June), and late season (mid-July). Prior to completing any site descriptions, all field personnel received training in the identification of common woody riparian species and in estimating vegetation height and canopy closure. Vegetation composition (native versus exotic) at survey sites followed the definitions of Sogge et al. (2010) and the 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, (3) mixed-native: 50 to 90% of the vegetation at a site was native, or (4) mixed-exotic: 50 to 90% of the vegetation at a site was exotic. In addition to the overall vegetation composition, field personnel identified one or more vegetation types within the site and recorded the dominant overstory and understory species in each vegetation type. For each vegetation type, field personnel recorded visual estimates of overstory height (to the nearest meter [m]), understory height (to the nearest m), canopy closure (to the nearest 5%), whether wet soils were present within that vegetation type, and the percentage of the site occupied by that vegetation type.

Field personnel also recorded various metrics of surface hydrology for the site as a whole: percentage of soil within the site that was inundated, saturated, damp, or dry (to the nearest 5%, unless one category comprised only 1 or 2% of the site); depth of any standing water (to the nearest centimeter [cm] or nearest 5 cm if > 5 cm); and distance to water (to the nearest m) if no saturated or inundated soil (hereafter wet soils) was documented in the site. Surface soil moisture categories were qualitatively determined as follows: inundated soils were those that had water visible on the surface; soils were considered saturated if compression of the soil (e.g., by stepping on it) caused water to be expressed; soils were considered dry if squeezing a handful of soil did not result in the soil sticking together; and damp soils were any that did not have surface water and did not meet the criteria for either saturated or dry (i.e., compressing a handful of soil caused the soil to stick together, but no water was expressed). Field personnel also recorded information on the presence or absence of tamarisk beetles at the site and the condition (green, yellow/brown, defoliated, or refoliating) of any tamarisk within the site.

As part of each site description, field personnel provided a narrative description of the site and sketched the location of each vegetation type, surface water, and saturated soil on a map of the site that showed the site outline and aerial imagery. On each site description form, the observer selected a habitat suitability ranking on a scale of 1 to 5 based upon the observer's general impression, which was loosely guided by the criteria described above (see table 2-1). After the

conclusion of field season, information from the site description forms was used in conjunction with habitat photographs and comments in field notebooks and in survey data to formulate a comprehensive, qualitative description for each site and to assess habitat suitability.

RESULTS

Field personnel recorded site descriptions at 84 sites that were surveyed or monitored for flycatchers. Site descriptions were also recorded for an additional 17 sites that were evaluated for habitat suitability but were not formally surveyed (see orthophotos in attachment 3 for boundaries of survey and reconnaissance sites in 2018).

Hydrologic characteristics of each survey site are summarized in table 2-2.

Table 2-2.—Summary of hydrologic conditions by survey site, 2018*

Study area[1]	Survey site	Percent of site inundated[2]	Depth (cm) of surface water[2]	Percent of site with saturated soil[2,3]	Distance (m) to surface water or saturated soil[2]
TOPO	The Wallows	> 50 / 85 / > 20	1 / 8 / 3	– / 0 / –	0 / 0 / 0
	800M	> 10 / 65 / > 15	5 / 7 / 10	> 5 / 15 / > 10	0 / 0 / 0
	Swine Paradise[4]	0 / 5 / –	0 / 5 / –	5 / 3 / –	0 / 0 / –
	Platform[4]	1 / 2 / 3	5 / 5 / 6	1 / 1 / 2	0 / 0 / 0
	250M[4]	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	5 / 5 / 5
	Hell Bird[4]	– / 60 / 55	– / 30 / 35	– / 15 / 10	0 / 0 / 0
	Glory Hole[4]	> 10 / > 10 / 20	45 / 66 / 45	5 / 5 / 10	0 / 0 / 0
	Farm Ditch Road[4]	– / – / –	– / – / –	– / – / –	0 / 0 / 0
	CPhase 05[5]	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	20 / 15 / 15
	Lost Lake Slough 01[4]	– / – / –	– / – / –	– / – / –	0 / 0 / 0
	Lost Lake Slough 03[4]	70 / 85 / 40	15 / 10 / –	30 / 5 / 5	0 / 0 / 0
TOGO	Blankenship North[4]	– / – / –	– / – / –	– / – / –	0 / 0 / 0
	Blankenship South[4]	– / – / –	– / – / –	– / – / –	0 / 0 / 0
BIWI	Coyote Crossing[4]	1 / 25 / 5	20 / 3 / 15	3 / 10 / 5	0 / 0 / 0
	Bill Willow[4]	0 / 15 / 1	0 / 5 / 2	0 / 60 / 98	70 / 0 / 0
	Wispy Willow[4]	10 / 45 / 40	5 / 15 / 15	0 / 10 / 30	0 / 0 / 0
	Site 01[4]	10 / 10 / 10	3 / 3 / 5	5 / 40 / 40	0 / 0 / 0
	Burn Edge[6]	15 / – / –	30 / – / –	5 / – / –	0 / – / –

Table 2-2.—Summary of hydrologic conditions by survey site, 2018*

Study area[1]	Survey site	Percent of site inundated[2]	Depth (cm) of surface water[2]	Percent of site with saturated soil[2,3]	Distance (m) to surface water or saturated soil[2]
BIWI (cont.)	Site 04[4]	7 / 3 / 5	20 / 60 / 45	3 / 2 / 2	0 / 0 / 0
	Site 03	10 / 10 / 10	10 / 10 / 7	45 / 10 / 5	0 / 0 / 0
	Last Gasp	3 / 5 / 5	60 / 40 / 5	0 / 3 / 5	0 / 0 / 0
	Guinness	1 / 1 / 1	15 / 15 / 5	1 / 1 / 0	0 / 0 / 0
	Site 05	3 / 5 / 5	15 / 15 / –	20 / 5 / 5	0 / 0 / 0
	Beaver Pond North	6 / 15 / 15	15 / 15 / 15	4 / 5 / 5	0 / 0 / 0
	Beaver Pond	5 / 5 / 3	– / 15 / –	1 / 2 / 1	0 / 0 / 0
	Site 08	10 / 10 / 10	20 / 20 / 20	5 / 5 / 5	0 / 0 / 0
	Upstream Site 08[4]	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0
	Planet Ranch Road	8 / 8 / 8	50 / 50 / 50	1 / 1 / 1	0 / 0 / 0
ALAM	Bullard Wash[4]	10 / 10 / 10	100 / 100 / 100	0 / 0 / 80	0 / 0 / 0
	South Camp[4]	60 / 60 / 60	> 100 / > 100 / > 100	5 / 5 / 5	0 / 0 / 0
	Sidebar 01	0 / 0 / 5	0 / 0 / 50	10 / 10 / 5	0 / 0 / 0
	Camp 01[4]	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	2 / 2 / 2
	Camp 02[4]	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	10 / 10 / 10
	Camp 03[4]	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	10 / 10 / 10
	Middle Earth 01	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	500 / 700 / 520
	Middle Earth 02	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	485 / 350 / 500
	Prospect 01	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	600 / 1,000 / 700
	Burro Wash 01	10 / 3 / 0	5 / 20 / 0	60 / 7 / 0	0 / 0 / 200
	Burro Wash 02	5 / 0 / 0	5 / 0 / 0	30 / 0 / 0	0 / 370 / 610
	Motherlode 01	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	300 / 300 / 300
	Motherlode 04	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	70 / 500 / 100
	Santa Maria North 01	< 1 / < 1 / < 1	30 / – / –	0 / 0 / 0	0 / 0 / 0
PVER	Phase 02[5]	0 / 0 / 30	0 / 0 / 15	0 / 0 / 10	9 / 5 / 0
	Phase 03[5]	20 / 50 / –	3 / 10 / –	10 / 0 / –	0 / 0 / –
	Phase 04 Block 01[5]	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	7 / 56 / 56
	Phase 04 Block 02[5]	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	20 / 20 / 20
	Phase 04 Block 03[5]	60 / 0 / 0	3 / 0 / 0	10 / 0 / 0	0 / 145 / 145
	Phase 05 Block 01[5]	50 / 0 / 0	5 / 0 / 0	16 / 0 / 0	0 / 25 / 25
	Phase 05 Block 02[5]	10 / 0 / 0	6 / 0 / 0	35 / 0 / 0	0 / 25 / 25
	Phase 05 Block 03[5]	20 / 0 / 0	6 / 0 / 0	5 / 0 / 0	0 / 97 / 97

Table 2-2.—Summary of hydrologic conditions by survey site, 2018*

Study area[1]	Survey site	Percent of site inundated[2]	Depth (cm) of surface water[2]	Percent of site with saturated soil[2,3]	Distance (m) to surface water or saturated soil[2]
PVER (cont.)	Phase 06 Block 01[5]	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	15 / 78 / 97
	Phase 06 Block 02[5]	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	12 / 25 / 25
	Phase 07 Block 01[5]	0 / 20 / 15	0 / 8 / 5	0 / 15 / 20	110 / 0 / 0
	Phase 07 Block 02[5]	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	123 / 123 / 123
CIBO	Phase 01[5]	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	10 / 10 / 10
	Phase 02[5]	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	9 / 470 / 470
	Phase 03[5]	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	10 / 415 / 10
	Upper Hippy Fire[5]	< 1 / < 1 / < 1	4 / 4 / 4	5 / 0 / 5	0 / 0 / 0
	Nature Trail[5]	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	4 / 420 / 1,800
	C2729[5]	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	470 / 10 / 10
	Cibola Site 02	50 / 50 / 50	– / – / –	5 / – / –	0 / 0 / 0
	Cibola Site 01	40 / 40 / 40	– / – / –	5 / – / –	0 / 0 / 0
	Cibola Lake North[4]	1 / – / –	3 / – / –	1 / – / –	0 / 0 / 0
	Cibola Lake East[4]	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0
	Cibola Lake West[4]	1 / – / –	3 / – / –	1 / – / –	0 / 0 / 0
	Walker Lake[4,6]	30 / – / –	30 / – / –	0 / – / –	0 / – / –
IMPE	Rattlesnake[4]	100 / 20 / 0	25 / 15 / 0	0 / 70 / 0	0 / 0 / –
	Imperial NW[4]	80 / 80 / 10	10 / 20 / –	10 / 10 / 0	0 / 0 / 0
	Imperial Nursery	85 / < 1 / 0	5 / 3 / 0	10 / 0 / 0	0 / 0 / 20
	Ferguson Lake[4]	– / – / –	– / – / –	– / – / –	0 / 0 / 0
	Ferguson Wash[4]	1 / 1 / 1	– / 5 / –	0 / < 1 / 0	0 / 0 / 0
	Great Blue Heron[4]	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	130 / 130 / 130
	Powerline[4]	0 / 20 / 0	0 / 30 / 0	0 / 5 / 0	0 / 0 / –
	Martinez Lake[4]	0 / 0 / 0	0 / 0 / 0	0 / 10 / 0	0 / 0 / 0
MITT	Mittry West	20 / 20 / 0	10 / 3 / 0	10 / 10 / 15	0 / 0 / 0
	C4911[5]	90 / 0 / 0	15 / 0 / 0	0 / 0 / 0	0 / 75 / 75
	C4913[5]	90 / 0 / 0	15 / 0 / 0	0 / 0 / 0	0 / 80 / 80

Table 2-2.—Summary of hydrologic conditions by survey site, 2018*

Study area[1]	Survey site	Percent of site inundated[2]	Depth (cm) of surface water[2]	Percent of site with saturated soil[2,3]	Distance (m) to surface water or saturated soil[2]
YUMA	C4703[5]	< 1 / 3 / 0	5 / 20 / 0	0 / 2 / 0	0 / 0 / 10
	C4711[4]	2 / 2 / 2	100 / 20 / 20	0 / 0 / 0	0 / 0 / 0
	C4702[5]	0 / < 1 / 0	0 / 10 / 0	0 / 0 / 0	0 / 0 / 160
	Gila Confluence North[4]	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	15 / 15 / 15
	Gila River Site 02[4]	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	10 / 10 / 10
	Fortuna Site 01[4]	30 / 10 / 10	10 / 10 / 10	20 / 0 / 0	0 / 0 / 0
	Fortuna North[4]	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0

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

[1] TOPO = Topock Marsh, TOGO = Topock Gorge, BIWI = Bill Williams, ALAM = Alamo Lake, PVER = Palo Verde Ecological Reserve, CIBO = Cibola, IMPE = Imperial, MITT = Mittry Lake, and YUMA = Yuma.
[2] – = Hydrologic information not recorded.
[3] Percent of site with saturated soil does not include inundated areas.
[4] Site borders marsh, river, lake, or pond.
[5] Site is irrigated as part of restoration efforts; amount of standing water highly variable throughout survey season.
[6] Surveys discontinued because of poor habitat quality.

Topock Marsh, Arizona

Topock Marsh lies within the Havasu National Wildlife Refuge and encompasses over 3,000 hectares (ha) of open water, cattail (*Typha* spp.) and bulrush (*Schoenoplectus californicus*) marsh, and riparian vegetation. A large expanse (over 2,000 ha) of riparian vegetation occupies the LCR floodplain between the river on the western edge of the floodplain and the open water of Topock Marsh on the eastern edge of the floodplain. TOPO is located in this large expanse of riparian vegetation, which is primarily monotypic tamarisk with isolated patches of tall Goodding's willows (*Salix gooddingii*). Seasonally wet, low-lying areas are interspersed throughout the riparian area. Survey site elevation within the study area is 140 m. Marsh elevation data recorded at the South Dike gaging station show that water levels within Topock Marsh declined during the flycatcher breeding season and were 0.01–0.16 m higher throughout the 2018 survey season than they were on the corresponding day in 2017 (figure 2-1). In August 2015, a wildfire burned through TOPO north of the Firebreak Canal, consuming all or most of each survey site within the burned area. Habitat within the burned area continued to regenerate in 2018 but is still completely unsuitable for flycatchers in most areas. Two survey sites affected by the 2015 fire, The Wallows and 800M, regenerated sufficiently to be surveyed along with sites south of the Firebreak Canal in 2018. Tamarisk beetles and patchy defoliation were noted in TOPO in May, and the first full defoliation occurred by mid-June. Feral pigs have been historically present throughout TOPO, but in 2018 evidence of pigs was observed only in the Hell Bird, Lost Lake Slough 03, and Lost Lake Slough 04 survey sites.

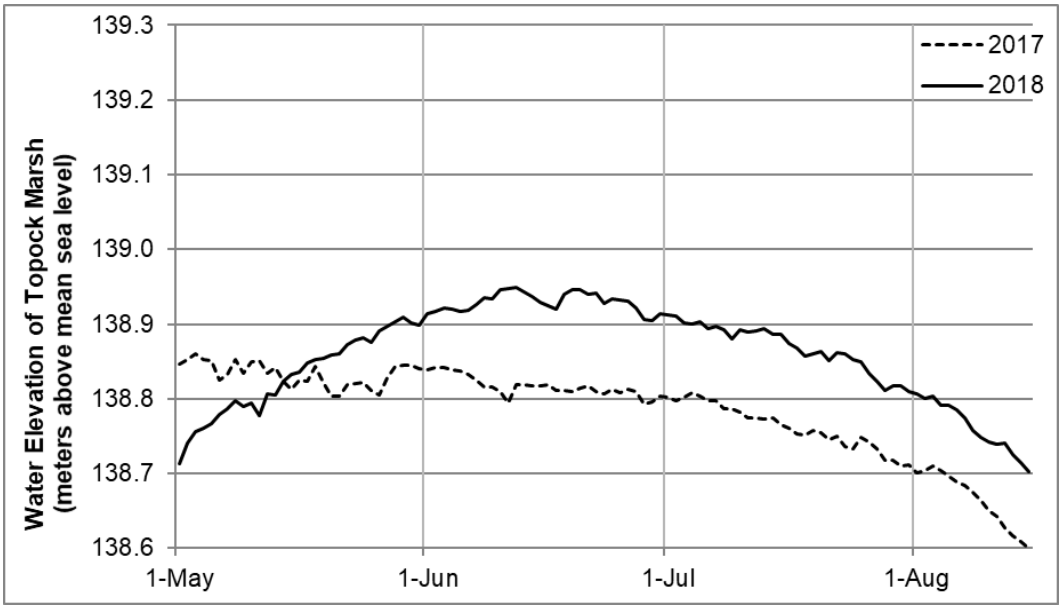

Figure 2-1.—Daily water elevation (meters above sea level) measured at the South Dike at Topock Marsh, May – August, 2017–18.

The Wallows

SWCA surveyed the site known as The Wallows from 2005 to 2015. Surveys were discontinued after a fire completely consumed the site in August 2015. Vegetation within portions of the site had recovered substantially by the start of the 2018 season, and surveys were resumed. The site originally encompassed tamarisk-dominated areas that are now vegetated with 2–4-m-tall tamarisk mixed with 2-m-tall arrowweed (*Plucea sericea*). These portions have canopy closure < 40% and were not surveyed in 2018. The current survey boundary encompasses a 10-m-wide stand of 6–7-m-tall Goodding's willows that rings the western end of an open cattail marsh. The Goodding's willows have an understory of cattails, and 3–4-m-tall coyote willows (*Salix exigua*) and a few Fremont cottonwoods (*Populus fremontii*) (hereafter cottonwood) are present along the edges of the Goodding's willows. Canopy closure is 40% along the edge of the Goodding's willow stand and 75% in the center.

Wet soils were present in the cattail marsh and surrounding willows when each site description was recorded (see table 2-2). Soils away from the marsh and willows were primarily dry and sandy or, in a few places, damp. Water levels within the site are dependent on the elevation of Topock Marsh, which increased gradually in 2018 to a peak in mid-June and then decreased gradually (see figure 2-1). Soil moisture conditions therefore likely did not fluctuate substantially from day to day.

Canopy closure within this site does not exceed 75%; thus, the site does not meet all the criteria for suitable habitat (see table 2-1). Stand width also barely meets the criterion for suitable habitat. Vegetation structure is likely to continue developing in future years.

800M

SWCA surveyed the site known as 800M from 2003 to 2015. Surveys were discontinued after a fire consumed most of the site in August 2015. Vegetation in the portions of the original site that were severely burned now consists of tamarisk 2 m in height sprouting from burned snags. Canopy closure is < 20%, and these areas were not surveyed in 2018. The current survey area is approximately 100 m north of the refuge road and was not as severely affected by the fire. It consists of a 150- x 60-m stand of 4–6-m-tall tamarisk with scattered cattails and saltmarsh fleabane (*Pluchea odorata*). The tamarisk stand is bordered to the north and east by a cattail and bulrush marsh. At the beginning of the season, canopy closure was typically 70–80% but was as low as 50% near the marsh and as high as 85% in the very northern and southern edges of the patch. Canopy closure decreased as the tamarisk became defoliated. When the May and June site descriptions were recorded, adult and larval tamarisk beetles were present, and approximately 30% of the tamarisk foliage was green while the rest was yellow/brown. All the tamarisk foliage was yellow/brown during a visit in July, but no data on the presence of tamarisk beetles were recorded.

Wet soils were present in the marsh and in the tamarisk south and east of the marsh when each site description was recorded (see table 2-2). Water levels within the site are dependent on the elevation of Topock Marsh, which increased gradually in 2018 to a peak in mid-June and then decreased gradually (see figure 2-1). Soil moisture conditions therefore likely did not fluctuate substantially from day to day.

All characteristics of suitable habitat are present where canopy closure reaches the minimum suitable value (see table 2-1). Vegetation height and density may continue improving in future years, and habitat suitability would be improved if the tamarisk were fully foliated throughout the season.

Swine Paradise

The survey site known as Swine Paradise is adjacent to and south of the Firebreak Canal. Vegetation is mixed-exotic and consists of tamarisk 3–8 m in height and scattered, emergent Goodding's willows up to 18 m in height. Both the tamarisk and Goodding's willows are significantly shorter in the southern quarter of the site, with no woody vegetation exceeding 8 m in height. A dense, 40- x 60-m patch of coyote willows 4–7 m in height is present in the northeastern corner of the site, adjacent to the Firebreak Canal, with the shorter trees in this range being

on the eastern edge of the site, adjacent to the open marsh. The tamarisk are tallest adjacent to the coyote willow patch. Large patches of arrowweed dominate the understory in the southern half of the site. Canopy closure is 70–90% under the Goodding's willows and coyote willows and reaches 80% in the densest tamarisk. The tamarisk were yellow/brown throughout the field season, and adult tamarisk beetles were present in mid-June. Field personnel did not record data on the presence or absence of beetles on other visits.

Saturated or inundated soils were present along the eastern edge of the coyote willow patch when the May and June site descriptions were recorded (see table 2-2), but the remainder of the site was dry. Surface hydrology conditions were not described in July. Swine Paradise borders the open water of Topock Marsh, and water levels within the site vary directly with those in Topock Marsh (see figure 2-1); therefore, water levels did not fluctuate substantially from day to day.

Suitable and preferred nesting habitat occurs in areas where canopy closure reaches sufficient levels (see table 2-1). Habitat suitability would be improved if the tamarisk were fully foliated throughout the season.

Platform

The survey site known as Platform is 450 m southwest of Swine Paradise, between the main refuge road to the west and an open bulrush and cattail marsh to the east. Vegetation at the site is exotic and consists primarily of monotypic tamarisk 8–10 m in height with a few emergent Goodding's willows 15–18 m in height. A few screwbean (*Prosopis pubescens*) and honey (*Prosopis glandulosa*) mesquite trees are present along the western edge of the site. Two disjunct patches of coyote willows up to 5 m in height are present along the eastern edge, adjacent to the marsh. The northern patch is approximately 60 m long and 5–10 m wide, though some scattered coyote willows extend into the site up to 30 m from the eastern edge. The southern coyote willow patch is approximately 35 x 60 m in size. Canopy closure is 70% in the coyote willows and reaches 85% in the densest tamarisk. Most of the tamarisk foliage was yellow/brown throughout the season, and tamarisk beetles were present in May and June. Field personnel did not record data on the presence or absence of beetles in July.

Wet soils were present along the very eastern edge of the site bordering the marsh when each site description was recorded (see table 2-2), but the remainder of the site was very dry. Platform borders the open water of Topock Marsh, and water levels within the site vary directly with those in Topock Marsh (see figure 2-1); therefore, water levels did not fluctuate substantially from day to day.

Canopy closure barely met the criterion for suitable habitat (see table 2-1) during the defoliated conditions in 2018. The interior of the site has an extremely dense

midstory and lacks the flight paths typical of suitable and preferred habitat. Habitat suitability would be improved if the tamarisk were fully foliated throughout the season.

250M

The survey site known as 250M is 100 m south of Platform, between the main refuge road to the west and open marsh to the east. Vegetation is mixed-exotic, and composition and structure vary with distance from the road. Most of the site is vegetated in tamarisk 4–8 m in height, which is shorter near the road and taller near the eastern side of the site. A few emergent Goodding's willows approximately 12–15 m in height are present in the north-central portion of the site, and honey mesquite 6–9 m in height are scattered in the southern half. A patch of coyote willows 45 x 90 m in size and 4–6 m in height is present along the northern edge of the site. The coyote willow stems are sparse and emerge through heaps of fallen coyote willow stems. Canopy closure ranges from 30% in the coyote willows to 75% under the honey mesquites. The tamarisk had yellow/brown foliage in May and June, and portions of the tamarisk were refoliating in July. Tamarisk beetles were present in both June and July. Field personnel did not record data on the presence or absence of beetles in May.

Damp soil was present in approximately 5% of the site when the July site description was recorded; all other soils observed during site description visits were dry (see table 2-2). 250M borders the open water of Topock Marsh, and water levels within the site vary directly with those in Topock Marsh (see figure 2-1); therefore, water levels did not fluctuate substantially from day to day.

The interior of the site lacks the wet soils typical of preferred habitat and the flight paths in the understory typical of suitable habitat (see table 2-1). Canopy closure is also too low to meet the criterion for suitable habitat in any portion of the site.

Hell Bird

The survey site known as Hell Bird is on an island separated from the main riparian area by a narrow, deep channel. The site is bordered to the north by the open channel and to the east and south by marshes. Vegetation is mixed-exotic, and vegetation composition and structure are highly variable. The site is vegetated with a mosaic of tamarisk 4–8 m in height and Goodding's willows 12–15 m in height. Screwbean mesquite 4–6 m in height and arrowweed are also scattered throughout the site, and coyote willows 2–4 m in height are present along the northern edge. Marshes vegetated by cattails and bulrush are interspersed throughout the site, totaling approximately 30% of the site's areal extent. Canopy closure in areas of monotypic tamarisk is widely variable and reaches 70% in the densest areas. Patches of tamarisk were yellow in May and

June, and most of the tamarisk had brown foliage in mid-July. Tamarisk along the southeastern edge of the site, which was occupied by nesting flycatchers (see chapters 3 and 5), were partially brown in June but mostly green with a few brown tips in mid-July. Tamarisk beetles were present in both June and July. Field personnel did not record data on the presence or absence of beetles in May. Canopy closure was not thoroughly described for all areas with Goodding's willows, but it was > 85% along the southeastern border (A. Pellegrini, personal observation).

The marshes were inundated up to 30–45 cm in depth when each site description was recorded (see table 2-2). Adjacent soils were primarily dry, though some damp soils were noted. The marshes in the site are connected to Topock Marsh, and water levels within the site vary directly with those in the marsh (see figure 2-1); therefore, water levels did not fluctuate substantially from day to day.

Canopy closure was too low throughout the season to meet the suitability criterion in tamarisk-dominated areas (see table 2-1). Preferred nesting habitat is present in at least some portions of the site where Goodding's willows are present. Habitat suitability would be improved if the tamarisk were fully foliated throughout the season.

Glory Hole

The survey site known as Glory Hole is contiguous with and immediately to the southwest of Hell Bird. The site is bordered on the north by a sand dune and on other sides by a mix of woody vegetation and marshes. Vegetation is mixed-exotic, and vegetation composition and structure are highly variable. The site is vegetated primarily by a mosaic of tamarisk 6–8 m in height and Goodding's willows 12–18 m in height. Screwbean mesquite trees 9–10 m in height are also scattered throughout the site. Marshes vegetated by cattails and bulrush are interspersed throughout the site. Canopy closure is 60–90% in areas with Goodding's willows but does not reach 85% in tamarisk-dominated areas. Patches of tamarisk were yellow or defoliated throughout the season. Tamarisk beetle larvae were noted during two surveys in June, and beetles were also present in July. Field personnel did not record data on the presence or absence of beetles in May.

The marshes, totaling approximately 30% of the areal extent of Glory Hole, were inundated with 45–75 cm of water when each site description was recorded (see table 2-2). Adjacent soils were primarily dry, although extensive areas of damp soil were noted following a storm in July. The marshes in the site are connected to Topock Marsh, and water levels within the site vary directly with those in the marsh (see figure 2-1); therefore, water levels did not fluctuate substantially from day to day.

Portions of the site dominated by Goodding's willows where canopy closure meets the suitability criterion have all the components of suitable habitat (see table 2-1). Canopy closure is too low in the remainder of the site to meet the suitability criterion.

Farm Ditch Road

The survey site known as Farm Ditch Road is on the north side of Farm Ditch, about 500 m west of the boat launch to Glory Hole and Hell Bird. The interior of the site was described in 2015, at which time suitable habitat was noted along Farm Ditch, and the site was added to the annual survey list. Although areas of suitable habitat are as close as 10 m to the road that parallels the south side of Farm Ditch, they are very difficult to access on foot, being separated from the road by a high, steep bank and a deep channel. All suitable habitat is located within 50 m of the road, however, and it was determined that surveys would be conducted from the road. Because the site was surveyed primarily from the road in 2018, a thorough assessment of vegetation structure and hydrology is not available. The southern edge of the site consists of a mosaic of coyote willows, tamarisk, and honey mesquite 5–7 m in height with canopy closure of 70–90%. Cattails and bulrush are present along the very southern edge of the site and occasionally extend into the site. When vegetation north of the coyote willows was last described in 2015, it was primarily 2–2.5-m-tall arrowweed and willow baccharis (*Baccharis salicina*) with emergent 4–6-m-tall tamarisk, screwbean and honey mesquite, and 8–10-m-tall Goodding's willows. The trees were widely spaced and did not form a closed canopy; canopy closure north of the coyote willows ranged from 0 to 40%. The tamarisk had yellow/brown foliage throughout the 2018 season, but no data regarding the presence or absence of tamarisk beetles were recorded.

The extent of wet soils within the site was unknown in 2018, but some wet soils likely existed given the presence of marsh vegetation extending into the site.

Habitat suitability was not thoroughly assessed in 2018, as surveys were primarily conducted from outside the site. Vegetation along the southern edge of the site appears to meet the criteria for preferred nesting habitat where canopy closure reaches 90% (see table 2-1); however, suitable habitat is limited in areal extent.

CPhase 05

The survey site known as CPhase 05 is 1.8 km south of Glory Hole within the Beal Lake Conservation Area. Vegetation consists of a mosaic of cottonwoods, Goodding's willows, coyote willows, honey mesquite, screwbean mesquite, and arrowweed, with some tamarisk scattered throughout the site. Canopy height is highly variable and averages approximately 3–5 m over most of the site and up to 18 m in the cottonwood stands. There are several areas where the mesquite

understory beneath the cottonwoods has died completely. Some patches of coyote willows are 50% dead. Canopy closure is 10–30% in areas dominated by mesquite and arrowweed. Canopy closure reaches 75% in areas with coyote willows and is 40–80% in the cottonwood stands.

No wet soils were observed when any of the site descriptions were recorded (see table 2-2). Approximately 40% of the site had damp soils when the July site description was recorded. The amount of wet soils within the site is highly variable because the site is flood irrigated and sandy soil allows the water to drain rapidly after irrigation.

Canopy closure is too low to meet the criterion for suitable habitat in any portion of the site (see table 2-1).

Lost Lake Slough 01

The survey site known as Lost Lake Slough 01 is located approximately 100 m south of the bridge on South Dike Road. SWCA evaluated this site as part of reconnaissance efforts in 2009, 2010, and 2013, but it was never added to the formal survey roster because of its small size (McLeod et. al 2018a). The site consists of a 35- x 65-m patch of 3–5-m-tall tamarisk with scattered 2–4-m-tall coyote willows and a few mesquite trees. The southern half of the site is dominated by snags and has 20% canopy closure, whereas the northern half has primarily live trees and 40–60% canopy closure. Aerial imagery suggests the presence of a patch of coyote willows approximately 10 x 35 m in size along the southwestern edge of the site, but this was not described in 2018. Adult tamarisk beetles were present when the June site description was recorded. Field personnel did not record data on the presence or absence of tamarisk beetles on other visits. The tamarisk were mostly green in May and were completely brown in late June.

The site is surrounded by marsh, and standing water up to 30 cm deep was present immediately adjacent to the site during each visit, but surface hydrology within the site was not described. Lost Lake Slough 01 borders open water south of Topock Marsh, and water levels within the site vary directly with those of the open water.

Canopy closure is too low to meet the criterion for suitable habitat in any portion of the site (see table 2-1). This site could be visited at the beginning of the next survey season to investigate the area along the southwestern edge of the site that may contain coyote willows. If reconnaissance reveals that this area does not meet the suitability criteria, surveys could be discontinued with minimal risk of overlooking suitable habitat.

Lost Lake Slough 03

The survey site known as Lost Lake Slough 03 is located between Lost Lake Slough 01 and the new South Dike Road. SWCA evaluated this site as part of reconnaissance efforts in 2009, 2010, and 2013, but it was never added to the formal survey roster because of poor habitat suitability. The area burned in a fire at the beginning of 2016. The western half of the original site boundary consists of scattered 1–2-m-tall arrowweed, tamarisk, and screwbean mesquite and a clumpy patch of coyote willows 3.5–6 m in height with no continuous canopy and 1-m-deep deadfall in the understory. This area was excluded from the site in 2018.

The current survey site is bordered to the north by marsh and to the south by dry uplands adjacent to the road. The northern arm of the site is dominated by tamarisk 7 m in height, whereas the remainder of the site is vegetated by coyote willows ranging in height from 4 m toward the western edge to 6 m in the center. The very southern edge of the site is dominated by scattered 1–2-m-tall arrowweed, tamarisk, and screwbean mesquite. Canopy closure in the coyote willows is 40% along the edges of the patch and 80–85% in the tallest vegetation. Canopy closure in the tamarisk was 85–90% in May, when the tamarisk had green foliage but many tamarisk beetle eggs. Canopy closure declined to 30–70% by mid-June, when all the tamarisk were brown and both larval and adult beetles were present. Field personnel did not record data on the presence or absence of tamarisk beetles in July, but all the tamarisk were yellow/brown.

Standing water was present in the site when each site description was recorded (see table 2-2). Lost Lake Slough 03 borders open water south of Topock Marsh, and water levels within the site vary directly with those of the open water.

Prior to defoliation, all components of suitable and preferred nesting habitat (see table 2-1) were present in the tall, dense tamarisk in the northern arm of the site. The coyote willows in the southern portion of the site, however, barely meet the canopy closure criterion for suitable habitat. During defoliation in 2018, canopy closure in the tamarisk failed to meet the criterion for suitable habitat, although the other components of preferred nesting habitat were still present.

Reconnaissance

Pipes 01

Surveys at Pipes 01 were discontinued after the site was completely consumed in a fire in August 2015. Prior to the fire, Pipes 01 consisted of tamarisk 6–8 m in height with arrowweed occurring in dense patches within 50 m of the refuge road. The site now consists of tamarisk 1–3 m in height sprouting from the bases of charred snags. Canopy closure is < 20%. Arrowweed 2–3 m in height is present in the northeastern corner of the site, near the refuge road. Approximately 40% of

the tamarisk in the site were yellow/brown when the site was visited in May, and tamarisk beetle adults and larvae were present. All soils were dry. Vegetation at the site lacks all structural characteristics of suitable flycatcher habitat (see table 2-1), but some characteristics could develop as the site regenerates.

Pipes 03

Surveys at Pipes 03 were discontinued after the site was completely consumed in a fire in August 2015. Prior to the fire, Pipes 03 was vegetated primarily by tamarisk, with arrowweed occurring in dense patches within 50 m of the road. A few emergent Goodding's willows and open areas with willow baccharis and bulrush were present in the southern portion of the site. The site now consists primarily of 2–3-m-tall tamarisk sprouting from the bases of charred snags. Arrowweed is common near the road and also occurs in a dense 50- x 60-m patch near the northwestern corner of the site. In the southern half of the site, there are two small (< 10 x 10 m) clumps of Goodding's willows 6–7 m in height with 3-m-tall coyote willows growing in one of the clumps. Three patches of mostly dead cattails are present in the central portion of the site. Canopy closure does not exceed 30% anywhere in the site and is highest in the Goodding's willows. Saturated soils and some small, 3-cm-deep puddles were present in the southern half of the site, near the Goodding's willows, when the site was visited in May. Approximately 30% of the tamarisk were yellow/brown, and tamarisk beetle larvae were present. Vegetation at the site currently lacks all structural characteristics of suitable flycatcher habitat (see table 2-1), but some characteristics could develop as the site regenerates.

PC 6-1

Surveys at PC 6-1 were discontinued after the site was completely consumed in a fire in August 2015. Prior to the fire, PC 6-1 was vegetated primarily by tamarisk with scattered, emergent Goodding's willows in the southern two-thirds of the site. Arrowweed occurred in thick stands near the eastern edge and in the southern portion of the site. The site now consists primarily of 2–3-m-tall tamarisk sprouting from the bases of charred snags. Arrowweed dominates the eastern, western, and southern borders of the site. Small (< 10 x 10 m) patches of Goodding's willows 6–7 m in height are present in the southern half of the site, and two patches of cattails, one of which had water 2 cm in depth during the visit in May, are present in the northern half. Canopy closure does not exceed 30% anywhere in the site. A few tamarisk beetle larvae were observed, and most of the tamarisk were green. Vegetation at the site currently lacks all structural characteristics of suitable flycatcher habitat (see table 2-1), but some characteristics could develop as the site regenerates.

Pig Hole

Surveys at Pig Hole were discontinued after the site was completely consumed in a fire in August 2015. Prior to the fire, the site was vegetated almost entirely with tamarisk, although a few dense patches of arrowweed were present on the eastern edge. Most of the site now contains 2-m-tall tamarisk sprouting from the bases of charred snags. In the eastern quarter of the site, the tamarisk are 1–4 m in height, and arrowweed is present along the eastern edge. Cattails are also present in the eastern quarter of the site, although most are dead. Canopy closure does not exceed 10% anywhere in the site. Almost all observed soils were dry when the site was visited in May, though some damp soils were noted in areas with cattails. Almost all tamarisk were green, though tamarisk beetle eggs, larvae, and adults were all noted in the site. Vegetation at the site currently lacks all structural characteristics of suitable flycatcher habitat (see table 2-1), but some characteristics could develop as the site regenerates.

In Between

Surveys at In Between were discontinued after the site was completely consumed in a fire in August 2015. Prior to the fire, the site was vegetated entirely with tamarisk. The site now primarily consists of 1–2-m-tall tamarisk sprouting from the bases of charred snags. Cattails are interspersed with the tamarisk in the southeastern corner, center, and along the northern edge of the site. A few 3-m-tall Goodding's willows are present in the southeastern corner of the site. Arrowweed 2 m in height is present along the eastern border of the site. Canopy closure does not exceed 10% anywhere in the site. Soils in most of the areas with cattails were damp, and standing water 3 cm deep was noted in a small (0.5 x 1 m) depression on the northern edge of the site. Otherwise, all observed soils were dry during the visit in May. Most tamarisk were green during the May visit, and the presence or absence of tamarisk beetles was not noted. Vegetation at the site currently lacks all structural characteristics of suitable flycatcher habitat (see table 2-1), but some characteristics could develop as the site regenerates.

Pierced Egg

Surveys at Pierced Egg were discontinued after the site was completely consumed in a fire in August 2015. Prior to the fire, vegetation consisted of dense tamarisk with a scattered overstory of Goodding's willows. Patches of cattails and bulrush were scattered throughout the site. The site now consists of tamarisk sprouting from the bases of charred snags. The tamarisk sprouts range in height from 1 to 6 m, but most of them are 3–5 m in height. Arrowweed is prevalent along the southern and western borders of the site and in a small patch on the northern border. Several small (< 10 x 10 m) clumps of Goodding's willows up to 5 m in height are sprouting from the bases of Goodding's willow snags in the western and southern portions of the site and just beyond the northeastern boundary. A patch of cattails in the southwestern portion of the site is mostly dead, whereas a

patch of green cattails is present in the southeastern portion. Soils in the dead cattail patch were damp, and 2 cm of standing water were present in the green cattails when the site was visited in May. Old pig wallows in the north-central portion of the site contained 3–8 cm of water. Almost half of the soils in the site were damp during the visit, and the remaining soils were dry. Most of the tamarisk were yellow/brown during the visit in May, and adult tamarisk beetles were abundant in the southern half of the site. Vegetation at the site currently lacks all structural characteristics of suitable flycatcher habitat (see table 2-1), but some characteristics could develop as the site regenerates.

Lost Lake

Surveys at Lost Lake were discontinued after the site was heavily damaged in a fire early in 2016. The site is 4 km southeast of CPhase 05 and is separated from the Colorado River to the southwest by a low ridge of barren sand dunes and bordered to the northeast by marshy areas. The unburned portion of the site consists of a narrow (< 40 m wide) strip of mixed-native riparian vegetation. The northern portion of the unburned area consists of an overstory of planted cottonwoods 20 m in height on the edge of a cattail marsh, with an understory of 6-m-tall tamarisk, screwbean mesquite, and willow baccharis. Half of the cottonwoods are dead, and none of the canopies are interlocking; canopy closure is 20–60% in this portion of the site. Along the southeastern border of the site, there is a narrow, 5-m-wide strip of coyote willows 5 m in height bordered by tamarisk and screwbean mesquite. Canopy closure within the coyote willow strip was not described in 2018. Within the remainder of the original site boundary, vegetation is starting to regenerate. In the northwestern portion of the original site, clumps of 4–5-m-tall coyote willows are present in a patch approximately 75 x 30 m in size with 70% canopy closure. A majority of the rest of the site contains 2–3-m-tall arrowweed with a few scattered 5-m-tall mesquite. Canopy closure in this portion of the site does not exceed 5%. Most of the tamarisk were green when the visit was visited in May, though many tamarisk beetles were seen. Wet soils were present in the marsh immediately adjacent to the site and along the northern border of the site. Almost half of the soils in the site were damp and the remainder were dry to sandy. No portion of the site contains both suitable canopy closure and suitable patch width (see table 2-1). The coyote willows in the northwestern portion of the site have grown noticeably in the last year and might attain suitable structure in 1–2 years. Re-examination of the site at the beginning of future survey seasons would reduce the chance that suitable habitat is overlooked.

Lost Lake Slough 04

SWCA conducted habitat reconnaissance and opportunistic surveys at a site known as Lost Lake Slough 04 in 2009, 2010, and 2013. The site is approximately 85 m southwest of Lost Lake Slough 03, is bordered by a marsh

to the north and dry uplands to the south, and was heavily damaged in a fire in early 2016. The northern half of the site, adjacent to the marsh, consists of a band of coyote willows. In the eastern half of the site, the coyote willows are 4–5 m in height and are growing through thick deadfall, with 2-m-tall bulrush in the understory. The coyote willows in the western half are 4 m in height with scattered dead stems up to 6 m in height. Canopy closure in the coyote willows is < 80%. There is a 5–10-m-wide strip of 7-m-tall tamarisk in the western half of the site. The tops of the tamarisk are dead, and the foliage was brown during the visit in May. The southern edge of the site is dominated by a mix of tamarisk, arrowweed, and screwbean mesquite 2 m in height. Most of the site was inundated to a depth of 15–20 cm. Canopy height does meet the criterion for suitable habitat in some portions of the eastern half of the site, and canopy closure is too low throughout the site (see table 2-1). Re-examination of the area in 1–2 years would determine whether the coyote willows have increased in height or density and would reduce the chance that suitable habitat is overlooked.

Topock Gorge, Arizona

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. Starting in 2013, survey sites in the study area were put on the triennial survey schedule, and surveys were last conducted in 2015. Both sites surveyed in 2018 are in Blankenship Bend, which contains riparian and marsh vegetation along the eastern bank of the Colorado River adjacent to Blankenship Valley. The elevation in the study area is 138 m.

Blankenship North

Blankenship North is shaped like an inverted “L,” with a linear, 100-m-wide strip of riparian vegetation along the eastern edge of the site, and a 200-m-wide swath of vegetation that runs east-west along the northern edge of the site. These two portions of the site are nearly separated by a 5–70-m-wide strip of bulrush marsh. Vegetation along the eastern, upland edge of the site consists of honey mesquite 6 m in height that grades to tamarisk mixed with some honey mesquite and 4-m-tall common reed (*Phragmites australis*) and then to a few narrow, linear patches of coyote willows 5 m in height along the strip of marsh. Vegetation structure within the tamarisk is very dense. Due to the density of vegetation, field personnel conducted surveys from the site exterior. Canopy closure was not thoroughly assessed, although it was estimated to be at least 60% throughout the season. The northern portion of the site consists primarily of tamarisk 4–6 m in height with scattered honey mesquite, common reed, and arrowweed. Several small channels dominated by bulrush are braided throughout this portion of the site. A bulrush marsh also dominates the very western edge, along the main river

channel. Several emergent Goodding's willows 12–15 m in height are scattered in the northern portion of the site, primarily near the marsh that bisects the site. Most of the coyote willows in this portion of the site are 3–5 m in height and occur in narrow (5–10-m-wide) strips mixed with tamarisk along the edges of the bulrush channels. There is one patch of coyote willows 50 x 50 m in size at the northern end of the marsh that bisects the site. Trees in this patch are 5 m in height, and canopy closure is estimated to be at least 80%. Canopy closure was not assessed for the remainder of the northern portion of the site. Tamarisk within both portions of the site were partially to mostly yellow/brown throughout the season, and tamarisk beetle adults and larvae were present in mid- and late June. Field personnel did not record data on the presence or absence of tamarisk beetles in May or July.

The extent of wet soils within the site was unknown in 2018 (see table 2-2), but some wet soils were likely present given that marsh vegetation extends into the site. Soils along the upland border of the site were dry. Water levels within the site are directly influenced by those in the Colorado River, which fluctuate weekly and seasonally. Weekly fluctuations in groundwater levels at Blankenship Bend during the survey seasons of 2005–06, when water levels were measured via piezometer, were typically ≈30 cm (McLeod and Pellegrini 2013).

Habitat suitability was not thoroughly assessed in 2018. The largest coyote willow patch may meet the criteria for either suitable or preferred nesting habitat (see table 2-1), and examination of imagery on Google Earth suggests that this patch has increased in size over the last decade. Portions of the site that were dominated by tamarisk likely did not meet the canopy closure criterion for suitable habitat. Maintaining this site on the triennial survey schedule will ensure that any changes in habitat suitability will be noted in a timely manner.

Blankenship South

The survey site known as Blankenship South consists of a 100-m-wide strip of riparian vegetation along the eastern bank of Blankenship Bend. The eastern side of the site is bordered by dry upland and is vegetated primarily by 4–6-m-tall honey mesquite and 2–3-m-tall arrowweed. The honey mesquite and arrowweed transition into tamarisk up to 6 m in height. The tamarisk, in turn, grade into clumps of emergent Goodding's willows up to 12 m in height and patches of 4–6-m-tall coyote willows along the western edge of the site, which is bordered by bulrush marsh and open water. Vegetation structure within the tamarisk is very dense, and surveys were conducted from the exterior of the site on both the marsh and upland sides. Canopy closure was not directly observed in 2018 but was estimated at no higher than 85%. The tamarisk were mostly yellow/brown during visits in June and July, and tamarisk beetle larvae were present in mid-June. The site was not visited in May, and field personnel did not record data on the presence or absence of tamarisk beetles in July.

The extent of wet soils within the site was unknown in 2018 (see table 2-2), but some wet soils were likely present given that marsh vegetation extends into the site. All observed soils were dry along the upland border of the site. Water levels within the site are directly influenced by those in the Colorado River, which fluctuate weekly and seasonally. Weekly fluctuations in groundwater levels at Blankenship Bend during the survey season of 2005–06, when water levels were measured via piezometer, were typically ≈30 cm (McLeod and Pellegrini 2013).

Habitat suitability was not thoroughly assessed in 2018. Areas with emergent Goodding's willows may meet the criteria for either suitable or preferred nesting habitat, depending on canopy closure (see table 2-1). Portions of the site that were dominated by tamarisk likely did not meet the canopy closure criterion for suitable habitat. Maintaining this site on the triennial survey schedule will ensure that any changes in habitat suitability will be noted in a timely manner.

Bill Williams, Arizona

BIWI encompasses the Bill Williams River National Wildlife Refuge and the adjacent Planet Ranch property. The Bill Williams River National Wildlife Refuge contains the last expanse of naturally occurring native cottonwood-willow forest in the LCR region. The refuge encompasses over 2,500 ha along the Bill Williams River upstream of its mouth at Lake Havasu and contains a mixture of native forest, stands of monotypic tamarisk, beaver ponds, and cattail marsh. The Planet Ranch property is located adjacent to the upstream portion of the refuge and was incorporated into the LCR MSCP in 2015. Survey sites within BIWI are listed below from west to east, moving progressively farther upstream. Survey sites from Site 03 to Beaver Pond are within the Middle Bill Williams National Wildlife Refuge, which is acreage creditable to the LCR MSCP. The elevation within the study area ranges from 137 m in the Bill Williams River Delta to 171 m at Planet Ranch. Signs of burros (*Equus asinus*) were seen between the Mineral Wash area and the eastern border of the refuge. Tamarisk beetles were detected throughout the study area primarily during June and July, with limited observations in May. Water levels within survey sites in the Bill Williams River Delta in 2018 varied with the level of Lake Havasu (figure 2-2). The rate of discharge of the Bill Williams River (U.S. Geological Survey [USGS] Station #09426620, upstream of Site 05), was 0.0 cubic foot per second (cfs) throughout the flycatcher breeding seasons of 2015–17 (McLeod et al. 2018b). During this period, surface water was restricted to deep channels and beaver ponds, and vegetation within much of BIWI showed increasing signs of stress and mortality from the lack of water. Releases from Alamo Dam in 2018 resulted in a peak daily average flow of 2,870 cfs in mid-March and sustained flows of 10–15 cfs throughout the flycatcher breeding season (figure 2-3).

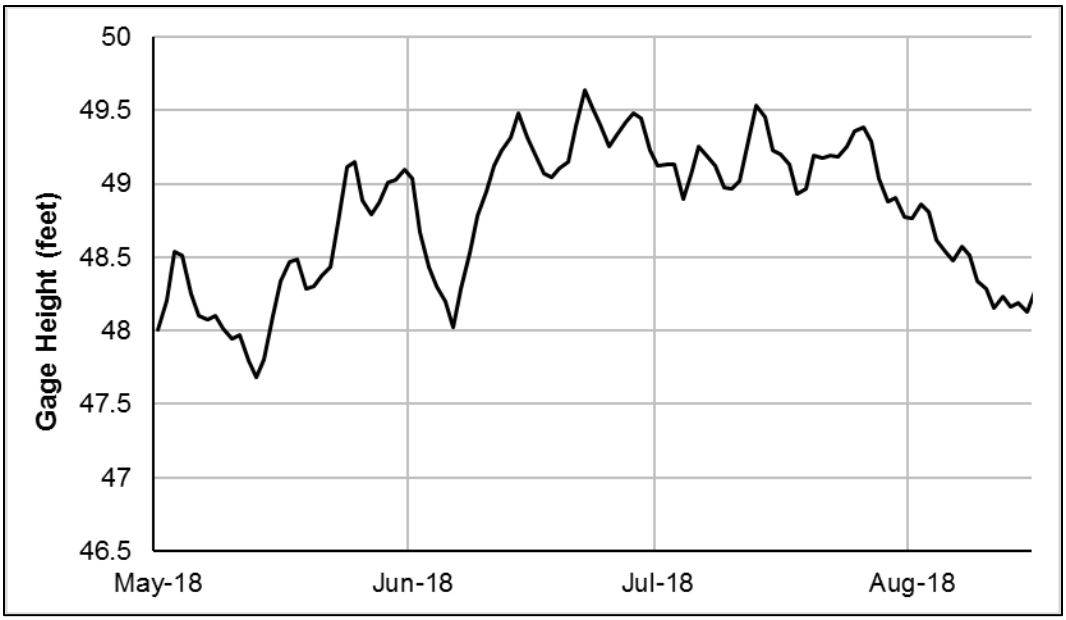

Figure 2-2.—Daily average gage height (feet) recorded at Lake Havasu near Parker Dam, Arizona (USGS Station #09427500), May 1 – August 15, 2018.
Data source: USGS 2018a.

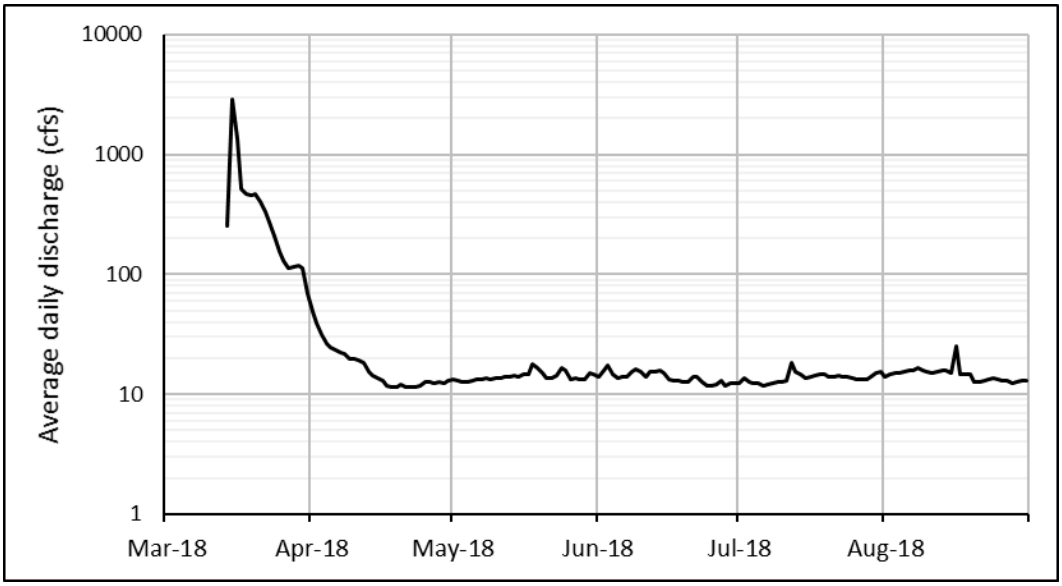

Figure 2-3.—Average daily discharge (cfs) recorded at the Bill Williams River near Parker, Arizona (USGS Station #09426620), March 1 – August 31, 2018.
Discharge prior to March 14 was 0.0 cfs and therefore does not appear on the logarithmic scale. Data source: USGS 2018b.

Coyote Crossing

The survey site known as Coyote Crossing forms a strip of riparian habitat in the very southwestern extent of riparian vegetation along the Bill Williams River. It is bordered by cattail marsh to the north, south, and west, and by the river to the east. Vegetation consists of 3–7-m-tall tamarisk with cattails around the periphery of the site. Canopy height is shortest near the southern and western edges where the tamarisk mix with cattails and is tallest along the northeastern edge near the river. Canopy closure ranges from 30 to 60% and varies directly with canopy height. The tamarisk were almost completely brown or defoliated throughout the field season, with a few small, green trees scattered in the site. No tamarisk mortality was noted. Tamarisk beetles were present in the site in late June. Field personnel did not record data on the presence or absence of beetles in May or July.

Wet soils were present within the site during each site description (see table 2-2). Standing water was noted during each site description in a small channel near the southern end of the site and occasionally in cattail marshes scattered throughout the site. This site is located within the Bill Williams River Delta, and water levels within the site vary directly with those in Lake Havasu (see figure 2-2).

Canopy closure throughout the site in 2018 did not meet the criterion for suitable habitat (see table 2-1), although the other components of preferred nesting habitat are present along the northeastern edge. Habitat suitability would be improved if the tamarisk were fully foliated throughout the season.

Bill Willow

The survey site known as Bill Willow is 250 m northeast of Coyote Crossing, at the very northwestern extent of riparian vegetation along the Bill Williams River and on the northern edge of an area that burned in 2006. It is bordered by cattail marsh to the north, east, and west and by riparian vegetation to the south. Vegetation within the site consists of 4–8-m-tall tamarisk with cattail stands in the understory, particularly near the northern and western borders. A few emergent, 9–15-m-tall Goodding's willows are present along the southern and eastern borders. Canopy closure is 40–50% in areas dominated by tamarisk. Canopy closure was not described in 2018 in areas with Goodding's willows.
The tamarisk had yellow/brown foliage or were defoliated during each site description. Tamarisk beetles were present in the site in late June and early July. Field personnel did not record data on the presence or absence of beetles in May.

Soils were completely dry when the May site description was recorded (see table 2-2). Wet soils covered most of the site when the June site description was recorded, and the entire site had wet soils when the July site description was recorded. This site is located within the Bill Williams River Delta, and water levels within the site vary directly with those in Lake Havasu (see figure 2-2).

Canopy closure throughout the tamarisk-dominated areas did not meet the criterion for suitable habitat (see table 2-1) in 2018. In 2017, the isolated Goodding's willows provided canopy closure that met the criterion for suitable or preferred nesting habitat, and it is possible that this was again the case in 2018. Habitat suitability would be improved if the tamarisk were fully foliated throughout the season.

Wispy Willow

The survey site known as Wispy Willow is 75 m southwest of Bill Willow and 60 m east of Coyote Crossing on the northern side of the Bill Williams River and the western edge of an area that burned in 2006. Vegetation composition is mixed-native. The western and southern portions of the site are vegetated primarily with 5–7-m-tall coyote willows occasionally mixed with tamarisk. Tamarisk 5–7 m in height dominate the northern arms and eastern side of the site and are scattered along the southern border. Small cattail marshes are scattered along the southern, western, and northern borders. Canopy closure is 70–90% within the coyote willows and as high as 70% within the tamarisk. Up to half of the tamarisk branches are dead. Of the remaining tamarisk, 75% were green and 25% were yellow during the May site description and almost all were brown during the June and July site descriptions. Tamarisk beetle eggs and larvae were present in mid-May, larvae were present in early June, and adults were present in early July.

Standing water was restricted to isolated cattail marshes and channels when the May site description was recorded and was present in almost half the site when the June and July site descriptions were recorded (see table 2-2). This site is located within the Bill Williams River Delta, and water levels within the site vary directly with those in Lake Havasu (see figure 2-2).

Canopy closure in the tamarisk-dominated portions of the site did not reach the values typical of suitable habitat in 2018, and substantial branch mortality may preclude suitable canopy closure being attained even if the remaining live branches were fully foliated. Some portions dominated by coyote willows have all the characteristics of preferred nesting habitat (see table 2-1).

Site 01

The survey site known as Site 01 is 60 m southeast of Wispy Willow and 200 m south of Bill Willow on the southern edge of an area that burned in 2006. The site is bordered to the west and south by cattail marsh along the main Bill Williams River channel and a side channel. Vegetation is mixed-native and consists of a mosaic of Goodding's willows, coyote willows, and tamarisk. Coyote willows 4–7 m in height form a dense stand along the southern, western, and northwestern borders of the site. The trees are larger in diameter along the southern edge of the site than along the northern edge. Several emergent Goodding's willows 12–15 m

in height are scattered throughout the site, while dense clumps of tamarisk 4–8 m in height are scattered throughout much of the central and eastern portions. Dense patches of arrowweed 2–3 m in height are also present in the center of the site. Canopy closure is approximately 80–90% within the coyote willows and 50–75% throughout the rest of the site. The tamarisk were mostly green when the May site description was recorded, and no tamarisk beetles were detected in May. The tamarisk were mostly brown during the June and July site descriptions, and beetle larvae were present in mid-June. Field personnel did not record data on the presence or absence of tamarisk beetles in July.

Wet soils were present within the site along the southern and western edges when each site description was recorded (see table 2-2). This site is located within the Bill Williams River Delta, and water levels within the site vary directly with those in Lake Havasu (see figure 2-2).

In places where canopy closure reaches 90%, the strip of coyote willows along the southern edge of the site has all the characteristics of preferred nesting habitat (see table 2-1). Most of the interior of the site lacks the dense canopy closure typical of suitable habitat and lacks the wet soils typical of preferred nesting habitat.

Burn Edge

The survey site known as Burn Edge is 675 m southeast of Site 01 near the northern edge of the Bill Williams riparian corridor and on the eastern edge of an area that burned in 2006. Vegetation is mixed-native and consists of an overstory of 12–15-m-tall Goodding's willows and 20-m-tall cottonwoods with an understory of 5–8-m-tall tamarisk. Several open areas with deadfall and little understory are present in the eastern half of the site. Some coyote willows, willow baccharis, mule-fat (*Baccharis salicifolia*), arrowweed, and honey mesquite are present in the understory in low abundance throughout the site. Canopy closure does not exceed 40%. An open area that was once a cattail marsh runs east-west through the center of the site. The tamarisk were a mixture of brown, defoliated, and dead during the site description in May. Tamarisk beetle larvae were present throughout the site in early June. Field personnel did not record data on the presence or absence of tamarisk beetles in May, and the site was not visited after early June.

Wet soils were present in a channel that runs through the center of the site when the May site description was recorded (see table 2-2). Most of the soils away from the channel were completely dry. This site is not located adjacent to a larger, open body of water, and water levels within the site were primarily influenced by the water table during the 2018 breeding season; therefore, water levels likely did not fluctuate substantially from day to day.

Canopy closure is much lower than 85%; thus, the site does not meet all the criteria for suitable habitat (see table 2-1). Midstory structural components are missing from several areas of the site as well. Surveys were discontinued after the first two visits because of the lack of suitable habitat. If water levels increased enough to fill the channel and wet soils persisted outside of the channel, the vegetation could increase in density and suitability. If flow in the Bill Williams River increases strongly in future years, re-evaluation of the site would reduce the chance that suitable habitat is overlooked.

Site 04

The survey site known as Site 04 is approximately 400 m south of Burn Edge on the southern edge of the riparian area. Vegetation is mixed-native and consists of an overstory of Goodding's willows 15–20 m in height with patches of tamarisk 3–7 m in height in the understory. Several 20-m-tall cottonwoods are scattered throughout the overstory as single trees or very small stands. Mule-fat, willow baccharis, honey mesquite, and patches of yerba mansa (*Anemopsis californicus*) are scattered throughout the site. Vegetation structure is highly variable. Deadfall is present in thick piles throughout much of the site. Canopy closure is 40–80% in the eastern portion of the site and as high as 60% in the western portion. Most of the tamarisk had yellow/brown foliage in mid-May and mid-June, and all the tamarisk had yellow/brown leaves in mid-July. Tamarisk beetle larvae were present in portions of the site in early June, and beetles were present in mid-July. Field personnel did not record data on the presence or absence of tamarisk beetles in May.

Surface water was present in the deep, backwater channel on the western side of the site when each site description was recorded (see table 2-2). The southeastern portion of the site also had surface water from a small spring when the June and July site descriptions were recorded; all other soils were dry. The backwater channel connects to the Bill Williams River Delta, and water depth within the channel is influenced by water levels in Lake Havasu, which did not fluctuate enough to result in overbank flooding (see figure 2-2). Given that neither lake nor river levels fluctuated strongly during the season, soil moisture conditions likely did not fluctuate substantially from day to day.

Much of the site lacks the midstory structural components typical of suitable habitat, and no portion of the site had canopy closure that met the suitability criterion in 2018 (see table 2-1). Overall habitat suitability has declined in recent years as trees and large limbs have fallen, decreasing overall canopy closure. Habitat suitability would be improved if the tamarisk were fully foliated throughout the season.

Site 03

The survey site known as Site 03 is contiguous with and immediately to the east of Site 04; together Site 03 and Site 04 are known as Mosquito Flats. Vegetation is mixed-native and consists of an overstory of Goodding's willows 15–25 m in height with patches of monotypic tamarisk 3–7 m in height. Several cottonwoods are scattered throughout the overstory, and mule-fat are scattered throughout the understory. The eastern half of the site has a small area where velvet ash (*Fraxinus velutina*) dominate the overstory. The understory in some areas is very open, and the ground in these areas is covered with thick yerba mansa. Many large willows and cottonwoods have fallen over the past several years, leaving large gaps in the canopy and creating patches of thick, dead, fallen woody vegetation. Canopy closure is variable and ranges from 40% in areas with little understory and large gaps in the overstory to 85% under the densest Goodding's willows and cottonwoods and in the area dominated by velvet ash. The tamarisk were mostly green, and very few tamarisk beetle larvae were present during the May site description. In mid-June, the tamarisk were 70–80% brown or defoliated, and many beetle larvae and a few adults were present. Many adult beetles were present in early July, and in mid-July, the tamarisk were still largely brown or defoliated.

Standing water and saturated soils were present when each site description was recorded (see table 2-2) and were more prevalent in the eastern half of the site. Given that neither lake nor river levels fluctuated strongly during the season (see figures 2-2 and 2-3), soil moisture conditions likely did not fluctuate substantially from day to day.

Suitable habitat is present in the few areas where canopy closure reaches 85%, but most of the site lacks the midstory structural components and dense canopy closure typical of suitable habitat (see table 2-1). As in Site 04, canopy closure has decreased in recent years as the large overstory trees have lost many limbs. Habitat suitability would be improved if the tamarisk were fully foliated throughout the season.

Last Gasp

Last Gasp is a narrow, mixed-native survey site along a channel on the northern edge of the Bill Williams River riparian area, approximately 375 m southeast of Burn Edge. This site was last formally surveyed in 2011 and was visited once in 2015 and in 2016. Surveys were discontinued for the remainder of the 2015 and 2016 seasons because of low canopy closure and poor habitat suitability. Vegetation consists of a broken overstory of 15–20-m-tall cottonwoods and 8–10-m-tall Goodding's willows with a clumpy understory of tamarisk 4–7 m in height. The tops of many of the Goodding's willows are dead, and the live portions of these trees are generally 6–7 m in height. Some of the healthier Goodding's willows have live crowns to 12 m in height. In the western quarter of

the site, 2-m-tall arrowweed and 3–6-m-tall honey mesquite form the understory. Some 2-m-tall mule-fat are also present along the edge of the channel. Canopy closure is 50% throughout most of the site and is as high as 70% under the densest cottonwood overstory. During field season, up to 30% of the tamarisk were dead or defoliated, and a majority of the remainder had yellow/brown foliage. Tamarisk beetle larvae were present in early June, and adult beetles were present in late June. Field personnel did not record data on the presence or absence of beetles in May or July.

Standing water was present in the channel when each site description was recorded, though water depth decreased through the season (see table 2-2). Soils away from the channel were dry. Water levels in the site are influenced by flows in the Bill Williams River and likely did not fluctuate substantially from day to day (see figure 2-3).

Canopy closure is much lower than 85%; thus, the site does not meet all the criteria for suitable habitat (see table 2-1). If water levels increased enough that wet soils persisted outside of the channel, the vegetation could increase in density and suitability. Substantial regenerative growth is needed, however, before the site could meet the suitability criteria. Re-evaluation of this site in several years or after a high flow event would ensure that no suitable habitat is overlooked. In the meantime, surveys could be discontinued with minimal risk of overlooking suitable habitat.

Guinness

The survey site known as Guinness is approximately 150 m east of Site 03. The site was last formally surveyed in 2015 and was visited once in 2016. Vegetation is mixed-native and is dominated by a patchy overstory of Goodding's willows 10–18 m in height and cottonwoods 20 m in height with an understory of 4–6-m-tall tamarisk. Some honey mesquite 4–6 m in height are scattered throughout the understory. Most of the Goodding's willows are dead, except for a patch in the east-central portion of the site. Many of the cottonwoods show signs of stress with either very narrow canopies or complete mortality, but a few still have rounded, full canopies. Cottonwood mortality is highest along the northern border but is also common along the southern border. The overstory does not provide continuous canopy, and canopy closure does not exceed 60% anywhere within the site. Some of the tamarisk are dead, and most of the remainder were brown throughout the season. Tamarisk beetle adults were present in May, and larvae were present in both May and June. Field personnel did not record data on the presence or absence of beetles in July.

A stream channel bisects the site and contained standing water throughout the season (see table 2-2). Water levels in the site are directly influenced by the Bill Williams River and therefore likely did not fluctuate substantially from day to day (see figure 2-3).

Canopy closure is much lower than 85%; thus, the site does not meet all the criteria for suitable habitat (see table 2-1). If water levels increased enough to fill the channel and wet soils persisted outside of the channel, the vegetation could increase in density and suitability. Substantial regenerative growth is needed, however, before the site could meet the suitability criteria. Re-evaluation of this site in several years or after a high flow event would ensure that no suitable habitat is overlooked. In the meantime, surveys could be discontinued with minimal risk of overlooking suitable habitat.

Site 05

The survey site known as Site 05 is approximately 1.4 km southeast of Site 03 on the northern edge of the Bill Williams River floodplain. It is bordered to the northeast by steep cliffs and to the southwest by a dry river channel. Vegetation is mixed-native, with Goodding's willows 10–12 m in height and cottonwoods 12–18 m in height forming a broken overstory. The overstory is predominantly Goodding's willows in the western two-thirds of the site, with the willows transitioning from widely scattered and emergent near the western edge to a broken overstory in the center of the site. Cottonwoods are more dominant in the overstory in the eastern third of the site. Many of the overstory trees along the southwestern border are completely dead. Within the remainder of the site, many of the Goodding's willows have dead tops, dead limbs, and sparse leaves, and several cottonwoods have died completely, creating gaps in the canopy. The understory consists of scattered patches of partially dead tamarisk 3–8 m in height, which are taller and denser in the western third of the site and shorter and more widely scattered in the eastern third. Cottonwood saplings are present along a channel of the Bill Williams River that runs through the site. Canopy closure is 30–45% in most of the site but reaches 75% toward the center of the western half. Most of the ground cover consists of thick piles of fallen, woody vegetation. The live tamarisk were green in May but had tamarisk beetle larvae. Both larvae and adults were present in June and July, and the tamarisk were a mix of brown, defoliated, and refoliating in July.

Surface water was present along the northeastern edge of the site in a series of beaver ponds along a small stream when each site description was recorded (see table 2-2). Soils away from the beaver ponds were dry. Given that river levels did not fluctuate strongly during the season (see figure 2-3), it is unlikely that surface soil moisture conditions fluctuated substantially from day to day.

No portion of this site has canopy closure that reaches 85%; thus, the site does not meet all the criteria for suitable habitat. Canopy closure has decreased in recent years as tree mortality has increased. Given the high degree of mortality, substantial regenerative growth is needed before the site could meet the suitability criteria. Re-evaluation of this site in several years would ensure that no suitable habitat is overlooked. In the meantime, surveys could be discontinued with minimal risk of overlooking suitable habitat.

Beaver Pond North

The survey site known as Beaver Pond North is approximately 2 km east-southeast of Black Rail. This site was last formally surveyed in 2015 and was visited once in 2016. One channel of the Bill Williams River runs along the southern border of the site and another through the center. Vegetation is mixed-exotic. Most of the site is vegetated with tamarisk, over half of which are dead, with scattered arrowweed and honey mesquite. Within 50 m of both river channels, 8–12-m-tall Goodding's willows, 8–15-m-tall cottonwoods, and 1–2-m-tall mule-fat are also present. Cattails line the edge of the southern river channel. Several young, planted cottonwood trees are present in the southwestern corner of the site along the river channel. Most of the Goodding's willows are completely dead, and the live Goodding's willows, which are concentrated in the southeastern corner of the site, have dead tops. Many of the cottonwoods are dead, but in some places along both river channels they are present in half-dead stands that form a broken overstory. The live tamarisk were mostly green in May, and no tamarisk beetles were detected. Tamarisk beetle larvae were present in high numbers in mid-June, and the tamarisk were mostly brown in June and July. Canopy closure is 10–25% in most of the site and reaches 20–50% in the southeastern corner.

Surface water was present in both river channels in the southern two-thirds of the site when all three site descriptions were recorded (see table 2-2). Water in the river channel in the center of the site consisted of a series of shallow pools connected by a small, shallow stream. Soils away from the river channels were dry and sandy. Given that river levels did not fluctuate strongly during the survey season (see figure 2-3), it is unlikely that surface soil moisture conditions fluctuated substantially from day to day between any two site descriptions.

Most of the vegetation is dead, and canopy closure is much lower than 85% throughout the site; thus, no portion of this site meets the criteria for suitable habitat (see table 2-1). Given the high degree of mortality, substantial regenerative growth is needed before the site could meet the suitability criteria. Re-evaluation of this site in several years or after a high flow event would ensure that no suitable habitat is overlooked. In the meantime, surveys could be discontinued with minimal risk of overlooking suitable habitat.

Beaver Pond

Beaver Pond is contiguous with the upstream end of Beaver Pond North. This site was last formally surveyed in 2015 and was visited once in 2016. The Bill Williams River runs through the center of the southern 400 m of the site and then bifurcates into two channels; one channel runs along the southern border of the site and the other through the center. Vegetation is mixed-exotic and consists primarily of dead 5–6-m-tall tamarisk with scattered arrowweed and honey mesquite. Within 50 m of both river channels, 4–12-m-tall Goodding's willows, 8–15-m-tall cottonwoods, live tamarisk, and 1–2-m-tall mule-fat are also

present. Many of the cottonwoods and Goodding's willows are dead. Where the cottonwoods are alive, they form loose stands that do not provide continuous canopy. Most of the living Goodding's willows have leaves only on the lower half of the tree, but in the very southern portion of the site, several Goodding's willows have live vegetation to 10–12 m in height. Most of the live tamarisk were green in May, and no tamarisk beetles were detected in May or early June. By mid-July, tamarisk beetles were present and the tamarisk were brown. Canopy closure is 15–40% throughout most of the site and reaches 75% in the Goodding's willows in the southern portion of the site.

Flowing water was present in the southern river channel for the entire length of the site when each site description was recorded (see table 2-2). Soils away from the active river channel were primarily dry throughout the survey season. Given that river levels did not fluctuate strongly during the survey season (see figures 2-3 and 2-4), it is unlikely that surface soil moisture conditions fluctuated substantially from day to day.

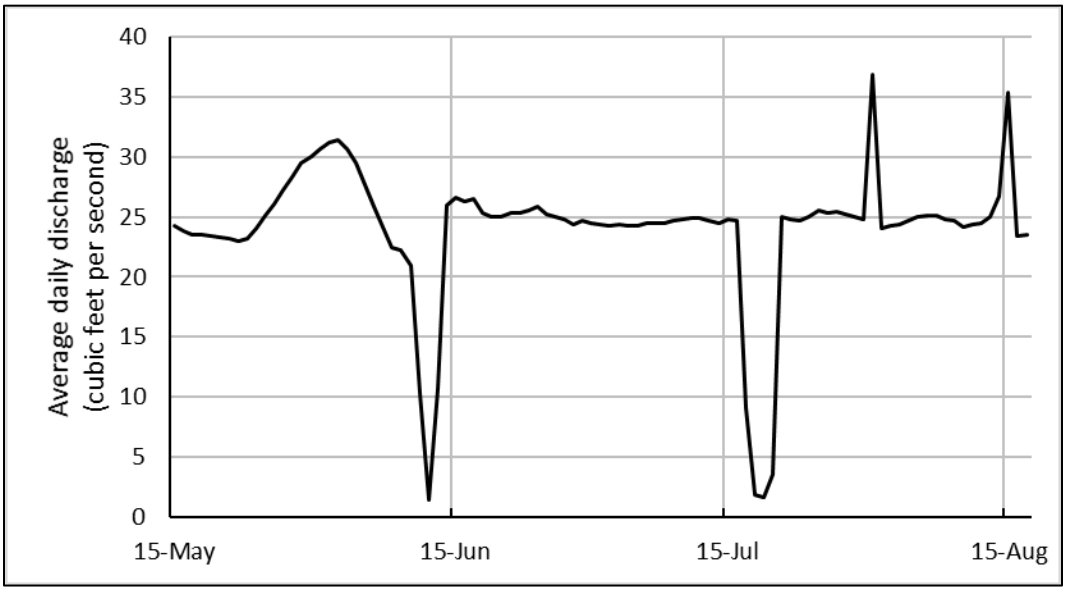

Figure 2-4.—Average daily discharge (cfs) recorded on the Bill Williams River below Alamo Dam (USGS Station #09426000), May 15 – August 17, 2018.
Data source: USGS 2018c.

Canopy closure is much lower than 85% throughout the site, and most of the vegetation is dead; thus, no portion of this site meets the criteria for suitable habitat (see table 2-1). Given the high degree of mortality, substantial regenerative growth is needed before the site could meet the suitability criteria. Re-evaluation of this site in several years or after a high flow event would ensure that no suitable habitat is overlooked. In the meantime, surveys could be discontinued with minimal risk of overlooking suitable habitat.

Site 08

The survey site known as Site 08 is immediately upstream of the confluence of the Mohave Wash and the Bill Williams River. The floodplain is confined to the north and south by high cliffs, creating a 150-m-wide riparian zone of mixed-native vegetation. Tamarisk and cottonwood saplings < 2 m in height are present along the edge of the stream. Vegetation near the river channel consists of an overstory of 10–12-m-tall Goodding's willows and some 12–15-m-tall cottonwoods with an understory of 2–6-m-tall tamarisk. Some of the cottonwoods and Goodding's willows are dead, and canopy closure ranges from 30% at the stream edge to 75% under live willows and cottonwoods. Vegetation away from the river channel is dominated by 5–6-m-tall tamarisk with some arrowweed and honey mesquite and a loose overstory of 10–12-m-tall cottonwoods and a few Goodding's willows. Most of the cottonwoods and tamarisk in the western two-thirds of the site are dead, and canopy closure in this area is 20%. In mid-June, the live tamarisk were green, and no tamarisk beetles were observed. The live tamarisk had yellow leaves during the July site description. Field personnel did not record data on the presence or absence of tamarisk beetles in May or July.

The Bill Williams River flows into the eastern end of the site and runs along the northern boundary. Flowing water was present in the channel when each site description was recorded. Surface water at the site is affected by riverflow but not by water levels in Lake Havasu. Given that the daily outflow from Alamo Dam varied only infrequently during the season (see figure 2-4), it is likely that there were few day-to day-fluctuations in the extent and depth of surface water.

The site has canopy closure much lower than 85%; thus, the site does not meet all the criteria for suitable habitat (see table 2-1). Given the high degree of mortality, substantial regenerative growth is needed before the site could meet the suitability criteria. Re-evaluation of this site in several years or after a high flow event would ensure that no suitable habitat is overlooked. In the meantime, surveys could be discontinued with minimal risk of overlooking suitable habitat.

Upstream Site 08

The survey site known as Upstream Site 08 is approximately 100 m east of Site 08 on the northern side of the riparian zone. Vegetation consists of a broken overstory of 10–15-m-tall Goodding's willows with an understory of 3–7-m-tall tamarisk. A few emergent 15–20-m-tall cottonwoods, most of which are dead, are scattered throughout the site. The northern and western edges of the site border a cattail marsh. Vegetation is healthiest near the western edge of the site and becomes increasingly stressed toward the eastern side, with many dead or partially dead Goodding's willows. Canopy closure ranges from 30 to 75% and is highest in areas with dense tamarisk. Many of the tamarisk were leafless when the May and June site descriptions were recorded, and yellow/brown foliage was

present in July. Tamarisk beetle larvae were present in June, and beetles were present in July, but field personnel did not record data on the presence or absence of tamarisk beetles in May.

Standing water was present in the cattail marsh along the northern and western borders of the site when each site description was recorded (see table 2-2). Soils within the site were dry or damp when each site description was recorded. Surface water at the site is affected by riverflow but not by water levels in Lake Havasu. Given that daily outflow from Alamo Dam varied only infrequently during the season (see figure 2-4), it is likely that there were few day-to day-fluctuations in the extent and depth of surface water.

Canopy closure did not meet the criterion for suitable habitat anywhere in the site in 2018 (see table 2-1). Mortality of the overstory trees in recent years and tamarisk defoliation over the last two seasons have decreased the canopy closure below suitable levels. Habitat suitability would be improved if the tamarisk were fully foliated. If the site is evaluated at the beginning of the next survey season and determined not to have improved in quality, surveys could be discontinued with minimal risk of overlooking suitable flycatcher habitat.

Planet Ranch Road

The survey site known as Planet Ranch Road is southeast of Upstream Site 08 along the southern edge of the riparian area in the Planet Ranch Conservation Area, just outside of the refuge property boundary. The eastern 600 m of the area that was surveyed in 2017 were eliminated from the site because of very low canopy closure, and the site was extended approximately 350 m upstream. The western 100 m of the current site contains a 50-m-wide beaver pond. For 100 m upstream of the eastern end of the beaver pond, the site is vegetated by Goodding's willows 12 m in height with 85% canopy closure. Vegetation within the eastern 350 m of the current site boundary consists of a mosaic of cottonwoods 12–15 m in height, Goodding's willows 6–8 m in height, and honey and screwbean mesquite 4–6 m in height with mule-fat in the understory. This area used to contain a series of small beaver ponds, and the Goodding's willows occur primarily in strips around the perimeter of each dry pond. Some of the Goodding's willows are dead and others have dead tops. Canopy closure is very patchy but reaches 85% in the densest vegetation. Tamarisk 2–3 m in height are widely scattered through the site. Tamarisk beetles were detected in low numbers when each site description was recorded, but most of the tamarisk remained green through the season.

The beaver pond contained water when each site description was recorded, and small channels that supply water to the beaver pond had saturated soils (see table 2-2). Soils within the remainder of the site were dry. In this reach, surface water is affected by riverflow but not by water levels in Lake Havasu. The

average daily outflow from Alamo Dam varied infrequently during the season (see figure 2-4), and it is likely that there were few day-to day-fluctuations in the extent and depth of surface water.

The Goodding's willows adjacent to the beaver pond and patches of vegetation farther upstream have all the characteristics of suitable habitat (see table 2-1). Habitat suitability at the site could improve in future years if canopy closure increases.

Reconnaissance

Black Rail

The survey site known as Black Rail is approximately 250 m southeast of Site 05 on the eastern edge of the Bill Williams River floodplain. The site was visited once in 2015 and 2016, but surveys were discontinued for the remainder of those seasons because of low canopy closure and poor habitat suitability. Vegetation is mixed-native. The overstory in most of the site consists of cottonwoods 12–16 m in height. In the western 30–40 m of the site, the overstory consists of 10–12-m-tall Goodding's willow snags. Tamarisk 3–4 m in height are loosely scattered in the understory, as are 4-m-tall honey mesquite and 1–2-m-tall mule-fat and willow baccharis. Patches of dense, completely brown cattails and bulrush 1–2 m in height are also scattered through the interior of the site. Canopy closure is 45–60% and is highest in areas with a live overstory. About half of the tamarisk were dead or defoliated during the visit in May, and 85% of the remaining live tamarisk were green and 15% had brown leaves. Adult and larval tamarisk beetles were present.

Soils were mostly damp with several areas of saturated soil and shallow puddles scattered throughout the site during the visit in May. Given that river levels did not fluctuate strongly during the field season (see figure 2-3), it is unlikely that surface soil moisture conditions fluctuated substantially from day to day.

Surveys were not scheduled for the remainder of the 2018 season following the initial visit because canopy closure is too low to meet the suitability criterion (see table 2-1) and many overstory trees are dead. Given the high degree of mortality, substantial regenerative growth is needed before the site could meet the suitability criteria. Re-evaluation of this site in several years would ensure that no suitable habitat is overlooked.

Alamo Lake, Arizona

ALAM is located along the Big Sandy and Santa Maria Rivers, near their confluence, and downstream along the Bill Williams River to the open water of Alamo Lake. The elevation within the study area is 335–347 m above sea level

and increases from south to north. The level of Alamo Lake rose early in 2010 following a large rain event but declined over the next 5 years (figure 2-5). Imagery available on Google Earth shows that the survey sites known as South Camp, Over the Edge, Sidebar 01, Edgewater 01, Camp 01–04, Middle Earth 01–02, and Burro Wash 01–02 were still under water as of June 24, 2011. Imagery also shows that as of November 2, 2013, South Camp was still partially under water, and Over the Edge had only recently been exposed. Lake levels fluctuated in 2014–16, but no wet soils were documented within any of the sites during those years (McLeod and Pellegrini 2018a). Storm events over the 2016–17 winter increased the level of Alamo Lake, which peaked in March 2017 at 10.4 m higher than on the corresponding day in 2016. Standing water was present in most survey sites in 2017, with water levels gradually decreasing by 1.3 m over the breeding season (see figure 2-8). Reservoir releases in March 2018 lowered the lake level by ≈2 m over 4 days, and lake levels continued to decline gradually throughout summer 2018, although water levels were still higher than those in 2014–17. Heavy rains in mid-July resulted in a temporary increase in flows in the Big Sandy River, but the water level in the lake increased by only 6 cm.

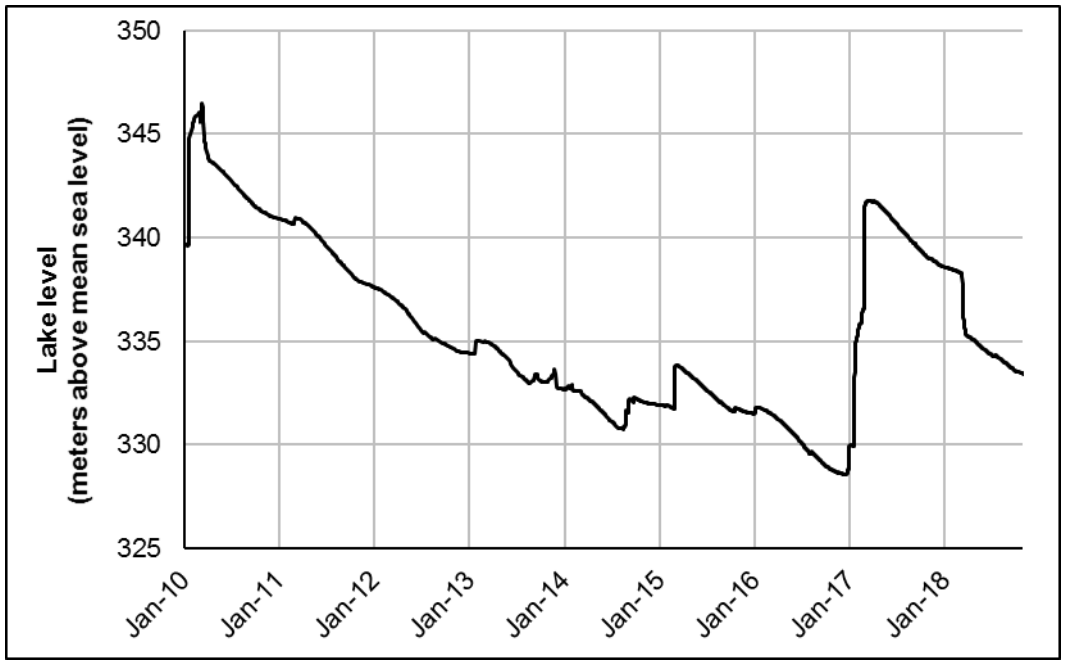

Figure 2-5.—Alamo Lake daily elevation (meters above mean sea level), 2010–18.
Data source: Lakes Online (2018).

Burros and cattle were noted in and near several of the sites at ALAM. Tamarisk beetles were present during the 2018 survey season. Tamarisk throughout the study area showed substantial dieback as the result of defoliation in 2017, and the living portions of the plants had yellow leaves or were defoliated when each site description was recorded.

Bullard Wash

The survey site known as Bullard Wash is on the eastern edge of the riparian area at the outflow of Bullard Wash. Most of the site consists of Goodding's willows 8–15 m in height. Canopy height is 12–15 m in the northwestern portion of the site, whereas many trees in the remainder of the site are leaning over at steep angles, reducing canopy height to 8–10 m. Tamarisk 3–4 m in height are present in the south-central portion of the site. Many of the tamarisk are dead, likely as the result of prolonged inundation in 2017. No tamarisk beetles were detected in May or June, but beetle larvae and yellow leaves were observed in July on the few remaining live tamarisk. Canopy closure ranges from 70% along the site perimeter to nearly 100% in places where leaning trees create very dense patches with few flyways in the midstory.

The western tip of the site was inundated with up to 1 m of water by the edge of Alamo Lake when each site description was recorded (see table 2-2). Most soils in the remainder of the site were damp when the May and June site descriptions were recorded, whereas soils in most of the site were saturated from flooding in Bullard Wash when the July site description was recorded.

The western edge of the site adjacent to the edge of Alamo Lake has all the characteristics of preferred nesting habitat (see table 2-1). Much of the rest of the site has all the structural characteristics of suitable habitat, although some patches of leaning trees lack midstory structural elements.

South Camp

The survey site known as South Camp is on the western edge of the riparian area, approximately 2 km due north of Bullard Wash. Vegetation in the southern half of the area surveyed in 2017 is dead and was not surveyed in 2018. Vegetation in the remainder of the site consists entirely of Goodding's willows 10–15 m in height, which are tallest and densest at the southern end. Most of the trees in the center of the site are dead, and the northern end has a mixture of dead and live trees. Canopy closure in the northern two-thirds of the site varies from 30 to 80%, depending on the degree of tree mortality. Canopy closure at the dense, southern end of the site was not assessed because deep water prohibited access on foot.

The southern half of the site was inundated with water over 1 m deep when all three site descriptions were recorded (see table 2-2). Soils in the remainder of the site were a mixture of damp and dry. Water levels at the site vary in accordance with the level of Alamo Lake and thus did not fluctuate substantially from day to day.

The northern two-thirds of the site lacks the canopy closure of suitable habitat (see table 2-1). The southern third of the site may contain all the characteristics of preferred nesting habitat, but canopy closure was not assessed.

Sidebar 01

The survey site known as Sidebar 01 is on the eastern edge of the riparian area, 1 km downstream from the end of Brown's Crossing Road. Vegetation consists of Goodding's willows 15 m in height. Live Goodding's willows are present along the western edge of the central portion of the site, but most of the willows elsewhere are dead. Canopy closure in the densest part of the site is 70%.

Wet soils were present in 5–10% of the site when each site description was recorded (see table 2-2). Soils within most of the rest of the site were damp.

No portion of the site has canopy closure that reaches suitable levels (see table 2-1), and tree mortality has increased steadily over the past few years. This site could be evaluated at the beginning of the next survey season, and if habitat quality has not improved, surveys could be discontinued with minimal risk of overlooking suitable habitat.

Camp 01

The survey site known as Camp 01 is approximately 125 m northeast of South Camp on the western edge of the riparian area. The site consists of two patches of Goodding's willows 12–15 m in height at the outflows of two small washes; these patches are connected by a 10-m-wide strip of Goodding's willows, some of which are dead. Canopy closure in the Goodding's willow patches reaches 90%, while the narrow strip of vegetation has openings with 50–60% canopy closure.

Soils in most of the site were damp, and surface water was present in the channel adjacent to the site when each site description was recorded (see table 2-2).

Portions of the site with canopy closure > 85% met all the criteria for suitable habitat, and patches with 90% canopy closure met all the structural criteria of preferred nesting habitat (see table 2-1). The narrow strip of Goodding's willows was barely wide enough to meet the criterion for suitable habitat, and canopy closure in many places was < 85%.

Camp 02

The survey site known as Camp 02 is 225 m northeast of Camp 01 on the western edge of the riparian area. Vegetation is native and consists of a 50- x 100-m patch of Goodding's willows 12–15 m in height, with dead cottonwoods interspersed

with the Goodding's willows in the western end of the site. Canopy closure reaches 90% in the center of the site and 70% near the periphery.
All soils in the site were damp when the May and July site descriptions were recorded but were dry in June. The nearest water was in the river channel adjacent to the site (see table 2-2).

The densest portions of the site contained all the structural components of suitable habitat (see table 2-1).

Camp 03

The survey site known as Camp 03 is 150 m north of Camp 02. This site is located at the outflow of a wash along the western edge of the riparian area and is bordered to the north and west by dry upland scrub. Vegetation is native and consists of Goodding's willows approximately 15 m in height with dead cottonwoods in the western end of the site. Canopy closure is 40–70% along the borders of the site and 60–80% in the interior.

Soils within the site were primarily damp when the May and July site descriptions were recorded but were mostly dry in June. The nearest surface water throughout the season was in the river channel 10 m from the edge of the site (see table 2-2).

No portion of the site currently has canopy closure that meets the criterion for suitable habitat. If the site is evaluated at the beginning of the next survey season and habitat quality has not improved, surveys could be discontinued with minimal risk of overlooking suitable habitat.

Middle Earth 01

The survey site known as Middle Earth 01 is approximately 700 m southwest of the end of Brown's Crossing Road in the middle of the riparian zone. The site consists of two disjunct polygons of mixed-native vegetation. The northern polygon consists of a 30–40-m-wide swath of Goodding's willows 12–18 m in height with 70–85% canopy closure flanked by dead tamarisk. Vegetation in the eastern two-thirds of the southern polygon consists of Goodding's willows 15–18 m in height with 70–95% canopy closure. The trees in the eastern third of this portion of the site are smaller than those in the center, and average canopy closure increases from west to east. Some of the willows are leaning over at 45° angles, creating pockets of very dense canopy closure. The western third of this portion of the site is vegetated by Goodding's willows 15–18 m in height with tamarisk 3–4 m in height in the understory. Most of the tamarisk are dead, likely as the result of prolonged inundation in 2017, and areas dominated by tamarisk have 50% canopy closure. Tamarisk beetle larvae were detected in June but not

in May or July, and the live tamarisk had yellow/brown foliage in June and July. Patches of dead Goodding's willows with 10% canopy closure are present on the southeastern and northwestern borders of the southern polygon.

Soils were mostly damp when the May site description was recorded and were dry when site descriptions were recorded in June and July. The nearest wet soils were at least 500 m away throughout the survey season (see table 2-2).

The center of the northern polygon has all the characteristics of suitable habitat, and areas of the southern polygon with ≥ 90% canopy closure have all the structural characteristics of preferred nesting habitat (see table 2-1). Areas of the site dominated by tamarisk or dead Goodding's willows lack the canopy closure of suitable habitat.

Middle Earth 02

The survey site known as Middle Earth 02 is in the middle of the riparian zone, 75 m north of Middle Earth 01 and 400 m due west of the end of Brown's Crossing Road. The eastern half of the site is primarily Goodding's willows 15–18 m in height with little tamarisk. Toward the western edge of the site, patches of tamarisk 3–4 m in height become common, and the Goodding's willows are 10–15 m in height. The southwestern corner of the site is tamarisk with few Goodding's willows. The tamarisk are almost entirely dead, likely as the result of prolonged inundation in 2017. The few live tamarisk had adult tamarisk beetles in June and beetle larvae in July, and the tamarisk foliage was yellow/brown in July. Canopy closure is 80–90% in the eastern half of the site and decreases to 30–50% in the southwestern corner.

The southwestern corner of the site had damp soils when the May site description was recorded; otherwise, soils in the site were dry, and the nearest wet soils were > 300 m away throughout the survey season (see table 2-2).

The eastern half of this site contains all the structural characteristics of preferred nesting habitat (see table 2-1). Areas of the site that have a significant tamarisk component lack the canopy closure of suitable habitat.

Prospect 01

The survey site known as Prospect 01 is 100 m west of the end of Brown's Crossing Road on the eastern edge of the riparian zone. Vegetation is mixed-native and consists of a 20–40-m-wide strip of Goodding's willows 10–18 m in height with patches of tamarisk 3–4 m in height in the understory. The Goodding's willows are generally shorter in the southern end of the site than in northern end. A 20-m-wide strip of dead Goodding's willows is present in the southern half of the site along the eastern edge. In the northern half of the site, a

strip of tamarisk 4–5 m in height is present along the eastern edge. Many of the tamarisk were affected by prolonged inundation in 2017 and appear dead. Tamarisk that are still alive had adult tamarisk beetles when the June site description was recorded, but no beetles were detected in May or July. The tamarisk foliage was yellow/brown in June and July. Canopy closure in the live Goodding's willows ranges from 50 to 90%, depending on how closely the trees are spaced. Canopy closure is 15% in the strip of dead Goodding's willows.

All soils in the site were damp when the May site description was recorded. During the June site description, 70% of the site had damp soils and the remainder was dry. All soils were damp from recent rains when the July site description was recorded. The nearest wet soils were at least 600 m away throughout the survey season (see table 2-2).

Portions of the site dominated by live Goodding's willows have all the structural characteristics of preferred nesting habitat (see table 2-1). Areas dominated by dead Goodding's willows lack the canopy closure needed for suitable habitat.

Burro Wash 01

The survey site known as Burro Wash 01 is upstream of Camp 03. The site was expanded to the west during the 2018 season to encompass a band of dense vegetation that abuts the uplands on the western side of the riparian zone. Vegetation consists primarily of Goodding's willows, many of which have fallen over but are still alive, with canopy height ranging from 8 to 15 m. Portions of the site have an understory of tamarisk, all of which appear to be dead as the result of prolonged inundating in 2017. An area near the southern end of the site is vegetated only with dead tamarisk. Canopy closure varies from 40 to 90% through the site depending on the density of the Goodding's willows.

When the May site description was recorded, approximately 10% of the site was inundated, and 60% of the site had saturated soils (see table 2-2). In mid-June, wet soils were present only in 10% of the site, and the remaining soils were damp. All soils were damp from recent rain when the July site description was recorded. Water levels at the site vary in accordance with the level of Alamo Lake and thus did not fluctuate substantially from day to day (see figure 2-5).

Portions of the site with canopy closure of at least 85% meet all the structural criteria for suitable habitat (see table 2-1).

Burro Wash 02

The survey site known as Burro Wash 02 is approximately 40 m east of Burro Wash 01 and forms a long strip of mixed-native vegetation 75–170 m wide and oriented north-south. It is bordered to the west by a matrix of open areas and

riparian vegetation, to the east by open areas, to the north by dry upland scrub, and to the south by riparian forest in Motherlode 01. Vegetation within most of the site consists of Goodding's willows 15 m in height with no understory. The site boundary was expanded approximately 300 m to the north during the 2018 survey season to encompass additional stands of Goodding's willows 10–15 m in height. Tamarisk 3–4 m in height are present in portions of the understory in the northern end of the site. Tamarisk beetles and defoliated tamarisk were present when this portion of the site was first described in mid-June, and beetle larvae and a mixture of green and yellow foliage were present in July. Several patches of dead or dying Goodding's willows, 100 x 50 m in size, are present. Canopy closure is 85–90% in most of the site but does not exceed 70% in the pockets of dead Goodding's willows.

When the May site description was recorded, the northern end of the site contained surface water and saturated soils, and the remainder of the site was damp. In mid-June, 75% of the site had damp soils, and soils in most of the site were dry in July (see table 2-2). Water levels at the site vary in accordance with the level of Alamo Lake and thus did not fluctuate substantially from day to day (see figure 2-5).

Most of this site contains all the structural characteristics of preferred nesting habitat (see table 2-1). The swath of dead and dying Goodding's willows in the southern half of the site lacks the canopy closure and midstory structural elements of suitable habitat.

Motherlode 01

The survey site known as Motherlode 01 is east of Burro Wash 01 and south of Burro Wash 02 and is contiguous with both sites. Vegetation within the western two-thirds of the site consists of a stand of Goodding's willows 8–15 m in height with widely scattered tamarisk 3–4 m in height in the understory. A 50-m-wide swath of dead or dying Goodding's willows with 10% canopy closure runs north-south through the western third of the site. Tree health is highest along the very western and southern borders of this portion of the site. The western border of this portion of the site has live Goodding's willows with 70–90% canopy closure while the southern border has a stand of Goodding's willows that have fallen over but are still alive, with canopy height of 4–5 m and 90% canopy closure. Most of the eastern third of the site is vegetated with tamarisk 3–5 m in height and emergent Goodding's willows 10 m in height. Mule-fat are also scattered through this portion of the site, and deadfall occurs in thick piles. A strip of 8-m-tall Goodding's willows is present along the southern boundary of the eastern third of the site, and a stand of Goodding's willows with tamarisk understory is present at the northern border; canopy closure in both areas is 70–90%. Many of the tamarisk are partially dead, and tamarisk throughout the site had yellow/brown

leaves when each site description was recorded. Tamarisk beetle adults and larvae were present in May, adults were present in June, and larvae were present in July.

No wet soils were present when any site description was recorded, and the nearest wet soils were 300 m away (see table 2-2). Damp soils were present throughout the site when the May site description was recorded and in the western half when the June site description was recorded. The entire site was damp from recent rain when the July site description was recorded. Water levels at the site vary in accordance with the level of Alamo Lake and thus did not fluctuate substantially from day to day (see figure 2-5).

Portions of the site with the healthiest trees and highest canopy closure have all the structural characteristics of preferred nesting habitat (see table 2-1), whereas portions of the site with canopy closure < 85% do not meet all the criteria for suitable habitat. Portions of the site with dead and dying trees also lack the midstory structural elements of suitable habitat, and surveys in these portions could be discontinued with minimal risk of overlooking suitable habitat.

Motherlode 04

The survey site known as Motherlode 04 consists of a patch of vegetation 100 x 50 m in size in the middle of the dry, open river channel. Vegetation within the northern two-thirds of the site consists primarily of Goodding's willows up to 15 m in height with little understory. Canopy closure ranges from 40 to 80%, increasing from west to east. Vegetation in the southern third of the site consists primarily of dead Goodding's willow stems and dead tamarisk with an occasional live Goodding's willow or cottonwood. Tamarisk beetle larvae were present in mid-July on the few live tamarisk, but beetles were not detected on other visits. Canopy closure in the southern portion is 10%.

Soils were dry when the May and June site descriptions were recorded, but 80% of the site was damp due to a recent rain event when the July site description was recorded (see table 2-2). Flowing water was present in the river channel approximately 100 m from the site when site descriptions were recorded in May and July but not in June. Any changes in soil moisture would be caused by local weather events or fluctuations in daily discharge in either the Big Sandy or Santa Maria Rivers. Daily discharge levels did not change in the Santa Maria River during the survey season (figure 2-6), but there was a flow event in the Big Sandy River in mid-July (figure 2-7). It is possible that water was present adjacent to the site during these higher flows.

No portion of the site has canopy closure that meets the criterion for suitable habitat (see table 2-1). Habitat suitability at this site has been declining over the last several years as trees have died. The condition of the vegetation did not improve with the rise in lake levels in 2017, and it seems unlikely to improve in future years without another significant rise in water levels. Surveys could be discontinued with minimal risk of overlooking suitable flycatcher habitat.

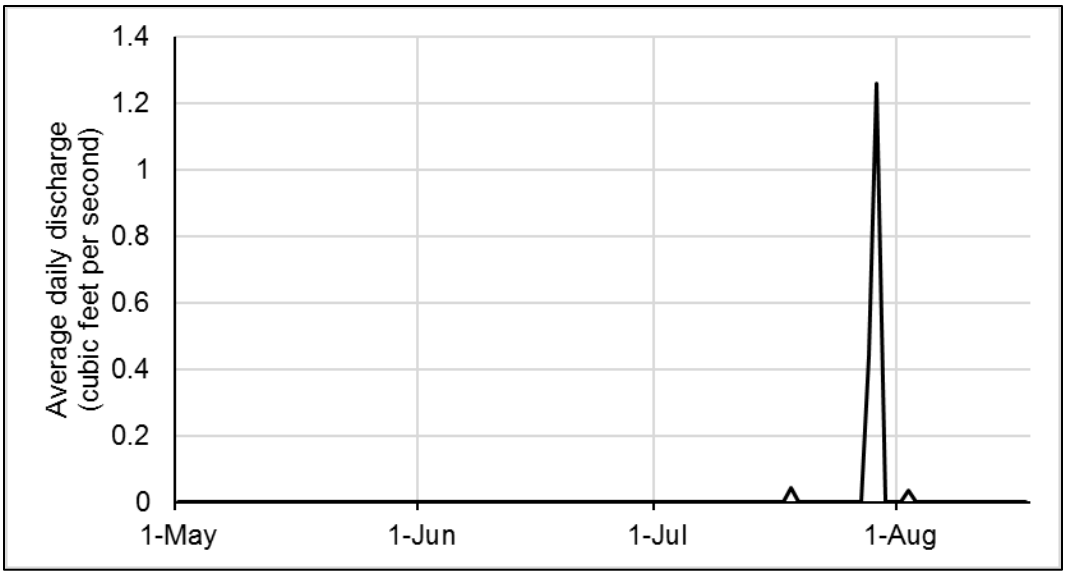

Figure 2-6.—Average daily discharge (cfs) recorded at the Santa Maria River near Bagdad, Arizona (USGS Station #09424900), May 1 – August 17, 2018.
Data source: USGS 2018d.

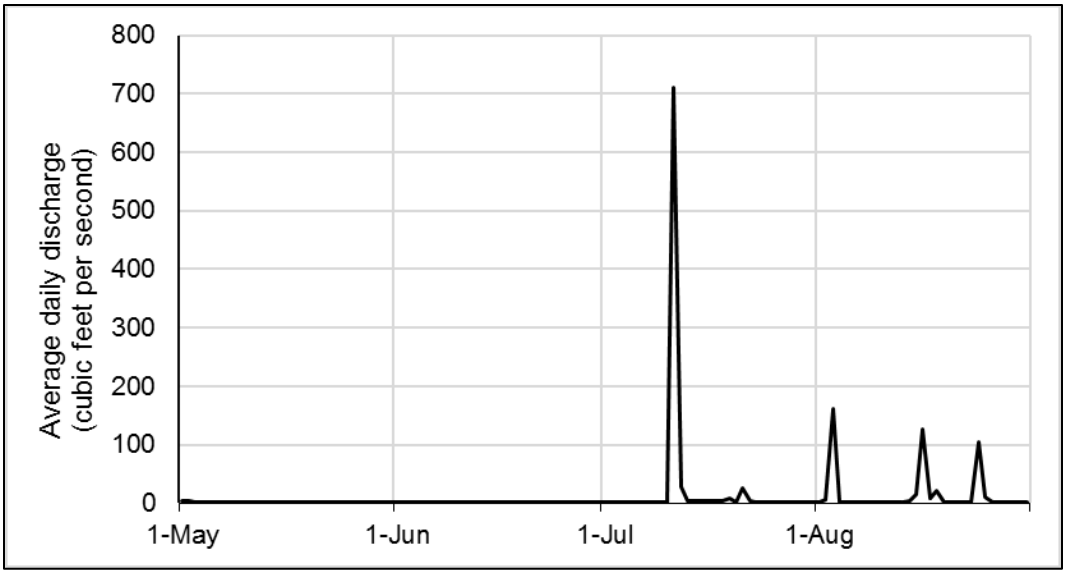

Figure 2-7.—Average daily discharge (cfs) recorded at the Big Sandy River near Wikieup, Arizona (USGS Station #09424450), May 1 – August 31, 2018.
Data source: USGS 2018e.

Santa Maria North 01

The survey site known as Santa Maria North 01 stretches upstream for 1.4 km from the confluence of the Santa Maria and Big Sandy Rivers, along the northern edge of the riparian area bordering the Santa Maria River. The site is bordered by open river channel to the south and dry upland scrub to the north. Vegetation is mixed-native in composition and consists primarily of cottonwoods and Goodding's willows 15–25 m in height with tamarisk 4–8 m in height in the understory. The density of both the overstory and understory is highly variable. In some places, the cottonwoods and Goodding's willows occur as emergent trees rather than as a continuous or broken overstory. Many of the overstory trees, particularly at the far eastern and western ends of the site, are dead or sparsely foliated, and large amounts of thick deadfall are found throughout the site. Tamarisk throughout the site are partially dead, and the live portions were defoliated throughout the survey season. Tamarisk beetle adults were present in May, and adults and larvae were present in July. The densest and healthiest overstory trees are near the northern edge of the western half of the site; canopy closure in this area is 70–80%, whereas canopy closure elsewhere in the site averages 50%. At the western end of the site, the southern boundary was extended approximately 75 m southward to encompass an area with young riparian vegetation along the active channel of the Santa Maria River. This portion of the site consists of a string of shallow beaver ponds ringed by a 2–3-m-wide strip of cottonwoods and Goodding's willows 3-4 m in height, some of which are vertical sprouts from larger, fallen trees. Canopy closure in this area does not exceed 30%.

The Santa Maria River along the southern edge of the site contained surface water when each site description was recorded, but a steep bank 1–2 m in height separates most of the site from the river channel. All surface soils in the site interior were dry when site descriptions were recorded in May and June, and most of the site was damp due to recent rain when the July site description was recorded (see table 2-2). Daily discharge in the Santa Maria River did not fluctuate during the survey season (see figure 2-6), and soil moisture conditions at the site likely did not fluctuate substantially from day to day, aside from temporarily damp soils caused by seasonal rains.

Canopy closure in Santa Maria North 01 in 2018 was lower than it was in previous years because of the progressive mortality of overstory trees and the tamarisk defoliation and dieback caused by tamarisk beetles. When the tamarisk are defoliated, canopy closure at the site no longer meets the criterion for suitable habitat.

Reconnaissance

Over the Edge

The survey site known as Over the Edge is in the middle of the riparian area, approximately 500 m southeast of South Camp. In 2016, vegetation within most of the site consisted of 7–8-m-tall Goodding's willows with tamarisk 3–5 m in height in the understory. Canopy closure averaged 80–90% at the beginning of the season, and by the end of the season, it ranged from 50 to 80% and averaged 70%. The site was completely submerged during the 2017 survey season and was assessed again in May 2018, at which time all vegetation was dead.

Edgewater 01

The survey site known as Edgewater 01 is located 100 m northeast of Over the Edge, in the middle of the riparian zone. In 2016, vegetation consisted of Goodding's willows 7–8 m in height with an understory of 1–4-m-tall tamarisk. Canopy closure under the Goodding's willows was 80–90% at the beginning of the season but decreased to 70% during the season as many of the Goodding's willows lost up to half of their leaves. The site was completely submerged during the 2017 survey season and was assessed again in May 2018, at which time only one Goodding's willow remained alive. Site assessments could be omitted in future years with minimal risk of overlooking suitable habitat

Bullard Wash North

Bullard Wash North is located on the eastern edge of the riparian area, 400 m downstream from Sidebar 01. It was visited in 2016, at which time it consisted of a stringer of Goodding's willows two to three trees wide with a broken canopy. Arrowweed and mule-fat were present in the understory. The site did not meet the patch width criterion for suitable habitat (see table 2-1) and was not visited again in 2016. The site was completely submerged during the 2017 survey season and was assessed again in May 2018, at which time it was still covered with ≈1 m of water and all the vegetation was dead. Site assessments could be omitted in future years with minimal risk of overlooking suitable habitat

Camp 04

Camp 04 is across the river channel to the southeast of Camp 02. In 2016, it consisted of a narrow stand of 7–8-m-tall Goodding's willows with 3–4-m-tall tamarisk. The site was completely submerged during the 2017 survey season and was assessed again in May 2018. Most of the vegetation at the site was scoured away during the high flows that filled Alamo Lake in 2017, and only a few dead trees remain. Site assessments could be omitted in future years with minimal risk of overlooking suitable habitat.

Confluence 02

Confluence 02 is a mixed-exotic survey site located along the eastern edge of the riparian zone, extending from the confluence of the Big Sandy and Santa Maria Rivers south for 1.3 km. The site sits on a terrace several meters above the river channel and is bordered by dry upland scrub to the east and open river channel to the west. The site was thoroughly described in 2016 (McLeod and Pellegrini 2017b), at which time two-thirds of the site was vegetated with scattered, emergent, and dying Goodding's willows and cottonwoods 15–18 m in height with tamarisk 3–7 m in height in the understory. The remaining third was vegetated with tamarisk 5–12 m in height. Canopy closure varied from 50% in gaps to 90% in patches of the densest tamarisk. Although some patches of tamarisk had canopy closure that met the criterion for suitable habitat (see table 2-1), the areal extent of dense vegetation was limited. The site in general was open and hot and was not visited again that season because of poor habitat quality. Confluence 02 was evaluated briefly in 2018 from the edge of the site to verify that the habitat had not improved. When the site was evaluated in mid-May, all tamarisk were defoliated, and canopy closure throughout the site was lower than it had been in 2016. Surveys at this site could be discontinued with minimal risk of overlooking suitable flycatcher habitat.

Confluence 01

The survey site known as Confluence 01 is at the confluence of the Big Sandy and Santa Maria Rivers. It is bordered to the north by dry upland scrub and on all other sides by open river channels. Vegetation is mixed-exotic. Goodding's willows and cottonwoods 10–18 m in height form a broken overstory along the southern and northwestern edges of the site with an understory of clumpy, 5-m-tall tamarisk and 2-m-tall willow baccharis and mule-fat. Many of the emergent trees are half dead. Canopy closure under the emergent trees is 75–80%. The interior of the site is vegetated entirely with tamarisk, some of which are 10 m in height and > 30 cm in diameter. There is no continuous canopy, however; canopy height is widely variable from plant to plant, and there are gaps between tamarisk clumps. Each tamarisk appeared partially dead, and living portions of the plants were defoliated during the visit in mid-May. Canopy closure does not exceed 70%.

Soils were completely dry during the visit in mid-May, though there was water flowing in the Santa Maria River adjacent to the southern edge of the site. The site sits on a terrace 2–3 m above both riverbeds and would not be inundated except during a high flow event.

No portion of the site has canopy closure that reaches 85%; thus, the site does not meet all criteria for suitable habitat (see table 2-1). Surveys site could be discontinued with minimal risk of overlooking suitable flycatcher habitat.

Sandy South 01

The survey site known as Sandy South 01 extends north from the confluence of the Big Sandy and Santa Maria Rivers for 1 km along the western edge of the riparian zone on the Big Sandy River. The site is bordered by dry upland scrub to the west and open river channel to the east. Vegetation is mixed-exotic and consists of tamarisk 5–7 m in height with a stringer of emergent cottonwoods along the edge of the wash and a few patches of emergent Goodding's willows and cottonwoods 12–18 m in height in the interior of the site. Many of the emergent willows are partially dead. Honey mesquite are scattered along the northwestern edge of the site. During the site visit in May, all the tamarisk were brown or defoliated and appeared to have dead terminal branches. Field personnel did not record data on the presence or absence of tamarisk beetles. A few widely scattered Athel tamarisk (*Tamarix aphylla*) 9–10 m in height are present; these were not defoliated. Tamarisk in the interior of the site are patchy, without a uniform or continuous canopy layer. Canopy closure throughout the site is ≈70%.

Soils were dry during the visit in May, and a steep bank ≈3 m in height prevents all but very high flows in the Big Sandy River from entering the site.

Canopy closure throughout the site is too low to meet the suitability criterion (see table 2-1). Surveys could be discontinued with minimal risk of overlooking suitable flycatcher habitat.

Santa Maria South 01

The survey site known as Santa Maria South 01 stretches along the southern edge of the riparian area bordering the Santa Maria River for 1.8 km upstream of the confluence with the Big Sandy River. The site is bordered to the south by dry upland scrub and to the north by a mixture of riparian forest and open river channel. Vegetation is mixed-exotic and consists primarily of dense tamarisk 4–7 m in height. During the site visit in May, the tamarisk were almost all leafless with 50% canopy closure, and it was difficult to determine how much of it was dead and how much was temporarily defoliated by tamarisk beetles. Field personnel did not record data on the presence or absence of tamarisk beetles. A stringer of emergent cottonwoods 20–25 m in height and Goodding's willows 12–18 m in height is present along a dry channel on the northern border of the western half of the site. Many of the emergent trees have dead branches. This area has a clumpy understory of 4–5-m-tall tamarisk, most of which appear dead. Canopy closure ranges from 50 to 70%. Emergent Goodding's willows and cottonwoods with an understory of leafless tamarisk are also present in the northeastern tip of the site, and canopy closure under these trees is 70%.

Soils were completely dry during the visit in May, although water was present in the river channel adjacent to the western end of the site. Any changes in soil

moisture would likely be caused by local weather events or fluctuations in daily discharge in the Santa Maria River, which did not vary from 0.0 cfs during the 2018 survey season (see figure 2-6).

Canopy closure throughout the site is much lower than 85%, and no part of the site meets the criteria for suitable habitat. Surveys were discontinued after the first visit. This site could be omitted from future years of surveys with minimal risk of overlooking suitable flycatcher habitat.

Palo Verde Ecological Reserve, California

The PVER is a conservation area located on the California bank of the Colorado River. The elevation of the study area is 85–87 m above sea level. All sites are periodically flood irrigated and typically become completely dry between irrigation bouts. Soil moisture monitoring at Phase 02 in 2013 and 2014 found that surface water was present in the site only during irrigation, and near-saturated soils were present only during and shortly after irrigation (GeoSystems Analysis, Inc. 2014). During the soil moisture monitoring, between March 1 and July 31, surface water was present no more than 8% of the time in 2013, and near-saturated soils were present up to 15% of the time in 2014. While conditions vary between sites depending on soil type and irrigation schedule, it is possible for surface soil moisture conditions to be dry a majority of the time within the conservation area. Lands immediately to the west are dominated by agricultural fields. The narrow strip of land between the conservation area and the river is dominated by tamarisk, and tamarisk beetles and small patches of defoliation were present in July. No signs of livestock were documented in or around the PVER study area.

Phase 02

The survey site known as Phase 02 is composed of distinct cells of vegetation, each dominated by a single tree species without any understory. Height and density of the vegetation vary within and between cells of the site. The northern three-quarters of the site contains 30–40-m-wide cells alternating between 8–12-m-tall Goodding's willows and 3–5-m-tall coyote willows. The Goodding's willows are taller (10–12 m) along the northern edge of the site and shorter (8–10 m) along the southern edge of each cell. There is a less obvious difference in Goodding's willow height along an east-west gradient, with trees slightly taller on the eastern side of the site than the western side. Vegetation height varies similarly in the coyote willow cells. Emergent cottonwoods up to 15 m in height are scattered throughout the northern three-quarters of the site and are more prevalent in the western half. Emergent Goodding's willows are scattered throughout the coyote willow cells. At the southern edge of each Goodding's willow cell, the trees are mostly dead, and canopy closure does not exceed 50%.

Canopy closure in both types of willow cells varies directly with vegetation height and is 60–85% in the Goodding's willows and 50–80% in the coyote willows. The southern portion of the site is dominated by two large (225 x 60 m) patches of 18–20-m-tall cottonwoods with 60–80% canopy closure. The ground beneath the cottonwoods is littered with deadfall both from whole trees and from many large limbs. The western edge of the site is vegetated in honey mesquite 3–4 m in height with 60–90% canopy closure. The southern edge of the site is vegetated with densely planted, 2–2.5-m-tall desert broom (*Baccharis sarothroides*). Some mortality is evident within this cell, but most bushes are alive and robust.

When the May and June site descriptions were recorded, soils throughout the site were damp (see table 2-2). Two site descriptions were recorded in July; all soils were completely dry during the first visit, and 40% of the site contained wet soils from active irrigation during the second visit. Conclusions on the frequency and duration of surface water within the site could not be drawn because of the high variability in water levels associated with flood irrigation. However, surface water was likely present only during active irrigation (see GeoSystems Analysis, Inc. 2014).

All elements of suitable habitat are present in small portions of the site where canopy closure reaches 85% (see table 2-1). This site lacks the continuous presence of wet soils and the canopy closure that are typical of preferred nesting habitat.

Phase 03

The western 80% of the survey site known as Phase 03 is vegetated primarily with cottonwoods 15–20 m in height with little or no understory. Goodding's willows 7 m in height are present in the understory near the western edge of the site, and small (10 x 10 m) patches of small-diameter, 3–5-m-tall coyote willows are scattered throughout the remainder of the western 80% of the site. The coyote willows are most prevalent on the northern and southern edges of the site. *Baccharis* sp. shrubs 1.5 m in height are scattered throughout the site. Many trees have fallen in the southern half of the site, creating piles of deadfall 2–2.5 m in height. Where there are no fallen trees, there are many downed cottonwood branches littering the ground. The cottonwoods throughout the site look healthy, though trees in the southern half of the site often have crowns that are limited to relatively small, round shapes at the very end of a mostly leafless trunk. Canopy closure in the western 80% of the site is 80–85% along the northern, eastern, and western edges and 60–80% elsewhere, depending on prevalence of deadfall. The eastern 20% of the site is vegetated with Goodding's willows 12–15 m in height with 80% canopy closure and clumps of *Baccharis* sp. shrubs reaching 1.5 m in height.

Surface water was present along the northern edge of the site near the irrigation canal when the May site description was recorded, and the eastern half of the site

was inundated from active irrigation when the June site description was recorded (see table 2-2). No description was recorded for July. Conclusions on the frequency and duration of surface water within the site could not be drawn because of the high variability in water levels associated with flood irrigation. However, if conditions are similar to those observed in Phase 02, surface water was likely present only during active irrigation (see GeoSystems Analysis, Inc. 2014).

Canopy closure reaches the minimum suitable level (see table 2-1) in some portions of the cottonwood stands, but areas with suitable canopy closure lack any type of midstory structure. In the eastern 20% of the site, suitable midstory structure is present, but canopy closure is less than the minimum suitable level. Thus, all elements of suitable habitat are present but do not co-occur. This site lacks the continuous presence of wet soils and the canopy closure that are typical of preferred nesting habitat.

Phase 04 Block 01

The survey site known as Phase 04 Block 01 is vegetated primarily by Goodding's willows 10–12 m in height with five evenly spaced, 20-m-wide strips of cottonwoods up to 15 m in height. Some coyote willows up to 5 m in height are present near the cottonwood-Goodding's willow boundaries, primarily near the northern and southern edges of the site. Many Goodding's willows have thin canopies and about 20% have dead tops or dead branches. The cottonwoods all appear healthy. Canopy closure in areas dominated by Goodding's willows is primarily 70–80% and occasionally reaches 85%. Canopy closure is 60–80% in the cottonwoods and is higher on the eastern side. *Baccharis* sp. shrubs are planted on the northern edge of the site and form a dense hedge.

All soils were damp when the May site description was recorded, and the nearest surface water was in an adjacent irrigation canal. When the June and July site descriptions were recorded, all soils were dry, with the nearest surface water located in the Colorado River (see table 2-2). Conclusions on the presence and duration of surface water within the site could not be drawn because of the high variability in water levels associated with flood irrigation. However, if conditions are like those observed in Phase 02, surface water was likely present only during active irrigation (see GeoSystems Analysis, Inc. 2014).

Although canopy closure reaches the minimum suitable level (see table 2-1) in a few places within the Goodding's willows, most of the site lacks the canopy closure typical of suitable habitat. This site lacks the continuous presence of wet soils and the canopy closure that are typical of preferred nesting habitat.

Phase 04 Block 02

The survey site known as Phase 04 Block 02 is vegetated primarily with Goodding's willows 10–15 m in height. Canopy height is slightly shorter on the western side of the site (10–12 m) than on the eastern side. Some coyote willows 3–6 m in height are present in small clumps in the understory or in strips along the perimeter of the site. Where the coyote willows extend into the site, most of the stems are dead. Cottonwoods 15–20 m in height are present in a square patch approximately 35 x 35 m in size near the center of the site. Canopy closure in the Goodding's willows ranges from 60% in one patch of stressed trees on the eastern side of the site to 70–85% throughout the rest of the site. Canopy closure is 75–80% in the cottonwoods.

When the May site description was recorded, all soils were damp (see table 2-2). When the June and July site descriptions were recorded, all soils were dry, and the nearest surface water was in the Colorado River. Conclusions on the presence and duration of surface water within the site could not be drawn because of the high variability in water levels associated with flood irrigation. However, if conditions are like those observed in Phase 02, surface water was likely present only during active irrigation (see GeoSystems Analysis, Inc. 2014).

Although canopy closure reaches the minimum suitable level (see table 2-1) in a few places within the Goodding's willows, most of the site lacks the canopy closure typical of suitable habitat. This site lacks the continuous presence of wet soils and the canopy closure that are typical of preferred nesting habitat.

Phase 04 Block 03

Vegetation within the survey site known as Phase 04 Block 03 is composed of cottonwoods, Goodding's willows, and coyote willows that occur in a much more heterogeneous mix than in the other two blocks in Phase 04. Cottonwoods 12–18 m in height and Goodding's willows 8–12 m in height form the overstory. Canopy height for both the cottonwoods and Goodding's willows is taller in the western third (15–18 m and 10–12 m, respectively) than in the eastern two-thirds of the site (12–15 m and 8–10 m, respectively). Spindly, partially dead coyote willows 3–5 m in height are scattered throughout the site. There are a few 20-m-wide strips containing only Goodding's and coyote willows. Goodding's willows look the healthiest and most robust in these strips, where they form the dominant overstory. A few gaps in the cottonwood canopy are present in the north-central portion of the site, and coyote willows 3–5 m in height are the dominant woody species in these gaps. Canopy closure is 85% in the western third of the site and 80% in the eastern two-thirds. In areas dominated by coyote willows, canopy closure varies from 50 to 80% depending on stem density.

When the May site description was recorded, wet soils were present in two-thirds of the site, and the remaining soils were damp or dry (see table 2-2). Soils were

completely dry when the June site description was recorded. One-third of the site had damp soils when the July site description was recorded and the remainder was dry. Conclusions on the frequency and duration of surface water within the site could not be drawn because of the high variability in water levels associated with flood irrigation. However, if conditions are like those observed in Phase 02, surface water was likely present only during active irrigation (see GeoSystems Analysis, Inc. 2014).

Although canopy closure reaches preferred density (see table 2-1) in a large portion of the site, midstory structure is lacking in much of the site. Thus, although all elements of suitable habitat are present in places, these elements rarely co-occur. This site lacks the continuous presence of wet soils and the canopy closure that are typical of preferred nesting habitat.

Phase 05 Block 01

The survey site known as Phase 05 Block 01 consists of a mosaic of vegetation. Cottonwood is the dominant woody species, with interspersed small patches and rows of Goodding's willows. The cottonwoods are 12–15 m in height in the northwestern corner of the site and 8–12 m in height elsewhere. The healthiest patches of Goodding's willows occur in the northwestern corner and along the southern border of the site, where the trees are 8–12 m in height and fully foliated. In the southwestern corner of the site, most of each willow appears dead, and vegetation height is 3–8 m. Along the eastern edge of the site, almost half of the Goodding's willows have dead tops or dead limbs, and vegetation height is 3–5 m. Some small, 2–3-m-tall coyote willow patches are present along the northern and southern borders of the site. Canopy closure is 70–75% in the tallest cottonwoods and Goodding's willows, 30–50% in the southwestern corner, and 60–70% in the rest of the site.

Three-quarters of the site contained wet soils when the May site description was recorded (see table 2-2). When the June and July site descriptions were recorded, soils were completely dry, and the nearest standing water was in the Colorado River. Conclusions on the frequency and duration of surface water within the site could not be drawn because of the high variability in water levels associated with flood irrigation. However, if conditions are like those observed in Phase 02, surface water was likely present only during active irrigation (see GeoSystems Analysis, Inc. 2014).

Canopy closure within this site does not exceed 75%; thus, the site does not meet all the criteria for suitable habitat (see table 2-1).

Phase 05 Block 02

Vegetation within the survey site known as Phase 05 Block 02 consists of cottonwoods 12–16 m in height in the western two-thirds of the site and Goodding's willows up to 8–10 m in height in the eastern third. Some Goodding's willows are mixed in under the cottonwoods as well. Canopy closure is 70–80% in most of the site. A few large, open areas dominated by grass and shrubs run diagonally through the center of the site from the northeast to the southwest. Canopy closure is 50–60% in these areas.

Almost half of the site contained wet soils when the May site description was recorded (see table 2-2). Soils were completely dry when the June site description was recorded, and 60% of the site was damp while the remainder was dry when the July site description was recorded. For both the June and July site descriptions, the nearest standing water was in the Colorado River. Conclusions on the presence and duration of surface water within the site could not be drawn because of the high variability in water levels associated with flood irrigation. However, if conditions are like those observed in Phase 02, surface water was likely present only during active irrigation (see GeoSystems Analysis, Inc. 2014).

Canopy closure within this site does not exceed 80%; thus, the site does not meet all the criteria for suitable habitat (see table 2-1).

Phase 05 Block 03

The survey site known as Phase 05 Block 03 is composed of three distinct cells of vegetation, each dominated by a single tree species. The western cell is predominantly cottonwoods 12–15 m in height. Canopy closure varies from 80% along the northern edge to 60% along the eastern edge. The upper canopies of some trees in this cell are dead. Where this occurs, there is vegetative growth along the bottom 3 m of the trunk, providing green vegetation throughout the vertical vegetation structure. There are 3–8-m-tall Goodding's willows in the western cell, but they are either completely or half dead and add only to the midstory structure. *Baccharis* spp. shrubs are 0.5 m in height and widely scattered. The eastern cell is predominantly vegetated with cottonwoods 12–18 m in height with full canopies and no vegetative growth along the lower trunks. Goodding's willows in the eastern cell are healthier than in the western cell and reach 10–12 m in height. Canopy closure in the eastern cell varies with canopy height and is 85% in the tallest cottonwoods and as low as 70% in areas dominated by Goodding's willows and along the eastern edge of the site. The central cell is vegetated with Goodding's willows that are 8–10 m in height with 60–80% canopy closure along the northern and southern edges and 6–8 m in height with 50–70% canopy closure in the middle of the cell. In areas with the shortest vegetation, many of the trees have dead tops. *Baccharis* spp. shrubs are 2–2.5 m in height and create a distinct understory layer in portions of the central cell.

Approximately 25% of the site contained wet soils when the May site description was recorded (see table 2-2). Soils were completely dry when the June site description was recorded, and the nearest standing water was in the Colorado River. Approximately 10% of the site had damp soil when the July site description was recorded. Conclusions on the presence and duration of surface water within the site could not be drawn because of the high variability in water levels associated with flood irrigation. However, if conditions are like those observed in Phase 02, surface water was likely present only during active irrigation (see GeoSystems Analysis, Inc. 2014).

Canopy closure reaches the minimum suitable level (see table 2-1) in some portions of the cottonwood stands, but areas with suitable canopy closure lack any type of midstory structure. Thus, although all elements of suitable habitat are present, these elements rarely co-occur. This site lacks the continuous presence of wet soils and the canopy closure that are typical of preferred nesting habitat.

Phase 06 Block 01

The survey site known as Phase 06 Block 01 is vegetated with a mosaic of cottonwoods and Goodding's willows. The two species occasionally occur in monotypic strips but more often occur together in mixed strips. The cottonwoods are primarily 15–18 m in height but are occasionally as short as 12 m in height. Where the Goodding's willows are present in narrow (< 10-m-wide) rows, they are 8–10 m in height, and some of the trees have dead tops. Where the Goodding's willows occur in wider rows (20 m wide), the trees look healthier, and canopy height is 10–12 m. Canopy closure ranges from 60% in open areas to 90% in the tallest, densest cottonwoods but is typically 80–85% in the cottonwoods. In areas dominated by Goodding's willows, canopy closure is 70–75%. Coyote willows up to 5 m in height are also present in 1–5-m-wide rows spaced at even intervals from east to west throughout the site. Canopy closure is 40–60% in areas dominated by coyote willows. Mule-fat and *Baccharis* sp. shrubs are scattered throughout the understory.

All soils were damp when the May site description was recorded, and the nearest standing water was in an irrigation canal adjacent to the southern edge of the site (see table 2-2). When the June site description was recorded, approximately 5% of the site had damp soils, and the nearest standing water was in an irrigation canal west of the site. Soils were completely dry when the July site description was recorded, and the nearest surface water was in the Colorado River. Conclusions on the presence and duration of surface water within the site could not be drawn because of the high variability in water levels associated with flood irrigation. However, if conditions are similar to those observed in Phase 02, surface water was likely present only during active irrigation (see GeoSystems Analysis, Inc. 2014).

Although canopy closure reaches suitable density (see table 2-1) in the densest cottonwoods, areas with suitable canopy closure lack any type of midstory structure. Thus, although all elements of suitable habitat are present, these elements do not co-occur.

Phase 06 Block 02

The survey site known as Phase 06 Block 02 is vegetated with a mosaic of 8–12-m-tall Goodding's willows and 12–18-m-tall cottonwoods. In the western three-quarters of the site, cottonwoods 12–15 m in height form the main overstory, and Goodding's willows 10–12 m in height form a subcanopy. Approximately 20% of these Goodding's willows have dead tops. Coyote willows 1–5 m in height and mule-fat 1–2 m in height occur in patches but do not form a continuous understory. The eastern quarter of the site is split into a section of 10–12-m-tall Goodding's willows with an understory of mule-fat 1–2 m in height and coyote willows 4–5 m in height and a section of monotypic, 12–18-m-tall cottonwoods. Several large, open areas vegetated primarily with grass are present in the southeastern portion of the site. Canopy closure within the trees varies from 70 to 85%, with the highest canopy closure occurring in areas with the healthiest Goodding's willows. Canopy closure is as low as 50% in open areas.

Most of the soils (80–90%) were damp when the May and June site descriptions were recorded. When the July site description was recorded, soils were completely dry. The nearest standing water was in an irrigation ditch in May and in the Colorado River in June and July (see table 2-2). Conclusions on the presence and duration of surface water within the site could not be drawn because of the high variability in water levels associated with flood irrigation. However, if conditions are like those observed in Phase 02, surface water was likely present only during active irrigation (see GeoSystems Analysis, Inc. 2014).

All the characteristics of suitable habitat (see table 2-1) are present in small portions of this site, but canopy closure in most of the site is below suitable levels, and midstory structural elements occur only in patches. This site lacks the continuous presence of wet soils and the canopy closure that are typical of preferred nesting habitat.

Phase 07 Block 01

The survey site known as Phase 07 Block 01 is vegetated primarily with a mixture of cottonwoods and Goodding's willows. In most of the site, cottonwoods 12–15 m in height form the overstory, and Goodding's willows 6–8 m in height, many of which have dead tops or sparse canopies, form the understory. The proportion of Goodding's willows with dead tops or sparse canopies is greater in the northern half of the site than elsewhere. There are portions of the eastern half

of the site where no cottonwoods are present and Goodding's willows 8–10 m in height form the overstory. Coyote willows occur throughout the site, varying from 3-m-tall, widely spaced wispy stems to 5-m-tall stands with 60–70% canopy closure. Dense coyote willow stands are more prevalent on the northern and southern edges of the site than in the center. Canopy closure is 70–85% in most of the site. *Baccharis* sp. shrubs are scattered throughout the site.

All observed soils were dry when the May site description was recorded, and the nearest surface water was in the Colorado River (see table 2-2). When the June and July site descriptions were recorded, 35% of the site contained wet soils. Conclusions on the presence and duration of surface water within the site could not be drawn because of the high variability in water levels associated with flood irrigation. However, if conditions are similar to those observed in Phase 02, surface water was likely present only during active irrigation (see GeoSystems Analysis, Inc. 2014).

All characteristics of suitable habitat (see table 2-1) are present within small patches. Most of the site, however, has canopy closure that does not reach suitable levels. This is one of the youngest sites surveyed by SWCA, and vegetation structure may continue to develop in future years.

Phase 07 Block 02

The survey site known as Phase 07 Block 02 is vegetated primarily by cottonwoods 12–15 m in height with 80–85% canopy closure. Canopy closure reaches 90% in a few places, and in the southeastern corner of the site, the cottonwoods are 10–12 m in height, and canopy closure is 70%. Goodding's willows and coyote willows are scattered throughout the site. Where these species occur as single stems or one-tree-wide rows under the cottonwoods, each willow stem is mostly dead, with live vegetation occurring only near the bottom of the trunk. In areas where the willows are dominant and not shaded by the cottonwoods, leaves are present all the way to the top of each crown, though the crowns are narrow. Canopy height in areas dominated by Goodding's willow is 6–7 m, and canopy closure does not exceed 70%. Coyote willows are the dominant vegetation in a few areas where they form 5-m-tall stands of wispy stems with 50–70% canopy closure. *Baccharis* sp. shrubs are also scattered throughout the site. Several open areas with widely spaced Goodding's and coyote willows are present, and canopy closure is as low as 60% in these locations.

Most soils (90%) were damp when the May site description was recorded (see table 2-2). Soils were completely dry when the June and July site descriptions were recorded, and the nearest standing water was in the Colorado River. Conclusions on the presence and duration of surface water within the site could not be drawn because of the high variability in water levels associated with flood

irrigation. However, if conditions are similar to those observed in Phase 02, surface water was likely present only during active irrigation (see GeoSystems Analysis, Inc. 2014).

Although canopy closure reaches preferred density (see table 2-1) in a few places, areas with dense canopy closure lack any type of midstory structure. Thus, although all elements of suitable habitat are present, these elements rarely co-occur. The consistently wet soils that are typical of preferred nesting habitat are also missing.

Cibola, Arizona and California

The survey sites in CIBO are a mix of conservation area sites and existing, unrestored riparian sites. The elevation of survey sites within the study area ranges from 64 to 73 m above sea level and decreases from north to south along the Colorado River. The conservation area sites are in the Cibola Valley Conservation Area (CVCA) and in the Cibola National Wildlife Refuge near the headquarters. All sites within the conservation areas are periodically flood irrigated and typically become dry between irrigation bouts. The CVCA sites are surrounded by agricultural fields. No signs of livestock or tamarisk beetles were documented in or around any sites in the study area.

Cibola Valley Conservation Area

Phase 01

Phase 01 at the CVCA consists of a mosaic of rectangular cells of cottonwoods, Goodding's willows, and coyote willows of varying sizes and densities. Each cell generally contains a single species and age class, though some emergent Goodding's willows are present in the coyote willow cells. Most of the site is vegetated with cottonwoods 12–15 m in height, although cottonwoods in cells on the eastern edge of the site reach 20 m in height. Canopy closure in the cottonwoods ranges from 60 to 95% depending on how densely the trees are planted. The cells planted with Goodding's willows range widely in tree health and density. Some areas have grassy openings and contain trees 8 m in height that have live foliage only in the lower half of the tree, while other stands of Goodding's willows reach 12 m in height and have canopy closure ranging from 60 to 90%. Most of the coyote willows are dead or nearly dead, though one patch of 5-m-tall coyote willows with 50% canopy closure is present along the northern border of the site. Willow baccharis are starting to fill in the areas with dead coyote willows.

No wet soils were present, and ≤ 5% of the site had damp soils when each site description was recorded (see table 2-2). The nearest standing water was in the

irrigation canal adjacent to the site. Conclusions on the frequency and duration of surface water within the site could not be drawn because of the high variability in water levels associated with flood irrigation.

Portions of the cottonwood and willow stands have canopy closure that meets the criterion for suitable habitat (see table 2-1), but these stands are lacking in midstory structural components, and there is no portion of the site where all the elements of suitable habitat co-occur.

Phase 02

The survey site known as Phase 02 at the CVCA is located immediately south of Phase 01. It consists of rectangular cells of cottonwoods 15–18 m in height mixed with Goodding's willows 10–12 m in height alternating with cells of coyote willows 2–6 m in height with emergent cottonwoods. The Goodding's willows in most of the site have dead tops, with live foliage present only on the lower half of the trees. Fully foliated Goodding's willows are present in the center of the site and in a narrow strip along the eastern border. Canopy closure in areas with cottonwoods and Goodding's willows ranges from 50 to 80%. The only patches of coyote willows that appear healthy are along the northern border of the site near irrigation inlets. The remainder of the coyote willows are dead or dying, and canopy closure in the coyote willow cells ranges from 40 to 75%, depending on the density and crown size of the emergent cottonwoods.

No wet soils were present when any site description was recorded (see table 2-2). All soils were completely dry during the June site description and were entirely damp from recent rain during the July site description. During the May site description, soils were a mix of damp and dry. The nearest standing water was either in the irrigation canal immediately to the north or in the Colorado River. Conclusions on the frequency and duration of surface water within the site could not be drawn because of the high variability in water levels associated with flood irrigation.

No portion of this site has canopy closure that meets the criterion for suitable habitat (see table 2-1).

Phase 03

The survey site known at Phase 03 at the CVCA is located 2.5 km west of Phases 01 and 02. It consists of a mosaic of rectangular cells that were planted with cottonwoods, Goodding's willows, or coyote willows. The cottonwoods reach approximately 18–20 m in height with 85–95% canopy closure in a narrow strip along the western edge of the site but are 10–14 m in height with 60–80% canopy closure throughout most of the site. Many of the willows of both species are mostly dead. The Goodding's willows are 9 m in height where they are the

healthiest but reach only 3 m in height where the main trunks are dead and the live portions are basal sprouts. Canopy closure in cells dominated by Goodding's willows ranges from 40 to 70% and varies directly with vegetation height. The coyote willows are still alive in one small area where the trees are 3–4 m in height with 60–70% canopy closure. Otherwise, the coyote willows are dead, and the areas that were planted in coyote willows now contain a scattered, emergent overstory of cottonwoods up to 20 m in height with wide canopies and an understory of honey and screwbean mesquite up to 8 m in height and willow baccharis up to 2 m in height. Canopy closure in these areas does not exceed 70%.

Damp soils were present in 5% of the site when the May and July site descriptions were recorded; otherwise, soils were dry during each visit (see table 2-2). The nearest standing water was either in the irrigation canal immediately to the west or in the Colorado River. Conclusions on the frequency and duration of surface water within the site could not be drawn because of the high variability in water levels associated with flood irrigation.

Portions of the cottonwood stands have canopy closure that meets the criterion for suitable or preferred nesting habitat (see table 2-1), but the cottonwood stands are lacking in midstory structural components, and there is no portion of the site where all the elements of suitable habitat co-occur. In most of the site, canopy closure it too low to meet the criterion for suitable habitat.

Upper Hippy Fire

The survey site known as Upper Hippy Fire is 2.3 km south of CVCA Phase 03. This conservation area site was planted primarily with cottonwoods that now reach 6–10 m in height. An irrigation canal bisects the site north to south, and the tallest trees are in the center of the site near the canal, with canopy height decreasing to the east and west. Canopy closure varies directly with canopy height and ranges from 50 to 90%. Goodding's willows 7 m in height and coyote willows 3 m in height are present throughout the site, often in narrow rows, and many are leafless. One block of Goodding's willows in the eastern half of the site has trees that are completely foliated, but the crowns are narrow, and canopy closure does not exceed 65%. The only understory is rows of mule-fat 2 m in height.

The only water present when each site description was recorded was in the irrigation canal that bisects the site. All soils underneath the woody vegetation were dry (see table 2-2). Conclusions on the frequency and duration of surface water within the site could not be drawn because of the high variability in water levels associated with flood irrigation.

Portions of the site where canopy closure reaches 85% have the characteristics of suitable habitat (see table 2–1), but these areas are limited to a strip on either side

of the irrigation canal. Canopy closure in the remainder of the site does not meet the criterion for suitable habitat. This site was planted in 2013 and may continue to mature in future years.

Nature Trail

The survey site known as Nature Trail is approximately 700 m west of the Cibola National Wildlife Refuge headquarters and consists of a mosaic of cottonwoods, Goodding's willows, mesquite, and willow baccharis. Approximately one-half of the site consists of scattered screwbean and honey mesquite 5–7 m in height with a thick understory of willow baccharis. The ratio of mesquite to baccharis varies from stands of fairly continuous mesquite to almost pure baccharis. Canopy closure in areas dominated by mesquite and baccharis is 10–90% and varies in direct proportion with the amount of mesquite present in an area. The northern half of the site contains a cell of Goodding's willows approximately 100 x 275 m in size. The majority of the Goodding's willows (> 90%) are mostly dead and reach 4–6 m in height with 10% canopy closure. There is a narrow band (5–10-m-wide) of Goodding's willows along the southern edge of the cell that are 8–10 m in height with 90% canopy closure. Cottonwoods 20 m in height with 85% canopy closure are present in the southwestern corner of the site and in narrow stringers along the pathways throughout the site. There is a very sparse understory of willow baccharis 1.5 m in height in the southwestern corner of the site.

The site was completely dry when each site description was recorded (see table 2-2). Conclusions on the frequency and duration of surface water within the site could not be drawn because of the high variability in water levels associated with flood irrigation.

Canopy closure that meets the criterion for suitable habitat is present under the cottonwoods, but midstory structural components are lacking (see table 2-1). Dense canopy closure is also present in a stringer of Goodding's willows, but the widest portion of the stringer barely meets the criterion for minimum patch width for suitable habitat. Canopy closure also reaches suitable density under the tallest mesquite trees, but these areas are small and patchily distributed.

C2729

The survey site known as C2729 is approximately 2 km west of the Cibola National Wildlife Refuge headquarters in the LCR MSCP site known as Crane Roost. The site consists of a mosaic of cottonwoods and coyote willows and is bisected east to west by a road. The northern half of the site is vegetated with a cottonwood overstory and a coyote willow understory. The cottonwoods are 12–15 m in height around the perimeter of the northern half and 6–10 m in height in the center. The coyote willows are 4–6 m in height and tend to be taller

around the perimeter of the northern half. Some patches of coyote willows in the northern half of the site are dead. Canopy closure in the northern half of the site ranges from 60% in the center to 85% in the tallest cottonwoods around the perimeter. The entirety of the southern half of the site is vegetated with coyote willows with emergent cottonwoods 15–20 m in height. The coyote willows in the northwestern 50% of the southern half are 9 m in height with large (8 cm) diameter at breast height stems and 80–90% canopy closure. An area of sparse 3-m-tall coyote willows with 10% canopy closure is present in the southeastern quarter of the southern half of the site. Where the cottonwoods occur along the southern border, the coyote willows reach 5 m in height but are half dead. Canopy closure reaches 75% under the cottonwoods. Some tamarisk, honey mesquite, and willow baccharis are scattered throughout both halves of the site.

Approximately 40% of the site had damp soils when the May site description was recorded; otherwise, soils were completely dry when each site description was recorded (see table 2-2). The nearest standing water was either in an irrigation canal adjacent to the site or in the Colorado River. Conclusions on the frequency and duration of surface water within the site could not be drawn because of the high variability in water levels associated with flood irrigation.

The coyote willows immediately south of the road have all the structural elements of preferred nesting habitat (see table 2-1) but lack a consistent presence of wet soils, while the cottonwoods in the northwestern corner of the site meet the criteria for suitable habitat. Canopy closure in the remainder of the site does meet the criterion for suitable habitat.

Cibola Site 02

Cibola Site 02 was last surveyed in 2011. The northern two-thirds of the original extent of the survey site consists of tamarisk with scattered honey and screwbean mesquite, with canopy height decreasing south to north and east to west, from 5 m to 2–3 m. Because canopy height in this portion of the original site rarely meets the criterion for suitable habitat, the survey site boundary was redrawn to include only the southern third of the site. The current extent of the site consists of a 200-m-wide strip of mixed-exotic riparian vegetation between the channelized Colorado River to the west and a levee road to the east. The eastern third of the site is vegetated by 2-m-tall arrowweed and tamarisk 2–3 m in height, with < 50% canopy closure. The western two-thirds of the site is dominated by two cattail marshes. The marshes are ringed by scattered, emergent Goodding's willows 12–15 m in height and cottonwoods 20–25 m in height. Many of the Goodding's willows have dead tops or broken branches. Between the emergent trees, the vegetation consists of tamarisk of uneven height, 3–5 m tall, and scattered honey and screwbean mesquite 5 m in height. A 5- x 20-m patch of coyote willows 4–5 m in height is present at the northern end of the southern marsh. Canopy closure adjacent to the marsh was not assessed.

The marshes contained water of undetermined depth when each site description was recorded, and all other soils in the site were dry (see table 2-2). Soil moisture conditions in the site are dependent upon groundwater levels, which likely fluctuate with the water level in the Colorado River.

The eastern third of the site has vegetation that is too short and too sparse to meet the canopy height and canopy closure criteria for suitable habitat (see table 2-1). Canopy closure adjacent to the marshes was not assessed, and habitat suitability in this portion of the site is unknown.

Cibola Site 01

The survey site known as Cibola Site 01 is contiguous with the southern end of Cibola Site 02 and was last surveyed in 2015. The site consists of a 200-m-wide strip of mixed-exotic riparian vegetation between the channelized Colorado River to the west and a levee road to the east. Vegetation in the eastern half of the site consists of a mix of dry and scrubby 3–4-m-tall tamarisk and 2-m-tall arrowweed with 40–60% canopy closure. The tops of many of the tamarisk are dead. Two cattail marshes dominate the western half of the site. Along the perimeter of the marshes, tamarisk reach 7 m in height, and coyote willows occur in sparse, 5-m-tall patches. Many of the coyote willows have dead tops. Emergent 10–15-m-tall Goodding's willows and 15–20-m-tall cottonwoods are scattered in a loose stringer along the eastern edge of the marshes, and many of the emergent trees have dead tops or broken branches. Honey and screwbean mesquite were scattered throughout the site. Canopy closure adjacent to the marshes was not assessed.

The marshes contained water of undetermined depth when each site description was recorded, and all other soils in the site were dry (see table 2-2). Soil moisture conditions in the site are dependent upon groundwater levels, which likely fluctuate with the water level in the Colorado River.

The eastern half of the site has vegetation that is too short and too sparse to meet the canopy height and canopy closure criteria for suitable habitat (see table 2-1). Canopy closure adjacent to the marshes was not assessed, and habitat suitability in this portion of the site is unknown.

Cibola Lake North

The survey site known as Cibola Lake North, on the western edge of Cibola Lake, was last surveyed in 2015. In a narrow band along the lakeshore, the site is vegetated by tamarisk 5–6 m in height with scattered screwbean and honey mesquite. Some of the tamarisk have leafless extremities, and canopy height is uneven. Scattered, emergent Goodding's willows 10–18 m in height, some of

which have dead limbs and sparse canopies, are present in the northern half of the site. Canopy closure in the densest tamarisk reaches 80–90%. The interior of the southern half of the site is sparsely vegetated and has open, sandy areas. The northern arm of the site along the lake edge has a strip of coyote willows 4–7 m in height with wispy tops. This willow strip is 20 m wide at the widest point but is more commonly 10 m wide. Canopy closure is 80–85%. To the west of the willow strip, vegetation consists of mesquite and tamarisk < 6 m in height.

When the first site description was recorded in early June, wet soils were present only along the lakeshore, and soils that were more than ≈2 m from the lake were damp. Soil moisture conditions were not assessed during the other site descriptions (see table 2-2). Soil moisture conditions vary according to water levels in Cibola Lake, which are influenced by the weekly and seasonal fluctuations of water levels in the Colorado River. Weekly fluctuations in groundwater levels at Cibola Lake during the survey seasons of 2005–06, when water levels were measured via piezometer, were typically ≈30 cm (McLeod and Pellegrini 2013).

The narrow band of dense vegetation adjacent to the lake has the canopy height and canopy closure of suitable habitat, but portions of the band were barely wide enough to meet the patch width criterion (see table 2-1). Suitability of the coyote willow strip could improve if it increases in width and canopy closure.

Cibola Lake East

The survey site known as Cibola Lake East, which borders the marsh on the eastern edge of Cibola Lake, was last surveyed in 2011. Vegetation consists entirely of tamarisk. Within ≈40 m of the marsh edge, the tamarisk are 6 m in height and have 90% canopy closure, with heaps of duff and deadfall in the understory. As distance from the marsh increases, canopy height and canopy closure decrease, reaching 2–4 m and 50%, respectively, at 75 m from the marsh. Beyond 75 m from the marsh, the tamarisk are 2–3 m tall with 20% canopy closure.

No wet soils were observed when any of the site descriptions were recorded, although soils beneath the duff in portions of the site were damp (see table 2-2). The far western edge of the site was not accessed to determine if wet soils were present adjacent to the marsh. Soil moisture conditions vary according to water levels in Cibola Lake, which are influenced by the weekly and seasonal fluctuations of water levels in the Colorado River. Weekly fluctuations in groundwater levels at Cibola Lake during the survey seasons of 2005–06, when water levels were measured via piezometer, were typically ≈30 cm (McLeod and Pellegrini 2013).

Canopy height and canopy closure meet the criteria for preferred habitat in the western 40 m of the site although the vegetation is so dense in some areas as to impede flight. Observed surface hydrology within the site did not meet the criterion for suitable habitat.

Cibola Lake West

Cibola Lake West was last surveyed in 2012. This mixed-exotic site borders Cibola Lake and is ringed by a narrow strip of cattail and bulrush. The perimeter of the site adjacent to the lake is vegetated by a 50-m-wide band of dense tamarisk with an understory of dense patches of arrowweed 2 m in height and occasional willow baccharis. Honey and screwbean mesquite are scattered through the tamarisk. Canopy height is 5 m along the lakeshore and declines to 3–4 m toward the interior of the site. Individual tamarisk trees near the lake reach 7 m tall, but there is no continuous canopy layer at this height. Canopy closure in the densest tamarisk is 90%, and the understory is choked with dead, brittle branches. A few emergent Goodding's willows 10 m in height and cottonwoods 15 m in height are present along the site perimeter. The interior of the site has patchy vegetation with a mix of tamarisk 3–4 m in height, arrowweed, screwbean mesquite, and open sandy areas. Canopy closure in the interior averages 30%.

Wet soils were present within 1–2 m of the lake edge, soils were damp 5 m from the lake edge, and soils more than 15 m from the lake were completely dry when the May site description was recorded (see table 2-2). Soil moisture conditions were not assessed during subsequent site descriptions but vary according to water levels in Cibola Lake, which are influenced by the weekly and seasonal fluctuations of water levels in the Colorado River. Weekly fluctuations in groundwater levels at Cibola Lake during the survey seasons of 2005–06, when water levels were measured via piezometer, were typically ≈30 cm (McLeod and Pellegrini 2013).

A narrow band around the perimeter of the site meets the suitable habitat criteria for canopy height and canopy closure, but midstory structural elements are lacking (see table 2–1). The interior of the site lacks the canopy height and canopy closure of suitable habitat. Surveys could be discontinued with minimal risk of overlooking suitable flycatcher habitat.

Walker Lake

The survey site known as Walker Lake was last surveyed in 2015. The site burned between 2015 and 2018 and now consists of resprouting tamarisk 2–3 m in height and several dead, emergent overstory trees. One emergent Goodding's willow near the southern edge of the site survived the fire.

No portion of the site meets the structural criteria for suitable habitat (see table 2-1), and the site was not visited again after the first survey. Reconnaissance of this site at the beginning of the survey season in 2021, when the next triennial surveys are scheduled, would ensure that no suitable habitat is overlooked.

Imperial, Arizona and California

IMPE is primarily composed of existing, unrestored lands within the Imperial National Wildlife Refuge and on adjacent public lands. The elevation within the study area is 57–60 m above sea level. All the sites within the study area were placed on the triennial survey schedule in 2013. Few signs of livestock were observed within the sites, although burros were abundant in adjacent uplands. No signs of tamarisk beetles were noted in or around the study area.

Rattlesnake

The site known as Rattlesnake was last surveyed in 2012 and burned in 2013. Examination of aerial imagery suggested that vegetation in this area might have recovered, and the site was visited in 2018. The northern edge of the original extent of the site is vegetated with widely spaced tamarisk. Vegetation density increases to the south, becoming a mixture of 3–5-m-tall tamarisk and 3-m-tall arrowweed in the center of the original extent of the site. Although canopy cover reaches 85–90%, vegetation in this portion of the site is often dense enough to impede flight. The northern half of the original extent of the site was not surveyed after the first visit, and the survey polygon was redrawn to include only the southern half and some areas to the south of the original site boundary. Vegetation within the new site boundary transitions from a mixture of tamarisk and coyote willows on the eastern edge of the site to coyote willows on the western edge. Canopy height is 6 m, and canopy closure averages 85%.

The site was entirely inundated when the May site description was recorded, although the presence of shelf fungi beneath the water suggested that the inundation was recent. Approximately 20% of the site was inundated when the June site description was recorded, and portions of site that had 10 cm of water on the previous visit had damp or saturated soils. During the July site description, no surface water was present, but soils were damp (see table 2-2). Soil moisture conditions in the site are influenced by water levels in the Colorado River, which fluctuate weekly and seasonally according to releases from Parker Dam. Weekly fluctuations in groundwater levels at Rattlesnake during the survey seasons of 2005–07, when water levels were measured via piezometer, were typically ≈50 cm (McLeod and Pellegrini 2013).

This site contains all the structural characteristics of preferred flycatcher habitat (see table 2-1). Although daily soil moisture characteristics were not described, large portions of the site had wet soils during the May and June site descriptions, and the site may also meet the soil moisture criterion for preferred habitat.

Imperial NW

The survey site known as Imperial NW was last surveyed in 2015. This "L"-shaped site is bordered by the Colorado River to the west, a cattail marsh to the northeast, and a road to the south. The long, narrow eastern arm of the site consists of a strip of woody vegetation, one tree wide, along the road bank. Tree species in this strip include one 15-m-tall cottonwood, a few Goodding's willows 6–7 m in height, and screwbean mesquite 4–5 m in height. Vegetation at the toe of the bank and extending to the north consists of cattails and common reed. The remainder of the site (the vertical portion of the "L") has a 5–25-m-wide strip of vegetation along the riverbank consisting of common reed, tamarisk, and sparsely foliated 4–5-m-tall screwbean mesquite. To the east of this, a 25-m-wide swath, which has been cleared of woody vegetation and is vegetated with common reed 1–2 m in height and sedges, extends the length of the site. In the southern 400 m of the site, vegetation for 50 m to the east of the cleared swath is primarily tamarisk of varying height with a patchy understory of common reed. Immediately adjacent to the cleared swath, canopy height is 5–6 m, common reed reaches 4–5 m in height, and canopy closure is up to 95%. Farther east, the height of the tamarisk becomes more uneven, varying from 3 to 6 m; common reed is 2–3 m in height and forms a dense understory; and canopy closure is 80–90%, varying directly with canopy height. A few openings vegetated only by common reed are present; canopy closure in these openings is 30%. The eastern edge of the site bordering the cattail marsh has patches of Goodding's willows 12–15 m tall with an understory of tamarisk 3–5 m in height and cattails. Some of the smaller clumps of Goodding's willows are completely dead, while approximately one-third of the Goodding's willows in the largest stand, which is approximately 50 m long, are dead. Canopy closure in this portion of the site is widely variable, ranging from 30 to 90% and averaging 75%. The northern tip of the site is vegetated with tamarisk 4–8 m in height and a dense understory of common reed 3–4 m in height. Some of the tamarisk have diameters over 30 cm, and these areas are very difficult to traverse, with many dead branches and dense common reed in the understory.

Approximately 90% of the site had wet soils when the May and June site descriptions were recorded, with 10 cm of water in the cleared swath along the Colorado River and 40 cm of water along the eastern edge of the site under the Goodding's willows. Soil moisture conditions were not thoroughly assessed when the July site description was recorded, but the cleared swath along the river was dry, and only 10% of the site was estimated to be inundated (see table 2-2). Soil moisture conditions in the site are influenced by water levels in the Colorado River, which fluctuate weekly and seasonally according to releases from Parker

Dam. Weekly fluctuations in groundwater levels in a nearby site during the survey seasons of 2005–08, when water levels were measured via piezometer, were typically 25 cm or less (McLeod and Pellegrini 2013).

Most of the site has canopy height and canopy closure that meet the criteria for suitable habitat (see table 2-1), but the midstory is thickly vegetated with common reed and lacks flyways. The eastern edge of the site where there are live Goodding's willows with an understory of tamarisk has all the characteristics of preferred nesting habitat, although dense canopy closure only occurs in small patches. The eastern 300 m of the southern arm of the site is not wide enough to meet the criterion for suitable habitat, and the strip of vegetation along the edge of the river lacks the canopy height of suitable habitat. Both areas could be eliminated from future surveys with minimal risk of overlooking suitable habitat.

Imperial Nursery

The survey site known as Imperial Nursery is a restoration site managed by the Imperial National Wildlife Refuge. It was last surveyed in 2015. The site is bordered to the north by a patchwork of cattails, common reed, and tamarisk and to the south by open fields. The site is vegetated primarily by cottonwoods 8–15 m in height, with the taller trees being along the perimeter. In the interior, the cottonwoods are shorter and more variable in height, and about half of the trees have dead branches in the canopy, or the top 2–3 m of the tree are dead. Canopy closure under the healthiest cottonwoods is 80–85% but is 65–80% in most of the site. The understory consists of patchy honey mesquite, most of which are ≈5 m in height, with a few individuals reaching 12 m in height. Willow baccharis are also present in the understory where there are gaps in the canopy. There is a 20- x 30-m patch of honey mesquite 4–5 m in height near the center of the site. This part of the site was formerly vegetated by 6-m-tall Goodding's willows (McLeod and Pellegrini 2017a). A few of these willows are still present but are sparsely foliated. Other than the increase in the prevalence of honey mesquite and the decrease in Goodding's willows, no major structural changes were noted at the site between 2015 and 2018.

The site is flood irrigated. During the May site description, 95% of the site contained wet soils, whereas only a small puddle at the irrigation inlet was present when the June site description was recorded, and the site was completely dry when the site description was recorded in July (see table 2-2). Sandy soil at the site allows the water to drain rapidly after irrigation. Conclusions on the frequency and duration of surface water within the site could not be drawn because of the high variability in water levels associated with flood irrigation.

In 2018, canopy closure that met the criterion for suitable habitat (see table 2-1) was present only in isolated areas under the healthiest cottonwoods. The site

contains the canopy height and midstory structural components of suitable flycatcher habitat, and habitat suitability would improve if canopy closure increases.

Ferguson Lake

The survey site known as Ferguson Lake was last surveyed in 2015. It is on a strip of land between Ferguson Lake to the west and the Colorado River to the east. In 2018, the site was surveyed both from the lake along the western edge and on land at the eastern tip during the first survey. Vegetation along the eastern side of the site consists of dense arrowweed 1–3 m in height with clumps of cottonwoods 6–10 m in height, Goodding's willows 3–10 m in height, honey mesquite 5 m in height, and tamarisk 3–7 m in height. Canopy closure does not exceed 50%. Because of the low canopy closure encountered on the eastern side of the site and the difficulty of accessing the area through the dense arrowweed, subsequent surveys were completed from the western edge of the site. Vegetation along the western edge of the site consists of tamarisk 4–6 m in height with scattered, emergent Goodding's willows 10 m in height. Canopy closure was not estimated in 2018 but in previous years reached 90% within dense tamarisk stands.

The eastern edge of the site was completely dry when the May site description was recorded. Soil moisture conditions in the western portion of the site were not assessed (see table 2-2). In past years, portions of the site up to 50 m from the lakeshore had saturated soils and fluctuating levels of standing water (McLeod and Pellegrini 2013), but personnel were unable to determine if these conditions were present in 2018.

Habitat suitability was not thoroughly assessed in 2018, but all the characteristics of preferred nesting habitat (see table 2-1) were present in portions of the western edge of the site in earlier years. Improving access to the interior of the site in future years would allow for a more thorough assessment of the extent of suitable and preferred nesting habitat.

Ferguson Wash

Ferguson Wash was last surveyed in 2012. This site, at the outflow of Ferguson Wash into Ferguson Lake, is dominated by dense, mature tamarisk that vary in height from 3 to 7 m. Vegetation height varies from one plant to the next, and the canopy, when viewed from the upland, has a lumpy appearance, with no portion of the site having canopy height that is consistently > 5 m. Canopy closure ranges from 50% in areas with shorter tamarisk to 90% beneath the taller trees. Dense deadfall and duff are present in the understory. Scattered honey and screwbean mesquite 5–7 m in height are present primarily near the upland edge. A few scattered, emergent Goodding's willows 10–15 m in height are present near the

lake, and arrowweed is the dominant understory beneath these willows. Canopy closure around the Goodding's willows is 75%. The site is bordered on the lakeside by cattails and bulrush and on the upland side by desert scrub. No major changes in vegetation structure or species composition were recorded between 2012 and 2018.

A backwater channel penetrates to the interior of the site, although the banks along the channel are abrupt and do not allow water to flow under the vegetation in this area. When the June site description was recorded, wet soils were present up to the trunks of some of the Goodding's willows along the edge of the marsh but did not extend any farther into the site. Soil moisture conditions along the edge of the marsh were not assessed for other site descriptions. Soils in the interior of the site were dry when each site description was recorded (see table 2-2).

Although canopy height and canopy closure reach suitable levels (see table 2-1) in small clumps of trees, suitable canopy height and closure are not consistently present in any portion of the site. Midstory structural components are also often lacking.

Great Blue Heron

Great Blue Heron is a survey site on the eastern shore of Martinez Lake and is bordered by marsh to the west and scrubby tamarisk to the east. It was last surveyed in 2015. Vegetation is dominated by tamarisk that vary in height from 4 to 9 m from one plant to the next. Clumps of emergent Goodding's willows up to 12 m in height are present in the central portion of the site. Some of these willows are dead or have dead tops, and the rest have narrow canopies. Canopy closure in the tamarisk is 80–90%, and the structure is often dense enough to impede flight. Canopy closure around the Goodding's willows is 70–85%, and willow baccharis are present in openings around the Goodding's willows. Heaps of deadfall and duff are present throughout the site. Overall, no major changes in vegetation structure or species composition were recorded between 2015 and 2018. An exploration of areas to the west of the site that appeared from aerial imagery to contain stands of coyote willows revealed that the area is vegetated by a mix of coyote willows and common reed that form a dense, 4–5-m-tall thicket that lacks flyways.

No wet soils were observed in 2018, although damp soils were present in portions of the site when the May and June site descriptions were recorded (see table 2-2). Soil moisture conditions in the site are influenced by water levels in Martinez Lake, which fluctuate weekly and seasonally according to releases from Parker Dam. Weekly fluctuations in groundwater levels during the survey seasons of 2005–08, when water levels were measured via piezometer, were typically 25 cm or less (McLeod and Pellegrini 2013).

Canopy height and canopy closure reach suitable levels (see table 2-1), but midstory structural components are often lacking. Individual trees reach the height typical of preferred breeding habitat, but the site does not contain areas where canopy height consistently reaches preferred levels.

Powerline

The survey site known as Powerline, on the eastern shore of Martinez Lake, was last surveyed in 2015. The site is a horseshoe of mixed-exotic riparian vegetation bordered by cattail marsh on the inside of the horseshoe and dry upland on the outside. Vegetation along the inside of the horseshoe consists of a stringer of Goodding's willows up to 20 m wide and 12 m tall and an understory of tamarisk 4–5 m in height. Canopy closure within this narrow band varies from 70% near the marsh edge to 90% in the densest portions of the interior. Vegetation between the Goodding's willows and the upland edge is dominated by tamarisk that are up to 6 m in height closest to the water and 3 m in height along the upland edge. Canopy closure ranges from 60 to 80%. Arrowweed 2 m in height is also present throughout much of the site. No major changes in vegetation structure or species composition were noted between 2015 and 2018.

Surface water was present along the marsh edge, and wet soils extended approximately 5 m under the woody vegetation when the June site description was recorded. Otherwise, soils observed within the site were dry, although wet soils were present in the marsh adjacent to the site when the May site description was recorded (see table 2-2). Soil moisture conditions in the site are influenced by water levels in Martinez Lake, which fluctuate weekly and seasonally according to releases from Parker Dam. Weekly fluctuations in groundwater levels during the survey seasons of 2005–08, when water levels were measured via piezometer, were typically 25 cm or less (McLeod and Pellegrini 2013).

All the elements of preferred nesting habitat (see table 2-1) are present at the site but are limited to the narrow band dominated by Goodding's willows.

Martinez Lake

The survey site known as Martinez Lake was last surveyed in 2015. The site is adjacent to and south of Powerline and is bordered to the west by marsh vegetation on the eastern shore of Martinez Lake and to the east by scrubby upland vegetation. Vegetation at the site is mixed-exotic and varies in composition and structure with distance from the lake. Goodding's willows 10–15 m in height and cottonwoods up to 25 m in height form a broken stringer up to 30 m wide on the western edge of the site, adjacent to cattails and common reed along the lakeshore. The tops of some of the willows are dead. Tamarisk 4–7 m in height and common reed form a patchy understory. Canopy closure is as high as 90% under the tamarisk and as low as 60% elsewhere. Heaps of

deadfall and duff completely obscure the ground. To the east of the strip of emergent trees, the site is dominated by tamarisk decreasing in height west to east from 6 to 3.5 m. Canopy closure under the tamarisk is 80–95% and varies inversely with canopy height. The strip of tamarisk varies in width from a few meters at the northern end of the site to over 50 m in the central and southern portions. The northeastern portion and eastern edge of the site are dominated by 2-m-tall arrowweed and scattered 3–4-m-tall tamarisk, with canopy closure < 30%. No major changes in vegetation structure or species composition were noted between 2015 and 2018.

Saturated soils were noted in 10% of the site, and damp soils were noted in 30% when the June site description was recorded. Soils were almost completely dry when the May and July site descriptions were recorded (see table 2-2). Soil moisture conditions in the site are influenced by water levels in Martinez Lake, which fluctuate weekly and seasonally according to releases from Parker Dam. Weekly fluctuations in groundwater levels during the survey seasons of 2005–08, when water levels were measured via piezometer, were typically 25 cm or less (McLeod and Pellegrini 2013).

The northeastern portion of the site, where canopy closure does not exceed 30%, should be removed from the survey area. The remainder of the site contains the elements of suitable habitat (see table 2-1), but these elements tend not to co-occur, with the largest area of dense canopy closure occurring where the tamarisk are < 4.5 m tall. Suitable canopy closure also occurs in the western portion of the site but is limited to patches of tamarisk.

Mittry Lake, Arizona and California

The Mittry Lake study area is located north of Mittry Lake and west of the Mittry Lake Wildlife Area. The elevation in this study area is 48–49 m above sea level. The survey sites in this study area are a mix of conservation area sites and existing, unrestored riparian sites. The conservation area sites are located in the Laguna Division Conservation Area (LDCA). Irrigation within the LDCA is driven by water levels in the central channel that bisects the area. Water levels are controlled through a series of water control structures, and when water levels are high, the effect is like overbank flooding. No signs of livestock or tamarisk beetles were noted within or near any of the survey sites.

Mittry West

The survey site known as Mittry West was last surveyed in 2015. It is approximately 3 km downstream from Imperial Dam on the California side of the LCR. Vegetation is mixed-native. The southern half of the site and the center of the northern half are dominated by Goodding’s willows 12–15 m in height

with a clumpy understory of tamarisk up to 5 m in height, arrowweed, willow baccharis, scattered honey and screwbean mesquite, and a few 2-m-tall palm (*Washingtonia* sp.) trees. Deadfall is common throughout the site, and canopy closure varies from 30% in clearings to 80% under the willows and up to 90% within dense tamarisk patches. The periphery of the site is dominated by 3–5-m-tall tamarisk and dense arrowweed and also has honey and screwbean mesquite. A marshy area 20 x 50 m in size in the southeastern corner of the site has an overstory of Goodding's willows and an understory of cattails and bulrush. The overall structure of the site has not changed since 2015, although more palm trees are present in the understory.

Approximately 20% of the site had surface water and 10% had saturated soils when the May and June site descriptions were recorded (see table 2-2). No surface water was present when the July site description was recorded, although 15% of the site had saturated soils. Soil moisture conditions are influenced by groundwater levels and likely did not fluctuate substantially from day to day.

Although the site contains all the elements of preferred nesting habitat (see table 2-1), suitably dense canopy closure occurs only within small, scattered patches of tamarisk.

C4911

The survey site known as C4911 at the LDCA consists of a mosaic of cottonwoods, Goodding's willows, and coyote willows. The very western edge of the site is vegetated with dense arrowweed 2–2.5 m in height. Adjacent to the arrowweed is a 10–15-m-wide strip of Goodding's willows (80% of the trees) and cottonwoods (20% of the trees) 8–10 m in height. Canopy closure in this strip ranges from 80% at the southern end to 95% at the northern end. East of this strip, the vegetation is a mix of cottonwoods 6–8 m in height, Goodding's willows 2–4 m in height, arrowweed 2–3 m in height, and scattered cattails and bulrush. Canopy closure ranges from 30% at the southern end to 70% at the northern end of the site. In the very northeastern corner of the site is a patch of coyote willows 3–5 m in height with 80% canopy closure underneath the tallest coyote willows.

Soil moisture conditions were widely variable through the season, with 90% of the site being inundated when the May site description was recorded and during a survey in late June, while all soils were dry when site descriptions were recorded in June and July (see table 2-2). When the site was dry, the nearest surface water was in the central channel that bisects the conservation area, due east of the site. Conclusions on the frequency and duration of surface water within the site could not be drawn because of the high variability in water levels associated with flood irrigation.

The strip of Goodding's willows and cottonwoods on the western side of the site has the canopy height, canopy closure, and midstory structural components of

preferred nesting habitat (see table 2-1), but the strip is narrow and lacks a consistent presence of wet soils; thus, it does not have all the characteristics of preferred nesting habitat. Most of the remainder of the site lacks the canopy closure needed for suitable habitat. This is a relatively young site that is still growing, and it is likely that canopy closure and overall structure will improve as the site matures.

C4913

The survey site known as C4913 at the LDCA consists of a mosaic of cottonwoods, Goodding's willows, and coyote willows. The northeastern third of the site is vegetated primarily with coyote willows 3–4 m in height with a few trees up to 5 m in height along the eastern border near the road. Canopy closure varies from 50 to 80% in accordance with canopy height. The southwestern two-thirds of the site is vegetated primarily with clumps of cottonwoods 7–9 m in height and a heterogeneous understory of Goodding's willows 3–6 m in height, honey and screwbean mesquite 3–5 m in height, and arrowweed and willow baccharis 2 m in height. Canopy closure in this section is 70–85%, with the densest vegetation occurring in the center of the southwestern portion of the site and consisting of cottonwoods 8–9 m in height and Goodding's willows 5–8 m in height. There is a small stand of cottonwoods up to 14 m in height near the southeastern corner of the site.

Soil moisture conditions were widely variable through the season, with 90% of the site being inundated when the May site description was recorded and during a survey in late June, while all soils were dry when the site description was recorded in June and damp when the site description was recorded in July (see table 2-2). When the site was dry, the nearest surface water was in the central channel that bisects the conservation area, due east of the site. Conclusions on the frequency and duration of surface water within the site could not be drawn because of the high variability in water levels associated with flood irrigation.

Canopy height and canopy closure increased notably between 2017 and 2018, and the center of the southwestern portion of the site now has the canopy height, canopy closure, and midstory structural components of suitable nesting habitat (see table 2-1). This is a relatively young site that is still growing, and it is likely that canopy closure and overall structure will continue to improve as the site matures.

Yuma, Arizona

YUMA is located along the Colorado and Gila Rivers near the city of Yuma. The study area includes two conservation areas: Yuma East Wetlands, approximately 4 km downstream from the Colorado and Gila confluence, and Hunters Hole,

3 km north of the Southerly International Boundary with Mexico. YUMA also includes unrestored sites along the Gila River from the confluence upstream to the Gila Gravity Canal. The elevation ranges from 46 m at the farthest upstream site along the Gila River to 26 m at Hunters Hole. All survey sites within the study area are located within a matrix of agricultural lands. No signs of livestock or tamarisk beetles were noted within or around any of the survey sites.

Yuma East Wetlands

Yuma East Wetlands is a conservation area located on either side of the Colorado River and is bordered by urban landscape to the west. Flood-irrigated sites within the conservation area are typically dry between irrigation bouts.

C4703

The survey site known as C4703 at Yuma East Wetlands is bisected by a dirt road and irrigation channel. Vegetation consists primarily of cottonwoods 10–15 m in height. The understory is composed of scattered 2-m-tall willow baccharis and 2–6-m-tall honey and screwbean mesquite and is densest in the central portion of the site. Canopy closure within the cottonwoods varies from 70 to 85% and is densest in the south-central part of the site. A stand of 4–6-m-tall coyote willows 60 x 120 m in size is present along the western edge of the site. In 2017, portions of the coyote willow patch had 90% canopy closure, but many of the coyote willows on the northern side of the road were mostly leafless in May (McLeod et al. 2018b). By the start of the survey season in 2018, the coyote willows were mostly dead and canopy closure, which consisted mostly of dead branches, was 50%.

Standing water was present in small puddles at the irrigation canal outlets when the May and June site descriptions were recorded (see table 2-2). Recent irrigation resulted in damp soils in 30% of the site when the June site description was recorded, and the entire site was damp from rain the previous night when the July site description was recorded. Conclusions on the frequency and duration of surface water within the site could not be drawn because of the high variability in water levels associated with flood irrigation.

Most of the site lacks the canopy closure and/or the midstory structure of suitable habitat (see table 2-1). Canopy closure reaches suitable levels only in the densest cottonwoods. The stand of coyote willows on the western side of the site had suitable canopy height and closure in previous years, although the stems were wispy and closely spaced, providing few flyways. The coyote willow stand is now mostly dead and unlikely to develop into suitable habitat without a marked increase in irrigation.

C4711

The survey site known as C4711 at Yuma East Wetlands consists of a stringer of cottonwoods and Goodding's willows along the northern edge of a cattail-bulrush marsh. The site is bisected by an open water channel extending north from the marsh. East of the channel, the stringer consists of 10–12-m-tall cottonwoods with a few Goodding's willows and is rarely more than one tree wide. Honey mesquite is scattered in low density in the understory east of the channel, and canopy closure ranges from 50 to 70%. West of the channel, the stringer widens slightly and consists of 8–10-m-tall Goodding's willows and 15-m-tall cottonwoods with mule-fat, willow baccharis, and honey mesquite in the understory. Canopy closure varies from 70 to 85%. There is a small area of dead cattails and bulrush along the southern edge of the western portion of the site. The very western end of the stringer is bordered to the south by a stand of coyote willows approximately 80 x 10 m in size and 4–5 m in height with 80% canopy closure.

Standing water was documented in the open water channel when all three site descriptions were recorded (see table 2-2). Much of the site had damp soils from rain the previous day when the site description was recorded in July; otherwise, all soils away from standing water were dry, including in the cattails and bulrush in the western side of the site.

Canopy closure in the coyote willow patch on the western side of the site is lower than it was in previous years (see McLeod et al. 2018a) and no longer meets the criterion for suitable habitat (see table 2-1). Canopy closure within most of the remainder of the site is too low to meet the criterion for suitable habitat. Where canopy closure does reach suitable levels in the cottonwoods and Goodding's willows, midstory structural components are lacking.

C4702

The survey site known as C4702 at Yuma East Wetlands consists primarily of cottonwoods 8–15 m in height with a patchy understory of 2-m-tall willow baccharis and 2–6-m-tall honey mesquite. A fire affected the northern edge of the site prior to the 2018 survey season, burning only the understory in some places but also burning patches of cottonwoods all the way to the crowns. The habitat is divided into cells that are separated by dirt roads, and vegetation density varies by cell, with canopy closure ranging from 60 to 85%. Areas with lower canopy closure are characterized by more widely spaced trees and a more dominant understory. One cell on the western side of the site contains a 20-m-wide, dense stand of cottonwoods 10–12 m in height with 70–80% canopy closure and no understory. This cottonwood stand is bordered to the west by a stand of coyote willows roughly 70 x 50 m in size and 3–5 m in height. When the May site

description was recorded, the coyote willows were green and had 85–90% canopy closure. By late June, however, the top 2 m of the taller stems were leafless, and canopy closure was approximately 30% (M.A. McLeod, personal observation).

Standing water was present in the irrigation canals when the May and June site descriptions were recorded, but all other soils in the site were dry (see table 2-2). Damp soils were present from recent rain when the July site description was recorded, but otherwise the site was dry, and the nearest surface water was in the Colorado River. Conclusions on the frequency and duration of surface water within the site could not be drawn because of the high variability in water levels associated with flood irrigation.

The coyote willow patch on the western side had all the characteristics of suitable habitat and the canopy closure of preferred nesting habitat (see table 2-1) at the beginning of the season, but canopy closure declined dramatically and was only 30% by mid-season. Most of the remainder of the site lacks the canopy closure needed for suitable habitat, and the few areas where canopy closure reaches 85% generally lack midstory structural components.

Gila Confluence North

The survey site known as Gila Confluence North borders the northern side of the Colorado River at the confluence of the Gila and Colorado Rivers. The site was last surveyed in 2015. Vegetation is mixed-native. In the western half and along the northern border of the site, one-tree-wide stringers of 8–12-m-tall Goodding's willows and 12–14-m-tall cottonwoods form a broken overstory with willow baccharis in the understory. All the overstory trees have narrow canopies. These stringers surround a small low-lying area vegetated with common reed and some cattails near the northern side of the site. Common reed is present between the site and the river and extends into the understory along the southern border. Areas away from the cottonwood and Goodding's willow stringers are dominated by arrowweed, with scattered willow baccharis, screwbean mesquite, and tamarisk. Canopy closure is variable and ranges from 10% in areas dominated by arrowweed to 65% in the densest portions of the cottonwood-willow stringers. No major changes in vegetation structure or species composition were noted between 2015 and 2018.

All soils were completely dry when each site description was recorded (see table 2-2). Soil moisture conditions are dependent on groundwater levels, which likely fluctuate with the water level in the Colorado River.

Canopy closure at this site is much lower than 85%; thus, the site does not meet all the criteria for suitable habitat (see table 2-1). Surveys could be discontinued with minimal risk of overlooking suitable flycatcher habitat.

Gila River Site 02

The survey site known as Gila River Site 02 is on the north side of the Gila River approximately 7 km upstream of the confluence of the Gila River and the LCR and was last surveyed in 2015. It is bordered to the north by agricultural fields and to the south by an open, sandy area vegetated by arrowweed. Vegetation is mixed-exotic. The southeastern half of the site has a broken overstory of cottonwoods 10–12 m tall, an understory of tamarisk and Goodding's willows approximately 5 m in height, and canopy closure of 50–60%. The remainder of the site is tamarisk 4–6 m in height with occasional Goodding's willows of similar size. Some areas of tamarisk are very dense with large heaps of deadfall completely obscuring the ground. Canopy closure in the densest tamarisk reaches 90% but more typically is 70–80%. No substantial changes in vegetation structure or species composition were noted between 2015 and 2018.

No wet soils were observed when any site description was recorded, but the northwestern edge of the site bordered a pond, which held water during each visit (see table 2-2). Soil moisture conditions are dependent on groundwater levels and likely did not fluctuate substantially from day to day.

Canopy closure in most of this site is much lower than 85%. In the pockets of dense tamarisk where canopy closure reaches 90%, the vegetation is dense enough to inhibit flight. Although the components of suitable habitat (see table 2-1) are present, they do not co-occur, and no portion of the site meets all the criteria of suitable habitat. Vegetation at the site has remained unchanged since SWCA began surveying in 2003; surveys could be discontinued with minimal risk of overlooking suitable flycatcher habitat.

Fortuna Site 01

Fortuna Site 01 is a mixed-native survey site approximately 750 m upstream of Gila River Site 02 on the north side of the Gila River. It is bordered to the north by agricultural fields and to the south by marshy areas along the Gila River. It was last surveyed in 2015. Between 2015 and 2018, a swath of tamarisk and arrowweed up to 30 m wide was cleared along the northern edge of the site, leaving a strip of vegetation 20–40 m wide in the eastern three-fifths of the site. This strip consists of emergent 12–15-m-tall cottonwoods and 5–10-m-tall Goodding's willows with an understory of tamarisk 3–5 m in height. Many of the emergent trees have dead limbs or dead tops. In the western end of the site, Goodding's willows 5–8 m tall form a broken overstory with tamarisk 3–5 m tall and arrowweed 2–3 m tall in the understory. Canopy closure throughout the site is patchy, ranging from 50 to 80%. Other than the clearing of vegetation along the northern edge of the site, no major changes in vegetation structure or species composition were noted between 2015 and 2018.

Wet soils were noted at the eastern end of the site and in the adjoining marsh when each site description was recorded (see table 2-2). Wet soils were also present at the western end of the site when the May site description was recorded. Soil moisture conditions are influenced by levels in the Gila River and likely did not fluctuate substantially from day to day.

Canopy closure at the site does not exceed 80%; thus, the site does not meet all the criteria for suitable habitat (see table 2-1). This site could be evaluated before future surveys to determine whether canopy closure has increased. If no increase in canopy closure occurs, surveys could be discontinued with minimal risk of overlooking suitable flycatcher habitat.

Fortuna North

The survey site known as Fortuna North was last surveyed in 2015. It is approximately 2.5 km upstream of Fortuna Site 01 along the Gila River, which runs along the western edge of the site. The site is vegetated primarily by mature tamarisk 3–7 m in height, with dense arrowweed along the eastern and southwestern borders. Canopy closure in the tamarisk is widely variable, ranging from 40 to 80%. No major changes in vegetation structure or composition were noted between 2015 and 2018, although canopy closure decreased slightly.

Wet soils were limited to the river channel, and all other soils were dry when each site description was recorded (see table 2-2). Soil moisture conditions in the site are influenced by the Gila River and likely did not fluctuate substantially from day to day.

Canopy closure at the site does not exceed 75%; thus, the site does not meet all the criteria for suitable habitat (see table 2-1). This site could be evaluated before future surveys to determine whether canopy closure has increased. If no increase in canopy closure occurs, surveys could be discontinued with minimal risk of overlooking suitable flycatcher habitat.

Hunters Hole

This survey site was incorporated into the LCR MSCP as a conservation area, and planting was completed in 2013. The northern two-thirds of the site consists of patches of cottonwoods and Goodding's willows, small patches of coyote willow, and scattered honey mesquite. The density of the patches is widely variable, and canopy closure ranges from 50 to 90%. The densest and tallest vegetation occurs in the center of the site, where canopy height reaches 10 m. The southern third of the site is open, with scattered honey mesquite and little ground cover. The site is bordered to the east by agricultural fields and on other sides by open areas sparsely vegetated by tamarisk. A low-intensity fire occurred in the central part

of the site prior to the 2018 survey season and resulted in the death of a few trees and a reduction in the amount of ground cover. The site is periodically flood irrigated and typically becomes completely dry between irrigation bouts.

Habitat suitability at the site was not assessed.

DISCUSSION

Tamarisk beetles were active at TOPO, BIWI, and ALAM in 2018; the heaviest defoliation at TOPO and BIWI occurred in June and July, whereas tamarisk at ALAM showed signs of beetle activity throughout the season. Significant dieback of the tamarisk as the result of defoliation in 2017 was apparent throughout ALAM. Tamarisk dieback was less apparent at TOPO and the downstream portion of BIWI than at ALAM, but active defoliation during the 2018 season lowered the canopy closure in all tamarisk-dominated areas to levels below those typically seen in occupied flycatcher habitat. The continued presence of tamarisk beetles at these study areas is likely, and if defoliation continues to occur during the flycatcher breeding season, tamarisk-dominated areas are unlikely to meet the criteria for suitable habitat.

Areas of BIWI upstream of Mosquito Flats have experienced widespread mortality of native trees in the last few years as the result of low streamflow and a drop in the water table. Many of the tamarisk in these areas are also dead likely because of the combination of water stress and defoliation by tamarisk beetles. Significant regrowth of vegetation is needed before these sites can meet the criteria of suitable flycatcher habitat. Releases from Alamo Dam in March 2018 resulted in flooding in BIWI, which washed out many beaver dams that had previously impounded water, and wetted areas that had been dry in recent years. Sustained low-level releases during the flycatcher breeding season maintained water in channels in many of the survey sites. Despite the increase in water, little response was seen in the vegetation in 2018. Young cottonwoods were present along the stream margins in Site 08 and Site 05, and young mule-fat were also noted along channels. The overstory trees, however, showed little change.

Habitat quality at several sites at the CVCA and the PVER has declined in recent years as trees have become less robust or died, decreasing canopy closure. Canopy closure has declined most noticeably at the CVCA, where large swaths of coyote willows are dead. Habitat quality at the LDCA is improving, however, as trees mature and canopy height and closure increase.

Chapter 3 – Presence/Absence Surveys and Territory Monitoring

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. 2010). According to Sogge et al. (2010) and the USFWS (2002), willow flycatchers detected between approximately June 15 and July 20 in the breeding range of *E. t. extimus* (see figure 1-1) probably belong to the southwestern subspecies. However, because northbound individuals of all western subspecies of the willow flycatcher migrate through areas where *E. t. extimus* are actively nesting, and southbound migrants occur where *E. t. extimus* are still breeding (Sogge et al. 2010; USFWS 2002), field confirmation of the southwestern subspecies is problematic. 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 June 20 (Garrett and Dunn 1981), and Phillips et al. 1964 (as cited in Unitt 1987) documented *E. t. brewsteri* collected in southern Arizona on June 23. 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 territorial status of flycatchers.

Migration routes used by *E. t. extimus* are not well documented, though more is known of northbound migration in spring than southbound migration in fall because willow flycatchers are more vocal in spring 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), LCR (McKernan and Braden 1999), San Juan River (Johnson and Sogge 1997), and the Green River (M. Johnson, unpublished data). Although migrating willow flycatchers may favor young, native willow (*Salix* spp.) habitats (Yong and Finch 1997), migrants are also found in both spring and fall in a variety of habitats that are unsuitable for breeding. 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 2018, SWCA completed broadcast surveys at sites in nine study areas (TOPO, TOGO, BIWI, ALAM, PVER, CIBO, IMPE, MITT, and YUMA) along the LCR

and its tributaries to detect both migrant willow flycatchers and resident flycatchers (see figure 1-2). Reclamation completed surveys at Hunters Hole, and results of those surveys are included here.

METHODS

Broadcast Surveys

To elicit responses from nearby willow flycatchers, field personnel broadcast conspecific vocalizations recorded throughout the Southwest in 1996–98. All flycatcher surveys were conducted according to the methods described in Sogge et al. (2010) and followed the five-survey protocol, which calls for one survey between May 15 and 31, two surveys between June 1 and 24, and two additional surveys between June 25 and July 17. The surveys were separated by a minimum of 5 days whenever logistically possible. Field personnel surveyed within the habitat wherever possible using a Sansa® Clip or AGPTEK G05S MP3 player coupled to a Radio Shack 277-1008C or Vomaxtech Limited C3 speaker. In dense habitats, surveyors stopped every 30–40 m and broadcast flycatcher primary song (*fitz-bew*) and calls (*breets*). Survey points were more widely spaced in relatively open habitats. Field personnel watched for willow flycatchers and listened for vocal responses for approximately 1 to 2 minutes before proceeding to the next survey station. If an unidentified *Empidonax* flycatcher was observed but did not respond with song to the initial broadcast, other conspecific vocalizations were broadcast, 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 are frequently effective in eliciting a *fitz-bew* song, thereby enabling surveyors to positively identify willow flycatchers. Whenever a willow flycatcher was detected, the surveyor proceeded at least 50 m beyond the bird before resuming the survey to minimize the likelihood of the bird following the surveyor and being double counted.

Territory Monitoring

At all sites, except those surveyed on a triennial basis, field personnel discontinued broadcast surveys within a radius of 50 m and commenced territory monitoring wherever a flycatcher displaying territorial behavior (e.g., singing insistently from multiple perches) was detected. At study areas where breeding flycatchers were known to occur (i.e., TOPO, BIWI, and ALAM), all willow flycatcher detections, regardless of whether territorial behaviors were observed, were followed with monitoring visits to reduce the likelihood of a territory being overlooked. Each location where territory monitoring occurred was assigned a unique “territory number” to facilitate tracking of monitoring activities. No

monitoring was completed at sites surveyed on a triennial basis, but any detections of willow flycatchers displaying territorial behavior were reported to Reclamation within 24 hours.

At ALAM and at LCR MSCP conservation areas surveyed by SWCA,[1] monitoring was completed in conjunction with surveys, and detection locations were revisited, at minimum, in accordance with the survey schedule. The goal of territory monitoring at these sites was to determine the number of territories and whether each territory contained a single male flycatcher or a flycatcher pair. A territory was considered to be present wherever (1) a flycatcher was detected during the "non-migrant" period (i.e., after June 24 through to and including July 20), (2) a flycatcher exhibited extended, unsolicited song during the first survey period and on each of two visits in the second survey period, and/or (3) a flycatcher pair was present at any point during the season. A pair was considered to be present if any of the following were observed (per Sogge et al. 2010): (1) another, unchallenged flycatcher in the immediate vicinity of where a male was engaging in extended, unsolicited song, (2) *whitt* calls between nearby flycatchers in the immediate vicinity of where a male had engaged in extended, unsolicited song, (3) interaction twitter calls between nearby flycatchers, (4) physical aggression by flycatchers against cowbirds, (5) flycatchers copulating, or (6) evidence of an active nesting attempt including: (a) a flycatcher carrying nest material, (b) a flycatcher carrying food or a fecal sac, (c) a flycatcher sitting or standing on a nest, (d) a nest containing flycatcher eggs, or (e) recently fledged flycatcher young.

During the initial territory monitoring visit, the observer spent approximately 30 minutes in the vicinity, recording multiple locations of the flycatcher(s), locations of countersinging flycatchers, and behavioral observations. On subsequent visits, the observer spent up to 30 minutes in the area, recording flycatcher locations and behavioral observations. If no flycatcher activity was detected within 20 minutes, the observer played brief broadcasts of flycatcher vocalizations, if this could be done without disturbing nearby flycatchers, to try to elicit a response. Locations where no activity was detected were visited briefly once more on the next survey round, and if there was still no activity, broadcast surveys resumed at that location, provided it was at least 50 m from any other flycatcher territory. Once a territory was confirmed to contain a pair, subsequent visits focused on determining if the territory was still active and mapping the locations of adjacent flycatchers to determine if additional flycatchers had arrived. If an active nest was located during territory monitoring, the nest location was recorded but no attempt was made to observe the contents of the nest.

[1] Conservation areas include CPhase 05 at TOPO; Site 03 upstream to Beaver Pond at BIWI; Planet Ranch at BIWI; Upper Hippy Fire, Nature Trail, and C2729 at CIBO; and all sites in the PVER, the CVCA, the LDCA, and Yuma East Wetlands.

At sites that were within TOPO and BIWI but were outside of conservation areas, all willow flycatcher detections were followed with intensive monitoring, with the intention of finding and monitoring all flycatcher nests. Monitoring visits at these sites were more frequent than at ALAM and conservation areas, with single flycatchers monitored approximately every 4 days and pairs monitored every 2 days until a nest was found. Nests were visited according to the nest monitoring protocol (see chapter 5). If no activity was detected during the first 30 minutes of a monitoring visit, the observer played brief broadcasts of flycatcher vocalizations if this could be done without disturbing nearby flycatchers. If no activity was detected near the original detection during any of three subsequent visits, each spaced at least 4 days apart, monitoring visits stopped and surveys resumed.

At all sites where monitoring visits were completed in accordance with the survey schedule (i.e., visits were approximately 2 weeks apart), willow flycatchers that were detected in a given vicinity on consecutive visits were considered to be different individuals if no territorial behaviors were observed on any visit. At sites where monitoring visits occurred at 4-day intervals, individuals detected in a given location on multiple, consecutive visits were assumed to be the same individual. If a flycatcher was detected on multiple visits but one or more intervening visits failed to detect a flycatcher, the detections were considered different individuals in the absence of behavioral observations that indicated the flycatcher was actively defending a territory or was a member of a breeding pair.

Other Covered Species

The Yuma clapper rail (*Rallus longirostris yumanensis* [also known as Yuma Ridgway's rail = *R. obsoletus yumanensis*]) is listed as federally endangered by the USFWS, and the western population of the yellow-billed cuckoo (*Coccyzus americanus*) is listed as threatened. Both species occur along the LCR and its tributaries and are of concern to managing agencies. Surveys were not conducted specifically for either of these species, but all incidental detections were recorded at survey sites that were not within LCR MSCP conservation areas. Field personnel also recorded incidental detections of the gilded flicker (*Colaptes chrysoides*) and vermilion flycatcher (*Pyrocephalus rubinus*), both of which are covered species under the LCR MSCP, at survey sites that were not within LCR MSCP conservation areas.

Data Collection

All spatial data were recorded in Collector for ArcGIS on a Panasonic FZ-B2 Toughpad tablet running an Android operating system. Several feature services were published to ArcGIS Online for use in Collector. These included site boundaries, trails, a feature service to record real-time locations of the surveyor at

regular intervals (i.e., surveyor "tracks"), a 50- x 50-m grid, and feature services for field data. Field data included point locations of survey points, willow flycatcher detections (e.g., territorial male, territory center, pair, female, or family group), and detections of other covered species; line features to show the relationship between any two willow flycatcher detection locations (e.g., same bird, different bird, countersinging males, or possible pair); and a polygon feature to delineate the approximate boundaries of a flycatcher territory. High-resolution aerial imagery of all survey sites was loaded directly onto the tablets for use in Collector. All data collected in the field were recorded into an offline copy of the feature services, which the observer downloaded onto his/her tablet. In addition to survey point and detection locations, surveyors also recorded the presence of cowbirds at each survey point and the overall signs of livestock and tamarisk leaf beetles. Cowbirds may affect flycatcher populations by decreasing flycatcher productivity, while livestock may substantially alter the vegetation in an area (USFWS 2002).

Each observer had an individual user account for ArcGIS Online and an individual Microsoft OneNote notebook, which was used on the tablet to record survey start and stop times, behavioral observations, and any other pertinent information. At the end of each field day, each observer synchronized the Collector data with ArcGIS Online and also synchronized the OneNote notebook with an online copy. The observer then viewed the spatial data from ArcGIS Online in a custom online web application view created by SWCA and hosted on SWCA servers. If necessary, the observer edited the data using the web application to ensure that each feature was correctly labeled and all necessary fields were filled in.

Summary information for each territory visit (time in and out of the territory, territory stage [e.g., single male, pair, or no activity], and behavioral comments) was entered in a form in Survey123 for ArcGIS. Each form was a child feature linked to its respective territory center point.

RESULTS

Flycatcher Broadcast Surveys and Territory Monitoring

SWCA spent 702.2 observer-hours conducting flycatcher broadcast surveys at 87 sites across all study areas (see orthophotos in attachment 3 for boundaries of survey sites and occupancy[2] in 2018). In addition, Reclamation spent 3.9 observer-hours completing three broadcast surveys at Hunters Hole. Of the

[2] Occupied flycatcher habitat was defined as survey sites where at least one flycatcher territory was present.

sites surveyed by SWCA, four (Lost Lake and Lost Lake Slough 04 at TOPO, Black Rail at BIWI, and Santa Maria South 01 at ALAM) were surveyed opportunistically during reconnaissance efforts. Surveys were discontinued during the season at two sites (Burn Edge at BIWI and Walker Lake at CIBO) because of poor habitat quality. In addition to the 87 sites that were surveyed, 1 site (Lost Lake Slough 02 at TOPO) could not be formally surveyed or assessed because deep water and dense marsh vegetation made the site inaccessible, and no broadcast surveys were completed at another site (Prospect 01 at ALAM) because it was completely occupied by territorial flycatchers throughout the breeding season. Areas that were known to be occupied by flycatchers were monitored via territory visits rather than broadcast surveys, with 264.0 observer-hours spent on territory monitoring. An additional 10.7 observer-hours were spent at TOPO on intensive nest monitoring after nests were found; nest monitoring results are detailed in chapter 5. Each site or portion of a site that did not contain any flycatcher territories was formally surveyed four to six times (table 3-1 and attachment 4).

Ground reconnaissance was completed at 13 additional sites (Pipes 01, Pipes 03, PC6-1, Pig Hole, In Between, and Pierced Egg at TOPO; and Over the Edge, Edgewater, Bullard Wash North, Camp 04, Confluence 02, Confluence 01, and Sandy South at ALAM) for a total of 11.7 observer-hours, but these sites were not surveyed because of poor habitat quality.

SWCA detected 124 flycatchers from 72 territories at TOPO, BIWI, and ALAM (table 3-1). An additional 209 willow flycatchers that did not occupy territories were detected across all study areas.

Individual Study Areas

Topock Marsh, Arizona

Field personnel spent 77.9 observer-hours on broadcast surveys and 46.6 observer-hours on territory monitoring activities (table 3-1). Two territories, both of which were occupied by breeding flycatcher pairs, were detected (see chapter 5 for nest monitoring results). An additional 15 willow flycatchers were detected on or before June 7; most of these were detected only on a single occasion and responded weakly to the survey broadcast.

Topock Gorge, Arizona

Field personnel spent 19.2 observer-hours on broadcast surveys. No flycatcher territories were detected. One willow flycatcher, which responded briefly to broadcasts, was detected on May 21.

Bill Williams, Arizona

Field personnel spent 146.6 observer-hours on broadcast surveys and 30.6 observer-hours on territory monitoring activities. One territory, consisting of an unpaired male, was detected. Eight additional willow flycatchers were detected; seven of these were each detected for a single day on or before June 4, and the eighth was detected June 14–19 (table 3-1).

Alamo Lake, Arizona

Field personnel spent 49.3 observer-hours on broadcast surveys and 197.5 observer-hours on territory monitoring activities. A total of 119 territorial flycatchers, comprising 69 territories, were detected. Fifty territories contained flycatcher pairs. Nests were found incidentally during territory monitoring in 40 of those territories, and 11 fledglings were observed. The remaining 19 territories consisted of unpaired flycatchers. An additional 28 willow flycatchers were recorded at ALAM; 22 of these were each detected on a single occasion, and the remaining 6 were detected for periods ranging from 2 days to 2 weeks.

Palo Verde Ecological Reserve, California

Field personnel spent 195.0 observer-hours on broadcast surveys. Sixty-three willow flycatchers were detected, each on a single occasion, between May 15 and June 7 (table 3-1); none displayed territorial behavior.

Cibola, Arizona

Field personnel spent 112.7 observer-hours on broadcast surveys. Nineteen willow flycatchers were detected, each on a single occasion, between May 29 and June 7 (table 3-1); none displayed territorial behavior.

Imperial, Arizona and California

Field personnel spent 56.4 observer-hours on broadcast surveys. Thirty-five willow flycatchers were detected, each on a single occasion, between May 21 and June 14 (table 3-1); none displayed territorial behavior.

Mittry Lake, Arizona and California

Field personnel spent 13.2 observer-hours on broadcast surveys. Thirteen willow flycatchers were detected, each on a single occasion, between May 21 and June 5 (table 3-1); none displayed territorial behavior.

Yuma, Arizona

Field personnel spent 35.9 observer-hours on broadcast surveys. Twenty-seven willow flycatchers were detected, each on a single occasion, between May 19 and June 6 (table 3-1); none displayed territorial behavior.

Other Covered Species

Detections of yellow-billed cuckoos were recorded at multiple sites at ALAM and at one site at BIWI (see attachment 5 for details). Yuma clapper rails were recorded at TOPO, TOGO, BIWI, CIBO, and IMPE, while vermilion flycatchers were recorded at ALAM. No gilded flickers were detected.

DISCUSSION

As was the case in 2017, two territories, both consisting of breeding pairs, were detected at TOPO. The pairs occupied adjacent territories in the Hell Bird survey site, in the same portion of the site that was occupied in 2017. The number of flycatcher territories detected at TOPO declined after much of the available habitat was consumed in the Willow Fire in August 2015. Defoliation by tamarisk beetles occurred throughout TOPO during the 2017 and 2018 breeding seasons, further affecting habitat suitability. Both territories in 2018 were in one of few locations within the study area with a significant Goodding's willow overstory. If beetles continue to defoliate tamarisk at TOPO, or if the tamarisk display significant mortality as the result of defoliation events, flycatchers at TOPO are likely to persist only in areas with a substantial component of native, woody vegetation.

The number of territories detected at BIWI declined from seven (three pairs and four unpaired males) in 2017 to only one (an unpaired male) in 2018. All sites that had flycatcher territories in 2017 had a significant tamarisk component and were defoliated throughout the 2017 breeding season. In 2018, the tamarisk in these sites were partially dead, and the remaining live stems were defoliated during much of the breeding season, resulting in low canopy closure (see chapter 2). The decline in the number of territories and the absence of breeding flycatchers at BIWI in 2018 are likely the result of the decline in habitat suitability caused by defoliation by tamarisk beetles.

For the three years prior to 2018, average monthly discharge at the USGS gaging station (#09426620) on the Bill Williams River near Parker, Arizona, was 0.0 cfs (figure 3-1). This is the longest period of 0.0 cfs recorded at this gaging station since the USGS began recording in late 1988. The dry conditions within BIWI resulted in a decrease in canopy closure at many sites as large-diameter Goodding's willows and cottonwoods died or lost large limbs. Flycatcher

Table 3-1.—Summary of survey and monitoring effort and number of adult southwestern willow flycatchers and adult willow flycatchers detected during survey and monitoring activities, 2018*

Study area	Survey site	Elevation (m)	Area (ha)	Number of surveys	Survey hours[1]	Monitoring hours[2]	Territorial adult southwestern willow flycatchers					Adult willow flycatchers not occupying a territory[7]	
							All adults	Territories[3]	Pairs[4]	Unpaired adults[5] #	Unpaired adults[5] Dates of detection (n)[6]	#	Dates of detection (n)[6]
Topock Marsh	The Wallows	140	0.3	5	2.1	0.0	0	0	0	0	--	0	--
	800M	140	1.3	5	4.5	7.5	0	0	0	0	--	3	May 21–24 (2), June 2 (1)
	Swine Paradise	140	0.9	5	5.6	0.0	0	0	0	0	--	0	--
	Platform	140	1.9	5	4.6	0.0	0	0	0	0	--	0	--
	250M	140	1.6	5	6.5	0.0	0	0	0	0	--	0	--
	Hell Bird	140	6.3	5	11.5	14.4	4	2	2	0	--	0	--
	Glory Hole	140	6.4	5	14.7	2.8	0	0	0	0	--	1	June 5 (1)
	Farm Ditch Road	140	4.4	5	7.6	3.9	0	0	0	0	--	2	May 15 (1), May 23 (1)
	CPhase 05	140	11.4	5	16.6	1.3	0	0	0	0	--	1	June 4 (1)
	Lost Lake[8]	140	3.3	1	0.1	0.0	0	0	0	0	--	0	--
	Lost Lake Slough 01	140	0.2	5	0.9	3.1	0	0	0	0	--	3	May 24 (1), June 7 (2)
	Lost Lake Slough 02[9]	140	0.9	0	0.0	1.7	0	0	0	0	--	1	May 19 (1)
	Lost Lake Slough 03	140	0.6	5	2.7	2.3	0	0	0	0	--	1	May 19 (1)
	Lost Lake Slough 04[8]	140	0.5	1	0.6	0.0	0	0	0	0	--	0	--
	Near Farm Ditch Road[10]	140	--	0	0.0	5.3	0	0	0	0	--	2	June 2 (2)
	Near Lost Lake Slough[10]	140	--	0	0.0	4.5	0	0	0	0	--	1	May 24–29 (1)
	Study area total	**--**	**39.8**	**--**	**77.9**	**46.6**	**4**	**2**	**2**	**0**	**--**	**15**	**--**
Topock Gorge	Blankenship North	138	19.0	5	11.2	0.0	0	0	0	0	--	0	--
	Blankenship South	138	11.8	4	8.0	0.0	0	0	0	0	--	0	--
	Between North and South[10]	138	--	0	0.0	0.0	0	0	0	0	--	1	May 21 (1)
	Study area total	**--**	**30.8**	**--**	**19.2**	**0.0**	**0**	**0**	**0**	**0**	**--**	1	--
Bill Williams	Coyote Crossing	137	2.1	5	5.8	0.0	0	0	0	0	--	0	--
	Bill Willow	137	1.6	5	5.5	0.0	0	0	0	0	--	0	--
	Wispy Willow	137	1.3	4	2.1	15.4	1	1	0	1	May 17 – June 27 (1)	1	May 18 (1)
	Site 01	138	2.4	5	9.9	9.1	0	0	0	0	--	3	May 29 (1), June 2 (1), June 14–19 (1)
	Burn Edge[11]	143	3.2	2	2.1	0.0	0	0	0	0	--	0	--
	Site 04	146	9.9	5	21.0	0.0	0	0	0	0	--	0	--
	Site 03	146	12.9	5	25.2	1.0	0	0	0	0	--	1	June 3 (1)
	Last Gasp	146	2.1	5	5.6	0.0	0	0	0	0	--	0	--

Table 3-1.—Summary of survey and monitoring effort and number of adult southwestern willow flycatchers and adult willow flycatchers detected during survey and monitoring activities, 2018*

Study area	Survey site	Elevation (m)	Area (ha)	Number of surveys	Survey hours[1]	Monitoring hours[2]	Territorial adult southwestern willow flycatchers					Adult willow flycatchers not occupying a territory[7]	
							All adults	Territories[3]	Pairs[4]	Unpaired adults[5] #	Unpaired adults[5] Dates of detection (n)[6]	#	Dates of detection (n)[6]
Bill Williams (cont.)	Guinness	148	3.4	5	2.9	0.0	0	0	0	0	--	0	--
	Site 05	146	6.8	5	12.8	0.0	0	0	0	0	--	0	--
	Black Rail[8]	146	1.2	1	0.7	0.0	0	0	0	0	--	0	--
	Beaver Pond North	158	19.0	5	13.9	1.8	0	0	0	0	--	2	May 22 (1), June 4 (1)
	Beaver Pond	160	21.5	5	19.9	0.0	0	0	0	0	--	0	--
	Site 08	167	6.0	5	8.8	0.0	0	0	0	0	--	0	--
	Upstream Site 08	170	1.1	5	3.5	3.4	0	0	0	0	--	1	May 30 (1)
	Planet Ranch Road	171	2.2	5	7.0	0.0	0	0	0	0	--	0	--
	Study area total	**--**	**96.7**	**--**	**146.6**	**30.6**	**1**	**1**	**0**	**1**	**--**	**8**	**--**
Alamo Lake	Bullard Wash	335	1.4	6	4.6	6.2	2	1	1	0	--	1	June 6 (1)
	South Camp	335	1.4	4	0.8	2.5	1	1	0	1	June 1 – July 2 (1)	2	June 1 (2)
	Sidebar 01	335	1.0	5	2.3	0.0	0	0	0	0	--	0	--
	Camp 01	337	0.6	6	3.2	5.6	0	0	0	0	--	6	May 20 (2), June 1 (4)
	Camp 02	337	0.3	5	1.0	0.0	0	0	0	0	--	0	--
	Camp 03	337	1.2	5	3.1	1.0	0	0	0	0	--	1	May 20 (1)
	Middle Earth 01	337	1.7	4	0.9	10.9	6	4	2	2	May 30 – June 17 (1), May 30 – July 12 (1)	1	June 17 (1)
	Middle Earth 02	338	5.0	4	2.4	30.4	23	12	11	1	May 30 – June 17 (1)	1	May 30 – June 4 (1)
	Prospect 01	338	1.3	0	0.0	21.4	14	8	6	2	May 10 – June 18 (1), May 17 – June 18 (1)	1	May 10–15 (1)

Table 3-1.—Summary of survey and monitoring effort and number of adult southwestern willow flycatchers and adult willow flycatchers detected during survey and monitoring activities, 2018*

Study area	Survey site	Elevation (m)	Area (ha)	Number of surveys	Survey hours[1]	Monitoring hours[2]	Territorial adult southwestern willow flycatchers					Adult willow flycatchers not occupying a territory[7]	
							All adults	Territories[3]	Pairs[4]	Unpaired adults[5]			
										#	Dates of detection (n)[6]	#	Dates of detection (n)[6]
Alamo Lake (cont.)	Burro Wash 01	338	10.5	5	11.6	33.1	24	14	10	4	May 16 – June 19 (2), June 2–29 (1), June 18–29 (1)	5	May 21 (1), June 13 (2), June 18 (1), June 19 (1),
	Burro Wash 02	338	10.2	1	1.1	67.9	45	26	19	7	May 15 – June 15 (1), May 15 – June 30 (1), May 15 – July 13 (1), May 16 – July 13 (1), May 22 – June 30 (2), June 3–30 (1)	3	May 15 – June 3 (1), June 2–3 (1), June 15 (1)
	Motherlode 01	340	4.4	5	5.9	8.9	1	1	0	1	May 21 – June 29 (1)	3	May 16 (1), May 16–21 (1), May 16 – June 2 (1)
	Motherlode 04	343	0.4	3	0.4	2.0	0	0	0	0	--	1	May 21 (1)
	Santa Maria South 01[8]	347	25.6	1	1.1	0.0	0	0	0	0	--	0	--
	Santa Maria North 01	347	30.8	5	11.0	7.5	3	2	1	1	May 23 – July 16 (1)	3	May 17 (1), May 31 (1), June 5 (1)
	Study area total	**--**	**95.8**		**49.3**	**197.5**	**119**	**69**	**50**	**19**	**--**	**28**	**--**
Palo Verde Ecological Reserve	Phase 02	85	21.4	5	14.0	0.0	0	0	0	0	--	3	May 18 (1), June 1 (2)
	Phase 03	85	21.4	5	16.1	0.0	0	0	0	0	--	2	May 18 (1), June 1 (1)
	Phase 04 Block 01	86	7.7	6	8.3	0.0	0	0	0	0	--	0	--
	Phase 04 Block 02	86	4.0	6	7.6	0.0	0	0	0	0	--	2	May 17 (2)
	Phase 04 Block 03	87	23.7	5	15.2	0.0	0	0	0	0	--	2	May 17 (2)
	Phase 05 Block 01	87	15.8	5	12.8	0.0	0	0	0	0	--	8	May 15 (7), June 7 (1)
	Phase 05 Block 02	86	23.7	5	16.9	0.0	0	0	0	0	--	8	May 15 (8)
	Phase 05 Block 03	86	29.6	5	19.1	0.0	0	0	0	0	--	13	May 15 (13)
	Phase 06 Block 01	86	38.8	5	20.2	0.0	0	0	0	0	--	4	May 16 (2), June 1 (2)
	Phase 06 Block 02	86	37.6	5	21.1	0.0	0	0	0	0	--	9	May 17 (5), June 2 (4)
	Phase 07 Block 01	86	36.8	5	21.1	0.0	0	0	0	0	--	8	May 16 (6), June 2 (2)
	Phase 07 Block 02	86	40.6	5	22.6	0.0	0	0	0	0	--	3	May 16 (1), May 17 (1), June 2 (1)
	Near Phase 05 Block 03[10]	86	--	0	0.0	0.0	0	0	0	0	--	1	June 1 (1)
	Study area total	**--**	**301.2**	**--**	**195.0**	**0.0**	**0**	**0**	**0**	**0**	**--**	**63**	**--**

Table 3-1.—Summary of survey and monitoring effort and number of adult southwestern willow flycatchers and adult willow flycatchers detected during survey and monitoring activities, 2018*

Study area	Survey site	Elevation (m)	Area (ha)	Number of surveys	Survey hours[1]	Monitoring hours[2]	Territorial adult southwestern willow flycatchers					Adult willow flycatchers not occupying a territory[7]	
							All adults	Territories[3]	Pairs[4]	Unpaired adults[5]			
										#	Dates of detection (n)[6]	#	Dates of detection (n)[6]
Cibola	Phase 01	73	26.2	5	18.7	0.0	0	0	0	0	--	1	June 7 (1)
	Phase 02	73	25.5	5	17.1	0.0	0	0	0	0	--	3	June 7 (3)
	Phase 03	72	38.5	5	23.5	0.0	0	0	0	0	--	1	May 29 (1)
	Upper Hippy Fire	70	28.1	5	19.9	0.0	0	0	0	0	--	0	--
	Nature Trail	70	13.7	5	5.8	0.0	0	0	0	0	--	2	May 31 (2)
	C2729	70	6.0	5	8.7	0.0	0	0	0	0	--	2	June 7 (2)
	Cibola Site 02	65	6.9	5	3.2	0.0	0	0	0	0	--	4	June 1 (4)
	Cibola Site 01	65	7.7	5	3.3	0.0	0	0	0	0	--	1	June 1 (1)
	Cibola Lake North	64	12.2	5	3.5	0.0	0	0	0	0	--	1	May 31 (1)
	Cibola Lake East	64	4.5	5	3.5	0.0	0	0	0	0	--	3	June 1 (3)
	Cibola Lake West	64	6.8	5	4.5	0.0	0	0	0	0	--	1	May 31 (1)
	Walker Lake[11]	64	4.6	1	1.0	0.0	0	0	0	0	--	0	--
	Study area total	**--**	**180.8**	**--**	**112.7**	**0.0**	**0**	**0**	**0**	**0**	**--**	**19**	**--**
Imperial	Rattlesnake	60	3.7	5	6.3	0.0	0	0	0	0	--	7	May 21 (3), June 6 (3), June 14 (1)
	Imperial NW	58	12.0	5	7.0	0.0	0	0	0	0	--	2	May 23 (2)
	Imperial Nursery	58	1.4	5	3.5	0.0	0	0	0	0	--	3	May 23 (2), June 4 (1)
	Ferguson Lake	57	18.7	5	10.2	0.0	0	0	0	0	--	16	May 22 (12), June 5 (4)
	Ferguson Wash	58	6.4	5	7.5	0.0	0	0	0	0	--	5	May 22 (1), June 5 (4)
	Great Blue Heron	58	6.8	5	12.0	0.0	0	0	0	0	--	1	May 23 (1)
	Powerline	58	1.2	5	3.5	0.0	0	0	0	0	--	0	--
	Martinez Lake	58	4.6	5	6.4	0.0	0	0	0	0	--	1	May 23 (1)
	Study area total	**--**	**55.0**	**--**	**56.4**	**0.0**	**0**	**0**	**0**	**0**	**--**	**35**	**--**

Table 3-1.—Summary of survey and monitoring effort and number of adult southwestern willow flycatchers and adult willow flycatchers detected during survey and monitoring activities, 2018*

Study area	Survey site	Elevation (m)	Area (ha)	Number of surveys	Survey hours[1]	Monitoring hours[2]	Territorial adult southwestern willow flycatchers					Adult willow flycatchers not occupying a territory[7]	
							All adults	Territories[3]	Pairs[4]	Unpaired adults[5]			
										#	Dates of detection (n)[6]	#	Dates of detection (n)[6]
Mittry Lake	Mittry West	48	4.4	5	7.0	0.0	0	0	0	0	--	3	May 21 (1), May 22 (2)
	C4911	49	1.0	5	3.1	0.0	0	0	0	0	--	4	May 21 (2), June 5 (2)
	C4913	49	0.7	5	3.1	0.0	0	0	0	0	--	6	May 21 (3), June 5 (3)
	Study area total	**--**	**6.1**	**--**	**13.2**	**0.0**	**0**	**0**	**0**	**0**	**--**	**13**	**--**
Yuma	C4703	36	8.4	5	6.2	0.0	0	0	0	0	--	0	--
	C4711	36	0.9	5	2.1	0.0	0	0	0	0	--	2	May 24 (2)
	C4702	36	6.4	5	7.2	0.0	0	0	0	0	--	7	May 24 (5), June 3 (2)
	Gila Confluence North	40	2.2	5	4.3	0.0	0	0	0	0	--	0	--
	Gila River Site 02	45	2.5	5	4.1	0.0	0	0	0	0	--	4	May 19 (3), June 6 (1)
	Fortuna Site 01	45	2.6	5	4.8	0.0	0	0	0	0	--	8	May 19 (6), June 6 (2)
	Fortuna North	16	2.4	5	3.2	0.0	0	0	0	0	--	0	--
	Hunters Hole[12]	23	17.7	3	3.9	0.0	0	0	0	0	--	6	May 30 (6)
	Study area total	**--**	**43.1**	**--**	**35.9**	**0.0**	**0**	**0**	**0**	**0**	**--**	**27**	**--**
Total		**--**	**849.4**	**--**	**706.1**	**274.7**	**124**	**72**	**52**	**20**	**--**	**209**	**--**

* This table includes sites where at least one survey was completed or where willow flycatchers were detected and does not include sites where habitat reconnaissance was conducted but no willow flycatchers were detected.

[1] Number of hours spent doing broadcast surveys (does not include time spent monitoring territories).
[2] Number of hours spent monitoring territories, monitoring nests, and following up on willow flycatcher detections (does not include time spent doing broadcast surveys).
[3] A territory was considered to be present wherever (1) a flycatcher was detected during the "non-migrant" period (i.e., after June 24 through to and including July 20), (2) a flycatcher exhibited extended, unsolicited song during the first survey period and on each of two visits in the second survey period, and/or (3) a flycatcher pair was present at any point during the season.
[4] A pair was considered to be present if any of the following were observed (per Sogge et al. 2010): (1) another, unchallenged flycatcher in the immediate vicinity of where a male was engaging in extended, unsolicited song, (2) *whitt* calls between nearby flycatchers in the immediate vicinity of where a male had engaged in extended, unsolicited song, (3) interaction twitter calls between nearby flycatchers, (4) physical aggression by flycatchers against cowbirds, (5) flycatchers copulating, or (6) evidence of an active nesting attempt including: (a) a flycatcher carrying nest material, (b) a flycatcher carrying food or a fecal sac, (c) a flycatcher sitting or standing on a nest, (d) a nest containing flycatcher eggs, or (e) recently fledged flycatcher young.
[5] Adults were considered unpaired if they met the criteria for a territory (footnote 3), but no evidence of pairing was observed.
[6] The number in parentheses is the number of individuals detected on the given date(s).
[7] Non-territorial adults were all those that did not meet the criteria (footnote 3) for a territory.
[8] Surveys conducted opportunistically during site reconnaissance.
[9] Site not surveyed; inaccessible because of deep water and dense marsh vegetation. Willow flycatcher detected during survey of nearby site.
[10] Not an official survey site. Willow flycatcher(s) detected incidentally.
[11] Surveys were discontinued during the season because of poor habitat quality.
[12] Surveyed by Reclamation.

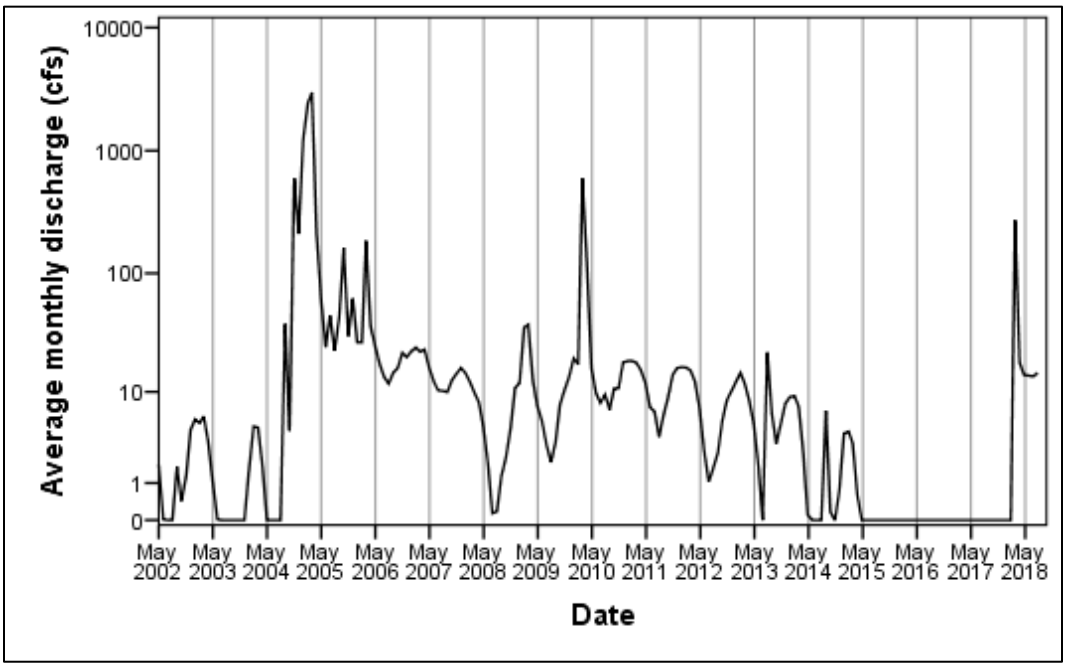

Figure 3-1.—Monthly average streamflow (cfs) recorded at the Bill Williams River near Parker, Arizona (USGS Station #09426620), 2002–18.

occupancy shifted within the landscape accordingly, with most flycatcher territories in recent years being in the Bill Williams River Delta, where water levels are influenced by the level of Lake Havasu rather than by streamflow in the Bill Williams River. In 2018, releases from Alamo Dam resulted in a peak average monthly flow of 281 cfs in March and a sustained flow of > 10 cfs throughout the flycatcher breeding season (figure 3-1). These flows resulted in surface water being present in many survey sites that had been dry in previous years (see chapter 2). Despite the wetter conditions, canopy closure did not increase notably, and no flycatcher territories were detected upstream of the Bill Williams River Delta.

The level of Alamo Lake declined over 5 m between the breeding seasons of 2017 and 2018 (see figure 2-5), but the number of territories remained essentially unchanged, with 65 territories detected in 2017 and 69 in 2018. A higher proportion of the territories were known to contain pairs in 2017 (94%) than in 2018 (72%); however, it is not clear whether the proportion of pairs was truly lower in 2018. In 2017, field activities at ALAM focused on intensive territory and nest monitoring, whereas field activities in 2018 comprised surveys and less intensive territory monitoring. Territory visits were less frequent and shorter in duration in 2018 compared to in 2017, and this could have resulted in the misclassification of some territories as single individuals when they contained pairs.

The distribution of flycatcher territories across the sites at ALAM was generally similar in 2017 and 2018, with territories concentrated in Prospect 01, Middle Earth 02, and Burro Wash 01 and 02 in both years. Burro Wash 02 was expanded to the west in 2018 to encompass areas that contained flycatcher territories in 2018 but had not been previously visited. The number of territories detected in Motherlode 01 and Santa Maria North 01 declined between 2017 and 2018 from nine to one in Motherlode 01 and eight to two in Santa Maria North 01. Vegetation health in Motherlode 01 declined dramatically in 2016 and 2017, with a large swath of dead or dying Goodding's willows in 2017. An additional portion of the site that contained healthy vegetation and flycatcher territories in 2017 was described as having live but fallen Goodding's willows in 2018, and no flycatcher territories were detected in these portions of the site in 2018. Santa Maria North 01 was the only site at ALAM with an understory of dense, mature tamarisk that was occupied by flycatchers in 2017. During the 2017 breeding season, the tamarisk were defoliated by tamarisk beetles. In 2018, the tamarisk understory was partially dead, and portions that were not dead were defoliated. The decline in the number of territories detected in Santa Maria North 01 is likely related to the decrease in density of the understory.

There were 157 flycatcher detections recorded south of the Bill Williams River in 2018, all which were before June 24. Behavioral observations (lack of territorial and aggressive behaviors exhibited toward conspecific broadcasts) and subsequent surveys at these sites suggest these flycatchers were not resident or breeding individuals but migrants. These results are consistent with those recorded in the same survey sites in 2003–17 (McLeod et al. 2008, 2018a; McLeod and Pellegrini 2013). Given that willow flycatchers are one of the last long-distance neotropical migrant passerines to arrive in the Southwest in spring, the occurrence of northbound, migrant flycatchers along the LCR in June is not surprising.

Chapter 4 – Resighting

INTRODUCTION

Long-term monitoring of 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. Color banding was in integral part of Reclamation's flycatcher studies along the LCR in 1997–2017 (see McLeod et al. 2018a for details on banding methodologies), but banding was discontinued in 2018. Although no new flycatchers were banded in 2018, field personnel resighted as many flycatchers as possible to determine whether each individual was banded and, if it was, to identify the unique color combination on its legs.

METHODS

The identity of a color-banded flycatcher was determined by observing with binoculars, from a distance, the unique color combination on its legs. Field personnel also used digital cameras (Canon PowerShot SX50 HS or SX60 HS) to take pictures of flycatchers; these photos supplemented any resight data. Typically, territories and active nests were focal areas for resighting, but entire sites were surveyed.

Data Collection

Observers recorded all resight information in their OneNote notebooks on their tablet. Multiple observations of an individual bird could be recorded during a single visit. Information recorded for each observation included band status (i.e., was each leg banded or unbanded), the colors and band type (Federal band or metal color band) observed on each leg, standardized confidence level of the resight (i.e., A = saw full color combination with 100% confidence at least twice, B = saw full color combination with 100% confidence once, C = saw full color combination with 95–99% confidence, N = less than 95% confidence, and P = used broadcast to obtain the resight), and gender of the flycatcher. Flycatchers observed engaging in lengthy, primary song from high perches (male advertising song) were sexed as male, and flycatchers observed carrying nest material or constructing or incubating a nest were sexed as female. Individuals not observed engaging in one of these diagnostic activities were sexed as unknown. One clear photograph was considered an "A" resight.

Summary information for each individual resighted on a given day (i.e., a single "best guess" of the color combination, overall confidence level, gender determination, and comments explaining any uncertainty in the resight or gender) was entered in a form in Survey123 for ArcGIS. Each form was a child feature linked to its respective territory center or nest flag point. If photographs were taken, they were transferred from the camera to a field computer.

Data Analyses

After the conclusion of the field season, all resight data were exported to a Microsoft Excel spreadsheet where they were sorted by study area, territory, and date. All resights of an individual flycatcher were evaluated as a group to determine whether the identity of the bird could be confirmed. Identities were confirmed for all birds that had two "A" resights or three "B" resights. Identities were also confirmed in instances where fewer resights or resights with lower confidence levels were available, but the color combination was consistent with an individual that was likely to be in that location (e.g., an adult that held a territory in that location in the previous year).

Movement

All movements were defined as the straight-line distance between two known locations of activity. Activity could include breeding, defense of a territory, or the brief detection of an individual in a particular area. Adult movements could occur either between years or within season but were always between study areas; movements within a study area are not described. All adult between-year movement distances were calculated from the last known location in one study area in a given year (year t) and the first known location in another study area in a subsequent year (year t + 1). Years are not always consecutive. For juvenile dispersal, the last known location was always the nest location even if the juvenile was detected as a fledgling elsewhere. The distance between the nest location and the first known location of the juvenile in a subsequent year was always calculated even if the individual returned to its natal survey site.

RESULTS

Overall, 333 adult flycatchers and willow flycatchers were detected in the project area. Of these, 15 (5%) were known to be banded, and 10 of the 15 were individually identified. A total of 127 adults were known to be unbanded, and band status was undetermined for 191 adults (table 4-1). Banded flycatchers were detected only at BIWI (1 individual) and ALAM (14 individuals). Band status was determined for less than 15% of individuals at study areas (TOGO, PVER,

Table 4-1.—Summary of adult southwestern willow flycatchers and willow flycatchers detected during the 2018 breeding season*

Study area[1]	Survey site	Total adults detected	Identity confirmed	Banded (identity unknown)	Unbanded	Band status unknown
TOPO	800M	3	0	0	2	1
	Hell Bird	4	0	0	4	0
	Glory Hole	1	0	0	1	0
	Farm Ditch Road	2	0	0	1	1
	CPhase 05	1	0	0	1	0
	Lost Lake Slough 01	3	0	0	1	2
	Lost Lake Slough 02	1	0	0	0	1
	Lost Lake Slough 03	1	0	0	1	0
	Near Farm Ditch Road[2]	2	0	0	1	1
	Near Lost Lake Slough[2]	1	0	0	0	1
	Study area total	**19**	**0**	**0**	**12**	**7**
TOGO	Between North and South[2]	1	0	0	1	0
	Study area total	**1**	**0**	**0**	**1**	**0**
BIWI	Wispy Willow	2	1	0	0	1
	Site 01	3	0	0	2	1
	Site 03	1	0	0	0	1
	Beaver Pond North	2	0	0	0	2
	Upstream Site 08	1	0	0	0	1
	Study area total	**9**	**1**	**0**	**2**	**6**
ALAM	Bullard Wash	3	0	0	2	1
	South Camp	3	0	0	2	1
	Camp 01	6	0	0	6	0
	Camp 03	1	0	0	1	0
	Middle Earth 01	7	0	1	4	2
	Middle Earth 02	24	3	1	14	6
	Prospect 01	15	0	0	14	1
	Burro Wash 01	29	1	0	14	14
	Burro Wash 02	48	4	3	30	11
	Motherlode 01	4	1	0	2	1
	Motherlode 04	1	0	0	1	0
	Santa Maria North 01	6	0	0	5	1
	Study area total	**147**	**9**	**5**	**95**	**38**
PVER	Phase 02	3	0	0	0	3
	Phase 03	2	0	0	0	2
	Phase 04 Block 02	2	0	0	0	2
	Phase 04 Block 03	2	0	0	0	2
	Phase 05 Block 01	8	0	0	0	8
	Phase 05 Block 02	8	0	0	0	8
	Phase 05 Block 03	13	0	0	3	10
	Phase 06 Block 01	4	0	0	1	3
	Phase 06 Block 02	9	0	0	2	7

Table 4-1.—Summary of adult southwestern willow flycatchers and willow flycatchers detected during the 2018 breeding season*

Study area[1]	Survey site	Total adults detected	Identity confirmed	Banded (identity unknown)	Unbanded	Band status unknown
PVER (cont.)	Phase 07 Block 01	8	0	0	1	7
	Phase 07 Block 02	3	0	0	0	3
	Near Phase 05 Block 03[2]	1	0	0	1	0
	Study area total	**63**	**0**	**0**	**8**	**55**
CIBO	Phase 01	1	0	0	0	1
	Phase 02	3	0	0	0	3
	Phase 03	1	0	0	0	1
	Nature Trail	2	0	0	0	2
	C2729	2	0	0	1	1
	Cibola Site 02	4	0	0	1	3
	Cibola Site 01	1	0	0	0	1
	Cibola Lake North	1	0	0	0	1
	Cibola Lake East	3	0	0	0	3
	Cibola Lake West	1	0	0	0	1
	Study area total	**19**	**0**	**0**	**2**	**17**
IMPE	Rattlesnake	7	0	0	1	6
	Imperial NW	2	0	0	1	1
	Imperial Nursery	3	0	0	2	1
	Ferguson Lake	16	0	0	0	16
	Ferguson Wash	5	0	0	0	5
	Great Blue Heron	1	0	0	0	1
	Martinez Lake	1	0	0	0	1
	Study area total	**35**	**0**	**0**	**4**	**31**
MITT	Mittry West	3	0	0	0	3
	C4911	4	0	0	0	4
	C4913	6	0	0	1	5
	Study area total	**13**	**0**	**0**	**1**	**12**
YUMA	C4711	2	0	0	1	1
	C4702	7	0	0	0	7
	Gila River Site 02	4	0	0	0	4
	Fortuna Site 01	8	0	0	1	7
	Fortuna North	0	0	0	0	0
	Hunters Hole	6	0	0	0	6
	Study area total	**27**	**0**	**0**	**2**	**25**
Total		**333**	**10**	**5**	**127**	**191**

* Survey sites where no flycatchers were detected are not included in this table.

[1] TOPO = Topock Marsh, TOGO = Topock Gorge, BIWI = Bill Williams, ALAM = Alamo Lake, PVER = Palo Verde Ecological Reserve, CIBO = Cibola, IMPE = Imperial, MITT = Mittry Lake, and YUMA = Yuma.

[2] Not an official survey site. Flycatcher(s) detected incidentally.

CIBO, IMPE, MITT, and YUMA) where no territories were detected. Band status was determined for 63, 33, and 74% of individuals detected at TOPO, BIWI, and ALAM, respectively.

One flycatcher at BIWI and nine flycatchers at ALAM were individually identified, and an additional five flycatchers at ALAM were known to be banded, but resights were insufficient to determine their identity (table 4-2).

Table 4-2.—Banded southwestern willow flycatchers detected during the 2018 breeding season*

Study area[1]	Survey site	Date banded[2]	Federal band #[2]	Color combination[3]	Age[4]	Sex[5]
BIWI	Wispy Willow	July 06, 2017	2660-23278	GB(M):VI	A3Y	M
ALAM	Middle Earth 01	INA	INA	Banded	AHY	M
	Middle Earth 02	July 13, 2016	2540-58392	VMV(M):TQ	4Y	M
		May 12, 2016	2660-23119	VI:WR(M)	A4Y	M
		INA	INA	Banded	AHY	M
		June 28, 2015	2660-23213	OG(M):VI	4Y	M
	Burro Wash 01	June 15, 2016	2540-58389	TQ:WBW(M)	4Y	M
	Burro Wash 02	May 22, 2015	2660-23176	VI:BR(M)	A5Y	F
		May 24, 2015	2660-23177	BG(M):VI	A5Y	M
		INA	INA	Banded	AHY	F
		INA	INA	Banded	AHY	F
		INA	INA	Banded	AHY	F
		July 27, 2015	2660-23220	VI:KWK(M)	4Y	M
		July 25, 2016	2660-23251	YB(M):VI	3Y	M
	Motherlode 01	June 6, 2014	2660-23066	VI:VR(M)	A6Y	M

[1] BIWI = Bill Williams and ALAM = Alamo Lake.
[2] INA = information not available.
[3] **Color-band codes**: B = light blue, Banded = bird was banded but combination could not be determined, G = green, K = black, M = mulberry, (M) = metal pinstriped band, O = orange, R = red, TQ = turquoise Federal band, V = violet, VI = violet Federal band, W = white, and Y = yellow. 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 left and right legs are separated with a colon.
[4] **Age in 2018**: 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 and M = male.

Returns and Movements

In 2017, 26 adult, resident flycatchers (3 at TOPO, 5 at BIWI, and 18 at ALAM) were individually identified at study areas that were monitored by SWCA in both 2017 and 2018. Of these 26 flycatchers, 8 (31%; 0 from TOPO, 2 from BIWI, and 6 from ALAM) were detected in 2018. Seven of these returned to the same study area where they were resident in 2017. One adult between-season movement was detected in which a male flycatcher moved 48.5 km from BIWI Site 01 to ALAM Burro Wash 01. No within-year, between-study-area movements were detected in 2018.

Two juvenile dispersals were detected in 2018; both were of males that fledged at ALAM, one at Burro Wash 02 in 2015 and the other at Middle Earth 02 in 2016, and returned to ALAM Burro Wash 02 as adults. Dispersal distances were 0.01 and 0.81 km, respectively.

DISCUSSION

Resighting Effort

Lower proportions of flycatchers at ALAM were resighted well enough to determine band status or to determine the individual's identity in 2018 in comparison to prior years. Of the 14 banded flycatchers detected at ALAM in 2018, 5 (38%) were not resighted clearly enough to determine their identities. This was a higher proportion than that recorded in either 2016 (23%) or 2017 (10%). Similarly, 38 (26%) of the 147 individuals detected at the study area in 2018 had an undetermined band status, which was a higher percentage than recorded in 2016 (12%) or 2017 (19%). These relatively low proportions of resighted individuals are likely related to less time being spent observing flycatchers at ALAM in 2018 than in previous years. Field effort at ALAM shifted from a focus on intensive territory and nest monitoring prior to 2018 to surveys and less intensive territory monitoring in 2018. As a result, only 194.1 observer-hours were spent on territory monitoring in 2018, compared to 530.0 observer-hours in 2017 (McLeod et al. 2018b).

Study areas that had high proportions of willow flycatchers for which band status was undetermined were typically also those at which no territories were detected. All willow flycatchers at those study areas were likely migrants and were detected on a single occasion and were often only weakly responsive to broadcast calls, making it difficult to obtain a clear look at the flycatchers' legs.

Returns and Movements

The adult return rate in 2018 (31%) was slightly lower than the 35–40% annual return rate observed at these same study areas over the last three years (McLeod and Pellegrini 2017a, 2017b; McLeod et al. 2018b). However, five adult flycatchers at ALAM in 2018 were known to be banded but could not be identified, and the apparent between-year adult return rate is likely underestimated. The only juvenile returns that were detected in 2018 were from flycatchers that had fledged prior to 2017. This is not surprising, given that only 2 of the 81 fledglings known to have been produced at ALAM in 2017 were banded because deep water precluded banding nestlings throughout most of the study area, and no fledglings were produced at either TOPO or BIWI in 2017 (McLeod et al. 2018b). Juvenile returns from 2017 would therefore likely have gone undetected.

Adult flycatchers typically exhibit high site fidelity to breeding areas, whereas juvenile flycatchers are more likely than adults to disperse to another study area (McLeod et al. 2018a; Paxton et al. 2007). Adult site fidelity is strongly influenced by breeding success, however, with most between-study-area movements occurring following a year in which the individual failed to produce young (McLeod et al. 2018a). This was the case for the one adult movement observed in 2018.

Chapter 5 – Nest Monitoring and Nest Site Characteristics

INTRODUCTION

In 2018, SWCA conducted intensive nest searches and nest monitoring at sites at TOPO and BIWI that were not within LCR MSCP conservation areas. Specific objectives of nest monitoring included determining which sites supported breeding flycatchers, calculating nest success and failure, documenting causes of nest failure (e.g., abandonment, desertion, depredation, and brood parasitism), and calculating nest productivity. Although no formal nest monitoring was completed at ALAM, nests were sometimes found during territory monitoring activities. No special attempt was made to determine the success of these nests, but fledglings were recorded if they were observed during territory monitoring activities.

It is apparent that flycatchers along the LCR and its tributaries typically select territories and nest sites that are close to surface water (McLeod and Pellegrini 2013). This preference for surface water has been demonstrated with flycatcher populations in the Cliff-Gila Valley (Stoleson and Finch 2003) and along the Gila and San Pedro Rivers (Paradzick 2005). Paradzick and Woodward (2003) also found that most occupied sites in Arizona from 1993 to 2000 were less than 50 m from water. Despite the general knowledge that flycatchers are drawn to surface water, relatively few data are available regarding the persistence of water at occupied areas throughout the breeding season, though Whitfield and Enos (1996) noted that most breeding areas dried up before young fledged. To broaden the understanding of the patterns of inundation throughout the breeding season, surface water conditions were documented periodically throughout the nesting cycle for each flycatcher nest that was formally monitored. General information on each nest was gathered, such as nesting substrate and percentage of the vegetation around the nest that consisted of tamarisk. This percentage estimate provides a qualitative assessment of the potential impact of tamarisk defoliation on each nesting attempt. In addition, temperature and humidity were measured via data loggers at all monitored nests. These data will add to the database describing conditions in occupied flycatcher territories.

METHODS

Nest Monitoring

Upon confirming or suspecting a pair of flycatchers was present, field personnel conducted intensive nest searches following the methods of Rourke et al. (1999).

Nest monitoring followed a modification of the methods described by Rourke et al. (1999) and 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 typically monitored every 2 to 4 days after nest building was complete and incubation was confirmed. During incubation and after hatching, nest contents were observed directly whenever possible 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 premature fledging of young (Rourke et al. 1999), nests were observed from a distance, using binoculars, once nestlings were 8 days of age. If no activity was observed at a previously occupied nest, the nest was checked directly to determine nest contents and condition. If no activity was observed at a nest close to or on the estimated fledge date, field personnel conducted a systematic search of the area to locate possible fledglings.

Per instructions from Reclamation biologists, a flycatcher nest was considered successful only if fledglings were observed near the nest or in surrounding areas. The number of young fledged from each nest was counted as the number of fledglings actually observed. This method of determining success produces a conservative estimate of both nest success rate and number of fledges and differs from methods recommended by some nest monitoring protocols (e.g., Martin et al. 1997; Rourke et al. 1999), which consider a nest as successful if chicks are observed in the nest within 2 days of the estimated fledge date.

A nest was considered 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 2 days prior to the estimated fledge date (depredated), (4) nestlings died in the nest despite being tended by the adults (nestlings died in nest), or (5) the entire clutch was incubated for an excess of 20 days (addled). If a nest was visited on the anticipated fledge date and the nest was empty but the adults were clearly not feeding fledglings, the nest was assumed to have been depredated. 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 disappearance of all flycatcher eggs coincided with the appearance of cowbird eggs.

For each nest check, field personnel recorded the date and time of the visit, monitoring method (observation via binoculars or mirror pole), nesting stage, nest contents, and the number and behavior of adults and/or fledges present. These data were recorded in a OneNote notebook on a tablet and then entered in a form in Survey123 for ArcGIS at the end of the field day. Each form was a child feature linked to its respective territory center or nest flag point. Flycatcher nest success was calculated using apparent nesting success (number of successful

nests/total number of nests containing at least one flycatcher egg), while fecundity was calculated as number of young produced per female over the breeding season. Parasitism rates were calculated as the percentage of nests with known contents that included at least one flycatcher egg and one cowbird egg.

Flycatcher nests that are parasitized by cowbirds and in which the cowbird egg hatches produce fewer flycatcher young than nests in which the cowbird egg does not hatch (McLeod and Pellegrini 2013); therefore, the nest monitoring protocol included replacing cowbird eggs in easily accessible flycatcher nests with artificial cowbird eggs. Three-dimensional printed cowbird eggs were obtained from Shapeways (http://www.shapeways.com/shops/VN, per Igic et al. 2015) and painted with BEHR PREMIUM PLUS ULTRA® interior paint to resemble cowbird eggs (figure 4-1). If the nest was accessible without a ladder, the cowbird egg was replaced as soon as it was discovered. If a ladder was required, the cowbird egg was replaced on the next regularly scheduled nest visit. Cowbird eggs were replaced only if a direct view of the nest contents could be obtained from a secure location either on the ground or on a ladder. The cowbird egg was replaced so as not to mimic a partial depredation event, which might result in nest desertion. If a nest was found with a cowbird nestling already in the nest, the cowbird nestling was removed from the nest.

Figure 4-1.—Artificial cowbird eggs used to replace cowbird eggs in easily accessible southwestern willow flycatcher nests.

Surface Hydrology

Soil moisture conditions were described near all monitored nests one to three times during the life of each nest. Descriptions included conditions of soil moisture at the nest (inundated, saturated, damp, or dry), depth of water at the nest (if any, to the nearest centimeter or nearest 5 cm if > 5 cm), distance from the nest to wet soils (inundated or saturated soil, to the nearest meter), and the percent of the area within 20 and 50 m of the nest that contained wet soils (to the nearest 5%). As described in chapter 2, soil moisture categories were qualitatively determined as follows: inundated soils were those that had water visible on the surface; soils were considered saturated if compression of the soil (e.g., by stepping on it) caused water to be expressed; soils were considered dry if squeezing a handful of soil did not result in the soil sticking together; and damp soils were any that did not have surface water and did not meet the criteria for either saturated or dry (i.e., compressing a handful of soil caused the soil to stick together, but no water was expressed). Estimates of distance to wet soils were determined by one of three methods: (1) a visual estimate in the field (if wet soils were visible from the nest), (2) using Collector for ArcGIS on a tablet in the field (finding the nearest wet soil, and using the measure tool to measure the distance between the observer's location and the nest location, thus displaying distance from wet soils back to the nest), or (3) by measuring on a georeferenced aerial photograph in an ArcGIS Online web application. The percentages of the area within 20 and 50 m of the nest that contained wet soils were estimated either visually in the field or, more often, by using on-the-ground knowledge of surface hydrology coupled with an aerial photograph to help with visualizing the area encompassed within a 20- or 50-m-radius circle around the nest. These data were scheduled to be collected when the nest was found, at the nest check before the estimated hatch day (or, if estimated hatch day was unknown, the nest check when nestlings were first detected), and again at fledge or failure. If a nest failed during laying or incubation or was found with nestlings, only two measurements of surface hydrology were collected.

Vegetation

Nest height was recorded up to three times for each nest: (1) if the nest was found during building and was not approached on the day it was found, a visual estimate was obtained; (2) the first time the nest was observed with a mirror pole, the pole (each section of which is 90 cm) was used to obtain an estimate of nest height; and (3) nest height was measured with a stadia rod after the nest was vacated. Each time nest height was estimated or measured, the observer also recorded the species of tree or shrub in which the nest was placed (nest substrate) as well as a visual estimate of the percentage of vegetation volume that consisted of tamarisk within a 2-m-radius cylinder and a 5-m-radius cylinder centered on the nest.

These two distances were chosen to try to assess, in the event of defoliation by tamarisk beetles, whether the level of defoliation in the immediate vicinity of the nest (2 m) or in the more general vicinity (5 m) had a greater influence on nest success and microclimate. It is typically not possible to see more than 5 m, so the percentage of tamarisk was not estimated at distances > 5 m. One of the following vegetation types was also assigned to each nest based on the foliage volume of the plant species present within 5 m of the nest:

TAMSPP = > 75% tamarisk

SALGOO = > 75% Goodding's willow

SALEXI = > 75% coyote willow

POPFRE = > 75% cottonwood

TAMSPP_SALEXI = tamarisk and coyote willow mix, neither > 75%

SALGOO_POPFRE = Goodding's willow and cottonwood mix, neither > 75%

TAMSPP_SALGOO = tamarisk with emergent Goodding's willow

SALGOO_TAMSPP = Goodding's willow overstory with tamarisk understory

OTHER = a vegetation type that does not fit one of the above descriptions

Each time soil moisture conditions at the nest were recorded, the observer also made note of whether signs of tamarisk beetles (either beetles themselves or evidence of defoliation) were present anywhere within the survey site and whether beetles or defoliation were present within 5 m of the nest. The observer recorded the condition of the tamarisk within 5 m of the nest (green, yellow/brown, defoliated, refoliating, or dead) as well as the percentage of the tamarisk within the site that was affected by beetles.

Temperature and Humidity

A Hygrochron iButton (Maxim Integrated, San Jose, California) was deployed at each monitored flycatcher nest after the nest was confirmed to be in the incubation phase, or after it was vacated if it failed before reaching incubation. The iButton was mounted on a key fob and hung in an inconspicuous location, no higher than 2 m above the ground or water surface but below nest height, and within 2 m horizontal distance of the nest. The loggers recorded temperature and relative humidity every 30 minutes and remained in place until the end of the breeding season.

Statistical Analyses

Temperature and humidity data were truncated to the midnight after the logger was deployed and the midnight before the logger was removed so that only full 24-hour periods were represented. Temperature (T, degrees Celsius [°C]) and relative humidity (RH) were converted to vapor pressure[1] (VP, Pascals [Pa]) as follows:

$$VP = RH*(610.7*10^{((7.5*T)/(237.3+T))})/100$$

The following temperature and humidity variables were calculated for each logger:

Maximum diurnal temperature
Minimum nocturnal temperature
Daily temperature range (diurnal maximum minus nocturnal minimum)
Mean diurnal vapor pressure
Mean nocturnal vapor pressure

Times from 0530 to 2000 hours were assigned as day and all others as night. Each variable was summarized over 2-week periods by study area and by vegetation type within each study area. Box plots summarizing the data over 2-week periods show the distribution of daily measurements from each logger as independent observations. Box plots illustrate the interquartile range (the ends of the box) and median (line within the box), with 'whiskers' extending up to 1.5x the interquartile range beyond the box and outliers beyond the whiskers plotted as individual points. Outliers that are more than 3x the interquartile range beyond the box are denoted with an asterisk.

Hourly temperature and relative humidity data were obtained from the weather station at the Needles airport near Needles, California (station ID WBAN23179). These data were summarized as described for the iButton data. For each temperature and humidity variable, the daily value recorded by the iButton was subtracted from the value recorded at the nearest weather station to obtain the difference in readings between the logger and the weather station. These differences were summarized with box plots over 2-week periods. Analyses of temperature and humidity and a summary of vegetation data were completed in IBM® SPSS® v. 22.0.

[1] Vapor pressure, unlike relative humidity, is not influenced by ambient temperature and may be a more biologically meaningful measure of water content of the air (e.g., the relative vapor pressure inside and outside an egg determines whether the egg loses moisture).

RESULTS

Nest Monitoring

Two flycatcher nesting attempts, one from each of the two flycatcher pairs detected at TOPO, were documented. No flycatcher pairs were documented at BIWI. Both nests were known to contain flycatcher eggs and were used in calculating nest success and productivity. Neither nest was parasitized. Both nests were depredated during the nestling period, and apparent nest success was 0%. Productivity and fecundity were also 0. The small sample size did not permit meaningful comparisons of nest success with that observed in other flycatcher studies and did not permit any analysis of possible factors affecting nest success.

Forty nests were located incidentally during territory monitoring at ALAM, and 11 fledglings from 6 nests were observed. No formal attempt was made to determine nest success, and the success of most nests at ALAM was unknown.

Surface Hydrology

Soil moisture conditions were described up to four times during the season at each nest at TOPO. Although the intention was to record these data up to three times, soil moisture data were collected four times at one nest when estimates were recorded on two different days for the same nest stage. When this occurred, the estimate further from the transition date was removed from the dataset. Soil moisture conditions were described at both nests on the day they were found; one was found during building, and the other was found the day before hatching.

Soils beneath both nests were damp when each estimate of soil condition was recorded. The distance to wet soils tended to increase during the season but never exceeded 12 m (figure 5-1). No changes in the percentage of wet soils within 20 and 50 m of the nest were recorded between mid-June and mid-July, but estimates recorded at the end of July were lower than those recorded earlier in the season.

Vegetation

Vegetation characteristics were recorded at both flycatcher nests at TOPO. Both nests were in an area with a Goodding's willow overstory and a tamarisk understory, and both nests were placed in tamarisk, at 3.1 and 4.7 m above the ground. Between 20 and 40% of the vegetation within 2 and 5 m of each nest consisted of tamarisk. The tamarisk within 5 m of each nest were affected by tamarisk beetles throughout the nesting cycle, with up to half of the tamarisk

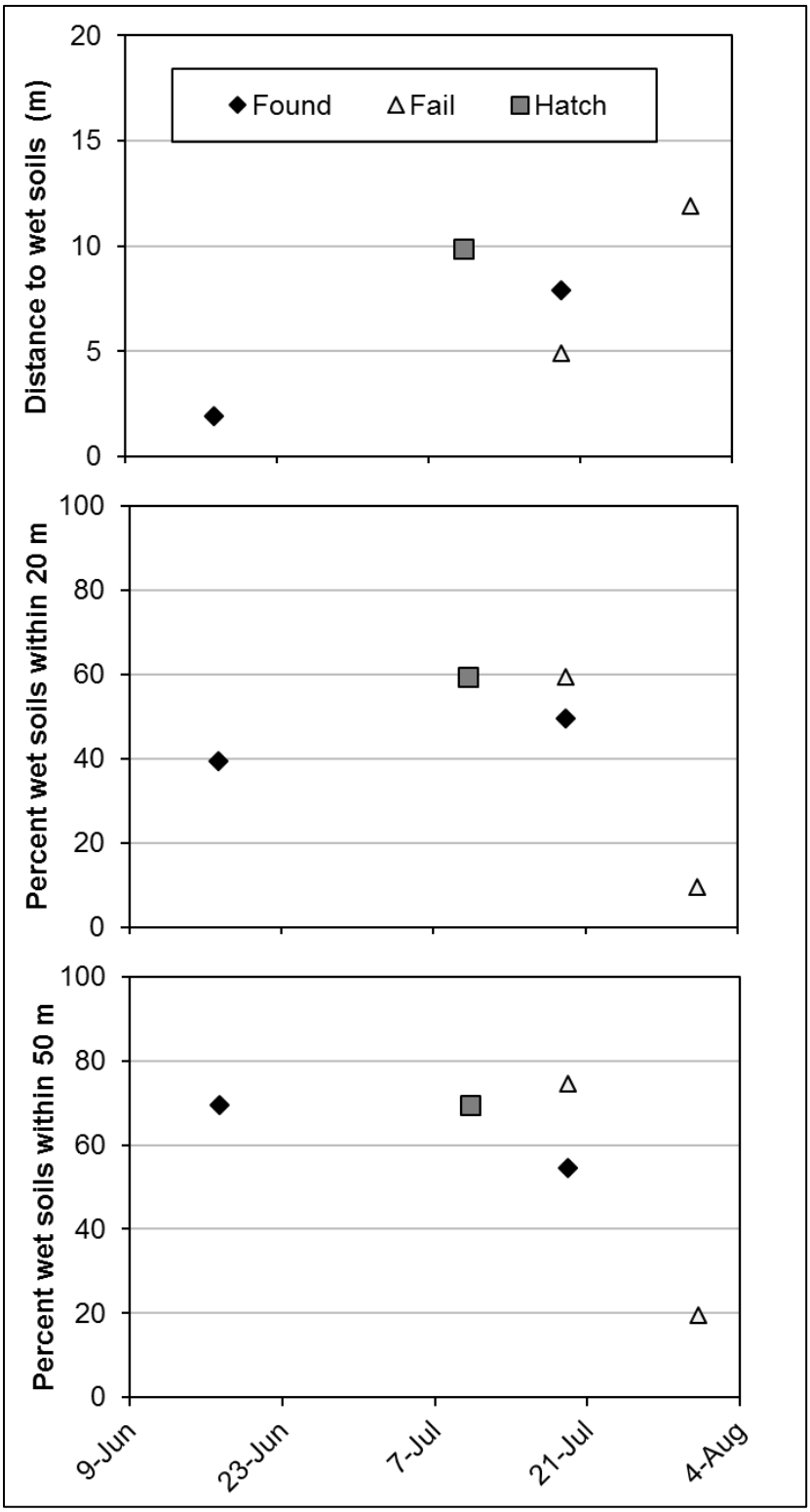

Figure 5-1.—Soil moisture characteristics at southwestern willow flycatcher nests at Topock Marsh (n = 2), 2018.

leaves being brown and the remainder green. The tamarisk in the immediate vicinity of the nests were not as severely affected by beetles as the tamarisk in the remainder of the site, which exhibited extensive browning and defoliation throughout the breeding season.

Temperature and Humidity

An iButton was deployed at both nests at TOPO. The loggers were deployed between late June and mid-July and were in place until the end of July. Both data loggers functioned properly.

Median and mean maximum daily temperatures over 2-week periods from mid-June to late July were between 40.9 and 41.8 °C (table 5-1, figure 5-2). Median and mean minimum nocturnal temperatures rose from ≈20.0 °C in mid-June to ≈26.5 °C in late July. The median and mean daily temperature ranges decreased accordingly, from ≈22.0 to 15.2 °C. Both diurnal and nocturnal vapor pressure increased from mid-June to late July.

Table 5-1.—Microclimate variables recorded over 2-week periods at two southwestern willow flycatcher nests at Topock Marsh, 2018

Variable	June 16–30		July 1–15		July 16–31	
	Median (25th–75th percentile)	Mean (standard error)	Median (25th–75th percentile)	Mean (standard error)	Median (25th–75th percentile)	Mean (standard error)
Maximum diurnal temperature (°C)	41.6 (39.6–43.1)	41.3 (1.1)	41.6 (39.1–42.1)	40.9 (0.6)	41.8 (41.1–43.1)	41.6 (0.5)
Minimum nocturnal temperature (°C)	20.1 (18.6–21.3)	20.0 (0.8)	24.6 (20.1–26.1)	23.3 (0.8)	26.6 (25.6–27.6)	26.3 (0.4)
Daily temperature range (°C)	22.0 (19.2–23.5)	21.4 (1.6)	17.5 (14.5–22.5)	17.5 (1.2)	15.2 (13.5–17.5)	15.2 (0.6)
Mean diurnal vapor pressure (Pa)	1,345 (1,306–1,446)	1,378 (49)	2,501 (1,678–2,697)	2,274 (138)	2,572 (2,548–2,645)	2,607 (24)
Mean nocturnal vapor pressure (Pa)	1,550 (1,509–1,734)	1,622 (88)	2,376 (1,929–2,673)	2,341 (106)	2,637 (2,584–2,728)	2,656 (23)

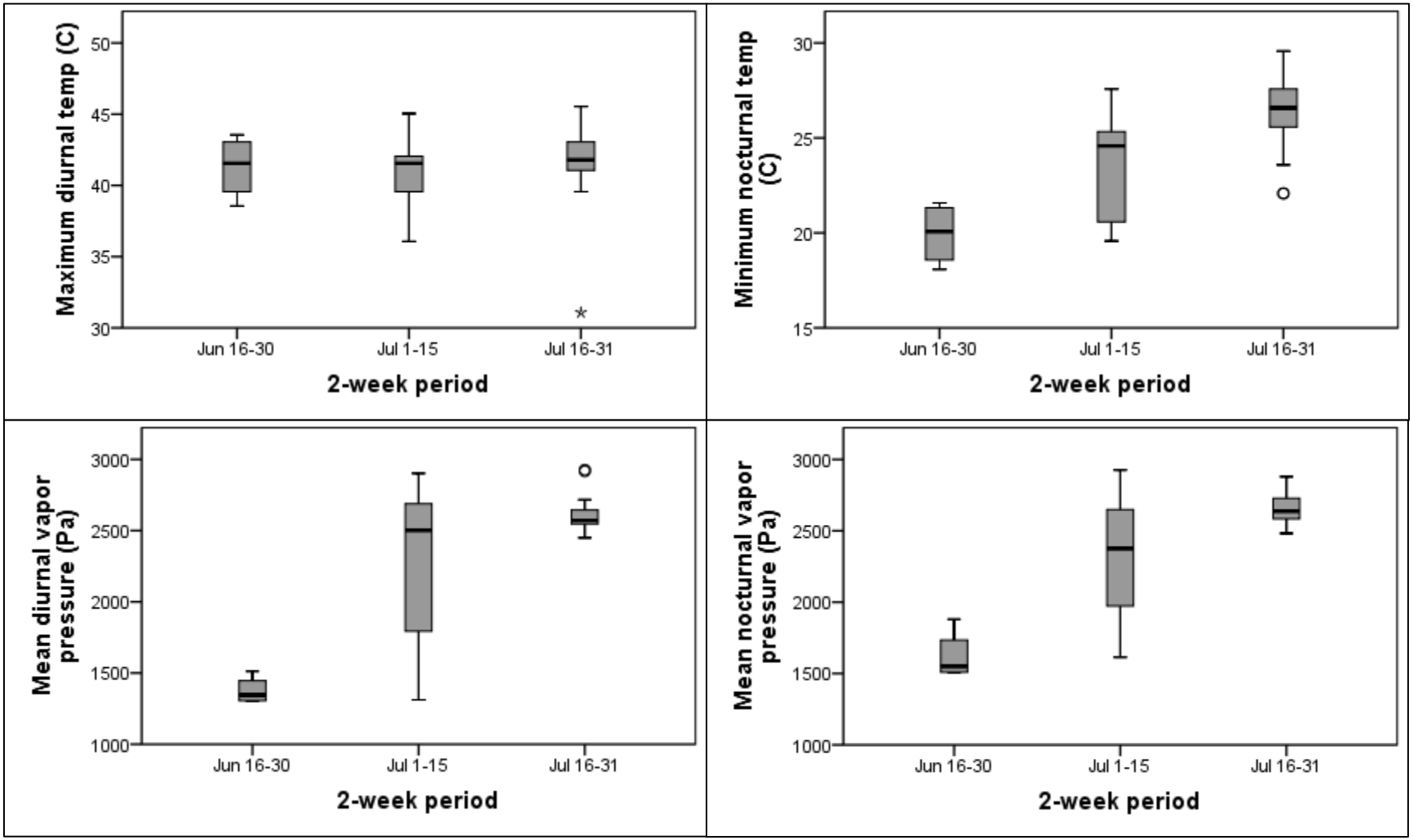

Figure 5-2.—Box plots of maximum diurnal and minimum nocturnal temperature (°C) and mean diurnal and nocturnal vapor pressure (Pa) at southwestern willow flycatcher nests (n = 2) at Topock Marsh, 2018.

DISCUSSION

Only two flycatcher pairs were detected at TOPO in 2018, as was the case in 2017. The number of flycatcher pairs has been consistently low at TOPO over the last decade, with no more than four pairs documented in any year since 2009. No young were produced at TOPO for the third consecutive year. The low number of breeding pairs and low productivity observed at TOPO in recent years suggest that TOPO does not currently provide high quality habitat for breeding flycatchers. Habitat at TOPO was affected by low water levels in 2010–11, a large fire in 2015, and tamarisk beetles in 2017 and 2018. Tamarisk throughout TOPO were defoliated during the 2018 breeding season, and the nesting flycatchers at TOPO selected locations that had a significant Goodding's willow overstory and placed their nests in tamarisk that had more green foliage than did most of the surrounding tamarisk.

Although neither nest succeeded in fledging young, both nesting attempts progressed to the nestling phase and were likely depredated. Depredation is typically the leading cause of nest failure at sites along the LCR (McLeod et al. 2018a) and at other sites across Arizona (Graber and Koronkiewicz 2009; Graber et al. 2007; Ellis et al. 2008).

Flycatchers are known for their propensity to nest near surface water (McLeod and Pellegrini 2013; Sogge and Marshall 2000; Sogge et al. 2010), which affects vegetation density, food availability (Iwata et al. 2003; Peterson et al. 2015), and microclimate (McLeod and Pellegrini 2013). Both flycatcher nests monitored in 2018 were within 15 m of surface water throughout the breeding season. The slight drying trend observed through the season around the flycatcher nests is consistent with marsh level data recorded at the South Dike at Topock Marsh, which show that water levels peaked in mid-June and gradually declined thereafter (see figure 2-1).

The small sample size precluded meaningful comparisons between microclimate conditions observed in 2018 and those observed in other years.

Chapter 6 – Summary of Study Design Discussions

For ease of reference, this chapter summarizes all study design discussions from previous chapters.

BROADCAST SURVEYS AND SITE ASSESSMENT

The habitat conditions at the following sites were assessed and may warrant having the survey area adjusted and/or the frequency of surveys changed if monitoring is continued within those portions of the LCR system in future years.

Lost Lake at TOPO was evaluated at the beginning of the 2018 survey season but was not added back to the survey list because of poor habitat quality resulting from a fire in 2016. Habitat quality has improved since 2017, and with the rate of growth in the most heavily damaged portion of the site, vegetation might reach suitable structure in 1–2 years. Lost Lake Slough #4 was also damaged in the same 2016 fire. Canopy height does meet the criterion for suitable habitat in some portions of the eastern half of the site, but canopy closure is currently too low throughout the site. Re-examination of both sites in 1–2 years would determine if the extent of suitable habitat has increased and would reduce the chance that suitable habitat is overlooked.

No portion of Lost Lake Slough #1 at TOPO had canopy closure that met the criterion for suitable habitat, but examination of aerial imagery suggests that a stand of coyote willows may be present on the southwestern edge of the site. If reconnaissance reveals that this area does not meet the suitability criteria, surveys could be discontinued with minimal risk of overlooking suitable habitat.

Surveys at Burn Edge in BIWI were discontinued after the first two visits because of the lack of suitable habitat. If water levels increased enough to fill the channel and wet soils persisted outside of the channel, the vegetation could increase in density and suitability. If flow in the Bill Williams River increases strongly in future years, re-evaluation of the site would reduce the chance that suitable habitat is overlooked.

Canopy closure is much lower than 85% in Last Gasp, Guinness, Site 05, Black Rail, Beaver Pond North, Beaver Pond, and Site 08 at BIWI. Significant levels of tree mortality are present in all these sites and substantial regenerative growth is needed before the sites could meet the suitability criteria. Re-evaluation of these sites in several years or after a high flow event would ensure that no suitable habitat is overlooked. In the meantime, surveys could be discontinued with minimal risk of overlooking suitable habitat. Canopy closure at Upstream Site 08

has also declined in recent years as the result of mortality of overstory trees and tamarisk defoliation. If the site is evaluated at the beginning of the next survey season and determined not to have improved in quality, surveys could be discontinued with minimal risk of overlooking suitable flycatcher habitat.

Over the Edge, Edgewater 01, and Bullard Wash North were all completely submerged by Alamo Lake in 2017. The submersion resulted in all vegetation dying except for one Goodding's willow at Edgewater. Most of Camp 04 was scoured away during the high flows that filled Alamo Lake, and complete submersion resulted in the death of the remaining vegetation. Site assessments at these sites could be omitted in future years with minimal risk of overlooking suitable habitat.

Tree mortality has increased steadily over the past few years at Sidebar 01 at ALAM. This site could be evaluated at the beginning of the next survey season, and if habitat quality has not improved, surveys could be discontinued with minimal risk of overlooking suitable habitat.

Several areas of Motherlode 01 contain dead and dying trees. These areas lack both the canopy closure and the midstory structural elements of suitable habitat. Surveys could be discontinued with minimal risk of overlooking suitable habitat.

Habitat suitability at Motherlode 04, Confluence 02, Confluence 01, Sandy South 01, and Santa Maria South 01 was poor in 2018. These sites were above the maximum lake levels at ALAM in 2017, and the rise in lake levels did not improve the habitat within these sites. Habitat quality in each site has declined in recent years and seems unlikely to improve in future years without another significant rise in lake levels. If lake levels remain at or below the levels observed in 2017, surveys could be discontinued with minimal risk of overlooking suitable flycatcher habitat.

At Cibola Lake West, a narrow band around the perimeter of the site meets the suitable habitat criteria for canopy height and canopy closure, but midstory structural elements are lacking. The interior of the site lacks the canopy height and canopy closure of suitable habitat. Surveys could be discontinued with minimal risk of overlooking suitable flycatcher habitat.

Walker Lake at CIBO burned sometime between 2015 and 2018 and now consists of resprouting 2–3-m-tall tamarisk, with several emergent snags. Reconnaissance of this site at the beginning of the survey season in 2021, when the next triennial surveys are scheduled, would ensure that no suitable habitat is overlooked.

Portions of both Imperial Northwest and Martinez Lake at IMPE could be eliminated from future surveys with minimal risk of overlooking suitable habitat. At Imperial Northwest, the eastern 300 m of the southern arm is not wide enough to meet the criterion for suitable habitat, and the strip of vegetation along the edge of the river lacks the canopy height of suitable habitat. At Martinez Lake, canopy closure does not exceed 30% in the northeastern portion of the site.

Habitat suitability was not thoroughly assessed in 2018 at Ferguson Lake at IMPE, but all the characteristics of preferred nesting habitat were present in portions of the western edge of the site in earlier years. Improving access to the interior of the site in future years would allow for a more thorough assessment of the extent of suitable and preferred nesting habitat.

Canopy closure is much lower than 85% throughout Gila Confluence North and most of Gila River Site 02 in YUMA. At Gila River Site 02, where canopy closure does reach 90% in some pockets, the vegetation is dense enough to inhibit flight. Although the components of suitable habitat are present, they do not co-occur, and no portion of the site meets all the criteria of suitable habitat. Surveys at both sites could be discontinued with minimal risk of overlooking suitable flycatcher habitat.

Canopy closure at both Fortuna Site 01 and Fortuna North in YUMA does not exceed 80 and 75%, respectively. Both sites therefore do not meet all the criteria for suitable habitat. The sites could be evaluated before future surveys to determine whether canopy closure has increased. If no increase in canopy closure occurs, surveys at these sites could be discontinued with minimal risk of overlooking suitable flycatcher habitat.

LITERATURE CITED

Bloodworth, B. 2014. Tamarisk Coalition, Grand Junction, Colorado, personal communication.

_____. 2017. Tamarisk Coalition, Grand Junction, Colorado, personal communication.

Brown, B.T., S.W. Carothers, and R.R. Johnson. 1987. Grand Canyon Birds. The University of Arizona Press, Tucson. 302 p.

Dudley, T. 2012. University of California, Santa Barbara, personal communication.

_____. 2014. University of California, Santa Barbara, personal communication.

_____. 2015. University of California, Santa Barbara, personal communication.

Durst, S.L., M.K. Sogge, H.C. English, S.O. Williams, B.E. Kus, and S.J. Sferra. 2006. Southwestern Willow Flycatcher Breeding Site and Territory Summary – 2005. U.S. Geological Survey Southwest Biological Science Center report to the Bureau of Reclamation.

Ellis, L.A., D.M. Weddle, S.D. Stump, H.C. English, and A.E. Graber. 2008. Southwestern Willow Flycatcher Final Survey and Monitoring Report. Research Technical Guidance Bulletin #10. Arizona Game and Fish Department, Phoenix.

Finch, D.M. and J.F. Kelly. 1999. Status of management of the southwestern willow flycatcher in New Mexico. Pages 197–203 *in* D.M. Finch, J.C. Whitney, J.F. Kelly, and S.R. Loftin (editors). Rio Grande Ecosystems: Linking Land, Water, and People. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station Proceedings, RMRS-P-7.

Garrett, K. and J. Dunn. 1981. Birds of Southern California. Los Angeles Audubon Society, Los Angeles, California.

GeoSystems Analysis, Inc. 2014. Soil Moisture Monitoring Pilot Study at Palo Verde Ecological Reserve Phase 2. Report submitted to the Bureau of Reclamation, Boulder City, Nevada, by GeoSystems Analysis Inc., Tucson, Arizona. 65 p + attachments.

Graber, A.E. and T.J. Koronkiewicz. 2009. Southwestern Willow Flycatcher Surveys and Nest Monitoring Along the Gila River Between Coolidge Dam and South Butte, 2008. Final 2008 summary report submitted to the Bureau of Reclamation, Phoenix, Arizona, by SWCA Environmental Consultants, Flagstaff, Arizona. 66 p.

Graber, A.E., D.M. Weddle, H.C. English, S.D. Stump, H.E. Telle, and L.A. Ellis. 2007. Southwestern Willow Flycatcher 2006 Survey and Nest Monitoring Report. Technical Report 249. Nongame and Endangered Wildlife Program, Arizona Game and Fish Department, Phoenix.

Harter, L. 2016. Great Basin Bird Observatory, Lake Havasu City, Arizona, personal communication.

Howell, N.G. and S. Webb. 1995. A Guide to the Birds of Mexico and Northern Central America. Oxford University Press, New York.

Igic, B., V. Nunez, H.U. Voss, R. Croston, Z. Aidala, A.V. Lopez, A. Van Tatenhove, M.E. Holford, M.D. Shawkey, and M.E. Hauber. 2015. Using 3D printed eggs to examine the egg-rejection behaviour of wild birds. PeerJ 3:e965; DOI 10.7717/peerj.965.

Iwata, T., S. Nakano, and M. Murakami. 2003. Stream meanders increase insectivorous bird abundance in riparian deciduous forests. Ecography 26:325–337.

Johnson, M.J. and M.K. Sogge. 1997. Southwestern Willow Flycatcher Surveys Along Portions of the San Juan River, Utah (Montezuma Creek – Mexican Hat and Clay Hills Crossing), 1997. U.S. Geological Survey Colorado Plateau Field Station, Flagstaff, Arizona.

Ketcham, S. 2016. Bureau of Land Management, Lake Havasu City, Arizona, personal communication.

Koronkiewicz, T.J., M.K. Sogge, C. Van Riper, III, and E.H. Paxton. 2006. Territoriality, site fidelity, and survivorship of willow flycatchers wintering in Costa Rica. The Condor 108:558–570.

Lakes Online. 2018. Alamo Lake water level http://alamo.lakesonline.com/Level.asp (accessed on October 31, 2018).

Lynn, J.C., T.J. Koronkiewicz, M.J. Whitfield, and M.K. Sogge. 2003. Willow flycatcher winter habitat in El Salvador, Costa Rica, and Panama: characteristics and threats. Pages 41–51 *in* M.K. Sogge, B.E. Kus, S.J. Sferra, and M.J. Whitfield (editors). Ecology and Conservation of the Willow Flycatcher, Studies in Avian Biology No. 26. Cooper Ornithological Society.

Marshall, R.M. and S.H. Stoleson. 2000. Threats. Pages 13–24 *in* Status, Ecology, and Conservation of the Southwestern Willow Flycatcher. U.S. Forest Service General Technical Report, RMRS-GTR-60.

Martin, T.E., C.R. Paine, C.J. Conway, W.M. Hochachka, P. Allen, and W. Jenkins. 1997. Breeding Biology Research and Monitoring Database (BBIRD) Field Protocol. Montana Cooperative Wildlife Research Unit, University of Montana, Missoula.

McKernan, R.L. and G. Braden. 1999. Status, Distribution, and Habitat Affinities of the Southwestern Willow Flycatcher Along the Lower Colorado River, Year 3 – 1998. Unpublished report submitted to the Bureau of Reclamation, Boulder City, Nevada; the U.S. Fish and Wildlife Service, Carlsbad, California, and Reno, Nevada; and the Bureau of Land Management, Caliente, Nevada, by the San Bernardino County Museum, Redlands, California. 71 p.

_____. 2002. Status, Distribution, and Habitat Affinities of the Southwestern Willow Flycatcher Along the Lower Colorado River, Year 6 – 2001. Unpublished report submitted to the Bureau of Reclamation, Boulder City, Nevada, and the U.S. Fish and Wildlife Service, Carlsbad, California, and Reno, Nevada, by the San Bernardino County Museum, Redlands, California. 58 p.

McLeod, M.A. and A.R. Pellegrini. 2013. Southwestern Willow Flycatcher Surveys, Demography, and Ecology Along the Lower Colorado River and Tributaries, 2008–2012. Summary report submitted to the Bureau of Reclamation, Boulder City, Nevada, by SWCA Environmental Consultants, Flagstaff, Arizona. 341 p.

_____. 2017a. Southwestern Willow Flycatcher Surveys, Demography, and Ecology Along the Lower Colorado River and Tributaries, 2015 Annual Report. Submitted to the Bureau of Reclamation, Boulder City, Nevada, by SWCA Environmental Consultants, Flagstaff, Arizona. 229 p.

_____. 2017b. Southwestern Willow Flycatcher Surveys, Demography, and Ecology Along the Lower Colorado River and Tributaries, 2016 Annual Report. Submitted to the Bureau of Reclamation, Boulder City, Nevada, by SWCA Environmental Consultants, Flagstaff, Arizona. 193 p.

McLeod, M.A., T.J. Koronkiewicz, B.T. Brown, W.J. Langeberg, and S.W. Carothers. 2008. Southwestern Willow Flycatcher Surveys, Demography, and Ecology Along the Lower Colorado River and Tributaries, 2003–2007. Five-year summary report submitted to the Bureau of Reclamation, Boulder City, Nevada, by SWCA Environmental Consultants, Flagstaff, Arizona. 206 p.

McLeod, M.A., A. Pellegrini, and G. Cummins. 2018a. Southwestern Willow Flycatcher Surveys, Demography, and Ecology Along the Lower Colorado River and Tributaries, 2013–2017 Summary Report. Submitted to the Lower Colorado River Multi-Species Conservation Program, Bureau of Reclamation, Boulder City, Nevada, by SWCA Environmental Consultants, Flagstaff, Arizona, under contract No. GS-10F-0209L.

McLeod, M.A., S. Nichols, and A. Pellegrini. 2018b. Southwestern Willow Flycatcher Surveys, Demography, and Ecology Along the Lower Colorado River and Tributaries, 2017 Annual Report. Submitted to the Lower Colorado River Multi-Species Conservation Program, Bureau of Reclamation, Boulder City, Nevada, by SWCA Environmental Consultants, Flagstaff, Arizona, under contract No. R13PD30017.

Moore, D. 2016. Bureau of Reclamation, Denver, Colorado, personal communication.

Munes, E. 2018. U.S. Fish and Wildlife Service, Imperial National Wildlife Refuge, personal communication.

Paradzick, C.E. 2005. Southwestern willow flycatcher habitat selection along the Gila and lower San Pedro Rivers, Arizona: vegetation and hydrogeomorphic considerations. Thesis. Arizona State University, Tempe.

Paradzick, C.E. and A.A. Woodward. 2003. Distribution, abundance, and habitat characteristics of southwestern willow flycatchers in Arizona, 1993–2000. Studies in Avian Biology 26:22–29.

Paxton, E.H., M.K. Sogge, S.L. Durst, T.C. Theimer, and J. Hatten. 2007. The Ecology of the Southwestern Willow Flycatcher in Central Arizona – A 10-Year Synthesis Report. U.S. Geological Survey Open-File Report 2007-1381.

Peterson, D., A.R. Pellegrini, M.A. McLeod, and T.C. Theimer. 2015. Distance to standing water is negatively correlated with invertebrate biomass, nestling feeding rate, and productivity in southwestern willow flycatchers (*Empidonax traillii extimus*). Pages 262–270 *in* Proceedings of the 12th Biennial Conference of Science and Management on the Colorado Plateau and Southwest Region.

Phillips, A., J. Marshall, and G. Monson. 1964. The Birds of Arizona. University of Arizona Press, Tucson. 212 p.

Ridgely, R.S. and G. Tudor. 1994. The Birds of South America, Volume II: The Suboscine Passerines. University of Texas Press, Austin.

Rourke, J.W., T.D. McCarthey, R.F. Davidson, and A.M. Santaniello. 1999. Southwestern Willow Flycatcher Nest Monitoring Protocol. Nongame and Endangered Wildlife Program Technical Report No. 144. Arizona Game and Fish Department, Phoenix.

Sogge, M.K. and R.M. Marshall. 2000. A survey of current breeding habitats. Pages 43–56 *in* D.M. Finch and S.H. Stoleson (editors). Status, Ecology, and Conservation of the Southwestern Willow Flycatcher. General Technical Report, RMRS-GTR-60. U.S. Forest Service, Rocky Mountain Research Station, Ogden, Utah. 131 p.

Sogge, M.K., D. Ahlers, and S.J. Sferra. 2010. A Natural History Summary and Survey Protocol for the Southwestern Willow Flycatcher. U.S. Geological Survey Techniques and Methods 2A-10. 38 p.

Stiles, F.G. and A.F. Skutch. 1989. A Guide to the Birds of Costa Rica. Cornell University Press, New York.

Stoleson, S.H. and D.M. Finch. 2003. Microhabitat use by breeding southwestern willow flycatchers on the Gila River, New Mexico. Studies in Avian Biology 26:91–95.

U.S. Fish and Wildlife Service (USFWS). 1995. Final rule determining endangered status for the southwestern willow flycatcher. Federal Register 60:10694–10715.

_____. 2002. Final Recovery Plan, Southwestern Willow Flycatcher (*Empidonax traillii extimus*). Prepared by the Southwestern Willow Flycatcher Recovery Team Technical Subgroup. August 2002.

U.S. Geological Survey (USGS). 2018a. USGS National Water Information System. https://nwis.waterdata.usgs.gov/az/nwis/uv/?cb_00065=on&format=rdb&site_no=09427500&period=&begin_date=2018-01-01&end_date=2018-11-26 (accessed on November 26, 2018)

_____. 2018b. USGS National Water Information System. https://nwis.waterdata.usgs.gov/az/nwis/uv/?cb_00060=on&cb_00065=on&format=rdb&site_no=09426620&period=&begin_date=2018-03-01&end_date=2018-08-31 (accessed on November 27, 2018)

_____. 2018c. USGS National Water Information System. https://nwis.waterdata.usgs.gov/az/nwis/uv?cb_00060=on&format=rdb&site_no=09426000&period=&begin_date=2018-05-15&end_date=2018-08-17 (accessed on November 20, 2018).

_____. 2018d. USGS National Water Information System. https://nwis.waterdata.usgs.gov/usa/nwis/uv/?cb_00060=on&format=rdb&site_no=09424900&period=&begin_date=2018-05-01&end_date=2018-08-17 (accessed on November 15, 2018).

_____. 2018e. USGS National Water Information System. https://nwis.waterdata.usgs.gov/az/nwis/uv/?cb_00060=on&format=rdb&site_no=09424450&period=&begin_date=2018-05-01&end_date=2018-11-16 (accessed on November 15, 2018).

USFWS (see U.S. Fish and Wildlife Service).

USGS (see U.S. Geological Survey).

Unitt, P. 1987. *Empidonax traillii extimus*: an endangered subspecies. Western Birds 18:137–162.

_____. 1997. Winter Range of *Empidonax traillii extimus* as Documented by Existing Museum Collections. San Diego Natural History Museum report to the Bureau of Reclamation, Phoenix, Arizona.

Whitfield, M.J. and K.M. Enos. 1996. A Brown-headed Cowbird Control Program and Monitoring for the Southwestern Willow Flycatcher, South Fork Kern River, California, 1996. Final Report for the U.S. Army Corps of Engineers, Sacramento District, prepared by the Kern River Research Center, Weldon, California.

Yong, W. and D.M. Finch. 1997. Migration of the willow flycatcher along the Middle Rio Grande. Wilson Bulletin 109:253–268.

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ATTACHMENTS

1 Study Area and Survey Site Organization Within Lower Colorado River Multi-Species Conservation Program (LCR MSCP) Areas and Sites, 2018

2 Field Data Forms

3 Orthophotos Showing Study Sites

4 Southwestern Willow Flycatcher (*Empidonax traillii extimus*) Survey Dates for Lower Colorado River Multi-Species Conservation Program (LCR MSCP) Areas and Sites, 2018

5 Detections of Covered Species Within Lower Colorado River Multi-Species Conservation Program (LCR MSCP) Areas and Sites, 2018

6 Contributing Personnel

ATTACHMENT 1

Study Area and Survey Site Organization Within Lower Colorado River Multi-Species Conservation Program (LCR MSCP) Areas and Sites, 2018

Table A1-1.—Study area and survey site organization within LCR MSCP areas and sites, 2018*

Study area	Management Unit[1]	River drainage	LCR MSCP area	LCR MSCP site	LCR MSCP section
Topock Marsh	Hoover to Parker	Lower Colorado River	Topock	Topock Marsh	Pipes 01
					Pipes 03
					The Wallows
					PC6-1
					Pig Hole
					In Between
					800M
					Pierced Egg
					Swine Paradise
					Platform
					250M
					Hell Bird
					Glory Hole
					Farm Ditch Road
			Beal Lake Conservation Area	CPhase 05	CPhase 05
			Topock	Topock Bay	Lost Lake
					Lost Lake Slough 01
					Lost Lake Slough 02
					Lost Lake Slough 03
					Lost Lake Slough 04
Topock Gorge	Hoover to Parker	Lower Colorado River	Topock Gorge South	Blankenship Valley	Blankenship North
					Blankenship South

Table A1-1.—Study area and survey site organization within LCR MSCP areas and sites, 2018*

Study area	Management Unit[1]	River drainage	LCR MSCP area	LCR MSCP site	LCR MSCP section
Bill Williams	Bill Williams	Bill Williams River	Bill Williams River West	BW Delta	Coyote Crossing
				North of Main Delta	Bill Willow
				North Burn	Wispy Willow
					Site 01
					Burn Edge
				Mosquito Flats	Site 04
					Site 03
				Cross River	Last Gasp
					Guinness
				Sandy Wash	Site 05
					Black Rail
			Bill Williams River East	Esquerra Ranch	Beaver Pond North
					Beaver Pond
				Honeycomb Bend	Site 08
				Cave Wash	Upstream Site 08
			Planet Ranch	Planet Ranch West	Planet Ranch Road
Alamo Lake	Bill Williams	Bill Williams River	Alamo Lake	Lake	Bullard Wash
					Bullard Wash North
					South Camp
					Over the Edge
				Browns Crossing	Sidebar 01
					Edgewater 01
					Camp 01
					Camp 04
					Camp 02

Table A1-1.—Study area and survey site organization within LCR MSCP areas and sites, 2018*

Study area	Management Unit[1]	River drainage	LCR MSCP area	LCR MSCP site	LCR MSCP section
Alamo Lake (cont.)	Bill Williams	Bill Williams River	Alamo Lake	Browns Crossing	Camp 03
					Middle Earth 01
					Middle Earth 02
					Prospect 01
					Burro Wash 01
					Burro Wash 02
					Motherlode 01
					Motherlode 04
					Confluence 02
					Confluence 01
		Big Sandy River			Sandy South 01
		Santa Maria River			Santa Maria North 01
					Santa Maria South 01
Palo Verde Ecological Reserve	Parker to Southerly International Boundary	Lower Colorado River	Palo Verde Ecological Reserve	Phase 02	Phase 02
				Phase 03	Phase 03
				Phase 04	Phase 04 Block 01
					Phase 04 Block 02
					Phase 04 Block 03
				Phase 05	Phase 05 Block 01
					Phase 05 Block 02
					Phase 05 Block 03
				Phase 06	Phase 06 Block 01
					Phase 06 Block 02
				Phase 07	Phase 07 Block 01
					Phase 07 Block 02

Table A1-1.—Study area and survey site organization within LCR MSCP areas and sites, 2018*

Study area	Management Unit[1]	River drainage	LCR MSCP area	LCR MSCP site	LCR MSCP section
Cibola	Parker to Southerly International Boundary	Lower Colorado River	Cibola Valley Conservation Area	Phase 01	Phase 01
				Phase 02	Phase 02
				Phase 03	Phase 03
			Cibola National Wildlife Refuge Unit #1	Upper Hippy Fire	Upper Hippy Fire
				Nature Trail	Nature Trail
				Crane Roost	C2729
			Cibola Valley South	Trigo Mountains	Cibola Site 02
					Cibola Site 01
					Cibola Lake North
					Cibola Lake East
					Cibola Lake West
			Imperial North	Draper Ranch	Walker Lake
Imperial	Parker to Southerly International Boundary	Lower Colorado River	Picacho	Hoge Ranch	Rattlesnake
			Imperial South	Fishers Landing	Imperial NW
					Imperial Nursery
					Ferguson Lake
					Ferguson Wash
					Great Blue Heron
					Powerline
					Martinez Lake
Mittry Lake	Parker to Southerly International Boundary	Lower Colorado River	Laguna	Laguna West	Mittry West
			Laguna Division Conservation Area	Reach 01	C4911
					C4913

Table A1-1.—Study area and survey site organization within LCR MSCP areas and sites, 2018*

Study area	Management Unit[1]	River drainage	LCR MSCP area	LCR MSCP site	LCR MSCP section
Yuma	Parker to Southerly International Boundary	Lower Colorado River	Yuma East Wetlands	J	C4703
				C	C4711
				I	C4702
			Gila Valley	Gila Valley North	Gila Confluence North
		Gila River			Gila River Site 02
				Gila Valley South	Fortuna Site 01
					Fortuna North
		Lower Colorado River	Hunters Hole Conservation Area	Hunters Hole Conservation Area	1401-01[2]

* The LCR MSCP section name corresponds to the current survey site name, though the geography of corresponding sections and survey sites may not be identical.

[1] Management units are defined in the southwestern willow flycatcher recovery plan (USFWS 2002).
[2] Data are reported under the name Hunters Hole.

ATTACHMENT 2

Field Data Forms

MSCP Area: Do Not Use MSCP Site: Do Not Use → Proofed by:___ Date:___

SWFL General Site Description

[Complete at least 3 times during season: early (10–25 May), mid-season (10–25 June), and late season (5–20 July)]

Study Area: Study Area → **Survey Site:** Survey Site → **Visit:** Choose an item. → **Date:** Date → **Observer(s):** Observer(s)

VEGETATION					
Vegetation Type 1		**Vegetation Type 2**		**Vegetation Type 3**	
Dominant overstory spp:	Overstory spp	**Dominant overstory spp:**	Overstory spp	**Dominant overstory spp:**	Overstory spp
Overstory ht (m):	Overstory height	**Overstory ht (m):**	Overstory height	**Overstory ht (m):**	Overstory height
Dominant understory spp:	Understory spp	**Dominant understory spp:**	Understory spp	**Dominant understory spp:**	Understory spp
Understory height (m):	Understory height	**Understory height (m):**	Understory height	**Understory height (m):**	Understory height
% Canopy closure:	% Canopy Closure	**% Canopy closure:**	% Canopy Closure	**% Canopy closure:**	% Canopy Closure
Inundated?	Yes / No	**Inundated?**	Yes / No	**Inundated?**	Yes / No
Percentage of site:	% of Site	**Percentage of site:**	% of Site	**Percentage of site:**	% of Site

Overall vegetation composition at site: Choose an item.

Other vegetation types present (e.g., cattail)? Yes / No **If yes,** → **type of vegetation:** Type of vegetation → **percentage of site:** % of site.

→ → **type of vegetation:** Type of vegetation → **percentage of site:** % of site

HYDROLOGY			
% INUNDATED (% of site)	**% SATURATED Soils** (NOT including inundated areas!)	**% DAMP Soils** (NOT including inundated or saturated areas!)	**% DRY Soils** (NOT including moist soils!)

BEETLES		
Signs of beetles present? (Y/N)	**% of TAMSPP affected?**	**Foliage condition**
		Choose an item.

If INUNDATED:

Describe type of surface water (e.g., open marsh, surface water within woody vegetation, stream, etc): Type of surface water

Average depth of surface water (cm): Surface water depth

If NO Inundated or Saturated Soils are present:

Distance (m) to Standing Water or Saturated Soil from EDGE of site: Minimum distance to water → **How was distance determined?** Choose an item.

Describe type of nearest wet soils: Type of nearest wet soils

Approximate location of nearest wet soils: Easting: Easting Northing: Northing

LIVESTOCK

Were signs of livestock noted in or near the site? If yes, please describe. Signs of livestock. Include species, type of sign, freshness of sign, and abundance of sign.

HABITAT SUITABILITY

How suitable is the habitat for flycatchers?: ☐ → ☐ → ☐ → ☐ → ☐

Section Break (Next Page)

NARRATIVE and PICTORIAL DESCRIPTION

Does this description cover the entire site? Yes / No **If not, which portion is described?** Portion of site described

On the hardcopy map, sketch and label the locations of the major vegetation types you observed. Delineate marshes, open areas, and other habitat that may be unsuitable for flycatchers. If water was present, show its location.

Give a narrative description of the site, including adjacent habitats: Narrative description of site. Use the numbers above to build your narrative. Explain any patterns present in the vegetation (e.g., shorter veg had lower canopy closure or vice versa). If you present averages above, make sure to also include the range in your narrative (as applicable) and vice versa.

Additional comments on habitat quality, other notable avian species, site access, etc:

Observed Leg Injuries

Study Area: Study Area **Survey Site:** Survey Site **Territory/Nest #:** Terr #
Date: Date **Observer(s):** Observer(s)

Color-band combination: Color combo **If captured, Federal Band #:** Prefix-Suffix

PHOTOGRAPH INFORMATION
Did you take photos? Yes / No **If yes, how many?** # of pics

After you download and name the photos, create a link to each photo:

Photo 1	
Photo 2	
Photo 3	
Photo 4	
Photo 5	
Photo 6	

NOTES
Detail all pertinent information including duration of observation, behaviors, how bird was holding its leg, whether the bird had use of the leg, etc. **Banders – describe the injury in detail. Was the band removed? If so, did the leg bleed? Was the bird stressed? Be precise, complete, and detailed.

Notes on observed leg injury

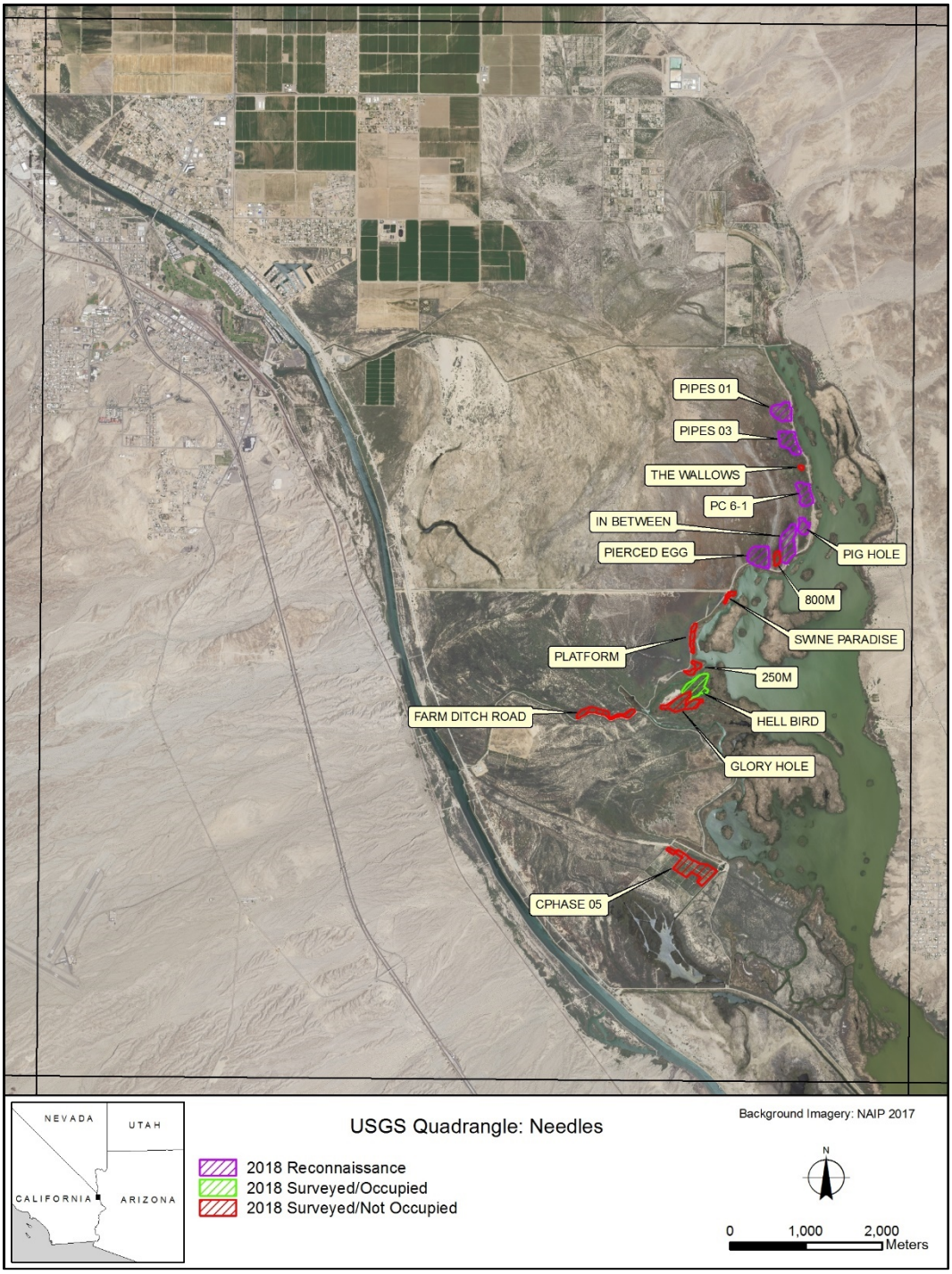
ATTACHMENT 3

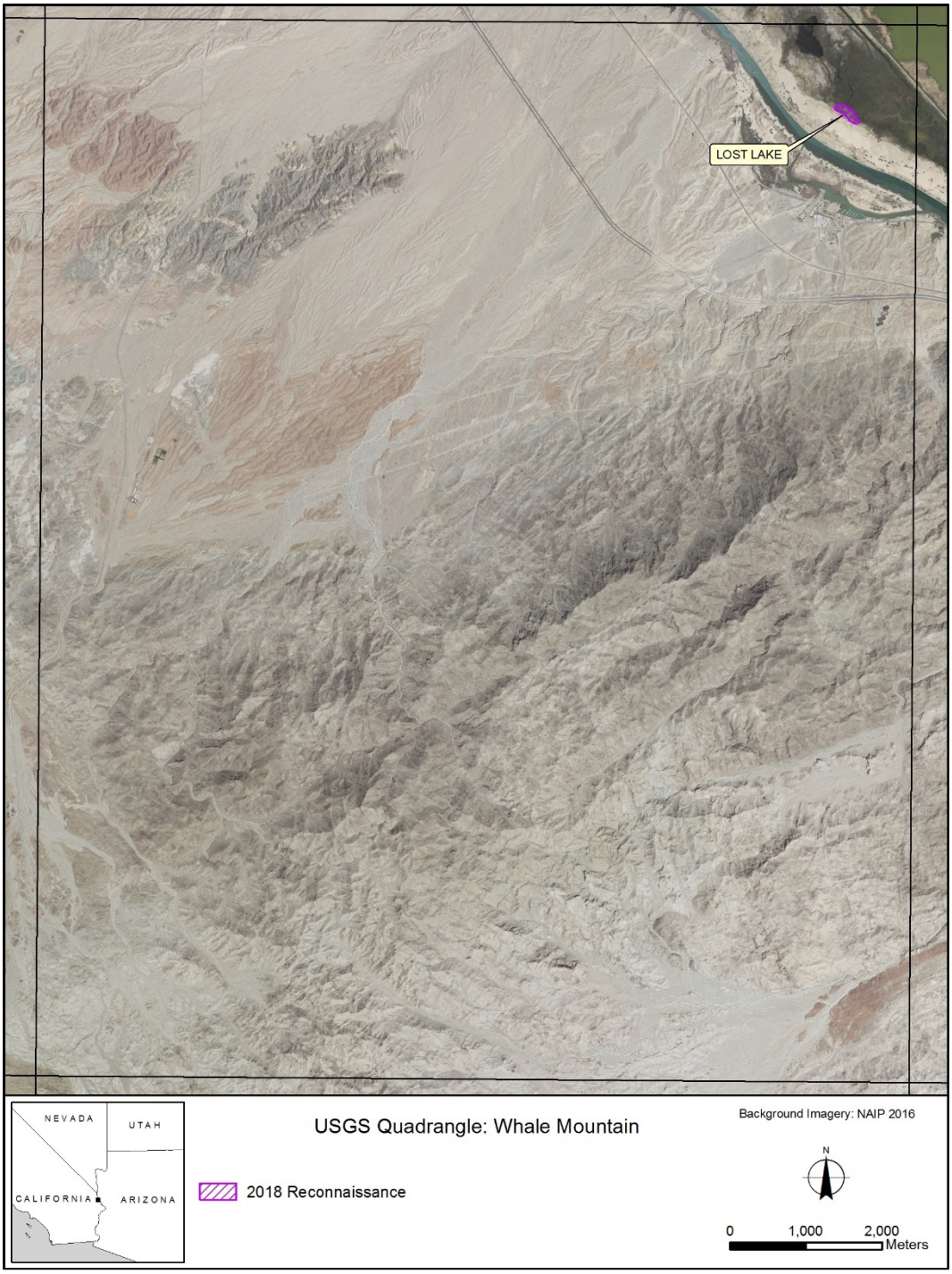
Orthophotos Showing Study Sites

Definition of Survey Site Occupancy – Survey sites are considered occupied if at least one southwestern willow flycatcher (*Empidonax traillii extimus*) (hereafter flycatcher) territory is detected.

A territory was considered to be present wherever (1) a flycatcher was detected during the "non-migrant" period (i.e., after June 24 through to and including July 20), (2) a flycatcher exhibited extended, unsolicited song during the first survey period and on each of two visits in the second survey period, and/or (3) a flycatcher pair was present at any point during the season. A pair was considered to be present if any of the following were observed (per Sogge et al. 2010): (1) another, unchallenged flycatcher in the immediate vicinity of where a male was engaging in extended, unsolicited song, (2) *whitt* calls between nearby flycatchers in the immediate vicinity of where a male had engaged in extended, unsolicited song, (3) interaction twitter calls between nearby flycatchers, (4) physical aggression by flycatchers against cowbirds, (5) flycatchers copulating, or (6) evidence of an active nesting attempt including: (a) a flycatcher carrying nest material, (b) a flycatcher carrying food or a fecal sac, (c) a flycatcher sitting or standing on a nest, (d) a nest containing flycatcher eggs, or (e) recently fledged flycatcher young.

U T A H
N E V A D A
St. George
Virgin River
Pahranagat Wash
Lake Mead
Colorado River
Las Vegas
Lake Mohave
Kingman
Flagstaff
TOPOCK MARSH
TOPOCK GORGE
BILL WILLIAMS
C A L I F O R N I A
Lake Havasu
ALAMO LAKE
Bill Williams River
A R I Z O N A
Verde River
Colorado River
Palm Springs
Quartzsite
PALO VERDE ECOLOGICAL RESERVE
Salton Sea
Phoenix
CIBOLA
IMPERIAL
MITTRY
Gila River
Yuma
YUMA
M E X I C O
Lower Colorado River Southwestern
Willow Flycatcher Study 2018
City/Town
Study Area
River
Highway
0 25 50 Mi
0 50 100 Km
1:3,300,000
N


PIPES 01
PIPES 03
THE WALLOWS
PC 6-1
IN BETWEEN
PIERCED EGG
PIG HOLE
800M
SWINE PARADISE
PLATFORM
250M
FARM DITCH ROAD
HELL BIRD
GLORY HOLE
CPHASE 05
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Needles
2018 Reconnaissance
2018 Surveyed/Occupied
2018 Surveyed/Not Occupied
Background Imagery: NAIP 2017
N
0
1,000
2,000
Meters


LOST LAKE
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Whale Mountain
2018 Reconnaissance
Background Imagery: NAIP 2016
N
0
1,000
2,000
Meters

LOST LAKE SLOUGH #1
LOST LAKE SLOUGH #2
LOST LAKE SLOUGH #3
LOST LAKE SLOUGH #4
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Topock
Inaccessible
2018 Reconnaissance
2018 Surveyed/Not Occupied
Background Imagery: NAIP 2016
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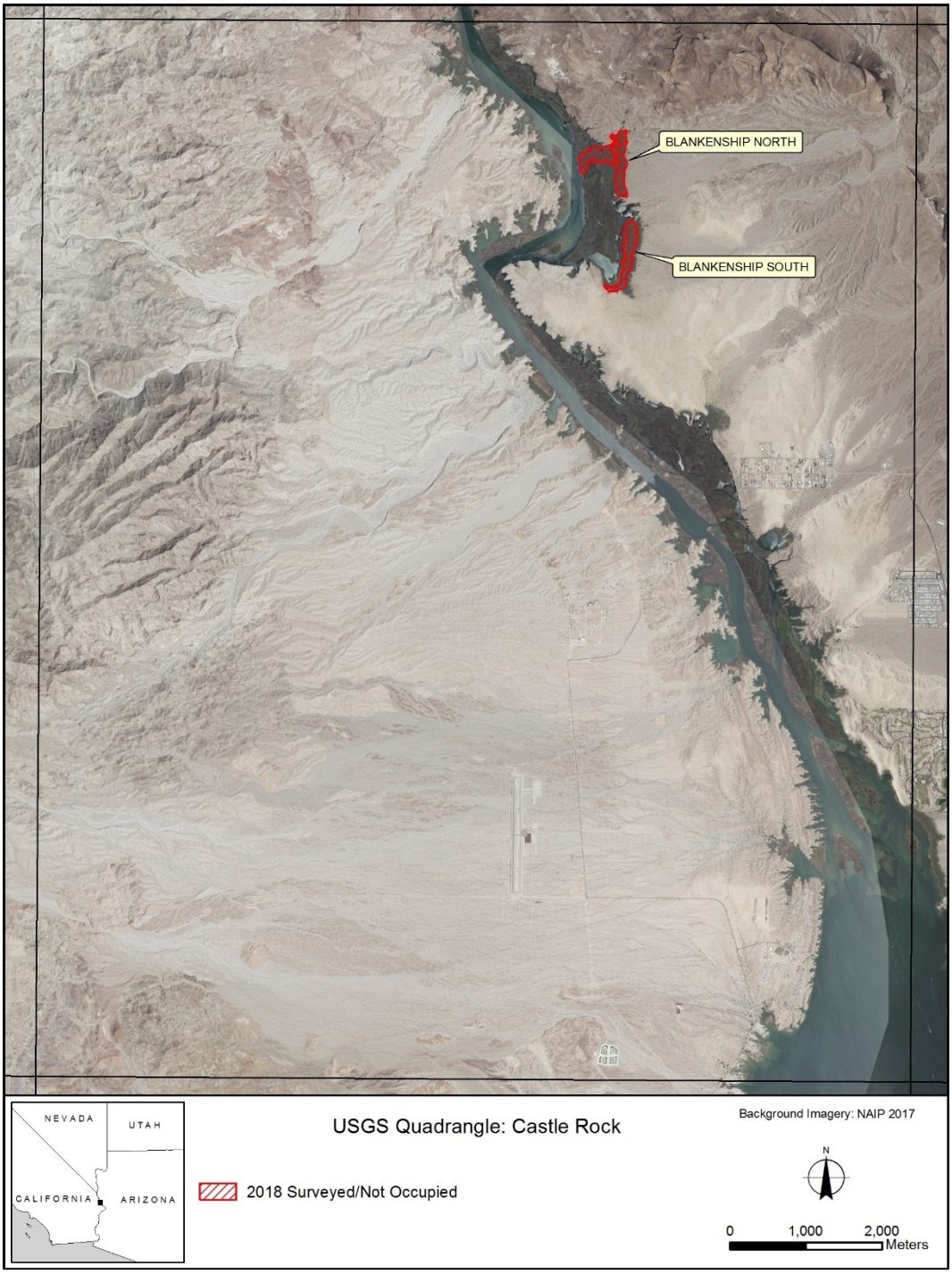
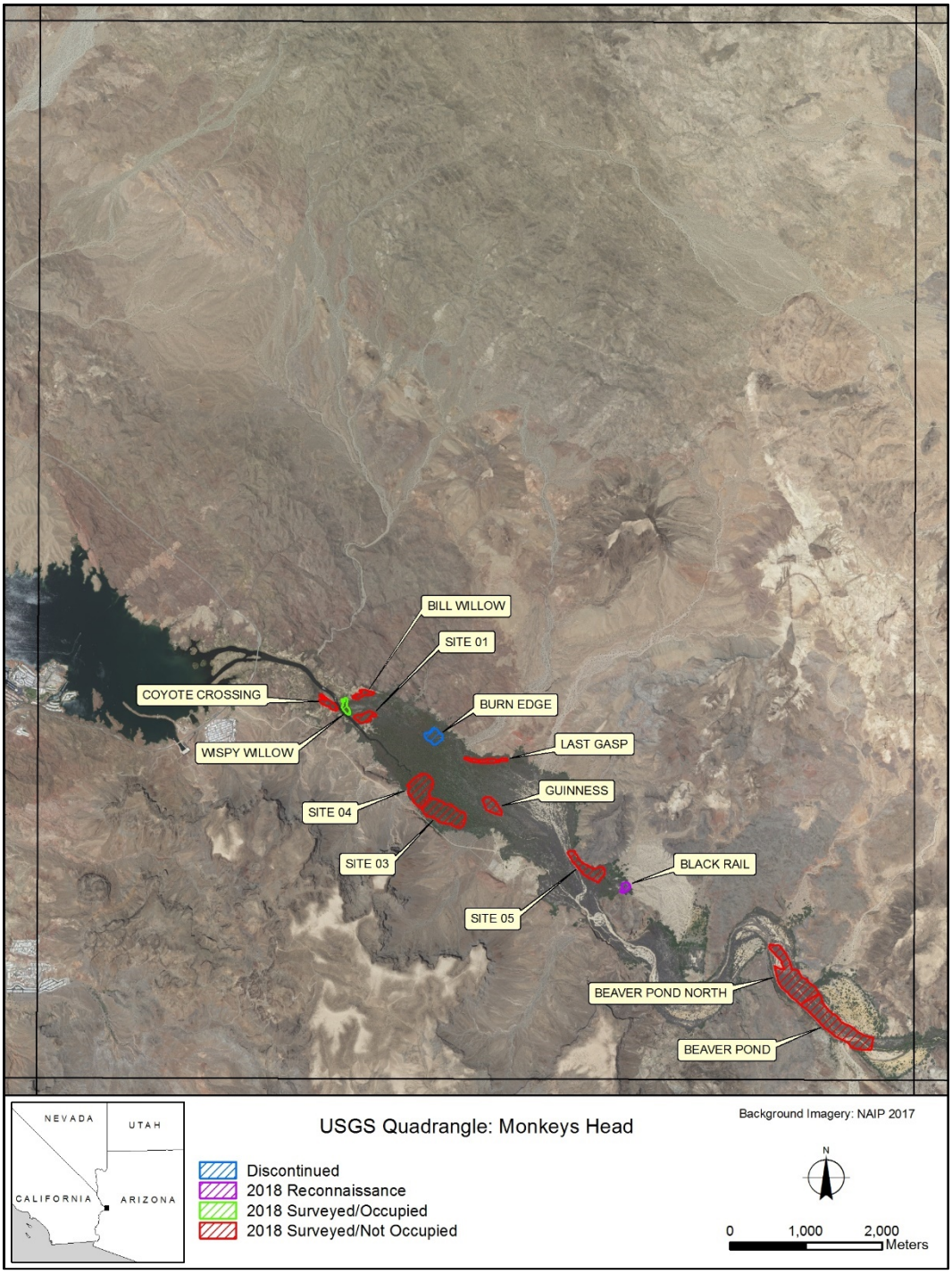
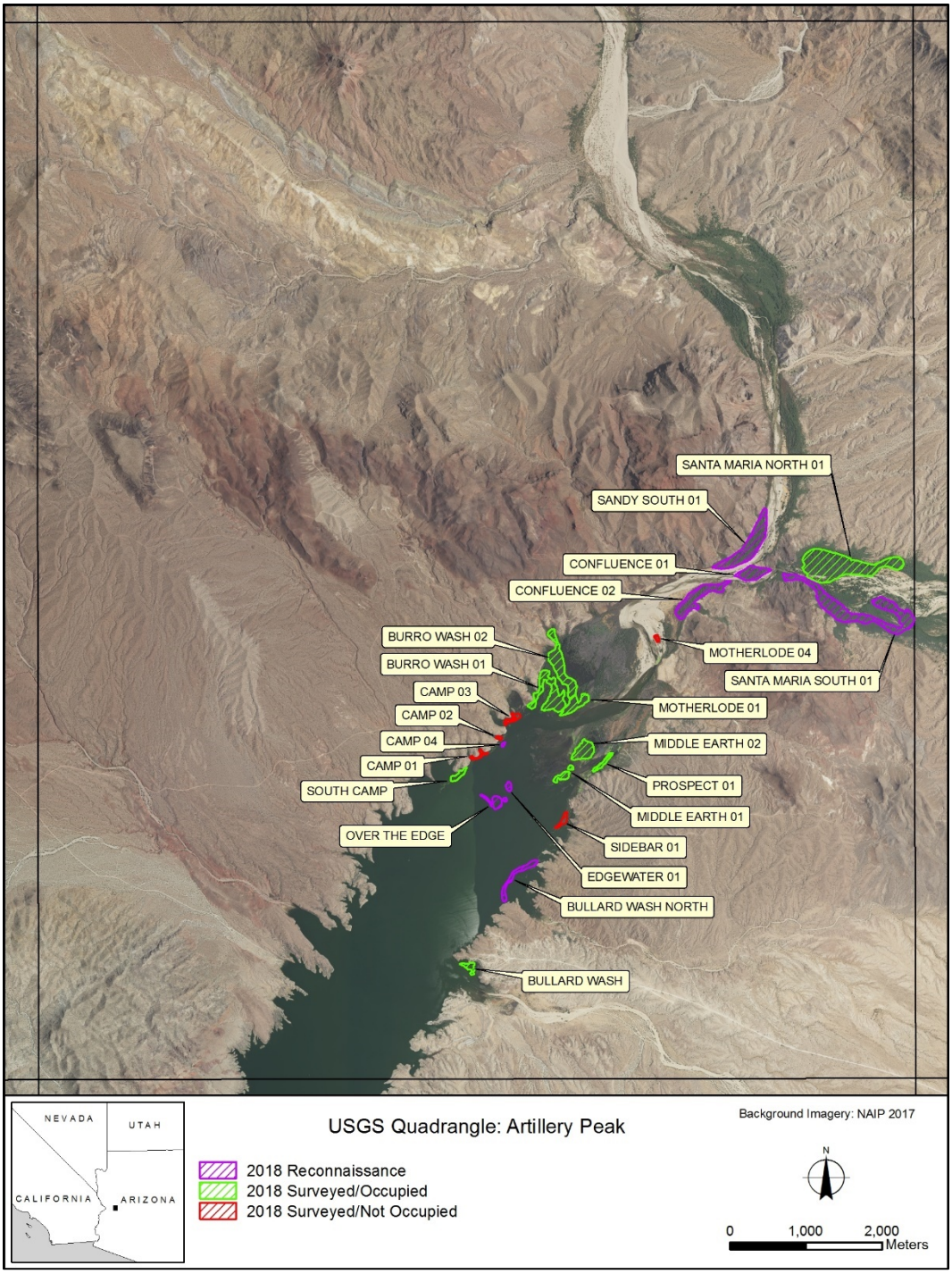
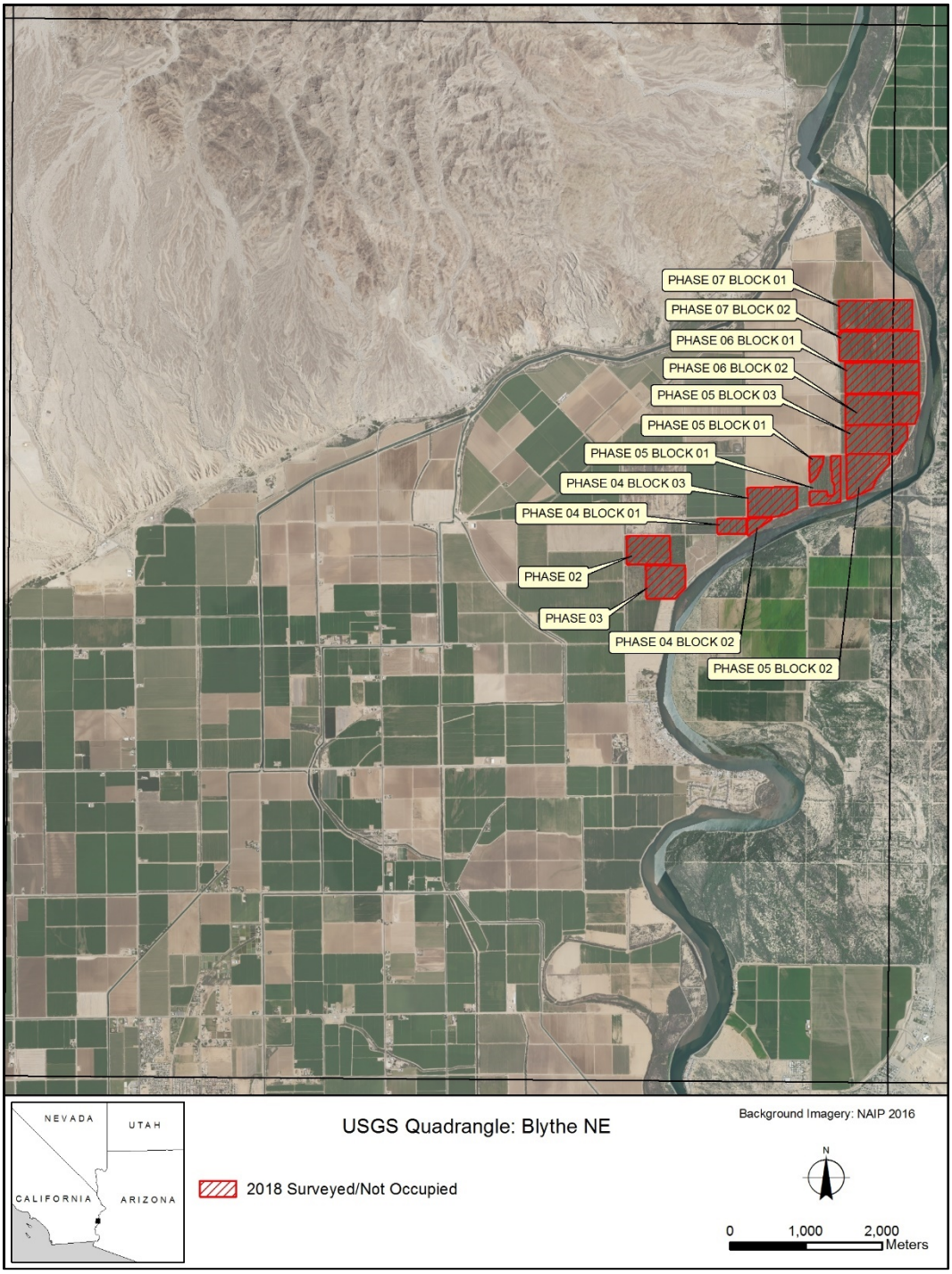
2,000
Meters

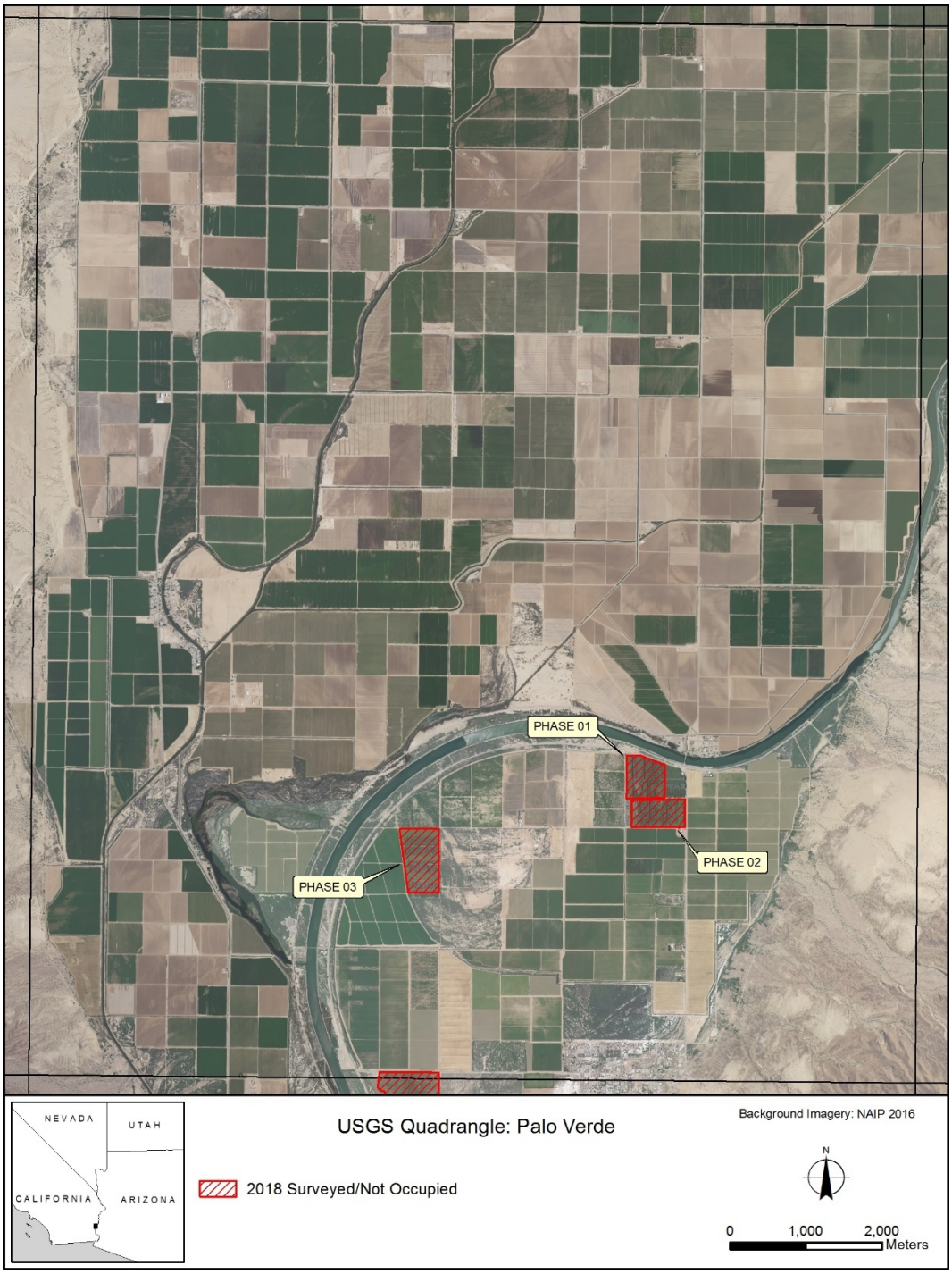

BLANKENSHIP NORTH
BLANKENSHIP SOUTH
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Castle Rock
2018 Surveyed/Not Occupied
Background Imagery: NAIP 2017
N
0
1,000
2,000
Meters

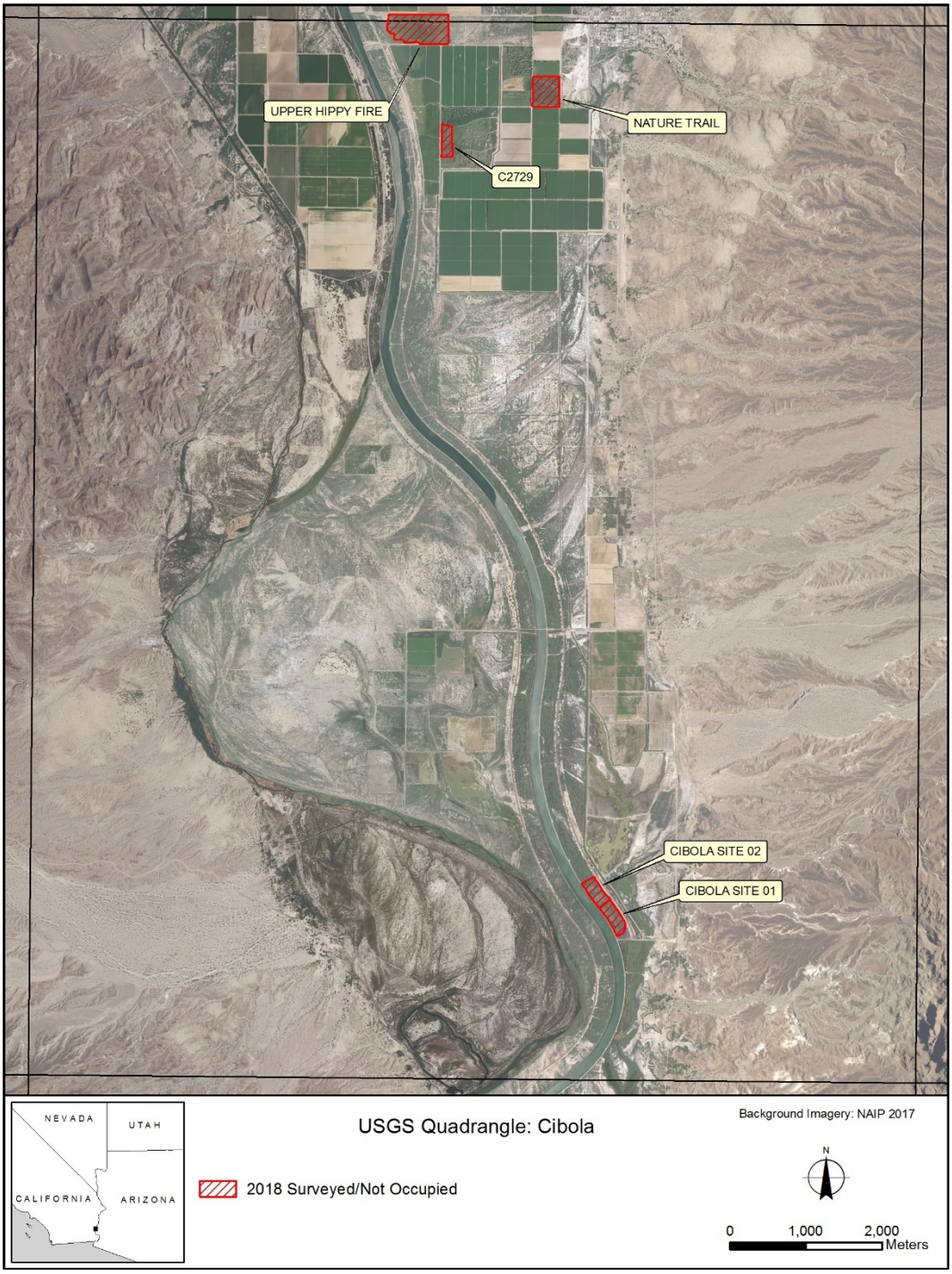

BILL WILLOW
SITE 01
COYOTE CROSSING
BURN EDGE
WISPY WILLOW
LAST GASP
GUINNESS
SITE 04
SITE 03
BLACK RAIL
SITE 05
BEAVER POND NORTH
BEAVER POND
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Monkeys Head
Background Imagery: NAIP 2017
Discontinued
2018 Reconnaissance
2018 Surveyed/Occupied
2018 Surveyed/Not Occupied
N
0
1,000
2,000
Meters

SITE 08
UPSTREAM FROM SITE 08
PLANET RANCH ROAD
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Castaneda Hills SW
Background Imagery: NAIP 2017
2018 Surveyed/Not Occupied
N
0
1,000
2,000
Meters


SANTA MARIA NORTH 01
SANDY SOUTH 01
CONFLUENCE 01
CONFLUENCE 02
BURRO WASH 02
BURRO WASH 01
MOTHERLODE 04
SANTA MARIA SOUTH 01
CAMP 03
CAMP 02
CAMP 04
CAMP 01
SOUTH CAMP
MOTHERLODE 01
MIDDLE EARTH 02
PROSPECT 01
MIDDLE EARTH 01
OVER THE EDGE
SIDEBAR 01
EDGEWATER 01
BULLARD WASH NORTH
BULLARD WASH
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Artillery Peak
2018 Reconnaissance
2018 Surveyed/Occupied
2018 Surveyed/Not Occupied
Background Imagery: NAIP 2017
N
0
1,000
2,000
Meters

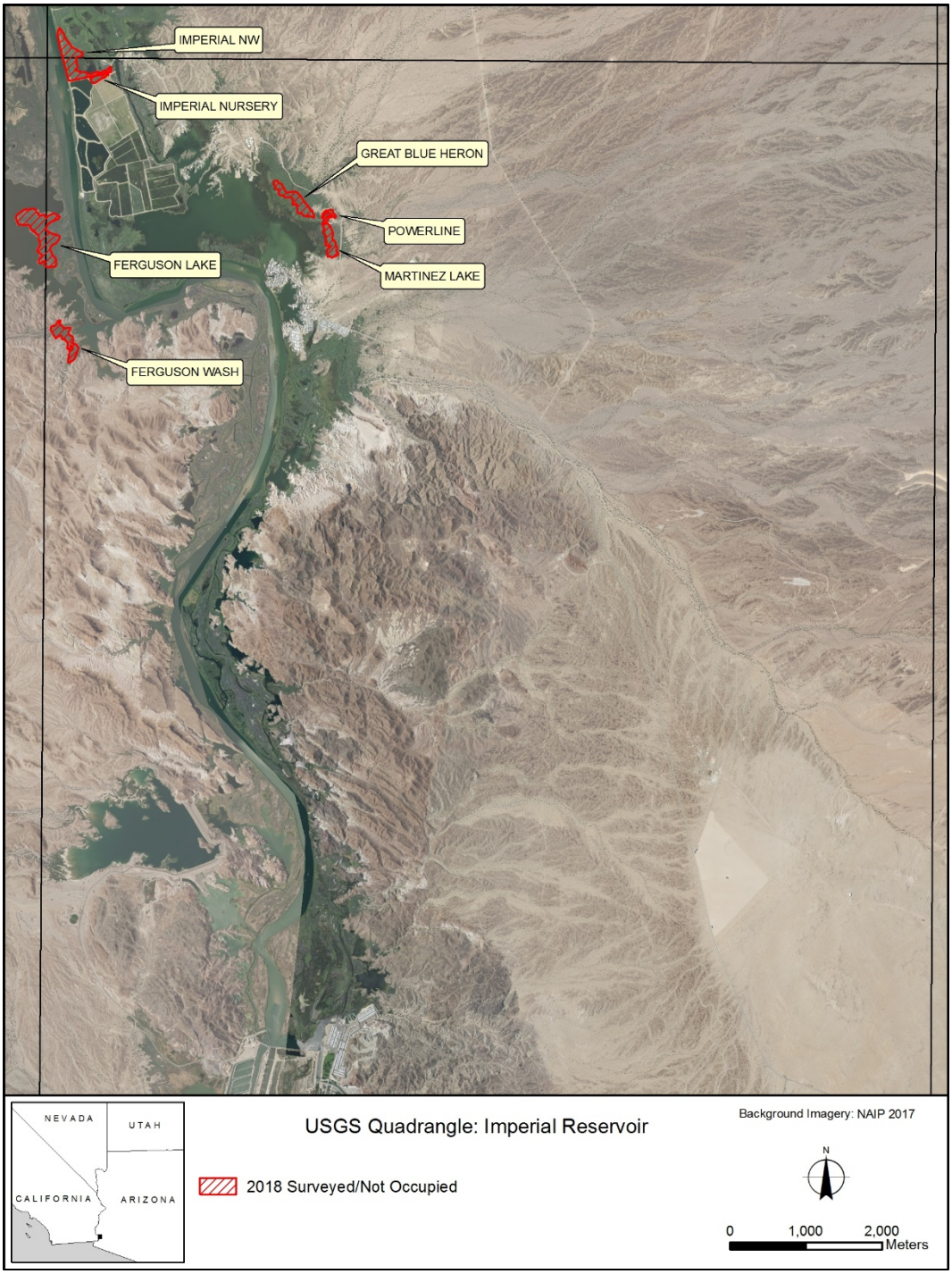

PHASE 07 BLOCK 01
PHASE 07 BLOCK 02
PHASE 06 BLOCK 01
PHASE 06 BLOCK 02
PHASE 05 BLOCK 03
PHASE 05 BLOCK 01
PHASE 05 BLOCK 01
PHASE 04 BLOCK 03
PHASE 04 BLOCK 01
PHASE 02
PHASE 03
PHASE 04 BLOCK 02
PHASE 05 BLOCK 02
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Blythe NE
2018 Surveyed/Not Occupied
Background Imagery: NAIP 2016
N
0
1,000
2,000
Meters


PHASE 01
PHASE 02
PHASE 03
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Palo Verde
2018 Surveyed/Not Occupied
Background Imagery: NAIP 2016
N
0
1,000
2,000
Meters

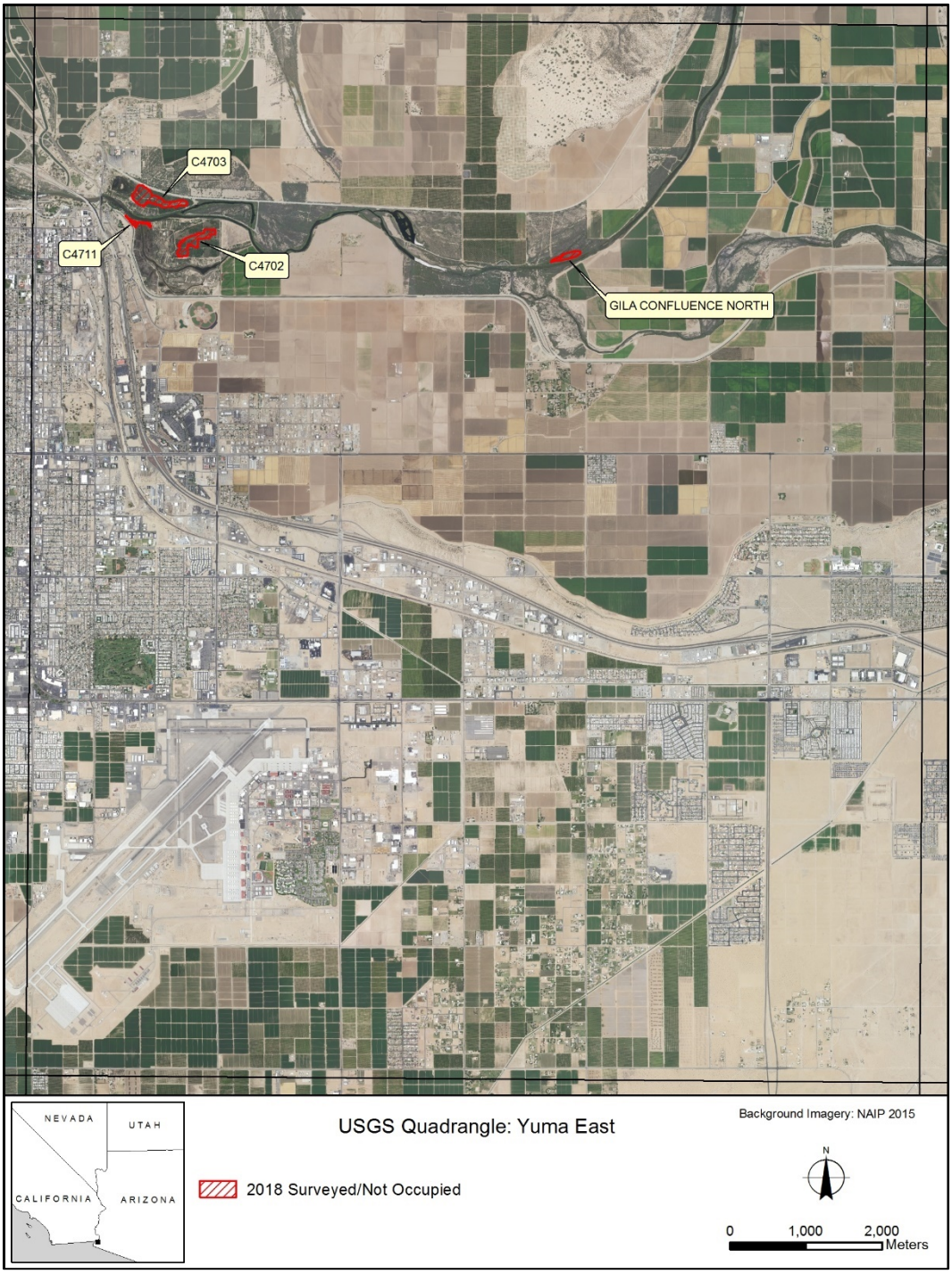

UPPER HIPPY FIRE
NATURE TRAIL
C2729
CIBOLA SITE 02
CIBOLA SITE 01
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Cibola
2018 Surveyed/Not Occupied
Background Imagery: NAIP 2017
N
0
1,000
2,000
Meters

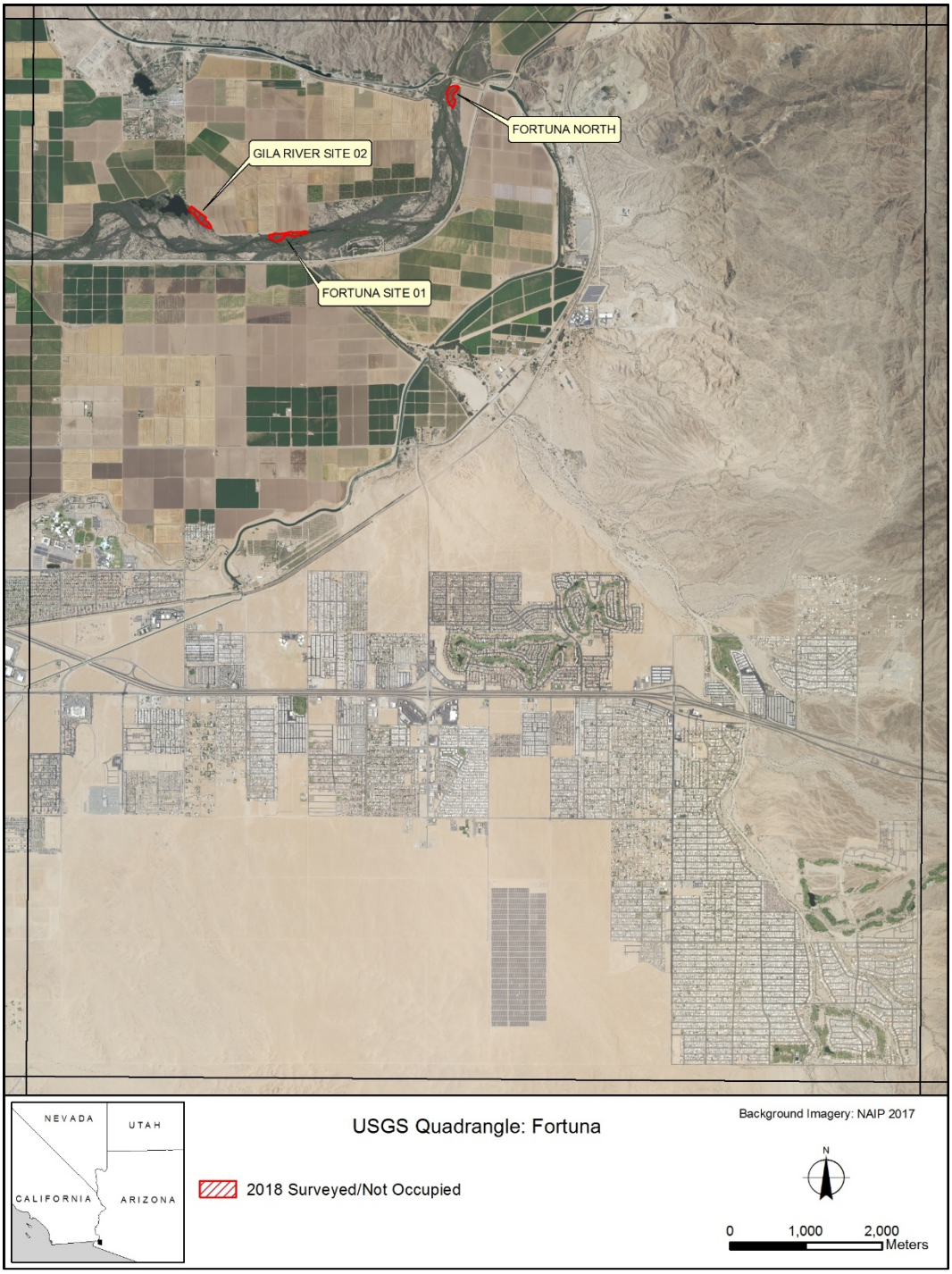
CIBOLA LAKE NORTH
CIBOLA LAKE EAST
CIBOLA LAKE WEST
WALKER LAKE
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Picacho NW
Background Imagery: NAIP 2016
Discontinued
2018 Surveyed/Not Occupied
N
0
1,000
2,000
Meters

RATTLESNAKE
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Picacho SW
2018 Surveyed/Not Occupied
Background Imagery: NAIP 2017
N
0
1,000
2,000
Meters


IMPERIAL NW
IMPERIAL NURSERY
GREAT BLUE HERON
POWERLINE
MARTINEZ LAKE
FERGUSON LAKE
FERGUSON WASH
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Imperial Reservoir
2018 Surveyed/Not Occupied
Background Imagery: NAIP 2017
N
0
1,000
2,000
Meters

MITTRY WEST
C4911
C4913
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Laguna Dam
Background Imagery: NAIP 2017
2018 Surveyed/Not Occupied
N
0
1,000
2,000
Meters


C4703
C4711
C4702
GILA CONFLUENCE NORTH
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Yuma East
2018 Surveyed/Not Occupied
Background Imagery: NAIP 2015
N
0
1,000
2,000
Meters


FORTUNA NORTH
GILA RIVER SITE 02
FORTUNA SITE 01
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Fortuna
2018 Surveyed/Not Occupied
Background Imagery: NAIP 2017
N
0
1,000
2,000
Meters

Hunter's Hole
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Gadsden
2018 Surveyed/Not Occupied
Background Imagery: NAIP 2017
N
0
1,000
2,000
Meters

ATTACHMENT 4

Southwestern Willow Flycatcher (*Empidonax traillii extimus*) Survey Dates for Lower Colorado River Multi-Species Conservation Program (LCR MSCP) Areas and Sites, 2018

Table A4-1.—Dates of presence/absence surveys for southwestern willow flycatchers, 2018

Study area	Survey site	Survey dates
Topock Marsh	The Wallows	May 15, June 3, June 16, June 28, July 15
	800M	May 21, June 2, June 16, June 28, July 4
	Swine Paradise	May 15, June 3, June 17, June 30, July 4
	Platform	May 15, June 3, June 17, June 28, July 4
	250M	May 18, June 3, June 20, June 30, July 4
	Hell Bird	May 23, June 5, June 15/17*, June 26, July 5
	Glory Hole	May 23, June 5, June 17, June 28, July 10
	Farm Ditch Road	May 15, June 2, June 17, July 4, July 10
	CPhase 05	May 18, June 4, June 15, June 28, July 15
	Lost Lake[1]	May 19
	Lost Lake Slough 01	May 24, June 2, June 20, June 28, July 15
	Lost Lake Slough 03	May 19, June 2, June 15, July 4, July 10
	Lost Lake Slough 04[1]	May 19
Topock Gorge	Blankenship North	May 21, June 16, June 21, June 29, July 16
	Blankenship South	June 16, June 21, June 29, July 16
Bill Williams	Coyote Crossing	May 19, June 12, June 19, June 29, July 11
	Bill Willow	May 19, June 1, June 16, June 29, July 3
	Wispy Willow[2]	June 2, June 19, June 27, July 3
	Site 01	May 17/29*, June 14, June 19, June 27, July 3
	Burn Edge[1]	May 29, June 5
	Site 04	May 16/17*, June 1, June 14, July 1, July 11
	Site 03	May 16/20, June 3, June 19, July 1, July 17
	Last Gasp	May 29, June 5, June 14, June 27, July 5
	Guinness	May 29, June 14, June 22, June 27, July 5
	Site 05	May 17, June 1, June 15, July 1, July 17
	Black Rail[1]	May 30
	Beaver Pond North	May 22, June 4, June 18, June 30, July 13
	Beaver Pond	May 22, June 4, June 18, June 30, July 13
	Site 08	May 30, June 6, June 13, July 2, July 12
	Upstream Site 08	May 30, June 6, June 13, July 2, July 12
	Planet Ranch Road	May 30, June 6, June 13, July 2, July 12
Alamo Lake	Bullard Wash	May 20, June 1, June 6, June 16, June 27, July 12
	South Camp[2]	May 20, June 16, July 2, July 14
	Sidebar 01	May 19, June 2, June 17, July 1, July 12
	Camp 01	May 20, June 1, June 16, June 27, July 2, July 14
	Camp 02	May 20, June 1, June 16, June 27, July 14
	Camp 03	May 20, June 1, June 16, June 27, July 14

Table A4-1.—Dates of presence/absence surveys for southwestern willow flycatchers, 2018

Study area	Survey site	Survey dates
Alamo Lake (cont.)	Middle Earth 01[2]	May 17/19*, May 30, June 4, July 12
	Middle Earth 02	May 17, May 30, June 4, June 28, July 15
	Prospect 01[3]	--
	Burro Wash 01	May 16/21*, June 2, June 13/18/19*, June 29, July 15
	Burro Wash 02[2]	June 19
	Motherlode 01	May 21, June 2, June 13, June 29, July 14
	Motherlode 04[2]	June 16, July 2, July 11
	Santa Maria South 01[1]	May 17
	Santa Maria North 01	May 23, June 5, June 14, July 1, July 16
Palo Verde Ecological Reserve	Phase 02	May 18, June 1, June 20, July 1, July 10
	Phase 03	May 18, June 1, June 19, June 25, July 1
	Phase 04 Block 01	May 17, June 7, June 12, June 18, June 30, July 11
	Phase 04 Block 02	May 17, June 7, June 12, June 18, June 30, July 11
	Phase 04 Block 03	May 17, June 5, June 19/20*, June 30, July 11
	Phase 05 Block 01	May 15, June 7, June 19, June 28, July 4
	Phase 05 Block 02	May 15, June 7, June 19, June 28, July 4
	Phase 05 Block 03	May 15/16*, June 1, June 19, June 28, July 4
	Phase 06 Block 01	May 16, June 1, June 19, June 29, July 5
	Phase 06 Block 02	May 17, June 2, June 18, June 30, July 5
	Phase 07 Block 01	May 16, June 2, June 18, June 29, July 4
	Phase 07 Block 02	May 16/17*, June 2, June 18, June 29, July 4
Cibola	Phase 01	May 29, June 7/12*, June 21, June 26, July 2
	Phase 02	May 29, June 7, June 21, June 26, July 12
	Phase 03	May 29/31*, June 12, June 20/21*, June 27, July 3
	Upper Hippy Fire	May 31, June 12, June 17, June 27, July 2
	Nature Trail	May 31, June 7, June 13, June 27, July 2
	C2729	May 18, June 7, June 13, June 27, July 2
	Cibola Site 02	June 1, June 13, June 21, July 1, July 14
	Cibola Site 01	June 1, June 13, June 21, July 1, July 14
	Cibola Lake North	May 31, June 13, June 20, June 26, July 14
	Cibola Lake East	June 1, June 13, June 20, July 1, July 14
	Cibola Lake West	May 31, June 13, June 20, June 26, July 14

Table A4-1.—Dates of presence/absence surveys for southwestern willow flycatchers, 2018

Study area	Survey site	Survey dates
Imperial	Rattlesnake	May 21, June 6, June 14, July 2, July 13
	Imperial NW	May 23, June 4, June 12, June 29, July 15
	Imperial Nursery	May 23, June 4, June 12, June 29, July 15
	Ferguson Lake	May 22, June 5, June 15, July 3, July 12
	Ferguson Wash	May 22, June 5, June 15, July 3, July 12
	Great Blue Heron	May 23, June 4, June 14, July 1, July 11
	Powerline	May 23, June 4, June 13, June 30, July 11
	Martinez Lake	May 23, June 4, June 13, June 30, July 11
Mittry Lake	Mittry West	May 21/22*, June 5, June 14, June 27, July 15
	C4911	May 21, June 5, June 14, June 27, July 15
	C4913	May 21, June 5, June 14, June 27, July 15
Yuma	C4703	May 24, June 3, June 17, June 28, July 10
	C4711	May 24, June 3, June 17, June 28, July 10
	C4702	May 24, June 3, June 17, June 29, July 10
	Gila Confluence North	May 24, June 3, June 17, June 28, July 10
	Gila River Site 02	May 19, June 6, June 15, July 3, July 14
	Fortuna Site 01	May 19, June 6, June 15, July 3, July 14
	Fortuna North	May 19, June 6, June 15, July 3, July 14
	Hunters Hole[4]	May 30, June 19, July 13

* = Part of the site was surveyed on one day and the rest on another. The two dates together constitute a complete survey of the site.

[1] Surveys were discontinued at this site because of poor habitat quality.
[2] Site completely covered via territory monitoring for a portion of the survey season; no surveys completed during monitored period.
[3] Site occupied throughout survey season; no surveys conducted.
[4] Surveyed by Reclamation.

ATTACHMENT 5

Detections of Covered Species Within Lower Colorado River Multi-Species Conservation Program (LCR MSCP) Areas and Sites, 2018

Table A5-1.—Yellow-billed cuckoo (*Coccyzus americanus occidentalis*) detections recorded outside of LCR MSCP conservation areas during southwestern willow flycatcher (*Empidonax traillii extimus*) broadcast survey and territory monitoring activities, 2018*

Study area	Survey site	Date	Behavioral observations[1]
Bill Williams	Near Guinness[2]	July 5	One individual heard (COO)
Alamo Lake	Bullard Wash	June 6	One individual heard
	Middle Earth 02	May 30	One individual seen and heard
	Burro Wash 01	June 15	Two individuals heard; one COO, one COO and CON
		June 18	Two individuals heard
		July 15	One individual heard
	Burro Wash 02	June 19	One individual heard
	Santa Maria North 01	May 31	One individual heard

* All individuals were detected passively, and no protocol surveys were conducted. These detections indicate the presence of the species in a given location but cannot be used to estimate population size or infer absence of the species in other locations.

[1] Vocalization codes follow those described in the standard yellow-billed cuckoo survey protocol. COO = coo call, and CON = contact call (kuk and kowlp notes).
[2] Detection location between Guinness and Last Gasp.

Table A5-2.—Yuma clapper rail (*Rallus longirostris yumanensis* [also known as Yuma Ridgway's rail = *R. obsoletus yumanensis*]), detections recorded outside of LCR MSCP conservation areas during southwestern willow flycatcher (*Empidonax traillii extimus*) broadcast survey and territory monitoring activities, 2018*

Study area	Survey site	Date	Behavioral observations
Topock Marsh	800M	June 7	One individual heard
		June 16	One individual heard
	Swine Paradise	May 15	Two individuals heard
	250M	June 3	One individual heard
		June 20	One individual heard
	Glory Hole	June 5	One individual heard
	Farm Ditch Road	May 23	One individual heard
		May 29	One individual seen and heard
		June 2	Two individuals heard
		June 7	One individual heard
	Lost Lake Slough #1	May 29	One individual heard
		June 17	One individual heard
	Lost Lake Slough #3	May 19	One individual heard
		May 23	Two individuals heard
	Lost Lake Slough #4	May 19	Two individuals heard (pair clatter)
	Near Lost Lake Slough #3[1]	May 31	One individual heard
		June 15	Three individuals heard
Topock Gorge	Blankenship South	July 16	One individual heard
Bill Williams	Wispy Willow	May 29	One individual heard
	Bill Williams River Delta[2]	May 29	Two individuals heard
		June 12	Three individuals heard
		June 16	One individual heard
Cibola	Cibola Lake North	May 31	One individual heard (kek-kek-kek)
	Cibola Lake East	June 1	One individual heard (kek-kek-kek)
	Cibola Lake West	June 20	Two individuals heard (kek-kek-kek)
Imperial	Powerline	May 29	One individual heard

* All individuals were detected passively, and no protocol surveys were conducted. These detections indicate the presence of the species in a given location but cannot be used to estimate population size or infer absence of the species in other locations.

[1] Detection locations east and south of Lost Lake Slough #3.
[2] Detection locations along the Bill Williams River west of Wispy Willow.

Table A5-3.—Vermilion flycatcher (*Pyrocephalus rubinus*) detections recorded outside of LCR MSCP conservation areas during southwestern willow flycatcher (*Empidonax traillii extimus*) broadcast survey and territory monitoring activities, 2018*

Study area	Survey site	Date	Behavioral observations
Alamo Lake	Camp 03	June 27	One adult and two juveniles seen and heard
	Sidebar 01	May 19	Male and female seen
		June 17	Male seen and heard
		July 1	Two individuals heard
	Middle Earth 02	May 30	One individual heard
	Burro Wash 01	May 16	One individual seen, one individual heard
		May 21	One individual seen and heard
		June 2	Male heard singing
		June 18	One individual seen and heard
	Santa Maria South 01	July 1	Two individuals seen and heard
	Santa Maria North 01	June 14	One individual seen

* All individuals were detected incidentally. These detections indicate the presence of the species in a given location but cannot be used to estimate population size or infer absence of the species in other locations.

ATTACHMENT 6

Contributing Personnel

Contributor	Role
Mary Anne McLeod, M.S.	Project Manager/Scientific Investigator/Field Supervisor
Anne Pellegrini, M.S.	Project Coordinator/Scientific Investigator/Field Supervisor
Clay Donaldson	Collector, Survey123, and ArcGIS Online Specialist
Glenn A. Dunno, M.A.	Geographic Information System Specialist
Jacque Muehlbauer	Project Administrator
Dorothy A. House, M.A.	Technical Editor
Thomas J. Koronkiewicz, M.S.	Boat Training
Guillermo Alba, M.S.	Field Coordinator
Dan Pittenger	Field Coordinator
Quick Yeates-Burghart, M.S.	Field Coordinator
Kelly Alm	Field Personnel
Neil Clark	Field Personnel
Cédric Duhalde	Field Personnel
Molly Marks	Field Personnel
Sarah Nichols	Field Personnel