Southwestern Willow Flycatcher
(Empidonax traillii extimus)

5-Year Review:
Summary and Evaluation

Photo of southwestern willow flycatcher resting in willow
Photographer: Susan Sferra, USFWS

U.S. Fish and Wildlife Service
Arizona Ecological Services
Phoenix, Arizona

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5-YEAR REVIEW

Species reviewed: Southwestern willow flycatcher (*Empidonax traillii extimus*)

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1.0 GENERAL INFORMATION

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1.2 Purpose of 5-Year Reviews:

The U.S. Fish and Wildlife Service (Service) is required by section 4(c)(2) of the Endangered Species Act (ESA) to conduct a status review of each listed species once every five years. The purpose of a 5-year review is to evaluate whether or not the species' status has changed since it was listed (or since the most recent 5-year review). Based on the 5-year review, we recommend whether the species should be removed from the list of endangered and threatened species, be changed in status from endangered to threatened, or be changed in status from threatened to endangered. Our original listing as endangered or threatened is based on the species' status considering the five threat factors described in section 4(a)(1) of the ESA. These same five factors are considered in any subsequent reclassification or delisting decisions. In the 5-year review, we consider the best available scientific and commercial data on the species, and focus on new information available since the species was listed or last reviewed. If we recommend a change in listing status based on the results of the 5-year review, we must propose to do so through a separate rule-making process including public review and comment.

1.3 Methodology used to complete the review:

The Service conducts status reviews of species on the List of Endangered and Threatened Wildlife and Plants (50 CFR 17.12) as required by section 4(c)(2)(A) of the ESA (16 U.S.C. 1531 *et seq*.). The Service provided notice of the southwestern willow flycatcher (*Empidonax traillii extimus*) (herein after referred to as the flycatcher) 5-year review via the Federal Register (FR), contacted Service species leads for information, and on May 16, 2008, sought input from over 800 knowledgeable individuals throughout the Southwest (Federal, State, Tribal, and private organizations). We received four responses to the FR notice (included in the Literature Cited section 5.0). The Arizona Game and Fish Department (AGFD) submitted their 2006 summary report on flycatcher distribution/abundance in Arizona (AZ) (Graber *et al.* 2007); ERO Resource Corp., provided information on flycatcher natural history along the Kern River, California (CA) (Copeland 2004); and the U.S. Geological Survey (USGS) provided information on flycatcher distribution in southern CA (Rourke *et al*. 2004). Sparks Law Firm, representing the San Carlos Apache Tribe and Yavapai-Apache Nation in AZ, commented on their concern for water use in AZ and New Mexico (NM) and recovery of the flycatcher. The information received helped support, clarify, or add to existing known information about the flycatcher. Although the review period for this document was from 2003 to 2008, we present information available through the 2012 field season.

This review was prepared by Gregory L. Beatty, Fish and Wildlife Biologist, at the AZ Ecological Services Office (AESO) (602/242-0210 x247). It was reviewed by scientific staff at the Service's Region 2 Regional Office; cooperating Service offices within the range of the subspecies in the divisions of Ecological Services, Migratory Birds, and National Wildlife Refuges System; USGS; AGFD; and 28 Native American Tribes within the flycatcher's breeding range in CA, AZ, NM, and Colorado (CO). Responses to the FR notice and comments on the draft review are on file in the AESO.

In addition to information provided by individuals and agencies, we examined our files for recent survey information, research results, habitat management, literature, and conservation actions not reflected in the most recent Southwestern Willow Flycatcher Recovery Plan (Recovery Plan) (USFWS 2002). These documents are cited herein and copies are maintained at the AESO.

Since completion of the Recovery Plan (USFWS 2002), there is new information that refines our understanding of the flycatcher's breeding distribution, abundance, and other aspects of its natural history, but no previously unknown biological information that changes our basic understanding. There is clarification on issues relating to flycatcher demographics, movements, and colonization of sites through long-term studies conducted in AZ, Nevada (NV), Utah (UT), CA, and NM by USGS (Paxton *et al*. 2007a), AGFD (Ellis *et al*. 2008), and SWCA Inc. (under contract with U.S. Bureau of Reclamation [USBR]) (MacLeod *et al*. 2008a, 2008b, 2009). USGS (Paxton 2000, Paxton *et al.* 2007b) published information about genetics and the northern boundary of the subspecies across CO, UT, and NM. We have new information about threats to flycatcher habitat from introduced biocontrol tamarisk (also known as saltcedar) leaf beetles

(beetles) (*Diorahbda carninulata*, formerly known as *D. elongata.*) and predictions about future water availability and impacts from climate change. We also have challenges maintaining comprehensive and up-to-date flycatcher statewide/rangewide databases and reporting. In reaching the recommendations resulting from this five-year review, our discussion focuses primarily on flycatcher conservation and recovery issues since completion of the Recovery Plan.

1.4 Background

1.4.1 FR Notice citation announcing initiation of this review:

Vol. 73 FR 14995-14997

1.4.2 Listing history:

Original Listing
FR notice: Vol. 60 FR 10694-10715
Date listed: February 27, 1995
Entity listed: Subspecies
Classification: Endangered

1.4.3 Associated rulemakings:

Critical Habitat: Vol. 62 FR 39129-39147, July 22, 1997 (USFWS 1997a); Vol. 70 FR 60886-61009, October 19, 2005 (USFWS 2005)
Correction Notice Critical Habitat: Vol. 62 FR 44228, August 20, 1997 (USFWS 1997b)
Current Final Critical Habitat: Vol. 78 FR 344-534, January 3, 2013 (USFWS 2013a)

1.4.4 Review History:

No previous 5-year status reviews have been conducted. Status of the flycatcher has been summarized for the 2002 Recovery Plan, biological opinions, habitat conservation planning activities, and annual internal assessments, but these do not constitute a formal status review under section 4(c)(2)(A) of the ESA.

1.4.5 Species' Recovery Priority Number at start of 5-year review: 3C

Species are assigned priority numbers ranging from 1 – 18 based upon degree of threats, recovery potential, and taxonomic distinctiveness (48 FR 43098). A 3C indicates the threats to the species are high, the recovery potential is high, the "species" listed under the ESA is taxonomically classified as a subspecies, and conflict with economic development is possible.

1.4.6 Recovery Plan: Final Recovery Plan for the Southwestern Willow Flycatcher (*Empidonax traillii extimus*).

Date issued: August 30, 2002

2.0 REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment (DPS) policy

2.1.1 Is the species under review a vertebrate? Yes.

2.1.2 Is the species under review listed as a DPS? No.

2.1.3 Is there relevant new information for this species regarding the application of the DPS policy? No.

The southwestern willow flycatcher is not listed as a DPS, but is one of four recognized subspecies of the willow flycatcher (Hubbard 1987, Unit 1987) and is classified as endangered under the ESA. A potential fifth subspecies may breed in the central and midwestern United States (Browning 1993).

2.2 Recovery Criteria

2.2.1 Does the species have a final, approved recovery plan[1]? Yes.

2.2.1.1 Does the recovery plan contain objective, measurable criteria? Yes.

2.2.2 Adequacy of recovery criteria

2.2.2.1 Do the recovery criteria reflect the best available and most up-to date information on the biology of the species and its habitat? Yes.

2.2.2.2 Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria (and is there no new information to consider regarding existing or new threats)? Yes.

All the relevant listing factors are considered in the recovery criteria. The tamarisk leaf beetle is mentioned in the Recovery Plan and strategies to manage for possible effects are described (not in response to the beetle itself, but in the form of habitat management). Also, the identification of climate change and potential impact is not specified in the Recovery Plan, but the impact of loss of suitable habitat through water regulation/management and measures to offset those effects are addressed. This does not diminish the adequacy of the recovery criteria; the recovery criteria still address the abundance, distribution, quality, and

[1] Although the guidance generally directs the reviewer to consider criteria from final approved recovery plans, criteria in published draft recovery plans may be considered at the reviewer's discretion.

protection of habitat. The leaf beetle and climate change are discussed below in section 2.3.1 Biology and Habitat – 2.3.1.7 Other.

2.2.3 List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information:

The 2002 Flycatcher Recovery Plan includes objective and measurable criteria (USFWS 2002, p. 77-85). The overall recovery objective for the endangered flycatcher is to attain a population level and an amount, quality, and distribution of habitat sufficient to provide for the long-term persistence of metapopulations, even in the face of local losses (e.g. extirpation).

Downlisting Criteria - *Reclassification from Endangered to Threatened*
There are two alternative sets of criteria to help determine when to reclassify the flycatcher from endangered to threatened (USFWS 2002, p. 77-78). Neither set of criteria equates to achieving approximate, historical, pre-European settlement population levels.

Criteria Set A: Increase the total known population to a minimum of 1,950 territories (equating to approximately 3,900 individuals), geographically distributed to allow proper functioning as metapopulations, so that the flycatcher is no longer in danger of extinction. For reclassification to threatened status, these prescribed numbers and distributions must be reached as a minimum, and maintained over a five-year period.

Across all or portions of seven states, the breeding range of the flycatcher is separated into six large Recovery Units (defined by large watershed and hydrologic units) (Figure 1). Within these large Recovery Units are 32 smaller Management Units, defined by watershed and major drainage boundaries (Table 1) (USFWS 2002, p. 61-65).

To meet the conditions for Criteria Set A, each Management Unit must meet and hold at least 80 percent (%) of its minimum population target, yet each Recovery Unit must at least meet its goal. Therefore, if one Management Unit targeted for 50 territories reaches 40 territories, its shortage of 10 territories may be offset by an overage of 10 territories in another Management Unit within that same Recovery Unit. This flexibility is based on the fact that the recovery goals specified for each Management Unit are estimations of the number needed and that small departures from those specific goals are not biologically significant and therefore will not likely imperil the flycatcher - as long as the overall Recovery Unit and range-wide goals are met.

Criteria Set B: Increase the total known population to a minimum of 1,500 territories (equating to approximately 3,000 individuals), geographically distributed among Management Units and Recovery Units so that the flycatcher is no longer in danger of extinction. For reclassification to threatened status, these prescribed numbers and distributions must be reached as a minimum and maintained over a three-year period, and the habitats supporting these flycatchers must be protected from threats and loss.

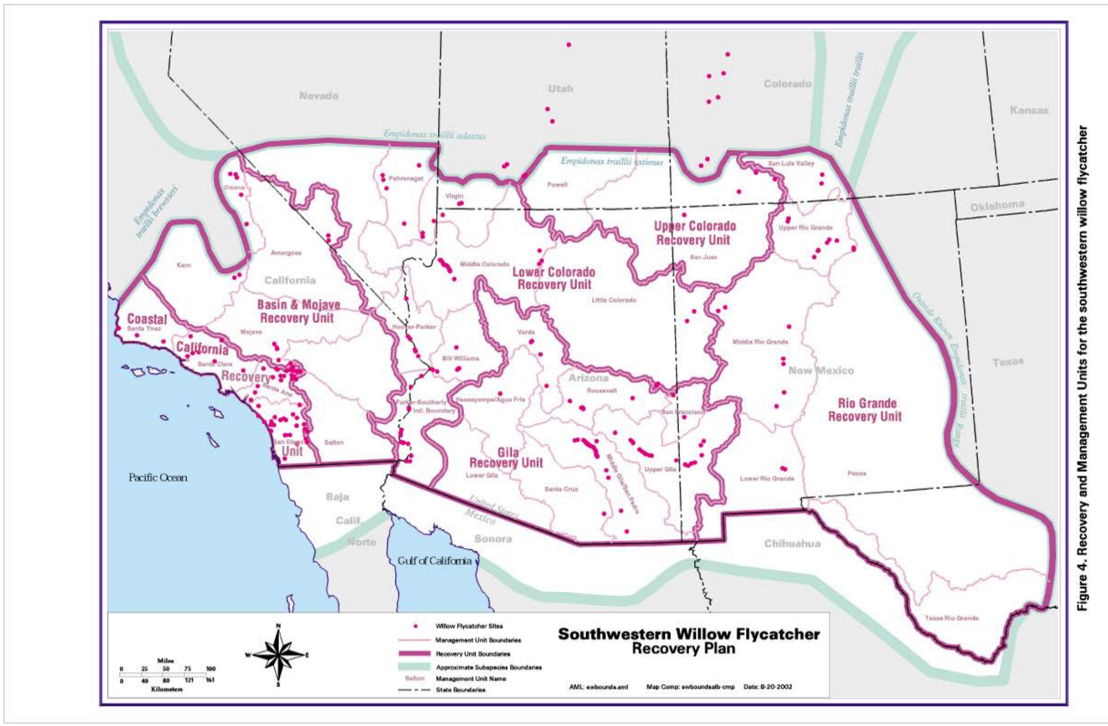

Figure 1. Southwestern willow flycatcher recovery and management units and known breeding sites (2002) (USFWS 2002, figure 4)

To meet Criteria Set B, each Management Unit must meet and hold at least 50% of its minimum population target, and each Recovery Unit must meet at least 75% of its goal. For Recovery Units to attain 75% of their population goal, some Management Units within each Recovery Unit will need to exceed 50% of their goals. Similarly, in order to meet the range-wide goal of 1,500 territories, some Recovery Units will need to exceed 75% of their goals.

The habitats supporting these flycatchers must be sufficiently protected from threats to assure maintenance of these habitats over time. Protection must be assured into the foreseeable future through development and implementation of conservation management agreements. Conservation management agreements may take many forms, including but not limited to the public land management planning process for Federal lands, habitat conservation plans (under Section 10 of the ESA), conservation easements, land acquisition agreements for private lands, and inter-governmental conservation agreements with Tribes. The Service must determine that the agreements provide adequate protection and/or enhancement of habitat.

By providing two sets of criteria, the Service recognizes the need to allow flexibility in achieving and maintaining recovery goals to accommodate management logistics, differing jurisdictions, natural stochastic events, and local variances in habitat quality and potential. Both criteria provide for substantial progress toward attaining a population level and an amount and distribution of habitat sufficient to provide for the long-term persistence of metapopulations. This flexibility is most effectively achieved at the Management Unit level. Therefore, numerical population goals for a particular Management Unit can be attained anywhere within that unit. This flexibility is intended to allow local managers to apply their knowledge to meet goals, possibly in areas the Service cannot identify and/or may not foresee. For example, local managers may know of areas that are logistically and/or biologically easier to recover than others. Managers should not focus recovery efforts only at the sites identified; for example, tributary stream reaches can and should be considered for recovery efforts. This is why the goals are generally specified only down to the Management Unit level. However, the Technical Subgroup of the Recovery Team highlighted some specific reaches where potential or suitable habitat exist, and/or where greater metapopulation stability can be achieved by establishing or enhancing populations in these areas (USFWS 2002, p. 86-92, Table 10).

Note that, under either criteria set, any additional flycatchers above the minimum needed within a Recovery or Management Unit are not "excess," and are deserving of (and require) the full protection afforded to all southwestern willow flycatchers until the flycatcher is delisted. Population levels above the minimum targets can provide for an important hedge against local catastrophic events, and are potential colonizers to other units.

Delisting Criteria *- Removal from the Federal Endangered Species List*
The following criteria must be achieved to remove the flycatcher from the Federal list of threatened and endangered species (USFWS 2002, p. 79-81):

1. Meet and maintain, at a minimum, the population levels and geographic distribution specified under reclassification to threatened Criteria Set A; increase the total known population to a minimum of 1,950 territories (equating to approximately 3,900 individuals), geographically distributed to allow proper functioning as metapopulations.

2. Provide protection from threats and create/secure sufficient habitat to assure maintenance of these populations and/or habitats over time. The sites containing flycatcher breeding groups, in sufficient number and distribution to warrant downlisting, must be protected into the foreseeable future through development and implementation of conservation management agreements. Conservation management agreements may take many forms, including but not limited to the public land management planning process for Federal lands, habitat conservation plans (under Section 10 of the ESA), conservation easements, and private land acquisition agreements, and inter-governmental conservation

agreements with Tribes. The flycatcher may be considered for delisting when (a) the Service has confirmed that the agreements have been created and executed in such a way as to achieve their role in flycatcher recovery, and (b) the individual agreements for all areas within all Management Units (public, private, and Tribal) that are critical to metapopulation stability (including suitable, unoccupied habitat) have demonstrated their effectiveness for a period of at least five years prior to delisting.

The current distribution of flycatcher breeding populations includes public, private, and Tribal lands in six of the seven States comprising its historical range (it has not been currently detected breeding in Texas). Given the dynamic nature of rivers, where ecological processes vary both spatially and temporally, coupled with the complex nature of land management and ownership along river corridors, a recovery strategy that relies solely on public lands is impractical and improbable. To achieve and maintain recovery, it is likely that a network of conservation on Federal, State, Tribal, and other public and private lands will be necessary. To ensure that the population and habitat enhancement achieved for downlisting persist over the long-term, and to preclude the need for future re-listing of the flycatcher under the ESA, the management agreements must address the following:

1. Minimize the major stressors to the flycatcher and its habitat (including but not limited to floodplain and watershed management, groundwater and surface water management, and livestock management);
2. Ensure that natural ecological processes and/or active human manipulation needed to develop and maintain suitable habitat prevail in areas critical to achieving metapopulation stability; and
3. The amount of suitable breeding habitat available within each Management Unit is at least double the amount required to support the target number of flycatchers described under reclassification to threatened Criteria Set A.

It is important to recognize that most flycatcher breeding habitats are susceptible to future changes in site hydrology (natural or human-related), human impacts such as development or fire, and natural catastrophic events such as flood or drought. Furthermore, as the vegetation at sites matures, it can lose the structural characteristics that make it suitable for breeding flycatchers. These and other factors can destroy or degrade breeding sites, such that one cannot expect any given breeding site to remain suitable in perpetuity. A breeding site is defined as a variably delimited geographic location, the limits of which may include elements of habitat, land ownership, and practicality. A breeding site may be delimited by habitat, that is, an entire patch of riparian vegetation, or it may be a subdivision of a riparian patch delimited by land ownership and/or the ability to survey effectively. A “site” may encompass a discrete breeding location, or several (USFWS 2002, p. C-4). Thus, the Service believes that long-term persistence of flycatcher populations cannot be assured by protecting only those habitats in which flycatchers currently breed. Rather, it is necessary to have additional suitable habitat available to which flycatchers, displaced by such habitat loss or change, can readily move.

The amount of additional habitat needed may vary in each Management Unit, based on local and regional factors that could affect the rate of occupied habitat loss and change. Until such time as these factors can be better quantified, the Service believes that conserving double the amount of breeding habitat needed to support the target number of flycatchers within each Management Unit assures that displaced flycatchers will have habitats in which to settle, given even a catastrophic level of local habitat loss. Based on a range-wide review of riparian patch sizes and southwestern willow flycatcher population sizes presented in published and unpublished literature, a patch has an average of 1.1 hectares (ha) (2.7 acres [ac]) (±0.1 SE) of dense, riparian vegetation for each flycatcher territory found within the patch. Therefore, delisting would require that twice this amount of breeding habitat (i.e., 2.2 ha or 5.4 ac) be protected for each flycatcher territory that is part of the recovery goal within a Management Unit. For example, a Management Unit with a recovery goal of 50 territories would need to assure the protection of 110 ha/272 ac (50 territories x 1.1 ha [or 2.7 ac for each territory] x 2) of suitable habitat. This total amount of available and protected breeding habitat includes: (a) habitat occupied by flycatchers meeting the population target (50 territories), (b) flycatchers in excess of the population target, and (c) suitable but unoccupied habitat.

The factor of 2.2 ha (5.4 ac) of breeding habitat per flycatcher territory can be modified based on more local data on patch sizes and population numbers. For example, if the average amount of dense, riparian vegetation per flycatcher territory was higher or lower for a given Management Unit, the amount of breeding habitat required to meet delisting criteria within that unit would change accordingly. Suitable habitat conditions at a site may be maintained over time through natural processes and/or active human manipulation.

Habitat objectives are incorporated in the delisting criteria because of the importance of providing replacement habitat for dispersing flycatchers after natural stochastic destruction of existing breeding habitat, and suitable habitat for future population growth. Essential to the survival and recovery of the flycatcher is a minimum size, distribution, and spatial proximity of habitat patches that promotes metapopulation stability. The current size of occupied habitat patches is skewed heavily toward small patches and small population sizes; this situation inhibits recovery. Following the central points identified above, recovery will be enhanced by increasing the number of larger populations and by having populations distributed close enough to increase the probability of successful immigration by dispersing flycatchers. For example, decreasing the proportion of small breeding groups can be achieved by striving for a minimum patch size that supports 10 or more territories. Available data indicate that current populations with 10 or more territories occupy patches with a mean size of 24.9 ha (61.5 ac).

Alternatively, along the lower San Pedro River and nearby Gila River confluence in AZ, smaller, occupied habitat patches show substantial between-patch movement by flycatchers and function effectively as a single site. Thus, to promote recovery, land managers and other conservation entities should strive to protect larger habitat patches (on the order of 25 ha [62 ac]) within Management Units and/or to minimize the distance between smaller occupied patches so that they function ecologically as a larger patch.

2.3 Analysis of whether downlisting criteria have been met:

Downlisting (or delisting) criteria established in the Recovery Plan have not been met. The most current estimated number of rangewide flycatcher territories is 1,299 (Durst *et al.* 2008, p.12-13), which is less than the minimum 1,500 territories needed for downlisting and 1,950 for delisting (USFWS 2002, p.84-85). The 1,299 territories are also not geographically distributed appropriately to meet downlisting or delisting criteria (Table 1), and therefore, habitat-related goals have not been met, nor have all necessary accompanying conservation/management plans been completed.

Updated Information and Current Species Status

2.3.1 Biology and Habitat

The flycatcher is a small, insect-eating (USFWS 2002, p. 26), Neotropical migrant bird. Adults are about 15 centimeters (5.8 inches) in length. It has a grayish-green back and wings, light grey-olive breast, and pale yellowish body (USFWS 2002, p. 4). Its song is a sneezy, “fitz-bew” and its call a repeated “whit” (USFWS 2002, p. 4). Although males are the primary singers, females also sing occasionally (USFWS 2002, p. 4). It eats a wide range of invertebrate prey including flying, and ground- and vegetation-dwelling, insect species of terrestrial and aquatic origins (Drost *et al.* 2003, pp. 96–102).

The known geographical area historically occupied by both migrating and breeding flycatchers includes southern CA, southern NV, southern UT, southern CO, AZ, NM, western TX, and extreme northwestern Mexico (Hubbard 1987, pp. 6–10; Unitt 1987, pp. 144–152; Browning 1993, pp. 248, 250). The flycatcher’s current breeding range is similar to the historical range, but the quantity of suitable habitat within that range is reduced from historical levels (USFWS 2002, pp. 7–10). Flycatchers nest within the southwestern United States from about May to September (Sogge *et al.* 2010, p. 11).

All willow flycatcher subspecies spend time migrating in the United States from April to June and from July through September. Willow flycatchers, like most small, migratory, insect-eating birds require food-rich stopover areas in order to replenish energy reserves and continue their northward or southward migration (Finch *et al.* 2000, pp. 71, 78, and 79; USFWS 2002, pp. E-3, 42). Migration stopover areas are likely critically important for flycatcher productivity and survival (Sogge *et al.* 1997a, p. 13; Yong and Finch 1997, p. 253; USFWS 2002, pp. E-3,19). The flycatcher spends the winter in locations such as southern Mexico, Central America, and probably South America (Ridgely and Gwynne

1989, p. 303; Stiles and Skutch 1989, pp. 321–322; Howell and Webb 1995, pp. 496–497; Unitt 1997, pp. 70–73; Koronkiewicz *et al.* 1998, p. 12; Unitt 1999, p. 14). The Pacific lowlands of Costa Rica appear to be a key winter location for the southwestern willow flycatcher, although other countries in Central America may also be important for the subspecies (Paxton *et al*. 2011a, p. 608).

The flycatcher currently breeds in areas from near sea level to over 2,600 meters (m) (8,500 feet [ft]) (Durst *et al.* 2008, p. 14) in vegetation alongside rivers, streams, or other wetlands (riparian habitat). It establishes nesting territories, builds nests, and forages where mosaics of relatively dense and expansive growths of trees and shrubs are established, generally near or adjacent to surface water or underlain by saturated soil (Sogge *et al.* 2010, p. 4). Habitat characteristics such as dominant plant species, size and shape of habitat patch, tree canopy structure, vegetation height, and vegetation density vary widely among breeding sites. Nests are typically placed in trees where the plant growth is most dense, where trees and shrubs have vegetation near ground level, and where there is a low-density canopy. Some of the more common tree and shrub species currently known to comprise nesting habitat include Gooddings willow (*Salix gooddingii*), coyote willow (*S. exigua*), Geyer's willow (*S. geyeriana*), arroyo willow (*S. lasiolepis*), red willow (*S. laevigata*), yewleaf willow (*S. taxifolia*), boxelder (*Acer negundo*), tamarisk (also known as saltcedar, *Tamarix ramosissima*), and Russian olive (*Elaeagnus angustifolia*) (USFWS 2002, p. D-2). While there are exceptions, generally flycatchers are not found nesting in areas without willows, tamarisk, or both.

Flycatchers are believed to exist and interact as groups of metapopulations (USFWS 2002, p. 72). A metapopulation is a group of geographically separate flycatcher breeding populations connected to each other by immigration and emigration (USFWS 2002, p. 72). Flycatcher metapopulations are most stable where many connected sites or large populations exist (USFWS 2002, p. 72).

Flycatchers have higher site fidelity (to a local area) than nest fidelity (to a specific nest location) and can move among sites within stream drainages and between drainages (Kenwood and Paxton 2001, pp. 29–31). Within-drainage movements are more common than between-drainage movements (Kenwood and Paxton 2001, p. 18).

Table 1. The estimated number of known range-wide flycatcher breeding sites/territories and number of territories necessary for recovery criteria, by Recovery Unit and Management Unit as of 2007 (Durst *et al.* 2008, p.12-13).				
Recovery Unit	**Management Unit**	**# of Sites**	**# of Territories**	**Recovery Criteria (# of territories)**
Basin and Mojave	Owens	5	28	50
	Kern	2	14	75
	Amargosa	3	1	25
	Mojave	7	4	25
	Salton	1	4	25
	TOTAL	***18***	***51***	***200***
Coastal California	Santa Ynez	4	7	75
	Santa Clara	12	8	25
	Santa Ana	33	28	50
	San Diego	24	77	125
	TOTAL	***73***	***120***	***275***
Gila	Verde	7	14	50
	Hassayampa - Agua Fria	2	1	25
	Roosevelt	7	75	50
	San Francisco	4	7	25
	Upper Gila	22	329	325
	Gila – San Pedro	46	233	150
	Santa Cruz	1	0	25
	TOTAL	***89***	***659***	***650***
Lower Colorado	Pahranagat	6	40	50
	Virgin	7	43	100
	Little Colorado	5	9	50
	Middle Colorado	20	4	25
	Hoover - Parker	6	14	50
	Bill Williams	9	39	100
	Parker – S. Intl Boundary	16	1	150
	TOTAL	***70***	***150***	***525***
Rio Grande	San Luis Valley	7	56	50
	Upper Rio Grande	16	21	75
	Middle Rio Grande	8	230	100
	Lower Rio Grande	3	2	25
	TOTAL	***34***	***309***	***250***
Upper Colorado River	San Juan	5	10	25
	Powell	0	0	25
	TOTAL	***5***	***10***	***50***
TOTAL		**288**	**1299**	***1950***

2.3.1.1 New information on the species' biology and life history:

The USGS (Paxton *et al.* 2007a) and AGFD (Ellis *et al.* 2008) (both under contracts with the USBR as a result of section 7 consultation under the ESA on the raising of Roosevelt Dam in AZ) completed 10-year studies on nesting flycatchers in AZ, with an emphasis on central and southern AZ along the Salt, San Pedro, and Gila rivers, Tonto Creek, and Roosevelt Lake (confluence of Salt River and Tonto Creek). Similarly, USBR continues to help conduct/fund long-term flycatcher monitoring along the Lower Colorado River (McLeod *et al*. 2008a, 2008b, McLeod and Koronkiewicz 2009, 2010; McLeod and Pelligrini

2011, 2012) and its major tributaries through the Multi-Species Conservation Plan (MSCP), as well as monitoring along the Middle Gila River in AZ (Graber and Koronkiewicz 2009, 2010), and Middle Rio Grande in NM (Moore and Ahlers 2006, 2007, 2008, 2009, 2010, 2011, 2012).

Since completion of the Recovery Plan, these long-term studies and monitoring have been the primary sources of special reports and publications about flycatcher natural history and management. These studies built upon the basic knowledge of the flycatcher and some of the initial work completed (i.e. Finch and Stoleson 2000) by improving our understanding and providing new information about flycatcher survivorship, reproductive success movements, and habitat use (see descriptions below in the appropriate section). Other flycatcher reports have been posted on the flycatcher specific web site maintained by USGS (2014).

Findings from ongoing or future flycatcher-related studies could provide new information on how altered dam operations can improve habitat and affect flycatcher demographics, and possibly clarify the subspecies' boundary and enhance habitat management techniques. The Army Corps of Engineers (ACOE) and a collection of other agencies are investigating how to operate Alamo Dam to improve habitat conditions for riparian habitat along the Bill Williams River and at Alamo Lake in central western AZ (Shafroth *et al*. 2010a, p. 5). Also, the efforts of the partners associated with the Lower Colorado River MSCP, combined with possible future efforts to counter anticipated effects from the leaf beetle in AZ, NM, NV, and UT may enhance our understanding of effective habitat/river management techniques for the flycatcher. Further investigation into flycatcher subspecies genetics along the northern portion of its range in UT, CO, and NM may help to more accurately define this area for flycatcher management and recovery.

Satellite imagery combined with associated predictive modeling techniques are being explored to assess suitability of flycatcher nesting habitat (Hatten and Paradzick 2003, Hatten and Sogge 2007) and evaluate habitat changes associated with the leaf beetle (Dennison *et al.* 2009). In 2002, AGFD applied the GIS-based model throughout AZ, for riparian areas below 1,524 m (5,000 ft) elevation and within 1.6 km of perennial or intermittent waters (Dockens and Paradzick 2004). Overall model accuracy (using probability classes 1-5, with class 5 having the greatest probability of nesting activity) for predicting the location of 2001 nest sites was 96.5%; accuracy decreased when fewer probability classes were defined as suitable. Based upon the model's robust performances in AZ, Hatten and Sogge (2007) believed that the model could be tested outside of AZ along the Rio Grande in NM where a large flycatcher breeding population occurs. Even though the GIS-based model was developed based on flycatcher habitat and nest location data from AZ (Hatten and Paradzick 2003), the model performed as expected along the Rio Grande. Thus, the GIS-based model can be a useful tool to managers in NM for identifying possible flycatcher breeding habitats, prioritizing survey efforts, identifying potential habitat improvement areas and monitoring riparian habitat changes over time. In addition, Dennison *et al*. (2009) identified that there were challenges to detection and monitoring of tamarisk defoliation including spectral mixing of tamarisk and other cover types at subpixel spatial resolution, spatial co-registration of time series images, the timing of image acquisition, and changes unrelated to defoliation in non-tamarisk land cover over time. They recommended continued development of the techniques presented in their paper which may allow monitoring the spread of the leaf beetle and assessment of habitat. These techniques are anticipated to become even more important tools in future flycatcher management and recovery.

2.3.1.2 Abundance, population trends (e.g. increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate, etc.), or demographic trends:

Survivorship, reproductive success, movements

The USGS estimated flycatcher survivorship, based on the banding and tracking of 1,080 flycatcher adults and 498 nestlings in central AZ over a 10-year period (Paxton *et al.* 2007a, p.1). Overall, average survivorship was 64% for adults and 34% for juveniles, with considerable yearly variation. For adults, yearly variation was the most important influence on survivorship, with no difference between breeding sites or sex. Because little mortality appears to occur while adult flycatchers are on their breeding grounds, seasonal variation in migration and/or wintering ground mortality may be the drivers of the overall observed annual variation in survivorship (Paxton *et al.* 2007a, p. 38). Mean life expectancy was 1.9 years following fledging, but some individuals lived to at least 9 years of age; for those few that lived beyond the average lifespan, there was an increase in survivorship compared to younger adults. For juveniles, the most important predictor of survivorship was fledge date, with nestlings fledging later in the breeding season having lower survivorship than those fledged early in the breeding season.

The USGS (Paxton *et al*. 2007a, p.1) examined several factors to identify what might influence adult flycatcher survivorship. Habitat type (native, exotic, or mixed) in which adults bred did not appear to influence survivorship; however, whether an adult flycatcher was successful in fledgling nestlings did (Paxton *et al*. 2007a, p.1). A successful breeder (successful breeders = individuals that fledged at least one young) had a higher survivorship than a non-successful breeder, unpaired individual, and those of unknown status (Paxton *et al.* 2007a, p. 24). As adult flycatchers age, their survivorship probability increases, suggesting that they may learn optimal strategies for foraging, predator avoidance, and migrating, and have presumably found high-quality wintering grounds (Paxton *et al.* 2007a, p. 37). Thus the relatively small percentage of flycatchers that survive through their first few years of life have high probabilities of returning each successive year (Paxton *et al.* 2007a, p. 37).

Using the extensive information derived from the tracking of banded flycatchers over multiple years, USGS determined that measures of reproductive success varied by site and year (Paxton *et al*. 2007a, p.2). Average seasonal fecundity (number of offspring) for females was 1.6 at Roosevelt Lake and 2.0 at the San Pedro/Gila river confluence area. Male seasonal fecundity was 0.4 higher than females at Roosevelt Lake and 0.5 higher at San Pedro/Gila river confluence. Older females had higher seasonal productivity than second-year females. Average Minimum Lifetime Productivity (the total number of young fledged per individual over their estimated lifetime) was 3.3 offspring per female (Paxton *et al*. 2007a, p. 92). Over a third of individuals did not fledge any young that were detected, and over 50% of the young fledged were contributed by just 16% of the breeding adults.

Flycatchers showed a high degree of movement, with movements common among breeding sites that were 30 to 40 kilometers (km) (18.6 to 24.9 miles [mi]) apart and within the same drainage (Paxton *et al.* 2007a, p.2). Therefore, the idea of a biologically meaningful breeding site has shifted from considering every habitat patch as a distinct site, to a network of patches within the same drainage as a site. At a larger geographic scale, infrequent movements that connect different drainages allow for metapopulation-scale processes to occur. Along the Lower Colorado River and its major drainages, flycatchers demonstrated similar patterns of movement (MacLeod *et al*. 2008a, p. 101&110). Thus, consideration of drainage and regional patch connectivity when planning flycatcher recovery and management will be more effective.

Distribution and abundance

Throughout the range of the flycatcher and since completion of the Recovery Plan, the overall abundance of flycatcher territories has increased, but not every Recovery Unit or Management Unit has increased (Table 2). Since 2002, the overall estimated number of flycatcher territories rangewide has increased from 986 (USFWS 2002, p. 85) to 1,299 (Durst *et al.* 2008, p. 10). In particular, there have been increases in the Gila and Rio Grande Recovery Units, but little change or declines in numbers within the Lower Colorado, Basin and Range, Upper Colorado River, and Coastal California Recovery Units. Tracking the distribution and abundance of the flycatcher has become more challenging due to the reduced amount of surveys (Durst *et al*. 2008, p.5).

Rio Grande and Gila Recovery Units - There have been increases in the number of territories in both the Rio Grande and Gila Recovery units since completion of the Plan. The increases have largely occurred in the middle Rio Grande (from 51 to 230 territories), Upper Gila (from 187 to 329 territories), and Middle Gila/San Pedro Management (from 120 to 233 territories) units (Durst *et al*. 2008, pp.12-13). The number of territories has continued to increase in 2008 and 2009 along the Middle Rio Grande, with 319 territories detected in 2009 along the San Marcial reach (Moore and Ahlers 2010, p.30). These two Recovery Units have surpassed their overall numerical goal, but still have Management Units that require increases (including Verde, Hassayampa/Agua Fria, Santa Cruz, San Francisco, Upper and Lower Rio Grande).

Basin and Mojave, Lower Colorado River, and Upper Colorado Recovery Units - The Basin and Mohave and the Lower Colorado River Recovery Units are the farthest from reaching their numerical reclassification goals, with both approximately 75 % short. There has been little change overall in the territory numbers within these three Recovery Units since completion of the Plan. In 2002, the Basin and Mohave Recovery Unit had 69 known territories (USFWS 2002, p. 62,63,84, Fig. 6) and now has 51 (Durst *et al.* 2008, p.12); the Lower Colorado Recovery Unit had 146 territories (USFWS 2002, p. 62,63,84, Fig. 8-9) and now has 150 (Durst *et al.* 2008, p.12). The Upper Colorado Recovery Unit has a minor change of three (USFWS 2002, p. 84) to 10 territories (Durst *et al.* 2008, p. 13).

While the overall numbers in the Lower Colorado Recovery Unit may not have declined, there is concern for the how territories are distributed within the Lower Colorado Recovery Unit. Population stability is achieved by having multiple breeding sites no farther than about 30 to 40 km (19 to 25 mi) apart from each other (Paxton *et al.* 2007a, p. 4, 76, & 139). The entire 402 km (250 mi) length of the Lower Colorado River (from Hoover Dam to the international boundary with Mexico) has been surveyed for breeding flycatchers annually since the mid-1990s by the USBR and partners associated with the Lower Colorado River MSCP, with the only nesting population found at the Havasu National Wildlife Refuge (NWR). At the refuge, the number of flycatcher territories declined from a high of 34 in 2004 (64 individual adult flycatchers), to 12 territories in 2008 (20 individual adult flycatchers) (McLeod and Koronkiewicz 2009, p. 60). The eight known nests from these 2008 territories had the lowest productivity ever recorded from this site (MacLeod and Koronkiewicz 2009, p. 82-83). Only one nest was successful along the entire length of the mainstem Colorado River from Hoover Dam to the international border with Mexico (MacLeod and Koronkiewicz 2009, p. 79).

Due to the nature of colonization of sites and typical flycatcher movements (described above), the persistence and success of maintaining flycatcher territories along the Lower Colorado River are important for flycatcher recovery. Because there are currently no large known populations in close proximity to the Lower Colorado River, the loss of breeding pairs will reduce and/or delay the likelihood of recovery.

Table 2. Estimated number of known rangewide flycatcher breeding sites/territories in 2002 (USFWS 2002, p. 84-85), 2007(Durst *et al.* 2008, p. 12-13), and territories necessary for recovery by Recovery and Management Unit (USFWS 2002, p. 84-85).				
Recovery Unit	**Management Unit**	**# of Territories 2002**	**# of Territories 2007**	**Recovery Criteria (# of territories)**
Basin and Mojave	Owens	28	28	50
	Kern	23	14	75
	Amargosa	3	1	25
	Mojave	13	4	25
	Salton	2	4	25
	TOTAL	***69***	***51***	***200***
Coastal California	Santa Ynez	33	7	75
	Santa Clara	13	8	25
	Santa Ana	39	28	50
	San Diego	101	77	125
	TOTAL	***186***	***120***	***275***
Gila	Verde	3	14	50
	Hassayampa - Agua Fria	0	1	25
	Roosevelt	140	75	50
	San Francisco	3	7	25
	Upper Gila	187	329	325
	Gila – San Pedro	120	233	150
	Santa Cruz	1	0	25
	TOTAL	***454***	***659***	***650***
Lower Colorado	Pahranagat	34	40	50
	Virgin	40	43	100
	Little Colorado	6	9	50
	Middle Colorado	16	4	25
	Hoover - Parker	15	14	50
	Bill Williams	32	39	100
	Parker – Southern. Intl Boundary	3	1	150
	TOTAL	***146***	***150***	***525***
Rio Grande	San Luis Valley	34	56	50
	Upper Rio Grande	37	21	75
	Middle Rio Grande	51	230	100
	Lower Rio Grande	6	2	25
	TOTAL	***128***	***309***	***250***
Upper Colorado River	San Juan	3	10	25
	Powell	0	0	25
	TOTAL	***3***	***10***	***50***
TOTAL		**986**	**1299**	***1950***

Experiments conducted during the 2010-2011 breeding seasons by the Service and USBR at Havasu NWR may increase flycatcher nesting habitat suitability (vegetation rigor and insect abundance) by pumping water directly onto the surface of the ground at known breeding sites at an earlier date than what has typically occurred. Similarly, efforts continue by the Lower Colorado River MSCP partners to improve the distribution, abundance, and quality of flycatcher nesting habitat.

The Upper Colorado Recovery Unit is the smallest of the all Recovery Units, with few known breeding sites and territories. It is comprised of only two

Management Units, the Powell Management Unit (southern UT and northern AZ) and the San Juan Management Unit (portions of UT, CO, NM, and AZ). Both Units have a recovery goal of 25 territories. There has been little change in known sites and territories since completion of the Recovery Plan. There are still no known breeding sites and territories within the Powell Management Unit (USFWS 2002, p. 84; Durst *et al.* 2008, p. 13), while the San Juan Management Unit, the largest of the two units, has increased from three known territories (USFWS 2002, p. 84) to 10 (Durst *et al.* 2008, p. 13). Overall, there continues to be relatively low survey effort within this Recovery Unit (USFWS 2002, p. 64).

Coastal California Recovery Unit – This Recovery Unit has experienced the overall largest proportion of decline in the number of known flycatcher territories since 2002. When the Recovery Plan was completed there were 186 known territories, but now they are estimated at 120 (Durst *et al.* 2008, p 12). The decline of 66 territories is about 35% of the 2002 total, and numbers have been reduced in all of the four coastal Management Units. It may be that the lack of recent survey information to determine whether flycatchers still occur at breeding sites combined with the known decline of territories at some key breeding sites (i.e. Camp Pendleton – Santa Margarita River, Prado Basin – Santa Ana River) has contributed to the change. The detected declines at known sites have no obvious cause.

There are varying reasons why the number of territories in specific Management or Recovery Units has changed since completion of the Plan. In general, riparian habitat is dynamic due to river flooding, water storage, dam releases, river diversion, fire, agricultural return flow, drought, etc. As a result, nesting habitat and distribution can rapidly change in quality and quantity (Paxton *et al*. 2007a, p. 3), which will reflect the number of breeding territories. For example, nesting habitat can grow out of suitability; vegetation can develop from seeds to nesting suitability within five years; heavy river flow can remove/reduce habitat suitability in a day; and water storage can inundate habitat within conservation pools of lakes, etc. The flycatcher's use of habitat in different successional stages can also be dynamic. For example, over-mature or young habitat not suitable for nest placement can be occupied and used for foraging and shelter by migrating, breeding, dispersing, or non-territorial flycatchers (Cardinal and Paxton 2005, p. 19-23). There is little doubt that these habitat changes, along with accompanying surveys, have led to detected increases in the Middle Rio Grande (Moore and Ahlers, 2006-2012), Middle Gila/San Pedro (Ellis *et al*. 2008, Graber and Koronkiewicz 2009), and Upper Gila Management Unit (Dockens *et al*. 2006), and decreases in the Roosevelt Management Unit (Ellis *et al*. 2008).

Another contribution to the change in number of territories reported is due to the reduction in the overall amount of surveys being performed (Durst *et al*. 2008, p. 5). Not all of the 288 sites where flycatcher territories have been discovered over the past 17 years are surveyed annually. Searches for new flycatcher breeding locations are not occurring as frequently, unless they are associated with an ongoing or potential project. The number of sites surveyed each year increased from 1993 to 2001, but it has been declining since. This results in a greater gap between what is known and what is estimated. For example, of the 288 sites where flycatchers have established territories since 1993, fewer than half (only 115 sites) were surveyed in 2007 (Durst *et al.* 2008, p. 7).

The rangewide compilation of flycatcher survey data forms, database entry, and preparation of reports is becoming more difficult to integrate and accomplish across six states without dedicated funding to facilitate this effort. Although, the USGS in CA has improved the collection of flycatcher information, and USBR is compiling data for the State of NM, the AZ database is antiquated and data entry needs to become more efficient. There were annual statewide reports from AZ and rangewide reports completed between the mid-1990s to 2007. A draft flycatcher rangewide report has been compiled covering the years from 2008 through 2012, but is not yet ready to integrate into this document. As a result of the current limitation in database management, the ability to estimate populations and detect changes is becoming more difficult. Improved agency coordination and funding toward existing data reporting and compilation, in addition to innovative and improved survey and monitoring efforts would enhance our ability to more reliably track the flycatcher's local and rangewide distribution and abundance.

2.3.1.3 Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.):

Based upon the best available science, the northern boundary of the flycatcher was approximated through southern CO and UT (Paxton 2000, USFWS 2002, Fig 3, 4, 7-9, 11; Paxton *et al.* 2007b, p. 3). However, the exact boundary placement cannot be certain because there is no discreet boundary, but an intergradation zone with a non-listed willow flycatcher subspecies (*E. t. adastus)* (Paxton *et al.* 2007b, p. 1). To help provide more resolution to the northern boundary, USGS (Paxton *et al.* 2007b) evaluated the geographic distribution of mitochondrial and nuclear DNA by sampling flycatchers at breeding sites specifically across the four-corner states (AZ, CO, NM, and UT).

The current northern boundary of the southwestern willow flycatcher has been shaped by genetic and geographic song pattern evaluations (Owen and Sogge 1997, Langridge and Sogge 1998, Paxton 2000, Sedgwick 2001, USFWS 2002). Song patterns found evidence for intergradations further south than other studies, into high elevation areas of AZ and NM (Sedgwick 2001). However, based on the geographic distribution of cytochrome-b genetic sequences from flycatchers across their breeding range, Paxton *et al*. (2007b, p.4) found the strongest support for a southern CO/UT boundary (currently used), but recognized that more sampling of the region was needed.

In the most recent genetic evaluation targeting the flycatcher's northern boundary, USGS (Paxton *et al.* 2007b) found that with the exception of three breeding sites situated along the current boundary, breeding sites generally fell into two major groups and were appropriately located on either side of the currently designated boundary. However, delineating a precise boundary that would separate the two subspecies is difficult because (1) there is evidence for a region of intergradations along the boundary area, suggesting the boundary is not discreet, and (2) there are too few extant flycatcher breeding populations in the boundary region to precisely locate a boundary. As noted by Paxton et al. (2007b, p. 13), a zone on integradation between subspecific taxa is not unexpected.

The USGS suggested that latitudinal and elevation differences and their associated ecological effects could form an ecological barrier that inhibits gene flow between populations, forming a basis for the subspecies boundary. The elevation changes markedly over a relatively short distance in this region, with lower elevation deserts to the south and more mesic, higher elevation habitats to the north. As a result, they modeled changes in geographic patterns of genetic markers as a function of latitude and elevation. They created multiple subspecies boundaries, with the strength of each predicted boundary evaluated on the basis of how much genetic variation it explained.

The USGS's "candidate boundary," which accounted for the most genetic variation, is situated generally near, but farther south of the currently recognized subspecies boundary. They believe it should be more biologically meaningful because it incorporates the landscape features that may be driving separation of the subspecies. Even so, USGS cautioned that using any boundary line as an indicator of subspecies identity could be misleading because biologically there is no discrete boundary, but rather a region of intergradation.

Continuing to acquire and analyze more information about the genetic identity of breeding flycatchers near the northern boundary and developing appropriate ESA policy on the separation of intergradation zones could help provide information to guide an appropriate future decision about whether there needs to be change in the current boundary. There is little regulatory benefit/certainty for the flycatcher or agencies, private landowners, and/or other interested parties if the boundary changes with relative frequency. We currently recognize the northern geographic boundary of the flycatcher as described in the Recovery Plan (USFWS 2013, p. 345) (USFWS 2002, figures 3, 4)

2.3.1.4 Taxonomic classification or changes in nomenclature:

The willow flycatcher (*Empidonax traillii*) is a widespread species that breeds across much of the United States (Sedgwick 2000, pp. 1-7). Four subspecies commonly are recognized in North America, with each having a distinct breeding range: *E.t. adastus*, ranging across the northern Rocky Mountains and Great Basin; *E.t. brewsteri*, found west of the Sierra Nevada and Cascade Mountains along the Pacific Slope; *E.t. traillii*, ranging east of the northern Rocky

Mountains; and *E.t. extimus*, which breeds across the Southwest (Hubbard 1987, pp. 3–6; Unitt 1987, pp. 137–144; Sedwick 2000, p. 6; Sogge *et al*. 2010, p. 2). Browning (1993, p. 248) suggests a possible fifth subspecies (*E. t. campestris*) in the central and midwestern United States.

The southwestern willow flycatcher is the only subspecies listed under the ESA, but concern for the status of the other subspecies exists. Sedgwick (2000, p. 5) describes that *E. t. brewsteri*, once common the whole length of the Pacific Coast, is now rare to local within CA mountain meadows. In contrast to its association with riparian habitats, Altman *et al*. (2003 p. 76) describes *E.t. brewsteri* nesting in early seral coniferous forest (3-15 years) following even aged timber harvest or natural events that removed most or all of the forest canopy that allowed for extensive shrub layer growth. Siegel *et al*. (2008) describes that territorial willow flycatchers were not detected from Yosemite National Park, and strongly suggested they no longer breed there. Overall, the State of California lists *E.t. adastus, E.t. brewsteri, and E.t. extimus* as state endangered (Siegel *et al.* 2008, p. 8). Conversely, Sedgwick (2000, p. 5) also describes expansion of the eastern, nominate subspecies of willow flycatcher (*E.t. traillii*) northward into Ontario and southward into the south and southeastern U.S., including Ohio, Pennsylvania, Kentucky, West Virginia, Maryland, South Carolina, and Mississippi.

The Southwestern Willow Flycatcher Recovery Plan describes the taxonomic status of the flycatcher (USFWS 2002, p. 6). Other than the attempt to refine the subspecies' range described in section 2.3.1.3 above, we are not aware of any changes to the taxonomic classification or nomenclature of the flycatcher.

2.3.1.5 Spatial distribution, trends in spatial distribution (e.g. increasingly fragmented, increased numbers of corridors, etc.), or historic range (e.g. corrections to the historical range, change in distribution of the species' within its historical range, etc.):

The states of AZ, NM, and CA account for the greatest number of known flycatcher breeding sites and territories (Durst *et al*. 2008, p. 10) (Table 3). The flycatcher's breeding range in NV, CO, and UT, is relatively small in comparison to CA, AZ and NM, and combined account for just less than 12% of all the known flycatcher territories (Table 3). While west Texas (TX) and northern Mexico are within the historical range of the flycatcher, there are little to no current survey data or records to provide information on its status or distribution in those two locations. The flycatcher's current range is similar to the historical range, but the quantity of suitable habitat within that range is reduced from historical levels.

Throughout its range, the flycatcher's distribution follows that of its riparian habitat; relatively small, isolated, widely dispersed locales in a vast arid region. Nesting flycatchers are distributed over a wide elevation range (sea level to about 2,500 m [8200 ft]). Most territories occur between sea level and 1,600 m (5,249 ft); the highest proportion within this range occurs between 601 to 800 m (1968 to

2,624 ft) (the Gila/San Pedro River confluence and Roosevelt Lake, AZ) and 1,401 to 1,600 m (4,596 to 5,249 ft) (the Cliff-Gila Valley, NM). At the highest elevations, four breeding sites are known to occur just above 2,500 m (8,200 ft).

Flycatcher breeding sites typically have five or fewer territories. Of the 288 known flycatcher breeding sites where a territory has been detected, 34% held l to 5 territories (n=97) and half (n=142) no longer had breeding birds (Durst *et al*. 2008, p. 8). Breeding sites with fewer territories are the locations that typically become unoccupied. Of the 142 sites no longer occupied by nesting flycatchers tracked since 1993, 140 of them had 5 or fewer territories (mostly 1 or 2).

Table 3. Number of southwestern willow flycatcher breeding sites and territories by state, through the 2007 breeding season (Durst *et al*. 2008, p.10).

State	Number of sites	Percentage of total sites	Number of territories	Percentage of total territories
Arizona	124	43.1	459	35.3
California	96	33.3	172	13.2
Colorado	11	3.8	66	5.1
New Mexico	41	14.2	519	40.0
Nevada	13	4.5	76	5.9
Utah	3	1.0	7	0.5
Total	288	100%	1,299	100%

Sixty-four breeding sites have become re-occupied with nesting flycatchers after at least a single year when no territories were detected (Durst *et al*. 2008, p. 25). The re-colonization of a breeding site reflects the dynamic nature of flycatcher habitat and flycatcher use, and that habitat can cycle back into suitability for nesting birds.

Across the flycatcher's range, certain river drainages have more territories than others (Durst *et al*. 2008, p. 11). More flycatcher territories are found along the Gila River in NM and AZ than any other major drainage. Elsewhere in NM and in southwest CO, territories are mostly found along the Rio Grande. The primary drainages in CA with territories are the Kern, Owens, San Luis Rey, Santa Ana, and Santa Margarita rivers. In AZ, most flycatchers are found along the Gila, San Pedro, and Salt rivers (Roosevelt Lake). The Virgin River drainage supports the majority of flycatchers in UT, while the Virgin and Pahranagat rivers support the most territories in NV.

Four general locations across the flycatcher's range are known to have the most number of territories: Middle Rio Grande (NM); Cliff-Gila Valley (NM); Roosevelt Lake (Salt River/Tonto Creek confluence) (AZ); and middle Gila River/San Pedro River (AZ). Breeding locations along these drainages fluctuate in numbers, but each can have about 200 territories in a single season (sometimes increasing to about 300 along the Middle Rio Grande). As a result, those four locations can account for about 60% of all known territories (approximately 800 out of 1,299 range-wide territories). These sites create great colonization potential/opportunities to accomplish the Recovery Plan's goal of developing many breeding sites spread across the landscape (USFWS 2002, p.74-75). However, having a high proportion of territories at few locations increases concern for the impact to the subspecies from a widespread catastrophic event, or even how a long-term change (i.e. drought) that might impact of these important source populations. Additionally, two of these locations (Roosevelt Lake in AZ and Elephant Butte in NM) are associated with water storage. So, while these locations are anticipated to maintain the dynamic nature of habitat (drought/run-off), those cycles could be altered due to water demands.

The number of flycatcher breeding sites surveyed annually has declined since the year 2000 (Durst *et al.* 2008, p. 5). In the year 2000, nearly all of the approximately 200 known flycatcher breeding sites (at that time) were surveyed. Throughout the 2000s, the number of known breeding sites increased from about 200 to 300; however, the number of sites surveyed annually declined from about 200 to just above 100. More specifically, in 2007, only 115 of the 288 known sites were surveyed (Durst *et al.* 2008, p. 7). Therefore, over time, the distribution and abundance of flycatchers has become increasingly less precise and subject to estimation because of fewer surveys.

2.3.1.6 Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem):

Because the flycatcher exists in disjunct breeding populations across a wide geographic and elevation range, and its habitat (at mid and lower elevations) is subject to dynamic events generated by nature and man-made decisions, arriving at conclusions about its habitat or ecosystem condition at a single moment is difficult. Flycatcher habitat typically is the result of a dynamic river environment that germinates, develops, maintains, and regenerates the riparian forest and provides food for breeding, non-breeding, dispersing, territorial, and migrating birds. Anthropogenic factors such as dams, irrigation ditches, or agricultural field return flow can assist in providing conditions that support flycatcher habitat. We can examine aspects of habitat configuration, land ownership, population size, and surrogate indicators, such as the status of critical habitat, to help generate a conservative conclusion about habitat/ecosystem condition.

Habitat composition

Most flycatcher breeding sites are comprised of spatially complex habitat mosaics, often including exotic (mostly tamarisk) and native vegetation. Territories are frequently clumped or distributed near the patch edge. Thus, the vegetative composition of individual territories may differ from the overall composition of the patch. Flycatchers may move extensively within or between breeding patches, or exploit resources outside of a patch (Cardinal and Paxton, 2005, p.15-23, Cardinal *et al*. 2006, p.14-17). Therefore, an area larger than a territory or even a patch may be important to flycatcher breeding success and persistence at a particular site. This concept is supported by flycatcher habitat suitability modeling (Hatten and Paradzick, 2003, p.774).

The habitat at flycatcher breeding sites can be broadly characterized by proportion of native and exotic habitats into four broad categories (Sogge *et al.* 2010, p.4-10). Most commonly, tamarisk is the exotic plant species (Russian olive has also been used). Those categories are based on species composition of the tree/shrub layer(s) of the site:

1. Native = >90% native vegetation.
2. Mixed (>50% native) = 50 to 90% native vegetation.
3. Mixed (>50% exotic) = 50 to 90% exotic vegetation.
4. Exotic = >90% exotic vegetation.

Habitat patches are comprised of a variety of native and exotic mixtures across the flycatcher's range (Figure 2). Fewer than half (44%) of the known flycatcher territories occur in patches that are greater than 90% native vegetation and just 4% of the known territories occur at sites with almost all exotic vegetation. Another 50% are located at sites that include native/exotic mixtures. In many of these areas, exotic plants are significant contributors to the habitat structure by providing the dense lower strata vegetation that flycatchers prefer.

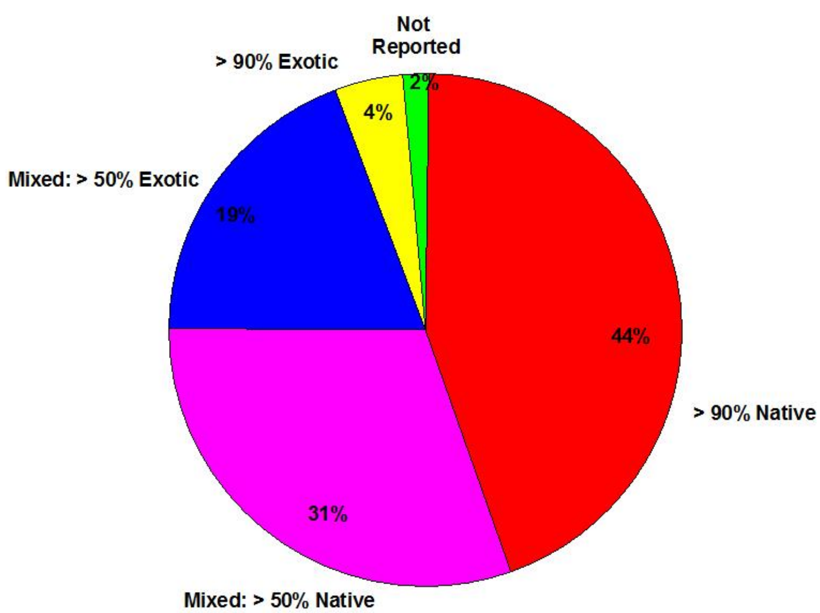

Figure 2. Percentage of flycatcher territories occurring within breeding sites of differing compositions of native and exotic vegetation, as of the 2007 breeding season (Durst *et al.* 2008, p.15).

A USGS comparative study (Sogge *et al.* 2005) found no difference in flycatcher physiology, immunology, site fidelity, productivity, or survivorship between flycatchers nesting in tamarisk-dominated habitat (>90% tamarisk vegetation) versus native dominated habitats (>90% native vegetation) (see section 2.3.1.7).

Land ownership of breeding sites

Fewer than half (44%) of known flycatcher breeding sites are on federally-controlled lands and 28% are on private lands; these privately-owned sites account for 34% of known territories (Figure 3). Approximately one-third (32%) of territories on privately owned sites are found in the Cliff-Gila Valley, NM. The wide distribution of land ownership demonstrates the multiple parties responsible for implementation of recovery tasks, and the importance of developing partnerships and cooperative strategies.

Some private, tribal, state, and Federal land owners/managers across the flycatcher's range have developed conservation/management plans for the flycatcher. Some of these plans were in response to the designation of flycatcher critical habitat in order to possibly be excluded from the final designation. Similarly, Habitat Conservation Plans (HCP) through section 10 of the ESA were developed by Salt River Project in central AZ, various counties in southern CA, and others, which have helped place lands in conservation status for the flycatcher. Some Safe Harbor Agreements (SHA) on private lands have also been developed that included the flycatcher. SHAs with private landowners are different from HCPs because they allow individuals who implement actions with a net conservation benefit to return to baseline conditions under a section 10(a)(1)(a) enhancement of survival permit, with assurances that land use restrictions will not be required. In contrast, HCPs are developed (which include conservation measures to reduce, minimize, and mitigate) and a permit issued for private actions that are not intended to result in conservation of the species and where take of the listed species is incidental to an otherwise lawful action.

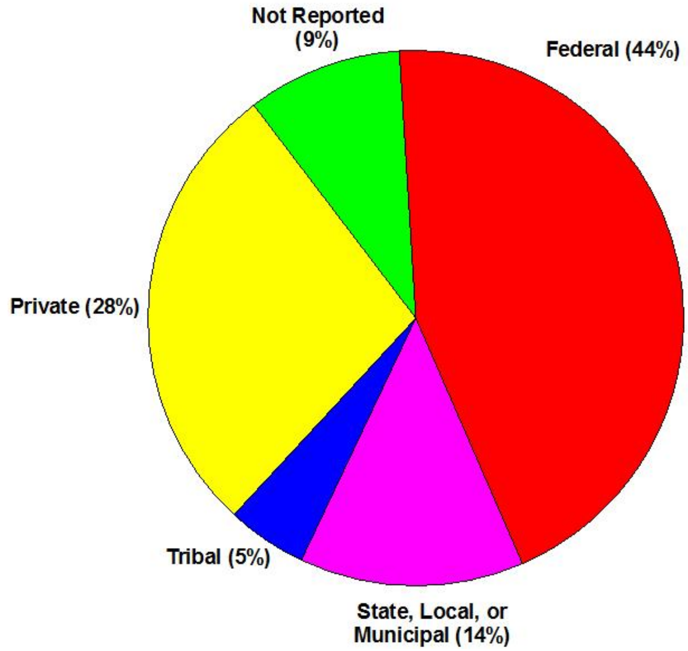

Figure 3. Percentage of flycatcher breeding sites found under different land ownership, as of the 2007 breeding season (Durst *et al*. 2008, p.17).

Number of territories and breeding sites over time

Despite a reduction in overall survey effort, recent range-wide reports describe a continued overall increase in known breeding sites and estimated number of territories. Since 1993, the number of known flycatcher breeding sites has grown from less than 50 to 288. This increase was also reflected in the number of estimated flycatcher territories, growing from less than 200 territories in the early 1990s to a maximum of 1,299. More recently, from 2005 to 2007, USGS (Durst *et al.* 2006, 2008) estimated that the number of flycatcher territories range-wide increased modestly from 1,214 to 1,299, and breeding sites from 275 to 288.

Recent flycatcher breeding site reports show increases and maintenance of some of the largest populations in AZ and NM. Along the Middle Rio Grande near Elephant Butte Reservoir in NM, the number of known flycatcher territories has increased from 51 territories in 2002 (USFWS 2002, p. 85) to 347 in 2011 (Moore and Ahlers 2012, p.12). At a collection of private and Federal lands in the Cliff/Gila Valley, along the Gila River in NM, from 2004 to 2009 territory numbers remain fairly steady varying between about 148 and 177 (Shook 2009, p. A2). Also in NM farther downstream along the most southwestern portion of the Gila River, near the AZ/NM border, the number of territories has recently climbed from 55 in 2005 to 107 in 2008 (Meyer 2008, p.9). Even farther downstream on the Gila River in central AZ below Coolidge Dam, the number of territories steadily increased from 28 in 2005, to an estimated 138 territories in 2010 (Graber and Koronkiewicz 2010, p. 13).

Critical habitat designation

The Recovery Plan's strategy, rationale, and science for flycatcher conservation guided our efforts to identify essential features and areas of critical habitat (USFWS 2002, pp. 61–95) for our 2013 flycatcher critical habitat revision (USFWS 2013a). Because of the flycatcher's wide distribution and the dynamic nature of its habitat, it was important for its conservation to propose critical habitat in areas throughout all of its breeding range that have recovery goals. This widespread distribution of habitat is intended to allow flycatchers to function as a group of metapopulations, realize gene flow throughout its range, provide ecological connectivity among disjunct populations, allow for breeding site colonization potential, and prevent catastrophic population losses.

We proposed stream segments as critical habitat within 29 of the 32 Management Units (which are geographic areas clustered within 6 Recovery Units) in order to meet the specific, numerical flycatcher territory and habitat-related recovery goals (USFWS 2002, pp. 84–85) (USFWS 2011, pp. 50550, 50558). Three of the 32 Management Units (Lower Gila, Pecos, and Texas) do not have any goals identified in the Recovery Plan, because of the lack of known breeding sites and the reduced likelihood of developing habitat. Numerical flycatcher territory recovery goals for each of the 29 Management Unit vary throughout the flycatcher's range from as few as 25 territories to as many as 325 (USFWS 2002, pp. 84–85).

The Recovery Plan (USFWS 2002, pp. 74–76) identifies important conservation strategies to consider in minimizing the likelihood of extinction that were incorporated into revision of flycatcher critical habitat. These factors were: (1) the territory is the appropriate unit of measure for numerical flycatcher recovery goals; (2) populations should be distributed throughout the bird's range; (3) populations should be distributed close enough to each other to allow for movement among them; (4) large populations contribute most to metapopulation stability, while smaller populations can contribute to metapopulation stability when arrayed in a matrix with high connectivity; (5) as the population of a site increases, the potential to disperse and colonize increases; (6) increase and decrease in one population affects other populations; (7) some Recovery and Management Units have stable metapopulations, but others do not; (8) maintaining or augmenting (or both) existing populations is a greater priority than establishing new populations; and (9) establishing habitat close to existing breeding sites increases the chance of colonization.

We designated stream ‘‘segments’’ as flycatcher critical habitat and identified the lateral extent of habitat within the riparian zone of the floodplain where the river is anticipated to flow and habitat is expected to grow over time. Flycatcher habitat within these designated areas is expected to expand, contract, or change as a result of flooding, drought, inundation, and changes in floodplains and river channels (USFWS 2002, pp. 18, D13-D15) that result from natural occurrences and water/land management choices.

Flycatcher migration habitat is captured by the same methods used for identifying critical habitat because: (1) we are designating areas as broader river segments; (2) our areas will be geographically located across a broad area of the Southwest encompassing most of the range of the flycatcher; and (3) we are identifying areas surrounding territory and breeding sites where migrant flycatchers are most often detected.

Following exclusions under section 4(b)(2) of the ESA, we designated flycatcher critical habitat along 1,227 stream miles within 24 Management Units found in six Recovery Units. The designated stream segments occur on a combination of Federal, State, and private lands in Inyo, Kern, Los Angeles, Riverside, Santa Barbara, San Bernardino, San Diego, and Ventura Counties in CA; Clark, Lincoln, and Nye Counties in southern NV; Kane, San Juan, and Washington Counties in southern UT; Alamosa, Conejos, Costilla, and La Plata Counties in southern CO; Apache, Cochise, Gila, Graham, Greenlee, La Paz, Maricopa, Mohave, Pima, Pinal, Santa Cruz, and Yavapai Counties in AZ; and Catron, Grant, Hidalgo, Mora, Rio Arriba, Socorro, Taos, and Valencia Counties in NM.

Since the 2005 designation and 2013 revision of flycatcher critical habitat, some proposed projects were anticipated to result in local permanent and/or temporary losses of designated critical habitat. However, of all the projects evaluated for their effects on flycatcher critical habitat, none resulted in an adverse modification determination under section 7 of the ESA.

Summary

By assessing flycatcher habitat ownership/configuration, population size, and critical habitat evaluation, we can reasonably conclude that the current range-wide condition of the flycatcher's habitat/ecosystem is similar to what it was five years ago. The most recent annual territory estimates from the range-wide reports show a maintenance and modest increase in territories and breeding sites through 2007 compared to the larger growth occurring from about 1995 to 2002 (Durst *et al.* 2008, p.4). Since 2007, the number of breeding sites has increased or remained stable for some of the larger populations in AZ (Gila River) and NM (Rio Grande, Gila River). Flycatcher breeding habitat occurs across a wide variety of private, Federal, state, and tribal land owners where there exists a collection of conservation/management plans committing parties to habitat protection. This broad distribution of the flycatcher territories reduces the likelihood of significant simultaneous changes to flycatcher habitat. The 2005 critical habitat designation also occurred across the subspecies' range, and since completion of that rule, no projects have resulted in an "adverse modification" determination. Therefore, all of these factors combined lead us to conclude that the current condition of flycatcher habitat (including its designated critical habitat) is similar to what it was five years ago. This however, does not consider potential future impacts such as the tamarisk leaf beetle (*Diorhabda elongata*/*carinulata*) which are discussed below.

2.3.1.7 Other:

Because the Recovery Plan is relatively recent (USFWS 2002), and took seven years to complete after the subspecies' listing (USFWS 1995), a considerable amount of information about threats to the flycatcher was studied, evaluated, and incorporated into the Recovery Plan. Some of the issues identified in the 1995 Federal Register listing rule as needing further study (like the flycatcher's use of tamarisk for nesting), were examined, assessed, and incorporated into the Recovery Plan.

Tamarisk leaf beetles (beetles) and the effect of drought are indirectly addressed in the Recovery Plan. Also, climate change science was not specifically discussed, and, since the release of the Recovery Plan, has become a more widely considered and evaluated issue with respect to endangered species conservation. Beetles are mentioned in the Recovery Plan, but when it was finalized, beetles were not anticipated to be able to occur and thrive within the flycatcher's range. As a result, there is no discussion in the Recovery Plan anticipating impacts from leaf beetles. Somewhat similarly, climate change, drought, and the indirect and inter-related effects of those factors are indirectly addressed in the Recovery Plan by discussing the importance of water through vegetation growth, dam operations, hydrologic regimes, river flow, groundwater, etc. We identify these issues immediately below and also discuss them within our five factor threats analysis.

Tamarisk leaf beetle

Comparative studies on flycatchers nesting in native vegetation versus tamarisk dominated habitats concluded that the exotic-dominated habitat was not, in and of itself, inadequate for flycatchers and was not as great of a threat as initially believed if other habitat attributes were suitable (USFWS 2002, Appendix F; Sogge *et al.* 2005, p.7). In contrast to general perceptions, tamarisk was found to be widely used by nesting flycatchers without negative consequences (Sogge *et al*. 2005, p.7). Across the flycatcher's range (USFWS 2002, pp.13-14), within central AZ (Sogge *et al.* 2005, p.7), and between AZ and NM (Owen *et al*. 2005, p.1261), no evidence was found that flycatchers nesting in tamarisk-dominated habitat (examining physiology, immunology, site fidelity, productivity, and survivorship) is detrimental. It is likely that tamarisk habitats vary with respect to suitability for breeding flycatchers across their range, just as do native habitats (Sogge *et al.* 2005, p.1).

Prior to the completion of Recovery Plan, the Flycatcher Recovery Team (Team) sent a letter to the Service's Southwest Regional Director identifying concerns about the effects to the flycatcher and other riparian obligate bird species from the plan to introduce the exotic bio-control insect, the tamarisk leaf beetle (USFWS 1998a). The tamarisk leaf beetle was expected to cause significant degradation and/or mortality to the plant. The Team made three specific points after reviewing Animal Plant and Health Inspection Service's (APHIS) proposal.

1. The flycatcher and other riparian obligates extensively use tamarisk for successful nesting. Replacement of tamarisk by less structurally diverse riparian vegetation can result in habitat less suitable for riparian birds. There may be more negative impacts to birds from removing than maintaining tamarisk.

2. Tamarisk sites may not be replaced by native vegetation with at least equal function for the needs of the flycatcher and other riparian specialists. The presence and spread of tamarisk is a symptom of a larger and more complex set of underlying problems affecting riparian ecosystems. Removal of tamarisk will not alleviate those problems. Without extensive regional changes in water and land management, altered site conditions in the form of high salinity, lowered water tables, reduced winter/spring flooding, and livestock grazing will continue to preclude establishment of native riparian vegetation suitable as nesting habitat for the flycatcher and other riparian obligate birds.

3. Biological control agents may not be contained within limited areas due to transport by humans (intentionally or unintentionally). If beetles do travel beyond the areas they are proposed to be limited to, eradication of the insect would seem unlikely.

In 1999, the Service concurred with APHIS' determination that their bio-control program of releasing beetles outside of the breeding range of the flycatcher would not likely adversely affect the bird. The concurrence was based on the conclusion that beetles would only move "tens of feet per year" and if they did occur south of the 38th parallel (into the flycatcher's range) they could not survive (USFWS 1999). The Service identified special concern for flycatchers and its habitat along the lower Colorado and Rio Grande rivers, and as a result, APHIS removed the component of their project to release insects on the Rio Grande in NM and TX.

The Recovery Plan recommended that any release of the tamarisk leaf beetle occur 322 km (200 mi) outside the occupied breeding range of the flycatcher, but did not extensively discuss the beetle or evaluate its impacts on flycatchers or their recovery (USFWS 2002, p. 121).

In 2003, APHIS again proposed to release insects on the Rio Grande in TX and NM, as well as other western states. A subtle change from the guidance in the Recovery Plan occurred in the Southwest Region 2 concurrence (USFWS 2003a). The recommendation in the Recovery Plan for beetle release (at least 322 km [200 mi] from the occupied range of the flycatcher) was altered to recommend release at least 322 km [200 mi] from the occupied range of where flycatchers use tamarisk for nesting (a smaller area). APHIS agreed to not release insects at sites along the Rio Grande in TX and NM.

In 2004, U.S. Department of Agriculture's (USDA) Agricultural Research Services (ARS) proposed to release beetles in west TX (including the Rio Grande) and received concurrence from the Service in TX. The Service in TX determined that the release would not likely adversely affect any listed species (USFWS 2004a). Work subsequently began to release leaf beetles adapted to more southern climates below the 38th parallel along the Rio Grande in TX.

In 2005, we designated flycatcher critical habitat along streams in the states of NM, AZ, CA, NV, and UT (USFWS 2005). Tamarisk was among a collection of riparian plants listed as a primary constituent element (USFWS 2005, p. 60912).

In 2006, the City of St. George, UT, collected leaf beetles from a site in Delta, UT, and transported the beetles south to the Virgin River in the Colorado River drainage in southwest UT near the NV and AZ border (APHIS 2009, p. 4). The Virgin River is located below the 38th parallel. The Virgin River at St. George is designated as flycatcher critical habitat, and flycatchers nest in tamarisk along the Virgin River.

In 2008, tamarisk leaf beetles were first detected defoliating tamarisk within flycatcher territories along the Virgin River in St. George, UT. Following the success of the earliest flycatcher nesting pairs while tamarisk was green and vegetated, the latest nesting pairs were found to not be as successful. Soon after three flycatcher pairs initiated incubation, beetles defoliated the tamarisk trees and two nests failed (Paxton *et al.* 2010). Both nests occurred in tamarisk habitat. Beetles were also found in southern NV within the flycatcher's range.

In contrast to 2008, beetle defoliation of tamarisk in 2009 along the Virgin River in St. George, UT, coincided with the onset of the flycatcher nesting season. Thirteen of the 15 (87%) flycatcher nests in this area of defoliation failed (Paxton *et al.* 2010). For comparison to a site where beetles do not occur, the long-term nest success percentage at Roosevelt Lake in central AZ was 52% (Paxton *et al.* 2007a, p. 53). Measurements of flycatcher habitat suitability and microclimate were adversely affected by beetle defoliation of the plants (Paxton *et al.* 2010). The USGS (Paxton *et al*. 2011b, p. 261-262) described the phenomenon as possibly being an "ecological trap." The habitat initially appears green and inviting to nesting birds only to change vegetation characteristics in the middle of the nesting season. Beetles expanded their distribution, and moved farther south into AZ down from the Virgin River into the Colorado River in Grand Canyon National Park. Beetles were also found in the Four Corners area of NM, AZ, UT, and CO (Tamarisk Coalition 2010).

Beetles are not only persisting and thriving below the 38th parallel, but are moving miles in a single season. APHIS (2009, p.5) predicts that the northern variety of the leaf beetle can persist down to the 32nd parallel (southern AZ, near Tucson). In addition to beetles moving on their own, beetles may also be transported accidentally or on purpose by human beings. Due to the variety of beetles introduced, including the more southern adapted variety in TX, it is also predicted that leaf beetles can occur throughout the western United States and into Mexico (Tracy *et al*. 2008).

In 2009, APHIS agreed to reinitiate section 7 consultation on their 2005 tamarisk leaf beetle proposal to expand releases across the western United States. APHIS initially determined in 2005 that the beetle would not likely adversely affect the flycatcher and its designated critical habitat.

On June 10, 2010, APHIS distributed a memo describing that it had terminated its tamarisk leaf beetle program in 13 western states. APHIS subsequently had discontinued issuing new permits for beetle use outside of containment facilities, and for interstate movement or environmental release. APHIS also cancelled all existing permits for interstate movement and environmental release, and will not authorize the release of leaf beetles from containment or caged facilities.

In May 2010, APHIS submitted a biological assessment (APHIS 2010a) concluding that due to the upcoming termination of their tamarisk leaf beetle program (APHIS 2010b), their actions would not likely adversely affect the flycatcher or its designated critical habitat. In addition, APHIS committed to participate through National Invasive Species Council and work with agencies to address the on-the-ground needs of the flycatcher associated with the effects of the leaf beetle (APHIS 2010b). On October 6, 2010, the Service concurred with APHIS's determination (USFWS 2010a).

Drought and climate change

Periods of drought in the Southwest are common; however, the frequency and duration of droughts may be altered by climate change. Global warming and associated effects on regional climatic regimes are not well understood, but climate predictions for the southwestern United States include less overall precipitation and longer periods of drought. Based on broad consensus among 19 climate models, Seager *et al*. (2007, p. 1182) predicted that the Southwest will become drier in the 21st century and that this drier climate change is already occurring. Increased aridity associated with the current on-going drought and the 1950s drought will become the norm for the American Southwest within a timeframe of years to decades if the models are correct.

The 2007 Intergovernmental Panel on Climate Change (IPCC) report outlines several scenarios that are, as defined by the IPCC, virtually certain or very likely to occur in the 21st century. These are: 1) over most land, there will be warmer and fewer cold days and nights, and warmer and more frequent hot days and nights; 2) areas affected by drought will increase; and 3) the frequency of warm spells/heat waves over most land areas will likely increase. The IPCC also noted concern for ecosystems describing that their resilience is likely to be exceeded this century by an unprecedented combination of climate change, disturbances (e.g. flooding, drought, wildfire, insects), and other global drivers (IPCC 2007a,

p. 8; 2007b, pp. 8-10). With medium confidence, IPCC predicts that approximately 20 to 30% of plant and animal species assessed so far are likely to be at an increased risk of extinction if increases in global average temperature exceed 1.5 to 2.5º Celsius (C) (IPCC 2007a, p. 48; 2007b, pp. 13-14).

In the southwest region of the United States, the average annual temperature is predicted to rise by about 2.5 to 3.9 º C (4.5 to 7 º Fahrenheit [F]) during this century (IPCC 2007). This increasing rate of 0.56 º C (1.0 º F) every 14 years has already been surpassed in AZ since the 1970s, and NM is just slightly below this rising temperature rate (Lenart *et al*. 2007, pp. 3-4). Hydrologic trends are less clear except when considering snow; less snowpack and earlier spring melt and runoff in the Intermountain West states is substantiated (Parmesan and Galbraith 2004; Udall and Bates 2007, pp. 1-8), yet the southwestern states show a long-term trend of increased precipitation since the 1970s (Parmesan and Galbraith 2004 pp. 3-5; Udall and Bates 2007, pp. 1-8; Enquist and Gori 2008, pp. 16-17).

Climate simulations of the Palmer Drought Severity Index (a calculation of the cumulative effects of precipitation and temperature on surface moisture balance) for the Southwest for the periods of 2006–2030 and 2035–2060 show an increase in drought severity with surface warming. Additionally, drought still increases during wetter simulations because of the effect of heat-related moisture loss (Hoerling and Eicheid 2007, p. 19). Annual mean precipitation is likely to decrease in the Southwest, as well as the length of snow season and snow depth (Christensen *et al.* 2007, p. 887). Most models project a widespread decrease in snow depth in the Rocky Mountains and earlier snowmelt (Christensen *et al.* 2007, p. 891).

2.3.2 Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)

The reasons for the decline of the flycatcher and current threats it faces now and into the future are numerous, complex, and inter-related. However, these factors vary in severity over the landscape, and at any given location, several are likely to be at work, with cumulative and synergistic effects. The most significant impact should be expected to vary from site to site. The major factors are summarized below by categories corresponding to the ESA's five listing factors (section 4(a)(1) and in order of their significance within each category. Much of the source material for the basic description of items and issues below is adapted from the Recovery Plan (USFWS 2002, pp. 33-42). Since completion of the Recovery Plan (USFWS 2002), new issues addressed are primarily the introduction and spread of the leaf beetle and climate change (see below). For additional discussions see USFWS (1995, 2002, Appendix A-O) and Finch and Stoleson (2000)**.**

2.3.2.1 Present or threatened destruction, modification or curtailment of its habitat or range:

Habitat Loss and Modification

The primary cause of the flycatcher's decline is loss and modification of habitat. Its riparian nesting habitat tends to be uncommon, isolated, dispersed, and dynamic due to natural disturbance and regeneration events such as floods, drought, and to a lesser extent, fire. These habitat characteristics have been exacerbated over time through alteration of river function from land and water management actions. With increasing human populations and related agricultural and urban development, riparian areas have largely been modified, reduced, and destroyed by various mechanisms. In some instances, there have also been site-specific and temporal increases in riparian habitat. Overall, riparian ecosystems in the Southwest have declined from reductions in water flow and groundwater, interruptions in natural hydrological events and cycles, physical modifications to streams, direct removal of riparian vegetation, and an increase in fire events, due to water management and land use practices.

<u>Dams and Reservoirs</u>

Most of the larger and many of the minor southwestern streams that likely supported flycatcher habitat are now dammed. Operation of dams modifies, reduces, destroys, or (in some instances) increases riparian habitats both downstream and upstream of the dam site. Below dams, changing the amplitude, magnitude, frequency, duration, timing, and rate of change of hydrologic conditions strongly influences the structure and function of riparian ecosystems (Poff *et al*. 1997, pp. 269-274). As a result of the operation of dams, maximum and minimum flow events can both be altered; base flows can be increased or decreased; and flood flows are reduced in size and frequency. Below dams managed for downstream water supply, high flows are often reduced or shifted from that of the natural hydrograph. Daily water fluctuations can be very high below dams operated for hydroelectric power. The more or less annual cycle of base flow punctuated by short duration floods is frequently lost.

In altering these downstream flows, dams inhibit the natural cycles of flood-induced sediment transport and deposition, floodplain hydration and flushing, groundwater aquifer replenishment, and timing of seed dispersal necessary for establishment and maintenance of native riparian habitats. Lack of flooding also allows a buildup of debris, resulting in less substrate available for seed germination and an increase in the frequency of fires. Because of the lack of flushing flood flows, natural levels of salt and other minerals are often artificially elevated in downstream alluvial soils. Changes in soil and water chemistry (as well as overall stream flow) can affect plant community makeup, often preventing native plants and trees from flourishing, but favoring more adaptable exotic vegetation, such as tamarisk.

Immediately upstream of dam sites, riparian habitats are inundated by water within the conservation space of the reservoir. In some areas, the effect to riparian habitat and flycatchers is partially reduced by large fluctuations in lake size. Reservoir fluctuations can mimic the dynamics occurring along rivers, causing development of riparian habitat on the newly exposed wetted floodplain as the lake's shoreline recedes (Figure 4). The development of riparian areas within the conservation space of reservoirs can result in flycatcher breeding populations that can be even more dynamic in habitat availability and number of flycatcher territories than those occurring along streams. As a result, these habitats and populations tend to be vulnerable, with riparian habitat often inundated or desiccated as dam management raises and lowers the water level (Figure 4). Some of these reservoir locations where these volatile flycatcher populations can occur are found at Elephant Butte Reservoir in NM; Roosevelt (Figure 4), Horseshoe, and Alamo lakes in AZ; Lake Mead on the Colorado River; and Lake Isabella on the Kern River in CA.

Although large flycatcher populations can occur in habitat created within the conservation space of reservoirs, those territories are likely not as stable, geographically dispersed, or persistent as those that occurred along miles of pre-dammed rivers. Some dam operations reduce water storage during the late spring and summer, exposing a wet floodplain during the portion of the year when few native riparian plant species are still producing seeds but when tamarisk seeds are being produced and are able to become established (Chew 2009, pp. 17-18). As a result, tamarisk can be a significant portion of the flycatcher habitat located within some reservoirs. With the release of the beetle (see below), these volatile lake populations may become even less stable and abundant in the future should the beetles reach these areas and reduce habitat quality.

Since listing and completion of the Recovery Plan, the impact from the operations of some dams on existing flycatcher populations has been evaluated under the ESA and resulted in the completion of section 7 consultations and Habitat Conservation Plans (HCP). This has resulted in reducing some of the impacts of dam operations to known flycatcher populations in many places within the flycatcher's range, such as at Roosevelt (SRP 2002), Horseshoe (ERO and SRP 2008), and Isabella (USFWS 1996, 2000) lakes. In these three instances, the primary measure to reduce impacts was to acquire and manage riparian habitat along streams away from the dam's impact (although this was not the lone conservation measure). Along the lower Colorado River, impacts associated with Hoover Dam and other lower Colorado River (LCR) dam operations and water diversions resulted in the development of a broad multi-species HCP, where a portion of the plan targets the acquisition and creation of riparian habitat on stream side agricultural fields downstream of Hoover Dam (LCR MSCP 2004). While not specific to the evaluation of dam operations, along the lower Rio Grande below Elephant Butte Dam, actions are proposed to improve the abundance and quality of flycatcher habitat by reducing land and water use stressors associated with river management (USFWS 2012a). While these examples are limited in their geographic scope, they show that regulatory mechanisms are working to reduce the overall threat from the ongoing operation of dams and reservoirs throughout the flycatcher's range.

However, we do note that avoidance, minimization, and conservation measures associated with section 7 consultations and other mechanisms, while generally beneficial, are not a panacea; the amount of project-level conservation has its limits. Due to the water demands of society in the southwestern United States and legal contracts there has been some flexibility, but only a little, to address the broader impact of dams and their operations on southwestern streams from these consultations. At Horseshoe Dam in central AZ, where water storage is limited, minor changes were implemented to help protect and prolong flycatcher habitat within the lake's conservation space (ERO and SRP 2008, pp. 169-170). Changes to dam operations have been considered and evaluated at Alamo Dam along the Bill Williams River in western AZ. Because Alamo Dam is primarily a flood control structure, there is some flexibility in the storage and timing of below-dam river flow. Currently the ACOE, Service, AGFD, and others are evaluating changes to Alamo Dam operations which could improve habitat at the lake and downstream. Overall, this option appears to be rare throughout the Southwest.

Figure 4. Panoramic views of the Tonto Creek inflow to Roosevelt Lake, AZ, in April 2004 (top) and April 2005 (bottom). The extensive flycatcher breeding habitat in the top photograph (2004) was completely inundated during the 2005 breeding season. Photographs by U.S. Geological Survey.

The development of major dams throughout the western United States occurred throughout much of the 20th Century, but the future development of abundant large dams on major streams does not appear likely (Billington *et al*. 2005, pp. 411-412). However, the reliance of society on these existing structures reinforces the importance of their ongoing persistence and operation. By 1996, the major water resource regions that include the flycatcher contained 4,659 dams of all sizes and 173 dams with storage capacity of greater than 100,000 acre feet (USFWS 2002, p. J-1). Overall, human populations in the arid southwestern United States continue to be the fastest growing in the country (Mackun and Wilson 2011, p. 2). More than 20 million people in the region depend directly on water from the dams and delivery structures, and as many as 50 million enjoy at least indirect benefits such as electricity from the regional power grid and recreation opportunities afforded by the rivers and reservoirs (USFWS 2002, p. J-1). Thus, the ongoing presence and operation of dams remain the greatest threat to flycatchers and their habitat; we expect it will be the most challenging to overcome in the species' recovery, but management activities, typically associated with implementation of the ESA, are currently working to reduce the threat.

<u>Diversions and Groundwater Pumping</u>
Surface water diversions and groundwater pumping for agricultural, industrial, and municipal uses are major factors in the deterioration of flycatcher habitat (USFWS 2002, p. 34). River flows and groundwater in the Southwest are appropriated, meaning that many different individuals, corporations, tribes, and government entities own the rights to withdraw and use the water within a specific set of allocations and priorities.

The principal effect of diversion and groundwater pumping activities on the flycatcher and its habitat is the simple reduction of water in riverine ecosystems and lowering of associated subsurface water tables, therefore removing or reducing the essential component that creates conditions for abundant riparian habitat to persist. Water in streams can be removed bit by bit through hundreds of small shallow groundwater pumps and diversions, and in other instances surface water can effectively cease through larger diversion dams. Without elevated groundwater tables, native woody riparian vegetation such as willow and cottonwood are unable to germinate, grow, and flourish. The drying of riparian areas through diversion and groundwater pumping reduces the ability of the area to support the habitat and conditions necessary for flycatcher territories and successful reproduction and concurrently creates drier conditions more conducive to the occurrence of fire (USFWS 2002, Appendix L).

In the future, water diversions and groundwater pumping are likely to continue and expand throughout the flycatcher's range; two of the larger projects that are being planned target the upper Verde River, AZ, and Gila River, NM. In order to satisfy the growing urban populations in the City of Prescott and nearby communities, there are plans to pump groundwater from the Big Chino Aquifer at the headwaters of the Verde River (Wirt 2005a, p. A8), where 80 to 86% of the Verde River's base flows originate (Wirt 2005b, pp. F31-32). The USGS (Garner *et al*. 2013, p. 12, 24) estimated past upper Verde River groundwater pumping and diversions up through and including the Verde Valley has led to about a 13% decrease (10,000 acre feet per year) in the annual base flow; and estimated that between 2005 and 2110, the upper Verde River base flow could decrease by an additional 8,100 to 12,400 acre feet per year (Garner *et al*. 2013, p. 28). This estimate did not include groundwater pumping planned from the Big Chino Aquifer and any associated mitigation measures that could occur, such as retiring nearby agricultural uses. The State of NM, through the 2004 AZ Water

Settlement Act (AWSA), has the opportunity to divert 140,000 acre feet of Gila River water in any ten-year period for the community of Silver City and nearby Cliff-Gila Valley (New Mexico Interstate Stream Commission 2013, pp. 1-6). Implementation of the AWSA in NM would include certain constraints that would take into account daily and seasonal flow standards before Gila River water could be diverted. The AWSA requires that notice be given to the Secretary of the Interior by December 31, 2014, whether NM intends to build a project (New Mexico Interstate Stream Commission 2013, p. 4).

Treated waste water discharged into streams can help generate riparian habitat and has been identified as a potential flycatcher recovery tool, especially in areas where water management has reduced stream flow (USFWS 2002, p. I-13). The Recovery Plan identified waste water as an important source of water along the Las Vegas Wash, NV; Santa Ynez River, CA; and Santa Cruz River, AZ (USFWS 2002, pp. I-13-14). Along the lower Salt and Gila river confluence, an area where stream flow has been reduced due to upstream diversion and damming, the City of Phoenix and ACOE established an agreement to supply treated waste water to manage riparian vegetation. This effort culminated in the development of the Tres Rios Safe Harbor Agreement, which included the flycatcher (USFWS 2013b). Conversely, in Los Angeles and Ventura counties, CA, tertiary treated water is being reclaimed. Along the Santa Clara River in Ventura County reclaimed waste water appears to have resulted in the drying of riparian vegetation that flycatchers previously relied upon (Holly 2011, pp. 1-2; BioResource Consultants, Inc. 2013, pp. 5-6, 27).

Water rights may be bought and sold, offering the opportunity in some cases for purchase of water for use by wildlife. However, purchase of water rights specific for the flycatcher population has been limited. Instead, water associated conservation actions will likely continue to rely on the existing (or highly similar) arrangement of water flows and rights. Entities such as The Nature Conservancy (TNC) and the Salt River Project (SRP) have been successful in acquiring properties with existing water rights, and managing those water resources to benefit wildlife, the flycatcher, and riparian habitat. However, severing and transferring irrigation water rights to instream flow (for the benefit of wildlife) is complex. Up until 2005, legal issues in the State of Arizona had prevented transfer applications from being approved (SRP 2011, p. 27, Medgal *et al*. 2011, pp. 267-269). Medgal *et al.* (2011, p. 269) reported that because of this complexity, other than the government, only TNC and a few individuals have held instream flow rights in AZ.

In addition to the legal difficulty in dedicating water for wildlife, even the way water law is written can create additional obstacles in conserving water for riparian habitat. For example, while groundwater and surface water form an interconnected hydrologic system, the State of AZ does not recognize this connection and regulates groundwater and surface water differently (Megdal *et al.* 2011, pp. 276-279). This split in the law provides a workable legal system, but it ignores the scientific reality that groundwater and surface water are often connected (Megdal *et al*. 2011, p. 276). Because of these different water management schemes, conflicts can arise when groundwater is hydrologically-connected to surface water. In most areas of the State, those with land overlying an aquifer could pump groundwater for the beneficial use of their land as long as the uses are reasonable. But if the aquifer and surface water are connected, nothing protects the surface water from depletion.

Water is a vital landscape component of flycatcher habitat and any attempt to use water to improve flycatcher habitat and populations must typically take into account the legal and economic aspects of water. In the Colorado River system, the "Law of the River" is the collection of international treaties, interstate compacts, court decrees, laws, rules, regulations and policies that govern the management, allocation and distribution of Colorado River water. Similar arrangements exist on all large rivers of the region that potentially provide flycatcher habitat, including coastal streams in CA; the Rio Grande in CO, NM, and TX; and Gila River in NM and AZ. However, there can be innovative flexibility. While slow to occur, site-specific in nature, and legally challenging, water purchases or modifications of existing legal arrangements can aid flycatcher recovery without disrupting established legal commitments. However, there appear to be few options for wide-scale changes to these and other river systems where water is regulated, diverted, and pumped in varying amounts by multiple parties. Groundwater pumping and diversion is one of the more widespread, ongoing, and significant impacts to the flycatcher and its habitat, with an expected increased need for water as human populations continue to grow (USBR 2005, p. 5).

<u>Channelization and Bank Stabilization</u>

Southwestern stream courses ecosystems have also been modified through physical manipulation. Channelization, bank stabilization, levees, and other forms of flow controls are carried out chiefly for flood control. Engineering activities, such as levees, can affect riparian systems by separating a stream from the floodplain. Stream control structures can prevent overbank flooding, reduce the extent of alluvial-influenced floodplain, reduce water tables adjacent to streams, increase stream velocity, increase the intensity of extreme floods, and reduce the volume and width of riparian habitats (Szaro 1989, pp. 77-80, Poff *et al.* 1997, pp. 772-779). Similar to groundwater pumping and diversions, the impact of these manipulations are difficult to quantify individually, and collectively have a greater impact on the development of flycatcher habitat.

Similar to the impact associated with water withdrawal, these activities are widespread and numerous throughout the flycatcher's range, and as a result, reducing the impact of these structures is challenging because these manipulations are often associated with protection of private property, water delivery, and in some instances can be associated with range and livestock management. For example, the Tonto National Forest in central AZ is currently evaluating the development of a broad, but unknown number of erosion control structures such as check dams, waddles, rock structures, or log structures along streams throughout the upper Salt River watershed in central AZ with potentially negative results to flycatcher habitat (Tonto National Forest 2013a, p. 8, 2013b, p. 93).

However, site-specific instances of improvement have also occurred. For example, a 3,390 foot long dike along the upper Gila River was removed in order to improve stream function by allowing the river increased access to its floodplain, thereby increasing the overall area where riparian habitat can grow (USFWS 2011a, pp. 2-6). And even though the International Boundary and Water Commission (IBWC) proposed future maintenance and management of levees and river channels along 105 miles of the Lower Rio Grande in NM, a portion of their project was to reduce the impacts and stressors of past actions to encourage better river function, more riparian vegetation, and flycatcher habitat (USFWS 2012a, pp. 2-13). Not only is the desire to implement these types of improvements infrequent, but the effort can require a great deal of technical expertise, labor, permitting, and funding. In these last two examples, the State of Arizona's Water Protection Fund and the Service's Partners for Fish and Wildlife Program contributed funding in AZ, while the Audubon Society and the Elephant Butte Irrigation District collaborated toward implementation of riparian improvement sites in NM.

Tamarisk leaf beetle

Tamarisk is a significant vegetative component of the flycatcher's breeding and foraging habitat (Durst *et al*. 2008, p. 15). Tamarisk is also an exotic plant within the flycatcher's breeding range, and often misunderstood for the reasons behind its presence and proliferation throughout the southwestern United States (Gelt 2008, pp. 2-3; Nagler *et al*. 2009, pp. 11-31). As introduced in section 2.3.1.7, the Flycatcher Recovery Team (1998) expressed great concern over the import and release of the leaf beetle into the western United States and the potential impact to the flycatcher and its habitat. Those Recovery Team concerns about the anticipated impacts from the tamarisk leaf beetle have been realized; introduced beetles have expanded beyond their expected geographical limitations into the flycatcher's breeding range and thrived (Figure 5).

Rangewide, about 50% of all known flycatcher territories are located within sites where the habitat includes native/exotic vegetation mixtures (Durst *et al.* 2008, p.15). Nesting habitat comprised mostly of native vegetation accounts for fewer than half (44%) of the known flycatcher territories (Durst *et al.* 2008, p.15). Exotic plants (primarily tamarisk) can be important to nesting flycatchers by providing the preferred densely vegetated lower strata habitat structure (Durst *et al.* 2008, p.15) and supporting insect prey species for health and successful reproduction (Sogge *et al.* 2005, pp. 5-6).

Leaf beetles defoliate tamarisk during the early portion of the flycatcher breeding season, reducing the vegetative cover relied upon for successful nesting (Paxton *et* *al.* 2011b, pp. 256-257). Along the Virgin River where nesting flycatchers and beetles occur, tamarisk was defoliated while birds were nesting, degrading habitat quality (i.e. vegetative cover, humidity), likely causing or contributing to flycatcher nesting failure (Figure 6) (Paxton *et al.* 2010). Paxton *et al*. (2011, pp. 261-262) described the effect of this sudden habitat change on nesting flycatchers and other riparian birds as an "ecological trap" (Figure 7 & 8). It is anticipated that tamarisk will re-sprout following defoliation and continue those cycles until some proportion of the tamarisk trees die, which itself may eliminate or reduce nesting flycatcher habitat suitability (Paxton *et al*. 2011b, p. 258).

From their initial release, beetles have spread into the flycatcher's breeding range in southern NV, southern UT, northern AZ, and northern NM (Figure 5). A southern-adapted tamarisk leaf beetle was released along the Rio Grande in TX that is more adapted to the arid southwestern desert environments of southern AZ and NM and is now moving north, farther into the flycatcher's breeding range. It is now believed that the beetle is capable of spreading and defoliating tamarisk throughout the full breeding range of the flycatcher (APHIS 2010a, p.5, Tracy *et al*. 2008).

Tamarisk is most prevalent as a part of the flycatcher's habitat within the central part of its range in AZ, but it also occurs within territories in NM (particularly along the Rio Grande), as well as southern NV, southern UT, small portions of southern CA, and possibly southwest CO. Throughout these areas where tamarisk is a part of the flycatcher's nesting habitat, it is likely the impacts of the beetle will be varied, as would the land management response (should they reach farther into the flycatcher's range and be effective defoliators). Along some streams or portions of streams, we can anticipate that relatively little to no effort would be necessary to address the potential impacts of the beetle. In other areas the ability to develop self-sustaining native riparian forests could be incredibly difficult and costly (see discussion below on the San Pedro and Lower Colorado rivers).

The San Pedro River in southern AZ, where tamarisk is present, may be a stream where there will be relatively minimal change in overall habitat quality if defoliation by the beetle occurs. Because the San Pedro River maintains its natural hydrologic regime (Poff *et al.*1997, pp. 770-771) and land/water management stressors are reduced (relative to other southwestern streams), we believe it is reasonable to anticipate native vegetation can continue to flourish and overall impacts to flycatchers and/or their habitat to be minimized, localized, or temporal in nature.

In contrast to the San Pedro River, we can anticipate the beetle causing greater impacts to existing streamside riparian vegetation quality along the length of the lower Colorado River from Glen Canyon Dam into Mexico. Along most of the lower Colorado River, dam construction and subsequent river management have led to a nearly complete streamside vegetation shift from native woody riparian plants (i.e. cottonwood/willow) to exotic woody vegetation (primarily tamarisk)

(USBR 2000, pp. 14-15, 30-35). Because of this water regulation, hydrologic conditions along the banks and relict floodplain (streamside) that exist (i.e. higher soil salinity, reduced groundwater elevation, loss of natural hydrologic regime, etc.) prevent native woody tree species from flourishing naturally (USBR 2000, p. 37). Therefore, even in tamarisk's absence, we would not anticipate native woody trees to become established and flourish along the streamside, but rather other plant species that would likely be of lesser quality for riparian-dependent wildlife. The lack of establishment of native woody streamside vegetation following impacts from the beetle will likely create greater management challenges for the most regulated streams, like the lower Colorado River.

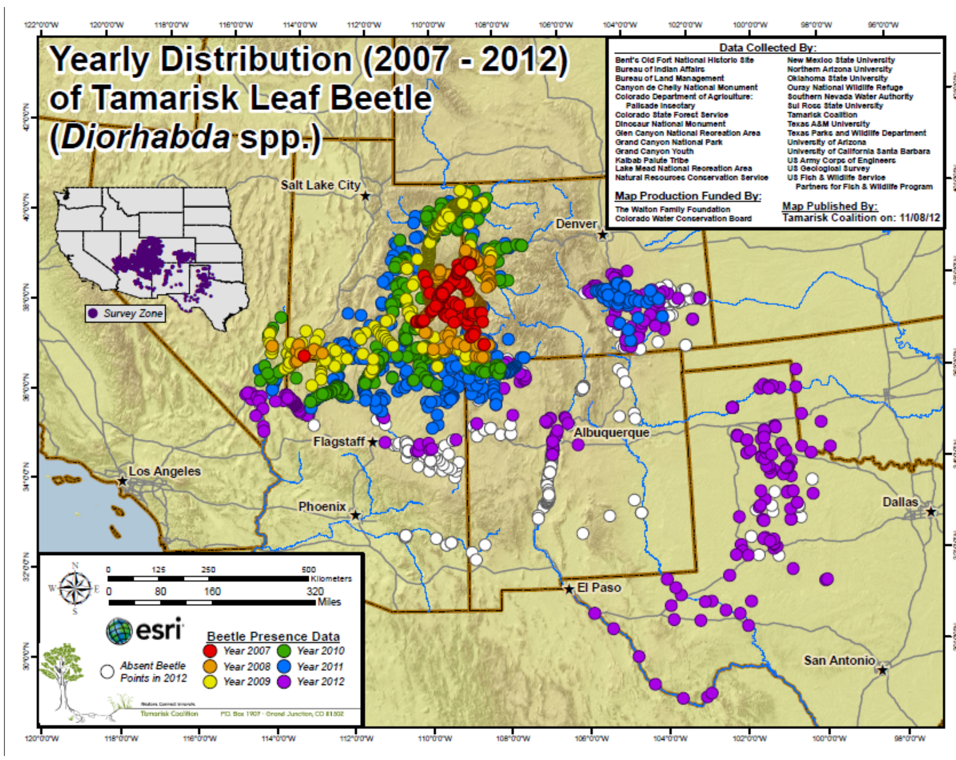

Figure 5. Yearly distribution of the detection of tamarisk leaf beetles, 2007-2012. Map produced by the Tamarisk Coalition, Grand Junction, CO.

There are streams or stream segments where beetle-related impacts to riparian vegetation may be significant, but where there will be opportunities to implement more traditional management actions to increase the abundance and distribution of native riparian habitat. The most appropriate habitat management strategies over parts of the flycatcher's range will be a combination of active and passive habitat management techniques (Shafroth *et al*. 2008, pp. 104-105, USFWS 2002; Appendix K). These strategies would combine reducing existing key land and water management stressors that have prevented native riparian vegetation from flourishing (i.e. groundwater pumping, surface water diversion, dam operations, over grazing, recreation, etc.), and in combination, preserving or planting native woody riparian plants to help provide a seed source and/or create refuge habitat until management actions can take effect, and the overall native riparian forest begins to recover.

Figure 6. Active flycatcher nest (center) that failed in tamarisk-dominated habitat along the Virgin River during a 2008 defoliation event caused by introduced leaf beetles, St. George, UT. Photograph by P. Wheeler, Utah Division of Wildlife Resources

At a broad level, it is not reasonable to expect that native riparian habitat will re-establish on floodplains where tamarisk flourishes along altered streams or that planting native trees will establish naturally functioning native riparian forests (USGS 2010, pp. 3-4). Within the flycatcher's breeding range, tamarisk flourishes largely because anthropogenic stressors degrade conditions favorable to establishment of native trees and improve conditions favorable for tamarisk (Stromberg *et al*. 2005, p. 303). In other words, the distribution and abundance of tamarisk is symptomatic of the more difficult and broader issue of land and water management and should be considered within the context of the underlying physical and biological processes that shape the ecosystem (Stromberg *et al.* 2005, p. 303). To provide meaningful long-term solutions to improving the quality of streamside riparian areas, attention must be given to reducing the stressors that create conditions that allow tamarisk to flourish and prevent native trees from persisting.

It is important to point out that concern for leaf beetle impacts are not restricted to the flycatcher, but extend to other riparian-dependent wildlife that rely on tamarisk as surrogate habitat. Sogge *et al*. (2008, p.148) examined data from the AZ Breeding Bird Atlas (Corman and Wise-Gervais 2005) and the Birds of North America species accounts and found that 76% (22 of 29) of low-to-mid elevation breeding riparian birds nested in tamarisk. Collectively, in these two documents, Sogge *et al*. (2008, p.148) described that 49 species throughout the western US were found to have nested in tamarisk. So while the flycatcher generates much of the attention because it is federally listed, there is concern for other species.

Figure 7. Virgin River streamside riparian habitat comprised primarily of dense, green tamarisk prior to June 1, 2010, Littlefield, AZ. Photograph by M. Kuehn, U.C. Santa Barbara.

Figure 8. Virgin River streamside riparian habitat comprised primarily defoliated and dead tamarisk following impacts from tamarisk leaf beetles, June 20, 2010, Littlefield, AZ. Photograph by M. Kuehn, U.C. Santa Barbara.

Because about 50% of all known flycatcher territories contain tamarisk as an important vegetative component and the beetle is anticipated to occur and impact tamarisk across the southwestern United States, the beetle is a significant threat to the quality and quantity of flycatcher habitat and recovery. This threat is emphasized especially in areas where native riparian habitat is unable to flourish due to land and water management activities, such as portions of streams regulated by dams, or affected by diversion/groundwater pumping.

While the Recovery Plan did not address the spread and occurrence of beetles throughout the flycatcher's range, it did provide tools for the best evaluation and improvement of riparian habitat. Because the distribution and success of tamarisk is largely symptomatic of changes to rivers, groundwater, hydrology, etc., the Recovery Plan provides specific appendices dedicated to the management of streams and habitat (i.e. river damming, river diversion/groundwater pumping, overgrazing, exotic vegetation, recreation, etc.). What the Recovery Plan did not take into account was the prioritization of recovery tasks in the face of beetles (USFWS 2002, pp. 142-169).

<u>Urbanization</u>

Urbanization in or next to flycatcher habitat provides the catalyst for a variety of related and inter-related direct and indirect effects to riparian ecosystems that can impact flycatchers and their habitat (see other sections in this evaluation). Urban development, even in areas away from streams with flycatcher habitat, can create increased demands for domestic and industrial water use. These demands are satisfied by diverting water from streams or through groundwater pumping. Municipal water management often involves developing reservoirs, removing or limiting riparian habitat, and creating flood control structures to alter stream courses and washes to protect floodplain development. Urban development can ultimately begin the slow degradation of habitat by instigating further activities that remove natural river processes and/or adding other stresses to riparian areas.

Urbanization provides the need for improved infrastructure such as increased or improved transportation systems that include bridges, roads, and vehicles, which can impact riparian habitat and wildlife. Marshall and Stoleson (2000, p. 18) described placement of bridges that resulted in the loss of seven known flycatcher territories in NM and AZ, and the possible collision and death of a flycatcher in AZ. Road and bridge renovations and developments have continued to be proposed, authorized, and developed in flycatcher habitat along streams such as the Gila (USFWS 2006), Virgin (USFWS 2010b), San Pedro (USFWS 2012b) and Big Sandy rivers (USFWS 2003b) and Tonto Creek (USFWS 2011b).

Establishing housing developments near rivers promotes additional risks to the rivers, riparian habitat, and flycatchers. Increased human presence generates a demand for recreational use of riparian areas. Developments can increase trash, bird feeders, and people, and as a result those can facilitate a more established or increased presence of brown-headed cowbirds (*Molothrus ater*), house cats, and other predators (e.g. great-tailed grackles, common ravens). Developers may remove or modify habitat nearest the floodplain, which can provide food, sheltering, perching, and foraging for the flycatcher. Development can reduce infiltration of water into the soil through changes in ground cover (i.e. concrete and asphalt). Urban development can also produce pollutants to the environment through run-off, waste, and other chemicals; and increase the occurrence of exotic plant species and flammable ignition sources.

Human populations are increasing across the southwestern United States. The USBR (2005, pp. 4-5) compiled a list of interrelated realities of water management that are creating “crises” in important areas in the West, noting explosive human population growth from 1990 to 2000. The USBR (2005, pp. 1-27) anticipates this growth will stress already limited water resources and the greatest conflict potential is anticipated to occur in areas within the flycatcher’s breeding range (USBR 2005, p. 9). From 1990 to 2000, AZ (40%) and NV (66%), two of the most arid states in the Nation (USBR 2005, p. 7), were the states with the greatest percent change in population growth (USBR 2005, p. 5). From 2000 to 2010, those trends in population increases continued; the largest percent increase nationally occurred in AZ (25%), NV (35%), and also UT (24%) (Mackum and Wilson 2011, p. 2).

In southern CA, a collection of HCPs have been completed by a variety of local governments in order to address threatened and endangered species and include them in overall community planning. For example, the flycatcher has been included in the completed HCPs for southern San Diego County (USFWS 1998b), the City of Carlsbad (2004) in northern San Diego County, Western Riverside County (USFWS 2004b), , and in two regions of Orange County (USFWS 2007). Large-scale HCPs such as these can be complex and take many years to develop, but the end result can foster a strategic ecosystem-based approach to habitat conservation planning. Through this process, the urban development permitted as the HCP process also addresses dozens of listed and other “covered” species, avoids and minimizes threats, and promotes habitat preservation and species conservation.

Throughout the southwestern United States we can anticipate expanded urbanization into areas where flycatcher habitat occurs and the multiple effects which are likely to follow. Even increased urbanization of communities far away from flycatcher habitat can draw water resources away from those essential habitats through canals and pipelines. When these changes occur and communities and infrastructure become established, the likelihood of reversing that change is slim. As a result of the wide-ranging inter-related impacts associated with urbanization that extend far beyond the footprint of an urban area, we believe urbanization to be a significant and increasing threat to the flycatcher and its habitat.

<u>Agricultural Development</u>

The availability of relatively flat land, rich soils, and high water tables in southwestern river valleys generated wide-scale agricultural development. Agricultural development can involve not only direct clearing of riparian vegetation (Figure 9), but also re-engineering floodplains (e.g., draining, protecting with levees), diverting water for irrigation, groundwater pumping, water storage, and applications of herbicides and pesticides.

In some river reaches, flycatchers can use riparian habitat that is partly sustained by agricultural return flows. Agricultural return flow can create atypical wet conditions farther away from the river and closer to the edge of the floodplain. However, in contrast to artificially developed areas, improved river condition and function would be more likely to develop a greater proportion of self-sustaining native vegetation and support flycatcher populations over the long-term. Depending on unique local situations, a reduction in agricultural return flows could pose a temporal impact or potentially more permanent impact to some flycatcher breeding sites.

A reduction in irrigated agriculture can create additional water and land for flycatcher habitat improvement. On streams such as the Gila, San Pedro, Verde, and Kern rivers, mitigation lands acquired for the flycatcher through implementation of HCP's (SRP 2002, ERO and SRP 2008) and biological opinions (USFWS 1996, 2000) led to a change in agricultural practices and overall habitat improvement. Agricultural fields have been retired and are in the process of being returned to native grasses and plants, and previously diverted water has been reduced or allowed to remain in the aquifer and stream, where it is available to riparian plants.

Strips of riparian vegetation that develop along drainage ditches or irrigation canals can sometimes, under the right conditions, create or augment adjacent flycatcher habitat. Benefits to the flycatcher are greatest when these riparian vegetation strips are dense, abundant, and relatively near adjacent floodplain habitat and also when the vegetation is left undisturbed, as opposed to being periodically cleared.

Along regulated streams such as the lower Colorado River along the AZ/CA border, the Rio Grande, NM, and adjacent to Roosevelt Lake, AZ, agricultural fields and land management techniques have been used to create riparian habitat for the flycatcher and other riparian-dependent wildlife. As a result of the lack of natural function along the Colorado River, the USBR uses existing agricultural fields and associated water rights to cultivate riparian habitat (LCR MSCP 2004, pp. 5-37-40). Similarly, because of alteration to the Rio Grande, the Service manages water distribution at Bosque del Apache National Wildlife Refuge to simulate the timing and dynamic nature of river flow to facilitate riparian habitat germination and growth (Melanson 2012, pp. 4-5). Also, in order to provide habitat for flycatchers following the raising of Roosevelt Lake, SRP has attracted nesting flycatchers to willows and cottonwoods cultivated on a 20-acre agricultural field adjacent to the lake (SRP 2011, pp. 15-17) (Figure 10 and 11).

Figure 9. Agriculture development and loss of riparian habitat along San Pedro River, AZ.

There is likely some local site-specific development or improvement of agricultural lands across the southwestern United States that impacts existing or future flycatcher habitat, but on a broad level the pace of new agricultural development and expansion appears to be slow. In 1996, following the listing of the flycatcher as endangered, up to 1.2 miles of occupied flycatcher nesting habitat was changed to agriculture along the Santa Ynez River in CA (USFWS 2002, p. 37). But overall, across the southwestern states of AZ, NM, CO, and UT, according to research conducted by Vanderbilt University, the number of overall irrigated acres decreased from 1959 (approximately 5,630,000 acres/2,278,429 hectares) to 2007 (approximately 5,460,000 acres/2,209,631 hectares) (Perrone and Hornberger 2007, p. 1). While it appears that significant riparian habitat is not being lost to agriculture (and could be decreasing), irrigated agricultural represents four-fifths of the Southwest's water use (Ackerman and Stanton 2011, p. 20), (see Diversions and Groundwater Pumping) and as a result, represents an ongoing significant threat to the flycatcher, its habitat, and recovery.

<u>Livestock Grazing and Management</u>

Domestic livestock has been a significant contributing factor in the alteration of riparian habitats in the arid western United States (Rickard and Cushing 1982, p. 360; Kauffman and Kruger 1984, pp. 430-434; Cannon and Knopf 1984, pp. 234-237; General Accounting Office 1988, pp 8-13; Clary and Webster 1989, pp. 1-3, Schultz and Leininger 1990, pp. 295-296; Belsky *et al*. 1999, pp. 1-4; USFWS 2002, Appendix G). If not managed, livestock grazing can alter plant community structure, species composition, relative abundance of species, and stream channel morphology, and increase cowbird nest parasitism (Goguen and Matthews 2007, pp. 1862-1869).

Figure 10. Cultivated riparian habitat for flycatchers at Rockhouse Farm, October 2011, Roosevelt Lake, AZ. Photograph by C. Paradzick, Salt River Project.

Figure 11. Interior of riparian habitat plantings at Rockhouse Farm, May 2011, Roosevelt Lake, AZ. Photograph by R. Valencia, Salt River Project.

The primary impact from livestock grazing is the feeding in and on riparian habitats. Livestock use of riparian vegetation can reduce the overall density of vegetation, which is a primary attribute of flycatcher breeding habitat (Taylor 1986, pp. 254-257). Palatable broadleaf plants like willows and cottonwood saplings may also be preferred by livestock, as are grasses and forbs comprising the understory, depending on season and the availability of upland forage. Flycatchers nesting in low-stature habitats, such as those found in high-elevation short-stature willows, may be vulnerable to livestock that physically contact and destroy nests as they move through flycatcher habitat (Sanders and Flett 1989, p. 263). In order to seek shade, livestock may also degrade and fragment nesting habitat by trampling vegetation and creating trails that nest predators and people may use (USFWS 2002, pp. G 4-7). Furthermore, improper livestock grazing in watershed uplands above riparian systems can cause bank destabilization, increased runoff, increased sedimentation, increased erosion, and reduced capacity of soils to hold water (USFWS 2002, p. G-5).

The effects of livestock grazing vary over the range of the flycatcher, due to variations in grazing practices, climate, hydrology, ecological setting, habitat quality, and other factors. Also, other stressors affect the flycatcher's habitat to varying degrees, including water management practices, stream channel control, recreational use, wild ungulate grazing (e.g. elk), and agricultural activities. In some situations, these and other factors may aggravate livestock impacts, and are sometimes difficult to separate from domestic grazing effects.

Because the impact of livestock herbivory can be highly variable both geographically and temporally, grazing management strategies to improve riparian habitat must be developed locally (USFWS 2002, p. G- 32). Measures to reduce the impact of herbivory in riparian areas have resulted in improvements in flycatcher habitat, territory distribution, and abundance along streams in the Southwest. For example, in central AZ, improved grazing management is believed to have contributed to habitat improvement and expansion of flycatcher breeding sites along Tonto Creek and the Salt River on the Tonto National Forest (Tonto National Forest 2013, pp. 27-30) and nearby Pinal Creek (Freeport McMoRan 2012, p. 5). Similarly, acquisition and/or management of private properties specifically for riparian habitat and/or flycatcher habitat by agencies and groups such as the ACOE, USBR, TNC, Los Angeles Department of Water and Power (LADWP), and SRP have improved cattle management along portions of streams such as the San Pedro, Gila, Verde, Santa Clara, Owens, and Kern rivers. Along both the upper Gila River in the Cliff-Gila Valley, NM, and along the Kern River, CA, livestock operators are able to support flycatcher habitat and populations while continuing their grazing operations through a unique combination of abundant water resources and use of alternative pastures outside of the riparian areas (USFWS 2002, p. G-21). With these resources available, operators are able to relieve pressure on the riparian areas and reduce potential conflicts (USFWS 2002, p. G-21). To contribute to improved private land management in 2012, the National Resource Conservation Service (NRCS), in combination with the Service, included the flycatcher in the "Working Lands for Wildlife Program." This rangewide program provides matching funds to private landowners to implement land management actions that could enhance, improve, maintain, and/or protect flycatcher habitat including improved livestock management.

The Technical Flycatcher Recovery Team Subgroup noted that, "the effort to fine-tune recovery recommendations with respect to livestock grazing is worthwhile, as livestock operators, biologists, and management agencies increasingly learn that much can be accomplished by working together" (USFWS 2002, p. G-22). Through an extensive literature review, the subgroup concluded that with respect to livestock grazing, flycatcher recovery would be most assured, and in the shortest time, with total exclusion of livestock grazing from those riparian areas that are deemed necessary to recover the flycatcher and where grazing has been identified as a principal stressor (USFWS 2002, p. G-22). However, "there is also evidence that under the right circumstances, certain types of grazing are likely to be compatible with recovery. While the data are insufficient to identify specifically what grazing systems are compatible in which specific circumstances, exploring the levels of grazing that may be compatible with maintenance of suitable flycatcher habitat is warranted" (USFWS 2002, p. G-22).

Maintaining, implementing, and documenting improved grazing strategies towards flycatcher recovery are still challenges throughout important areas of its breeding range. While habitat improvement and expansion of flycatcher breeding sites has occurred on the upper Salt River on the Tonto National Forest following the reduction in grazing pressure, a proposed increase of cattle in the riparian area is anticipated to cause adverse effects (Tonto National Forest 2013a, p. 40). It is uncertain whether the proposed increase in grazing and management can be compatible with the maintenance and development of flycatcher habitat at this location. Trespass cattle or conflicts with wild ungulates, such as elk, can add additional challenges to land management. For example, trespass cattle along the Virgin River in NV, from neighboring private lands, have impacted flycatcher habitat on BLM and State-managed wildlife conservation lands (S. Cooper, USFWS, pers. com). There are other federal lands throughout its breeding range where flycatchers are not known to occur and where grazing is believed to be a significant stressor; improved grazing practices and flycatcher surveys could increase the quality of habitat, the known distribution and abundance of territories, and contribute towards reaching recovery goals.

There is a general lack of specific information from land managers about grazing strategies that can be replicated which can sustain riparian habitat and flycatcher populations (USFWS 2002, p. G-1). In various parts of the flycatcher's range such as the Owens River in CA (LADWP 2005, p.6) and the San Luis Valley in CO (ERO 2012, p. 128), land managers have committed to implement grazing strategies which can increase the quality and quantity of flycatcher habitat. Efforts on these lands and others will be important to not only improve and maintain flycatcher habitat, but to also document sustainable and repeatable practices that contribute to flycatcher recovery.

Cattle ranching on private, tribal, state, and federal lands have a long tradition throughout much of the Southwest, with riverine and riparian areas as important portions of these operations. Because of the variety of land owners and managers associated with this activity over a broad geographic area, the impact of livestock grazing is not localized. However, where grazing is a significant stressor, a change in grazing management can improve riparian habitat quality. Therefore, because of the combination of these two factors, we believe that livestock grazing is an ongoing moderate threat to the flycatcher and its habitat. We continue to encourage partnerships and cooperation toward finding innovative solutions and common ground that can further improve grazing management and compatibility with flycatcher recovery.

Fire

Although fires occurred to some extent in some southwestern riparian habitats historically, many native riparian plants are neither fire-adapted nor fire-regenerated. Busch (1995, pp. 264-265) documented that the current frequency and size of fires in riparian habitats on two regulated rivers (Colorado and Bill Williams) is greater than historical levels because reduced floods have allowed buildup of fuels, and because of the expansion of the highly-flammable tamarisk. Especially at lower elevations of the flycatcher's range, land and water management stressors have created drier conditions with more flammable vegetation (including giant reed (*Arundo donax*)) that has led to fires, causing immediate and drastic changes in riparian plant density and species composition. In addition to natural ignition sources, such as lightening, there are increased anthropogenic sources from power lines and land clearing activities (ERO 2012, p. 76) to recreational, accidental, and negligent incidents. An increase in fuels generated by defoliation and mortality associated with the tamarisk leaf beetle may increase the impact and extent of fire in the future. Not surprisingly, the riparian plant species likely to recover following a fire are expected to be associated with the hydrologic conditions at a site; as a result, where elevated groundwater occurs, re-establishment of native plant communities is more likely (Smith *et al.* 2009, pp. 49-50). In contrast, where land and water management are stressors have caused groundwater elevations to decline or changed river hydrology, etc., establishment of native riparian trees following a fire would be less likely.

Riparian wildfires have occurred and impacted flycatcher habitat and nesting sites. Near the completion of the Recovery Plan, fires affecting riparian flycatcher habitat were recorded along the Rio Grande in NM, the San Pedro and Gila rivers in AZ, Colorado River along the AZ/CA border, and in the Escalante Wildlife Area in CO (USFWS 2002, p. 36 & Appendix L). Fire in riparian areas has continued to be documented at flycatcher breeding sites and within its breeding range, such as the Gila and San Pedro rivers (SRP 2011, pp. 27, 39-44) in AZ (Figure 12), and the middle Rio Grande in NM (Smith *et al.* 2009, p. 42).

In addition to the traditional firefighting actions by Federal (USFWS 2011c, pp. 27-31) and state land managers, other actions have been implemented to reduce the occurrence and/or impact of fires in flycatcher habitat. For example, the Forest Service consulted under section 7 of the ESA, on hazard vegetation management by power companies within transmission line corridors across National Forests in AZ to reduce power outages and wildfire (USFWS 2007, pp. 3-7; 2008, pp. 5-16). Because of the challenge of fighting fires on rural private lands, SRP developed response plans and established key contacts to help reduce the fire impacts on their AZ flycatcher mitigation properties (SRP 2011, p. 25). Additionally, a Tonto National Forest Protection Officer, working specifically toward flycatcher habitat protection, issued 16 citations for violating fire restrictions (including one for abandoning a fire) and educated hundreds of people at campsites about fire rules and restrictions at Roosevelt Lake (SRP 2011, p. 19).

Figure 12. Aerial view of Gila River flycatcher habitat conservation area following fire, February 15, 2011, near Fort Thomas, AZ. Photograph by C. Paradzick, Salt River Project.

While there has been an increased risk of fire in flycatcher habitat over time, especially at mid to lower elevations across the flycatcher's breeding range, the occurrence of fire has been site-specific and not widespread. As a result, we believe that fire is currently a moderate threat to the flycatcher and its habitat. However, with the anticipated increase in fuels related to defoliation and mortality of tamarisk caused by the tamarisk leaf beetle (Drus *et al.*2012) (and possibly under future drought and climate change scenarios), fire may become a greater threat in the future, especially in the central portion of the flycatcher's breeding range.

Recreation

In the Southwest, recreation is often concentrated in riparian areas because of the shade, water, aesthetic values, and recreation opportunities. As regional human populations grow, the magnitude and cumulative effects of these activities are considerable. Effects include: reduction in vegetation through trampling, clearing, woodcutting and prevention of seedling germination due to soil compaction; bank erosion; increased incidence of fire; promoting establishment of exotic plant species; promoting increases in predators and scavengers due to food scraps and garbage (ravens, jays, grackles, skunks, squirrels, domestic cats, etc.); promoting increases in brood parasitic cowbirds; and noise disturbance. Recreational development also tends to promote an increased need for foot and vehicle access, roads, pavement, trails, boating, and structures (e.g. verandas, picnic areas, camp sites), which fragment habitat. Reduction in the density and diversity of bird communities, including willow flycatchers (*E. t. adastus*), have been associated with recreational activities (Blakesley and Reese 1988, pp. 401-402; Szaro 1980, p. 413 & 1989, pp. 80-81; Knight and Cole 1991, pp. 238-239; Riffell *et al*. 1996, pp. 498-502; Marshall and Stoleson 2000, p. 18).

Management of recreation in and around flycatcher habitat can result in effective protection of riparian habitat, and conversely, less management of recreation can increase impacts to flycatcher habitat. The Tonto National Forest developed a broad vehicle closure surrounding portions of the exposed floodplain of the Roosevelt Lake conservation space where a flycatcher breeding population occurs. The closure was designed to reduce impacts to the flycatcher and its habitat, and provide other land management benefits within this area, such as a reduction in the occurrence of fire (USFS 2012, pp. 162-163). While foot and boat traffic allowed access to recreation areas within this dynamic floodplain, the vehicle closure was successful in helping to protect habitat for one of the largest breeding populations of nesting flycatchers (USFWS 2013a, pp. 427-428). The Forest has since developed a proposal to develop additional roads and trails and increase recreational opportunities at Roosevelt Lake within previously closed areas that may adversely affect flycatchers and their habitat (USFS 2012, pp. 162-163).

The impact of recreation is also a concern on non-federal conservation lands. State managed wildlife areas in NV along the Virgin River are affected by surface and noise impacts from recreation (USFWS 2013a, p. 486). Tribal management plans developed for riparian areas along the AZ/CA border on the lower Colorado River all identified alleviation of recreation impacts as a management objective (USFWS 2013a, pp. 413-414). Flycatcher conservation land management reports compiled by SRP along the Verde (SRP 2011, p. 38; 2013, B-11), Gila (SRP 2009, p. 24; 2012, p. 19; 2013 B-14), and San Pedro (SRP 2013, p. 36) rivers all describe concerns for impacts from recreationists, hunters, trespassers/vandals, and/or all-terrain vehicles. Overall, based upon the broad geographic nature and variety recreation-based impacts, we believe recreation is currently a moderate threat to the flycatcher and its habitat. Additionally, along the Owens River in CA, LADWP implements recreation management along riparian areas (LADWP and Ecosystem Science 2010, Chapter 4, pp. 3-4) to minimize the type, abundance, and location of access (LADWP 2005, pp. 6-7).

Phreatophyte Control

In some areas riparian vegetation (native and non-native habitat) is removed from streams, canals, and irrigation ditches to increase watershed yield, remove impediments to stream flow, and limit water loss through evapo-transpiration (Graf *et al.* 1984, pp. 1-2; USFWS 2002, p. 35). Plants with a root system that draws its water supply from near the water table are often described as "phreatophytes." Methods for removing vegetation include mowing, cutting, root plowing, and application of herbicides. Clearing or mowing riparian habitat can also result in establishment of other exotic plants species, with potentially other risks. The results are that riparian habitat is eliminated or maintained at very early successional stages, which is not suitable as flycatcher breeding habitat (Taylor and Littlefield 1986, pp. 1171-1172).

River managers do not always view groundwater-supported phreatophyte forests positively. Water users believe that the water transpired by the vegetation could be "salvaged" and used if they remove the phreatophytes, a concept that gave rise to phreatophyte removal programs and subsequent studies beginning in the 1930s and 1940s (Graf *et al*. 1984, pp. 8-9; 1991, p. 14; Chew 2009, pp. 24-25; Stromberg *et al*. 2009, pp. 178-181; USGS 2009, p. 40). Extensive experiments, investments in tens of millions of dollars, and subsequent published research have demonstrated that water savings from phreatophyte removal is very limited (Graf *et al.* 1984, p. 14; Graf 1991, p. 15). However, such programs continue, such as a 1997 project along the Pecos River in NM, which chemically treated about 2,700 acres of tamarisk, resulting in 85 to 90% plant mortality, but with no increase in river flow (Shafroth *et al*. 2010b, p. 43). Fort Huachuca in AZ, withdrew a proposal to remove 900 acres of mesquite within the San Pedro River National Conservation Area in order to create water savings to contribute to the resource management of their military installation and the Town of Sierra Vista (Fort Huachuca 2013, pp. 2-41-42).

Additional pressures to remove phreatophyte cover come from flood control interests who see riparian habitat growth in and near channels as reducing flow capacity and increasing the likelihood of flooding (ACOE 2011, pp. 4-8). The need to remove riparian habitat, while not related to river function, has also extended to the needs of the Border Patrol to improve visibility and detection along the Limnitrophe Division of the lower Colorado River by removing 560 acres of riparian habitat within about 24 linear river miles (USFWS 2008, pp. 3-4).

Groundwater storage or streamflow are not the only hydrologic characteristics that may be affected by vegetation removal (Shafroth *et al*. 2010b, p. 43). Removal of riparian habitat, including tamarisk and Russian olive has other impacts that also may affect the hydrologic setting and water availability, such as erosion, geomorphologic changes, water quality, sedimentation, wildlife habitat, and invasion by other nonnative plants (Shafroth *et al*. 2010b, p. 43).

Interest in salvaging significant quantities of water for human use remain a prime motivation for eradication of riparian plants (Graf *et al.* 1984, p. 1; Stromberg *et al*. 2009, p. 179). However, despite recent studies, experiments, and reports that phreatophyte control offers no panacea for western water shortages (Graf 1991, pp. 14-15; Shafroth *et al.* 2005, pp. 235-236; Nagler *et al.* 2008, pp. 142-143), projects still occur (Shafroth *et al*. 2010b, p. 43) and are proposed (Fort Huachuca 2013, p. 2-41-42).

The impact of phreatophyte control and similar habitat removal projects are typically a site-specific and serve as an overall moderate threat to the flycatcher and its habitat because these actions are less wide-spread and are not typically permanent. However, when these activities do occur, the effect of habitat removal can have great local impacts because they can directly remove all or much of the habitat flycatchers rely upon.

<u>Migration and Winter Range Habitat</u>

As a Neotropical migrant, the flycatcher spends more time (over two-thirds of the year) in migration and on the wintering grounds each year than it does on its North American breeding grounds (Sedgwick 2000, pp. 7-9). This part of the flycatcher's life cycle is the most difficult to study and evaluate because of its long-distance migratory movements; short-term and broad use of migration habitat; and time spent outside of the United States. Still, migrant and wintering flycatchers face a number of known and potential threats to its habitat and its survival during these non-breeding portions of the year.

Migration is a period of high energy demands, and migrating flycatchers must find suitable "stopover" habitat at which to replenish energy reserves needed for the next step of migration flight (Finch *et al*. 2000, p. 76-79). Insufficient stopover habitat could lead to increased mortality during migration, and/or prolonged migration resulting in late arrival to wintering or breeding sites (with reduced fitness upon arrival) (USFWS 2002, p. E-3).

Flycatcher use of riparian habitat along major southwestern drainages during migration has been regularly documented (Sogge *et al.* 1997, pp. 3–4; Yong and Finch 1997, p. 253; Johnson and O'Brien 1998, p. 2; McKernan and Braden 1999, p. 17; Koronkiewicz *et al.* 2004, pp. 9–11). Many of the willow flycatchers found migrating are detected in riparian habitats that would be unsuitable for nest placement (the vegetation structure is too short, and sparse, or the abundance of the overall vegetation is too small in size). Along these drainages, migrating flycatchers may use a variety of riparian habitats, including ones dominated by native or exotic plant species, or mixtures of both (USFWS 2002, p. E3). Migrant flycatchers can sometimes be found in unusual locations away from riparian areas (Finch *et al.* 2000, p. 76), but many, if not most, are detected while searching for nesting flycatchers along riparian areas (McLeod *et al.*2005, pp. 9–11; Ellis *et al.* 2008, pp. 26–27).

The introduction of the leaf beetle threatens to impact the quality and abundance of tamarisk within the flycatcher's range in the United States and Mexico that can be used for migration "stopover" habitat (shelter and foraging). Tamarisk is widespread across major river systems and reservoirs in the states of AZ, UT, CO, TX, NM, southern CA and NV (Shafroth *et al*. 2010b, p.12). As noted earlier, the leaf beetle has expanded its distribution farther than expected and is anticipated to impact the abundance and quality of tamarisk across the southwestern United States and Mexico. However, because of landscape changes to rivers from water and land management (damming, groundwater pumping, etc.) causing limitations to native riparian tree growth, we should not expect a commensurate increase in native riparian plants species following leaf beetle impacts to tamarisk. Research has found migrating riparian obligate birds, such as Wilson's warblers, acquire subtle benefits from using tamarisk by being able to refuel more quickly (Cerasale and Guglielmo 2010, p. 642). While there is no current credible estimate of the overall abundance of tamarisk, Shafroth *et al*. (2010b, p. 14-15) noted that it may be reasonable to assume that there are at least 900,000 acres (324,000 ha) within which tamarisk has a history of occurring. Regardless of the specific amount or estimate, tamarisk is one of the most common riparian plants within the flycatcher's migratory paths in the southwestern United States (Shafroth *et al*. 2010b, p. 18), and because of the leaf beetle, the amount of available migratory "stopover" habitat is undoubtedly expected to diminish in quality and abundance.

Knowing where the flycatcher population occurs throughout its annual cycle, such as its wintering location outside of the United States, is important for assessing threats and targeting conservation efforts at those areas important to the species' long-term viability (Bairlein 2003, pp. 249-150, Baker *et al*. 2004, pp. 875-876). Paxton *et al.* (2011a, pp. 615-616) suggests that there is moderate to strong geographic connectivity between the willow flycatcher subspecies' breeding and winter grounds. The distribution of the three western flycatcher subspecies on their breeding and winter grounds indicates a chain migration, where the more northern subspecies (*E. t. adastus* and *E. t. brewsteri*) winter in the northernmost portion of the winter range (Mexico and Central America) and the southernmost subspecies (*E. t. extimus*) winters farther . The southwestern willow flycatcher appears to winter primarily in the central to southern portions of Central America, with both a molecular genetics and museum study estimating Costa Rica as the primary wintering location (Paxton *et al.* 2011a, p. 614). Paxton *et al.* (2011a, p. 616) recommends that conservation of the flycatcher's winter habitat be initially focused on Costa Rica, with continued surveys and research to determine the extent of its winter range.

Surveys of wintering willow flycatchers and their habitats in Costa Rica, Ecuador, Guatemala, Mexico, and Panama (Nishida and Whitfield 2006, p. 25, Schuetz *et al.* 2007, p. 10), have found flycatchers occur within a wide range of habitats, generally characterized by trees or woody shrubs bordering standing or moving water. These habitats range from mature trees to young successional regrowth in disturbed habitats. However, natural sites with mature trees are possibly of higher quality than younger sites, but rarer than other habitats (Koronkiewicz *et al.* 2006, pp. 559-560, 568; Paxton *et al*. 2011a, p. 616), suggesting that continuing anthropogenic changes on the winter grounds may be degrading overall habitat quality. Willow flycatcher wintering habitat in Central America is often located in lowland areas that are subject to heavy agricultural uses, many of which negatively impact key habitat components (Koronkiewicz *et al*. 1998, pp. 26-29, Koronkiewicz and Sogge 2000, p. 1). In addition, agricultural chemicals and pesticides are described as being widely used in many regions where flycatchers migrate and wintering (Koronkiewicz *et al.* 1998, pp. 28-29; Nishida and Whitfield 2006, pp. 26-27), thereby potentially exposing flycatchers to contaminants. It is unknown if winter habitat is currently limiting for flycatchers (or exactly how much habitat is needed overall), but the amount of native lowland forest and wet areas that flycatchers currently use has decreased over the last 100 years (Koronkiewicz *et al*. 1998, pp. 26-29).

The annual cycle of migratory passerine birds, like the flycatcher, includes breeding, wintering, and two migration periods (spring and fall), with each having a different survivorship rate. Mortality of passerines is estimated to occur primarily in the nonbreeding period (Sillett and Holmes 2002, pp. 302-305), suggesting that breeding populations could be affected by events far from the breeding grounds, such as the migratory and wintering portions of their life cycle.

Based upon a long-term study across central Arizona (Paxton *et al*. 2007a), combined with an evaluation of winter survivorship (Koronkiewicz *et al*. 2006, pp. 558-570), much of the flycatcher's annual mortality did not appear to occur during their "stationary" periods (winter and breeding grounds) of the year, but during migration (Paxton *et al*. 2007a, p. 35). The average monthly estimate for winter season survival was 98%, which was similar to the monthly breeding grounds survival (99%) (Paxton *et al.* 2007a, p. 34). The USGS estimated that approximately 8% of the flycatcher's annual mortality is occurring on their breeding grounds, 28% on the wintering grounds, and 64% occurred on migration (Paxton *et al.* 2007a, p. 38). So, while the migratory period comprises only about one-quarter to one-third of a flycatcher's year, the highest proportion of estimated annual mortality occurs (Paxton *et al.* 2007a, pp. 37-38). Still, the estimated average adult flycatcher survival from central Arizona exceeded that of other passerine studies and is higher than the estimate for flycatchers at the Kern River (Paxton *et al*. 2007a, p. 37). As adult flycatchers age, their survivorship probability increases, suggesting that they may learn optimal strategies for foraging, predator avoidance, and migrating, and have presumably found high-quality wintering grounds (Paxton *et al*. 2007a, p. 37). If the flycatcher survivorship results of this long-term study, covering a broad geographic area, are representative, then this suggests that currently impacts to migrating or wintering flycatchers are not unusually excessive.

However, if migration is a limiting period for flycatchers, then increasing pressures on their migratory stop-over sites could suppress the population, delaying or hindering recovery efforts (Paxton *et al.* 2007a p. 38). In addition, a shortage of suitable migratory stop-over habitat may increase the time spent on migration, thus possibly increasing mortality during this already perilous time period (Paxton *et al*. 2007a p. 38).

The identification of the greatest proportion of flycatcher mortality occurring during migration and their wintering grounds combined with the anticipated loss of migratory stopover habitat from the leaf beetle and unregulated (or unmanaged) impacts to Central America wintering habitat, presents a moderate and potentially increasing threat to the flycatcher and its recovery. Possibly exacerbating the impacts to the flycatcher's migratory or wintering habitat during these itinerant and distant portions of their annual cycle are the effects from climate change (as noted earlier in this document). However, we still lack much basic information on habitat needs and threats to migrating and wintering flycatchers, such as whether different wintering and migration stop-over sites have different levels of mortality (Paxton *et al*. 2007a p. 38). The broad and distant geographic area where impacts to migrating and wintering flycatchers occur creates challenges to not only identify and understand the extent of any impacts, but to potentially implement effective conservation solutions.

Changes in Abundance of Other Species

<u>Exotic Plant Species</u>

Several exotic (non-native) plant species have become established in flycatcher riparian habitats. Tamarisk is the most widespread exotic plant and can be dominant in portions of southwestern riparian ecosystems, sometimes forming dense monotypic stands. Flycatchers will nest in riparian habitats containing mixtures of native vegetation and tamarisk, and those which are dominated by tamarisk (Durst *et al.* 2008, p.15). Other exotic plant species of note which can occur within the flycatcher's breeding range that are much less widespread and abundant compared to tamarisk, are Russian olive, tree of heaven (*Ailanthus altissima*), Siberian elm (*Ulmus pumilis)*, and giant reed.

Based upon the collection of new information, our understanding of whether tamarisk is actually a threat, or even a benefit to the flycatcher, has evolved since its listing in 1995. Our current understanding is that the spread of tamarisk and the loss of native riparian vegetation is primarily a product of land and water management actions. Additionally, the flycatcher has been found to use tamarisk extensively and reproduces successfully when habitat conditions are appropriate. Looking into the future, the recent introduction of the tamarisk leaf beetle adds an additional layer of complexity and threat to the flycatcher (see discussion on the leaf beetle above). Not to be understated, beyond the presence of tamarisk on the landscape, is the impact of how land and wildlife managers and private groups respond to and manage tamarisk. Application of habitat management actions that primarily target the removal of tamarisk where it flourishes but do not address the cause for the plant's persistence and reduction of native plants species are likely to not result in self-sustaining improvement (USFWS 2002, pp. K-11-14).

At listing, tamarisk was characterized as a threat to the flycatcher, but we also identified that further research was needed (USFWS 1995, p. 10708). We concluded that the spread of tamarisk was likely a factor in the loss and modification of flycatcher habitat (USFWS 1995, p. 10708). We summarized that tamarisk has "spread rapidly along southwestern watercourses, typically at the expense of native riparian vegetation, especially cottonwood/willow communities" (USFWS 1995, p. 10708). Further, we noted "manipulation of perennial rivers and streams has resulted in habitats that tend to allow tamarisk to outcompete native vegetation" (USFWS 1995, p. 10708). We also described that the flycatcher "…sometimes nests in tamarisk, but does so at lower densities, and apparently at lower success rates than in native vegetation" (USFWS 1995, p. 10699), and that potential impacts from tamarisk include low breeding densities, altered insect prey populations, increased occurrence of fires, loss of thermal protection, higher susceptibility to brood parasitism, etc. (USFWS 2005, p. 10708-10709).

By the time the Recovery Plan was completed, our understanding of the relationship between tamarisk and human-caused water and land management actions had improved, and more extensive surveys and research on flycatcher use of tamarisk had occurred (USFWS 2002, Appendix D&H). We found that in contrast to our characterization that flycatcher sometimes used tamarisk at low densities, the flycatcher extensively used tamarisk for nesting across its breeding range (Figure 13), adding that in 1998, three-quarters (194 of 250) of the known AZ flycatcher nests were in tamarisk (USFWS 2002, p. H-7). Also, different than our perspective that tamarisk had invaded and out-competed native vegetation, we presented and debated differing ideas about its proliferation, and more definitively concluded that human actions have facilitated the dispersal of tamarisk to new locales, and created opportunities for its establishment by clearing vegetation, modifying physical site conditions, altering natural river processes, and disrupting biotic interactions (USFWS 2002, p. H-11). We also concluded that "…tamarisk stands do mimic, to some degree, the riparian woodland structure once provided by willows. In the absence of willows, southwestern willow flycatchers nest in tamarisk at numerous river sites (and in some cases preferentially use tamarisk even when willows are present)" (USFWS 2002, P. H-7).

The flycatcher has taken advantage of the presence of tamarisk, especially where tamarisk flourishes in areas where landscape stressors impact the occurrence of native vegetation. This has created opportunities for flycatcher recovery where dam operations, agricultural practices, and other actions have helped generate large stands of tamarisk in conditions suitable for nesting flycatchers. Along less regulated and impacted streams, tamarisk may only represent a small overall proportion of the vegetation, but can be effective in adding to the lower stature, dense understory vegetation structure that nesting flycatcher prefers.

Figure 13. Southwestern willow flycatcher in tamarisk-dominated habitat, Roosevelt Lake, AZ. Photograph by Andre Silva, Tonto National Forest, U.S. Forest Service.

Specific research comparing the flycatcher's use of native plants and tamarisk was completed in central AZ by USGS (Sogge *et al.* 2005). While Sogge *et al.* (2005, p.1) provided caution about their conclusions being extended to the flycatcher's entire range (because the study occurred at a single location), they found no evidence from their long-term study that nesting in tamarisk-dominated habitat is detrimental to flycatcher physiology, immunology, site fidelity, productivity, or survivorship. And while they did detect a difference in the flycatcher's diet of insects between the two habitats, they did not determine that food resources are limiting or insufficient in one habitat compared to the other. Other items mentioned in the Recovery Plan (USFWS 2002, p. 39) indicate that unlike native trees, tamarisk can maintain its fine branching structure as it grows to maturity, which may make it attractive to nesting flycatchers for a longer period of time compared to some native willows. Furthermore, tamarisk flowers throughout much of the summer, which may be important in attracting pollinating insects (a major component of flycatcher diet) throughout the flycatcher's breeding season.

Research on riparian obligates, such as migrating Wilson's warblers, have found subtle benefits from tamarisk. Cerasale and Guglielmo (2010, p. 642) found that despite greater arthropod biomass in cottonwood and willow trees, migrating Wilson's warblers refueled more quickly in tamarisk, possibly as a consequence of high interspecific competition in cottonwood and willow habitat.

The USGS (Shafroth *et al.* 2010b), in a report specific to tamarisk and Russian olive requested by Congress, completed the most extensive assessment of tamarisk and its effects on the environment. From this assessment, many definitive, long-held beliefs about the impact tamarisk has on the environment were not supported by science. For example, tamarisk does not transpire excessive amounts of water (USGS 2010, p. 2), cause increased soil salinity (Shafroth *et al*. 2010b, p. 24), or preclude itself from being productively used by many wildlife species (USGS 2010, p. 2).

Resource managers, scientists, and the general public appear to have mixed views and understandings of why tamarisk persists and flourishes throughout portions of the Southwest, the costs and/or benefits of tamarisk, and the likelihood of establishing healthy self-sustaining riparian forests in areas where tamarisk has become the dominant vegetation type (Gelt 2008, pp. 2-3, Stromberg *et al.* 2009, pp. 177-178, 182). Gelt (2008, p. 1), when discussing the misunderstanding of issues surrounding tamarisk, wrote that what is "… at issue is the contribution of science to land and water management." Chew (2009), wrote exclusively on this topic, discussing that tamarisk "provides an example of scientific 'monstering' and how slaying the monster, rather than allaying its impacts, became a goal in itself." This is not particularly unusual considering there are state-to-state and/or stream-to-stream differences on the costs and benefits of tamarisk and the mechanisms of its persistence. Additionally, there continues to be inaccurate or misleading information published in various news and online articles, such as those written in the Las Vegas Sun (Tavares 2010) ("tamarisk, it chokes out native plants, sucks up precious water like a sponge and ruins recreation spots") that can perpetuate this confusion. A better understanding on why tamarisk flourishes in the southwestern United States and how to reduce or minimize those stressors to allow native riparian vegetation to flourish is necessary to address this issue on a range-wide level.

Russian olive is also well established in southwestern riparian systems, and is present in some current flycatcher nest sites, especially at mid-elevations. The foliage of Russian olive is more broad-leaved than tamarisk, and so may be similar to willows in the ways it affects microsite conditions of temperature and humidity. Other exotic trees, such as Siberian elm and tree of heaven occur in southwestern riparian ecosystems but do not appear to have value as flycatcher nesting habitat. Because the distribution of these other trees are more localized compared to tamarisk, the impact on the flycatcher may be limited to very local, perhaps minor changes in riparian community composition.

In southern CA (i.e. Santa Clara, Santa Margarita, and San Luis Rey rivers) and other locations in the Southwest, giant reed can form dense monotypic stands unsuitable for nesting flycatchers, while the biology of giant reed is well known, comparatively few studies have evaluated giant reed's impact to river form and processes (stream geomorphology, flood risk, sediment storage, erosion, and delivery, water transpiration) (Cal-IPC 2011, p. 50). Not unlike tamarisk, human alteration of river flood flow and sediment transport from such actions as dams and levees may influence the establishment of giant reed (Cal-IPC 2011, p. 89). The California Invasive Plant Council (Cal-IPC) (2011, p. 111) concluded that on selected streams, giant reed has greatly expanded its distribution and abundance since the 1980-1990s. Cal-IPC (2011, p. 118) compared geomorphic processes following giant reed removal and determined that removal created a greater active flow zone and dynamic system with potential for improved groundwater recharge, re-establishment of fluvial processes, and habitat function.

After examining why tamarisk flourishes, how flycatchers take advantage of tamarisk, and combining that improved understanding with the knowledge that flycatchers are abundant and reproduce successfully in tamarisk; our overall conclusion is that tamarisk, in and of itself, does not pose a threat to the flycatcher. This shift in understanding, in retrospect, should not be unexpected. Continued research does not support previous assertions about the many water and wildlife issues surrounding tamarisk (Sogge *et al.* 2005, p. 1; 2008, p. 1; Glenn and Nagler 2005, pp. 420-421; Stromberg *et al.* 2009, p. 177; and Shafroth *et al*. 2010b, pp. viii-x). However, our improved understanding does not suggest diminishing efforts to improve the abundance of self-sustaining native riparian habitat through reducing land and water management stressors (USFWS 2002, Appendix K). These land and water management improvement actions to improve the abundance of native vegetation will likely be more important in the future as a result of anticipated impacts from the tamarisk leaf beetle.

<u>Brood Parasitism</u>

Brood parasitism by brown-headed cowbirds can negatively affect flycatchers and populations by reducing reproductive performance. The cowbird lays its eggs in the nests of other species. The "host" species then incubate the cowbird's eggs and raise the young. Because cowbird eggs hatch after relatively short incubation and hatchlings develop quickly, they often out-compete the hosts' own young for parental care. Cowbirds may also remove eggs and nestlings of host species from nests (or injure nestlings in nests), thereby acting as nest predators.

Brown-headed cowbirds are a native species to North America, and have probably occurred naturally in much of the flycatcher's range, for thousands of years. However, they likely increased in abundance and distribution with European settlement, and are closely associated with anthropogenic actions such as forest clearing, livestock grazing, settlements, and agriculture (Goguen and Matthews 2007, pp. 1863, 1868). At normal levels, parasitism is rarely an impact on host species at the population level. However, for a rare host with a short reproductive life-span, parasitism may be a significant impact on production of young at the population level, especially with the high predation rates flycatchers can experience. When combined with negative influences of predation, habitat loss, and overall rarity, parasitism can be a significant contributor to a local population decline.

Since completion of the Recovery Plan, there has been increased monitoring of flycatcher nests to understand the extent and impact of cowbird parasitism. The Recovery Plan (USFWS 2002, p. 40) compiled mean annual parasitism levels (0 to 66%) from 396 flycatcher nests (range 3-163 nests) monitored in CA, NV, and AZ, between 1987 and 1997. Since completion of the Recovery Plan, long-term studies in AZ and NM have compiled brown-headed cowbird parasitism rates on just over 4,600 flycatcher nesting attempts from four of the densest and largest known flycatcher breeding sites. Flycatcher breeding sites at Roosevelt Lake, the San Pedro/ Gila River confluence (Ellis *et al*. 2008, pp. 71, 81), and the middle Rio Grande (Moore and Ahlers 2012, p. 66) implemented various methods of cowbird management, including combinations of trapping, removal of cowbird eggs from nests, and managing breeding season proximity of cattle. From 1996 to 2005, Ellis *et al.* (2008, p. 81) described that in AZ there was an overall low parasitism rate of 2.8% among 1,941 flycatcher nests monitored along the Salt River and Tonto Creek at Roosevelt Lake and surrounding the San Pedro and Gila River confluence. The highest rate of parasitism (42.9%) occurred in 2002 at both the Salt River and Tonto Creek study areas, likely due to reduced vegetation density and cover caused by drought conditions (Ellis *et al.* 2008, p. 88-89). From 1999 to 2012, along the Middle Rio Grande in NM, Moore and Ahlers (2012, p. 62) recorded an overall parasitism rate of 14% (313 out of 2,204 flycatcher nests). In western NM, along the Gila River, from 1997 to 2004, Brodhead *et al.* (2007, p.1218) detected an overall parasitism rate of 20.2% from monitoring 491 flycatcher nests (annual range from 11.3% to 32.2%).

Research into factors influencing the susceptibility of flycatcher nests to brown-headed cowbirds parasitism concluded that habitat configuration is an important factor (Moore 2006, pp. 14 and 19; Brodhead *et al*. 2007, p. 1213; Stumpf *et al.* 2011, p. 1). In southern NV and northwestern AZ, flycatcher nests greater than 330 feet from an edge were 50% less likely to be parasitized than those on an edge (Stumpf *et al.* 2011, p. 1). Brodhead *et al.* (2007, p. 1213) reached a similar conclusion about flycatcher nests placed deeper into habitat being less prone to parasitism, but also added that a larger patch size attracts nest parasites because of a potentially greater abundance of hosts. Brodhead *et al.* (2007, p. 1213) also concluded that parasitism was significantly lower within the core of large patches, but the insulating effect was not evident in small and medium-sized patches. Along the Middle Rio Grande in NM, Moore (2006, p. 14) concluded that the area with the highest density of trees and concealment had the least amount of cowbird parasitism of flycatcher nests. As a result, habitat loss, reduced habitat quality, and smaller patches of habitat, etc. are likely to increase the risk of brood parasitism on flycatcher nests.

The effects and management of cowbird parasitism with respect to the flycatcher is complex (USFWS 2002, Appendix F). Cowbird parasitism levels, as indicated from extensive monitoring across the flycatcher's range described above, can vary widely. Landscape management focusing on reducing cowbird feeding areas (e.g. corrals) or increasing the distance between feeding area attractants (e.g. livestock) and bird nesting areas may be useful alternatives (USFWS 2002, Appendix F, pp. 15-16; Goguen and Matthews 2007, p. 1868). Aggressive cowbird control, such as trapping, may or may not result in significant or even measurable flycatcher benefits (Moore 2006, p. 19). This is in part because cowbird parasitism acts in concert with many other negative influences on the flycatcher, some related and some not. These include habitat degradation, predation, size of flycatcher population, etc. In some cases a single impact like cowbird parasitism may not appear significant, but the additive (or synergistic) effects with other impacts may be very detrimental, even critical. But, even if the targeted flycatcher population does not grow due to cowbird management, flycatcher reproductive output may improve and thereby increase flycatchers that can colonize other nearby habitat patches, or stall declines in the targeted population (USFWS 2002, Appendix F, p. 26). Cowbird control, such as trapping, should be instituted with caution, and managers should in most cases consider cowbird control only when adequate data show that parasitism on a local population exceeds critical rates (USFWS 2002, p. F-29). The Recovery Plan appendix on cowbird parasitism provides further discussion on the complex issues associated with cowbird parasitism and management (USFWS 2002, Appendix F).

Due to the rangewide occurrence of cowbird parasitism, the results of long-term flycatcher nest monitoring studies, and the overall distribution of flycatcher territories, we conclude that parasitism is currently a moderate threat, but also recommend caution in the future. As identified at four of the largest known flycatcher breeding populations, local populations can grow, persist, and contribute to recovery concurrent with nest parasitism. The results from these study sites reinforce recommendations reached in the Recovery Plan that the best solution to cowbird parasitism is to improve the quality and abundance of riparian habitat (USFWS 2002, p. F-28). However, with 84% of the 288 known flycatcher breeding sites either having no flycatchers (50%) or less than five territories (34%) (Durst *et al.* 2008, p. 8), a large proportion of flycatcher breeding sites are established where riparian habitat is less expansive and potentially more susceptible to the impacts of parasitism, in contrast to the large populations with greater abundance of habitat described above. Additionally, future vegetation impacts from defoliating tamarisk leaf beetles may create more opportunities for brood parasites to find and lay eggs in flycatcher nests, similar to the increased parasitism rates detected at Roosevelt Lake in 2002 as a result of decreased plant vigor from drought conditions.

2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes:

No known recent effects from overutilization or collection have been documented for the flycatcher or its conspecifics. Overuse was not listed as a threat in the final rule to list the species nor in the Recovery Plan. Soon after listing, refinements in leg banding protocols and techniques were established that effectively reduced occurrence of leg injuries. Survey training occurs annually sponsored by Service Field Offices and other partners (State Wildlife Agencies, USGS, consultants, etc.) and provides technical and field experience to the flycatcher survey protocol and identification. This species is not a member of a taxon known to be collected or traded, therefore this threat likely does not exist, and there is no expectation for change in the future.

2.3.2.3 Disease or predation:

Nest Predation

Because the flycatcher builds open cup nests, its eggs and nestlings are susceptible to predation by birds, mammals, and reptiles. Predation, particularly during the nesting phase, is a significant factor in the natural history and population dynamics of most small birds, including the flycatcher (Finch and Stoleson 2000, p. 87, Paxton *et al*. 2007a, p. 47). Predation events on adults of most passerine birds are rarely observed, and there is virtually no data of this kind for the flycatcher (Finch and Stoleson 2000, p. 87).

Flycatcher nest monitoring studies have recorded a wide variety of nest predators such as the common kingsnake (*Lampropeltis getulus*), gopher snake (*Pituophis melanoleucus affinis*), Cooper's hawk (*Accipiter cooperii*), western screech owl (*Otus kennicottiii*), yellow-breasted chat (*Icteria virens*) (Ellis *et al*. 2008, Appendix J), and great horned owl (*Bubo virginianus*) (Finch and Stoleson 2000, p. 87). Brown-headed cowbirds can effectively function as nest predators if they remove flycatcher eggs or nestlings during parasitism events. Other potential predators of flycatcher nests are believed to include lizards (various species), raccoons (*Procyon lotor*), skunks (various species), domestic cats, jays (various species), crows (*Corvus brachyrhynchos*), ravens (*Corvus spp.)*, and roadrunners (*Geococcyx californianus*) (Finch and Stoleson 2000, p. 109).

For many flycatcher populations, nest predation is the major cause of nest failure (Finch and Stoleson 2000, p. 87). Soon after listing, nest monitoring in AZ, CA, and NM, recorded a wide range of nest predation rates, ranging from 14 to 60% (, Whitfield and Strong 1995, pp. 7-9; Spencer *et al*. 1996, pp. 12-13, 25; Sferra *et al*. 1997, p.21; Sogge *et al*. 1997b, p. 147; Stoleson and Finch 1999, pp. 10-13). Long-term monitoring studies of many AZ and NM flycatcher nests (which included time-lapse video) similarly found that nest predation was the leading cause of flycatcher nest failure (Ellis *et al*. 2008, p. 89; Moore and Ahlers 2012, p. 62). In central AZ, 36% of 1,873 flycatcher nests with a known outcome failed due to predation (Ellis *et al*. 2008, p. 131). Moore and Ahlers (2012, p. 62) 10-year effort along the Middle Rio Grande observed similar results, with predation at 35% of flycatcher nests (775 out of 2,204 nests). Also, Ellis *et al*. (2008, p.

113) found the probability of nest predation decreased as nest height increased, and predation was more likely with older nestlings (Ellis *et al*. 2008, p. 89).

While the nest predation rate of flycatchers can vary from year-to-year and site-to-site, he rates from long-term studies in AZ (Ellis *et al*. 2008) and NM (Moore and Ahlers 2012) are within the expected range of what small open-cup nesting birds experience (approximately 35%). Most small bird species in North America experience moderate rates of nest predation (30 to 60%) (Finch and Stoleson 2000, p. 21). The AGFD's review (Ellis *et al*. 2008, pp. 148-149) identified predation rates for open cup nesters, ranging from 1 to 82%. Populations within both central AZ and the Middle Rio Grande were able to persist and grow while experiencing normal nest predation rates and overall flycatcher breeding population has improved its known distribution and abundance.

As a result of the nest predation rate information collected on flycatcher, including about 4,000 nesting attempts in AZ and NM, predation rates are expected to be within the normal rates expected for the flycatcher. Because of the persistence of these large flycatcher populations and the overall improved known distribution and abundance of flycatcher territories, the impact of normal nest predation rates are believed to currently be an overall minor threat to the flycatcher. However, habitat fragmentation can increase the risk of nest predation for birds like the flycatcher (Finch and Stoleson 2000. p. 79). Similar to cowbird parasitism, nest placement and habitat quality are expected to influence predation rates and subsequently its impact to a population. Anticipated future changes in habitat quality as a result of the tamarisk leaf beetle and possibly climate change (Paxton *et al.* 2007a, p. 43) may cause increased exposure and access to flycatcher nests and therefore increase the impact from predation on productivity and population persistence.

Disease

Although wild birds are exposed to disease and various internal and external parasites, little is known of the role of disease and parasites on most species or populations. Disease and parasites may be significant factors in periods of environmental or physiological stress, during certain portions of a life cycle, or when introduced into a new or naive host.

The willow flycatcher is known to be a host to a variety of internal and external parasites (blood parasites, blow fly, and nasal mites) and susceptible to viral pox (USFWS 2002, pp. 27-28), but little overall is known (Paxton *et al*. 2007a, p. 141). Although these parasites likely occur in flycatchers, there is no information on what impact they have on infected birds or populations. McCabe (1991, pp. 109-110) identified mites (*Ornithonyssus sylviarum*) in 43% of flycatcher nests, and blowfly larvae (*Calliphora spp.)* in 32% of nests, but noted no significant negative effects from either. Whitfield and Enos (1998, p. 10) documented one case of nestling flycatcher mortality due to severe mite infestation.

The USGS collected mosquito samples and avian blood samples at Roosevelt Lake, AZ, to determine if West Nile Virus (WNV) was present (Paxton *et al*. 2007a, p. 141). While WNV has become established in the Southwest, USGS found no evidence of the virus in mosquitoes at Roosevelt Lake (Paxton *et al*. 2007a, p. 141). Paxton *et al*. (2007a, p. 141) did confirm WNV was present in at least two bird species, but not the flycatcher. The USGS (Paxton *et al*. 2007a, p. 142) indicated that flycatchers may be very susceptible to WNV because the Tyrannidae Family, to which the flycatcher belongs, evolved in the New World and WNV is of Old World origin. The same could be true of Highly Pathogenic Avian Influenza, which has not yet been found in North America, but which has the potential for eventual establishment through natural or human-assistance dispersal (Paxton *et al*. 2007a, p. 142).

While little is currently known about disease impacts to the flycatcher, based upon the overall improved understanding, distribution, and abundance of the flycatcher population since listing; the growth of some large local populations of flycatchers; and the lack of any known single disease or parasite which has noticeably affected flycatcher populations, we believe that currently, disease or parasites are a minor threat to the flycatcher.

2.3.2.4 Inadequacy of existing regulatory mechanisms:

If the flycatcher was not listed under the ESA, existing Federal and State regulatory mechanisms would be inadequate for its protection. While we have improved our knowledge of the flycatcher’s distribution and abundance since listing, there continue to be ongoing significant threats and anticipated future threats (discussed in this section) to the flycatcher, its habitat, and recovery that require continued protection under the ESA. Still, progress has been made in ensuring some long-term protections of flycatcher habitat as a result of commitments made under the ESA associated with some section 7 consultations (i.e. Lake Isabella) and HCPs (i.e. SRP’s Roosevelt and Horseshoe-Bartlett). However, without the habitat protections associated with the ESA, existing Federal regulations, such as the Migratory Bird Treaty Act (MBTA) (16 U.S.C. § 703–712), and state regulations are expected to be inadequate.

Listing under the ESA affords the flycatcher a number of protections, and also authorizes various conservation actions. Section 2 of the ESA directs all Federal agencies to seek to conserve endangered and threatened species, and to use their authorities in the furtherance of the purposes of the ESA. Section 4 of the ESA requires the Secretary to determine whether a species should be listed as threatened or endangered and subsequently designate critical habitat. Additionally, under section 4, the Department of Interior and the Department of Commerce are to develop and implement recovery plans for listed species. Section 7 reiterates the responsibility of all Federal agencies to proactively conserve and recover listed species, and requires all Federal agencies to consult with the Service on any actions they authorize, fund, permit, or carry out that may affect listed species or adversely modify critical habitat. Incidental “take” of a federally listed species may be authorized through this consultation process. Section 9 provides protection for the flycatcher by prohibiting “take.” “Take” is defined as “...to harass, harm , hunt, shoot, wound, kill, trap, capture, collect, or attempt to engage in any such conduct.” Within the realm of “take,” “harm” is further defined to include significant habitat modification or degradation that results in death or injury of the listed species, and significantly impairing essential behavior patterns, including breeding, feeding, or sheltering. Since listing, at least 226 formal consultations have been completed across the flycatcher’s range that address adverse effects, incidental take, and conservation measures for such actions as ongoing cattle grazing, bridge repair and development, dam operations, etc.

Section 10 of the ESA gives the authority to issue permits to non-Federal and private entities for “take” of listed species as long as such taking is incidental to, and not the purpose of, carrying out otherwise lawful activities. HCPs authorize incidental take, but not the activities that result in take. This process ensures that the effects of the authorized incidental take will be adequately minimized and mitigated. HCPs are used to develop creative partnerships between the public and private sectors in the interest of conserving listed species. In 1999, the Service issued a new policy under Section 10 of the ESA for SHAs through enhancement of survival permits for listed species. The standard for a SHA is that the agreement must realize a “net conservation benefit” (i.e., by implementing the terms of one or more SHA, populations of a listed species will increase and/or their habitats will be improved). SHAs are temporary habitat protections with “take” allowed at some time in the future back to an agreed upon baseline. As noted above, the flycatcher has been included in many HCPs, such as those developed for some southern California counties, dam operations along the lower Colorado River and central Arizona, etc. The flycatcher has also been included a number of SHAs for specific properties implementing habitat improvement projects and also for those choosing to engage in habitat improvement projects and enroll within a specific geographic area (Kane and Washington counties, UT) (Color Country Resource Conservation and Development Council 2008).

A large number of threatened or endangered species listed under the ESA occur within the riparian and aquatic habitats used by the flycatcher, and are described in the Recovery Plan (USFWS 2002, pp. 55-59). As a result, the flycatcher receives some collateral benefits in areas of habitat overlap. For example, because water is essential for fish, their habitat requirements can help protect similar flycatcher habitat needs.

Various other land management Acts can provide some local or serendipitous benefits to the flycatcher, but these are not focused enough on the flycatcher and its habitat to be an adequate surrogate. For example, the Federal Land Policy and Management Act of 1976 requires that “…the public lands be managed in a manner that will protect the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource, and archeological values; that … will preserve and protect certain public lands in their natural condition; (and) that will provide food and habitat for fish and wildlife …" Additionally, the National Forest Management Act of 1976 directs that the National Forest System "…where appropriate and to the extent practicable, will preserve and enhance the diversity of plant and animal communities." The Clean Water Act (CWA) of 1977 provides for the restoration and maintenance of the chemical, physical, and biological integrity of the nation's lakes, streams, and coastal waters. All of these can provide some potential improvement or long-term protection to flycatcher habitat in some portions of its range, but none are specific enough to distinguish the needs of endangered species or include enough of the flycatcher's range to provide adequate protection for the flycatcher and its recovery.

If the flycatcher was not listed under the ESA, the MBTA would be the only Federal protection provided specifically for the flycatcher and on its own would not provide adequate protection. The MBTA prohibits ''take'' of any migratory bird, which is defined as: ''…to pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to pursue, hunt, shoot, wound, kill, trap, capture, or collect…'' However, unlike the ESA, there are no provisions in the MBTA preventing habitat destruction unless direct mortality or destruction of active nests occurs. Because the reason for the flycatcher's endangerment is so closely connected to habitat impacts, this unique component of the ESA is essential for the flycatcher's protection and recovery.

State regulations address the flycatcher where it occurs in AZ, CA, CO, NM, NV, and UT, but are limited in the degree of habitat protection, and more closely mirror protections associated with MBTA. With the exception of AZ, all other states in the flycatcher's breeding range classify them as "endangered." In contrast, the State of AZ describes the flycatcher a "species of greatest conservation need" in their Wildlife Action Plan. State designations in AZ, CO, NV, NM, and UT do not convey habitat protection or protection of individuals beyond existing regulations on capture, handling, transportation, and take of native wildlife. Protections for state endangered species in CA are similar as other southwestern states, but the CA Endangered Species Act (CESA) and CA Environmental Quality Act (CEQA) add some additional considerations. CESA requires consultation between the CA Department of Fish and Wildlife and other State agencies to ensure that activities of State agencies will not jeopardize the continued existence of State-listed species. CEQA, which is similar to the National Environmental Policy Act, has three primary purposes: 1) Minimizing impacts on the environment by identifying impacts and then applying mitigation measures; 2) Disclosing to decision-makers and the public the potential impacts of a proposed action and associated mitigation measures; and 3) Disclosing the rationale behind decision makers' determinations to the public. We believe that outside of the ESA, other federal and state regulatory mechanisms are inadequate to ensure the continued existence of the southwestern willow flycatcher, largely because of their inability to establish a process to address impacts to its habitat.

2.3.2.5 Other natural or manmade factors affecting its continued existence:

Climate Change

Earlier in this document, we provided an overview of future anticipated changes in temperature, precipitation, and drought in the southwestern United States within the flycatcher's breeding range as a result of climate change. Below we describe how those anticipated future changes may impact habitat and prey the flycatcher relies upon, and how the flycatcher has responded to the recent extreme drought conditions. As a result of these predicted future changes in temperature, precipitation and drought, we can anticipate that the impact to riparian habitat (and subsequently the flycatcher) will be an extension or exacerbation of the overall existing impacts of water management and drought (Perry *et al.* 2011, p. 1).

Perry *et al*. (2011, p. 16) concluded that semiarid and arid western North American riparian ecosystems are likely to change dramatically with climate change and increased carbon dioxide. Specifically, Perry *et al*. (2011, p. 16) wrote that "lower late-spring and summer stream flows will compound effects of increased drought due to warming, leading to strong reductions in water availability. Greater water stress will alter plant community composition and structure, favoring drought-tolerant species and reducing abundance of currently dominant, drought-intolerant cottonwoods and willows. Tamarisk seems especially likely to increase, but other drought-tolerant species may increase instead if the recently released biocontrol tamarisk leaf beetle reduces tamarisk abundance..." Other drought-tolerant plant species likely to establish will most likely not be suitable substitutes for nesting flycatchers.

Insect prey items that flycatchers rely upon may be affected by climate change and increased carbon dioxide, which could provide additional obstacles for successful flycatcher reproductive success. For most arthropods that control body temperature through movement and choice of microhabitat (ectotherms), warming is likely to alter behavior and physiology, and may reduce survival (Perry *et al.* 2011, p. 11). Non-mobile ectotherms, like insect eggs and pupae, may be particularly vulnerable to warming, because they cannot move to cooler areas and instead must rely on parents or earlier life stages to select sites with favorable microclimates (Perry *et al.* 2011, pp. 11-12). Climate change and increased carbon dioxide may adversely affect insects that rely on carbon dioxide gradients to locate fruit, flowers, prey, or ovi-positioning sites (Perry *et al*. 2011, p. 15). Warmer and intermittent stream flows may also reduce abundance of some aquatic insects (Perry *et al*. 2011, p. 15).

Because increased occurrence of drought is predicted as a result of climate change, it is important to examine what impacts extreme drought has had on flycatchers in order to understand and anticipate potential future impacts from climate change. Since the flycatcher was listed, we have observed that drought has had negative and some positive effects on breeding flycatchers and their habitat. The USGS (Paxton *et al*. 2007a, p. 141) noted that the Southwest experienced a long-term drought during their 10-year study period, and in 2002, the year of most severe drought, there was strong evidence that it affected virtually all aspects of flycatcher ecology. The extreme drought of 2002 caused near complete reproductive failure of the 146 flycatcher territories at Roosevelt Lake in central AZ (Smith *et al*. 2003, pp. 8, 10), and caused a dramatic rise in the prevalence of non-breeding and unpaired flycatchers (Paxton *et al*. 2007a, p. 4). The high rate of failure was likely due to less vigorous vegetation conditions caused by the drought and that resulted in less cover for nests (Ellis *et al*. 2008, p. 89). Along the lower San Pedro River, long-term drought conditions, contributed to less water at the Cook's Lake breeding site (Ellis *et al*. 2008, p. 34). As a result, after years of being a productive nesting site, riparian habitat quality declined and flycatcher territories were not detected at Cook's Lake from 2002 to 2007 (Ellis *et al.* 2008, pp. 34-35). Not surprisingly, AGFD concluded that increases in rainfall had a positive effect on flycatcher nest success at the San Pedro and Gila River study areas (Ellis *et al*. 2008, p. ii).

While extreme drought during a single year can generate impacts to breeding success, the broader effect of drought can also have localized benefits in some regulated environments. At some reservoirs (i.e. Roosevelt Lake, AZ and Lake Isabella, CA), drought led to reduced water storage, which increased the exposure of wet soils at the lake's perimeter. Extended drought allowed the exposed areas to grow vegetation and become flycatcher nesting habitat (primarily comprised of tamarisk).

The USGS (Paxton *et al.* 2007a, p. 141) considered how drought and climate change could impact flycatchers and future management. Paxton *et al*. (2007a, p. 141) wrote that "the near total collapse of reproductive success in a single drought year like 2002, coupled with the short average lifespan of southwestern willow flycatchers, strongly suggests that several successive years of extreme drought could cause a major population crash and possible extirpation of flycatchers, the speed of which would depend on the starting population size. This is an important consideration with respect to forecasting the long-term persistence of flycatchers at our study sites, and possibly elsewhere. For example, most climate change models predict increased drought frequency and severity in the Southwest. Therefore, long-term management of southwestern willow flycatchers will be more effective if it considers how flycatcher habitat and breeding populations may respond to changes in southwestern climate, and whether there are management actions that can ameliorate any negative effects…"

Based upon how extreme drought impacted the flycatcher's habitat and reproduction (Smith *et al*. 2003, pp. 8, 10; Paxton *et al*. 2007a, p. 141; Ellis *et al*. 2008, p. 89) and the continued impacts from water/land management actions (see above), we anticipate that the impacts of climate change will be a significant threat to the flycatcher, its habitat, and recovery. Almost certainly the flycatcher's riparian habitat, which is reliant on relationship between precipitation and stream function to generate conditions for expansive riparian forests, will be affected in some manner by climate change. Friggens *et al*. (2013, p. 28) evaluated the vulnerability of 42 bird species to climate change along the Middle Rio Grande, and the flycatcher was ranked as the most vulnerable. It may be that because of climate change, the single season occurrence of extreme drought we observed in 2002 will be a more frequent future environmental condition. Riparian habitat features that the flycatcher relies upon (water and plant abundance, and insect prey items) would likely be adversely affected by climate change (Perry *et al*. 2011). Overall, Perry *et al*. (2011, p. 16) concluded that increased carbon dioxide and climate change may change plant community composition and reduce surface water, which would likely reduce habitat quality for many riparian animals. As a result, this habitat change would lead to lower riparian animal diversity and abundance and greater abundance of animals associated with drier conditions (Perry *et al*. 2011, p. 16).

Vulnerability of Small and/or Isolated Populations

Isolated populations

The distance or degree of isolation between flycatcher breeding groups (especially those with small numbers) can increase their risk of extirpation by reducing the likelihood of immigration from other populations to offset impacts from catastrophic dynamic habitat events (e.g. flooding) and demographic-related issues (e.g. birth/death rates and sex ratios) (Finch and Stoleson 2000, p. 14). The estimated 1,299 rangewide flycatcher territories are distributed in a large number of small breeding groups and a small number of relatively large breeding groups (Durst *et al*. 2008, p. 4). From 1996 to 2005, USGS collaborated with AGFD to conduct a 10-year flycatcher banding and re-sighting study in central AZ, as well as multiple auxiliary breeding sites to help understand flycatcher movements (Paxton *et al*. 2007a, Ellis *et al.* 2008). The discovery of flycatcher fidelity to breeding sites, year-to-year movement of adult and young-of-the-year flycatchers, and the interconnected nature of breeding sites (Paxton *et al*. 2007a, p. 2) improved our understanding about how territory distribution and abundance may affect population persistence and flycatcher recovery.

When we apply the improved understanding of flycatcher movement to the varied rangewide configuration of flycatcher territories, we reach complex conclusions about the vulnerability of the flycatcher breeding population. As a result of the flycatcher's ability to move, we increased our confidence in the general recovery strategy of establishing a network of populations throughout its breeding range (USFWS 2002, pp. 72-81). We also improved our confidence in the stability of larger flycatcher population centers and the benefits they provide other nearby populations. However, the rarity and limitation of long-distance flycatcher movements still causes concern for the persistence of territories that are the most isolated from population centers.

Adult flycatchers had high fidelity to productive breeding habitat (mostly within the same drainage), but can quickly move should habitat conditions and subsequent reproduction deteriorate (Paxton *et al*. 2007a, pp. 64-74; 76). On average, 41% of adult flycatchers moved between-years to another breeding location, but most movements were confined to nearby areas within the same drainage (Paxton *et al*. 2007a, p. 75). The USGS documented 712 adult flycatchers making between-year movements, with distances ranging from 0.1 to 133 mi (214 km) (mean distance moved by adults = 6 mi/9.5 km) (Paxton *et al*. 2007a, p. 65). Flycatchers can quickly colonize developing riparian habitat and immigration into the young habitat is the dominant movement pattern (Paxton *et al*. 2007a, pp. 76-77). In contrast, as the habitat matures, immigration declines while emigration from the patch increases (Paxton *et al*. 2007a, p.2). Reproductive success and habitat selection may strongly influence whether an individual returns to the same general breeding location (Paxton *et al*. 2007a p. 68).

Flycatchers, banded as nestlings, had less fidelity to their natal breeding site compared to the fidelity of breeding adults to the previous year's nesting location (Paxton *et al*. 2007a, pp. 62-78). The USGS and collaborators detected 123 of 498 flycatchers banded as nestlings in subsequent years; all but two returning nestlings dispersed to a non-natal area (Paxton *et al*. 2007a, p. 64). The average natal dispersal distance was 20.5 km (range = 0.03 to 444 km) (Paxton *et al*. 2007a, p.65).

While both adult and returning young-of-the year flycatchers regularly returned to locations within the same drainage, 30 long-distance between-drainage movement events by natal and breeding flycatchers were recorded (Paxton *et al*. 2007a, p. 61) (Figure 14). Adult flycatchers accounted for 21 instances (ranging from 30 to 133 mi/49 km to 214 km), while natal dispersal accounted for 9 cases (ranging from 32 to 276 mi/52 km to 444 km) (Paxton *et al*. 2007a, p. 61).

An improved understanding of flycatcher movements reinforced the recovery strategy of establishing a network of connected populations throughout the flycatcher's breeding range (USFWS 2002, pp. 61-92) and emphasized that geographically separate flycatcher populations are more inter-connected. The probability of flycatchers colonizing new breeding habitat appears to depend on distance from neighboring populations (Paxton *et al*. 2007a, p. 74). Flycatcher breeding habitats that are within 30 to 40 km of each other will have higher meta-population connectivity and a higher colonization probability of new habitat within this distance (Paxton *et al*. 2007a, pp. 75-76).

Because only 1% of flycatcher movements detected in central AZ were to other drainages, infrequent long-distance between-drainage movements are probably not sufficient to sustain declining populations in distant drainages that are reproductive "sinks" (Paxton *et al*. 2007a, p. 75). Even some of the larger, but relatively isolated flycatcher populations along the Kern River in CA and lower

Colorado River along the CA/AZ border were unable to sustain their numbers over time. Over a 24-year period, the number of Kern River breeding flycatchers declined from about 70 to 80 flycatchers to 11 (Whitfield 2013, p. 22). After eliminating other potential causes (i.e. habitat declines, etc.), Whitfield (2013, pp. 37-42) concluded that being 120 km away from the next closest breeding population, and the resultant lack of immigrant flycatchers from elsewhere, may be a likely reason for the decline of the Kern River flycatcher population. Similar slow declines in flycatcher nesting pairs, without apparent changes in habitat quality habitat or decline in reproductive output were detected at Camp Pendleton along the Santa Margarita River in southern CA.

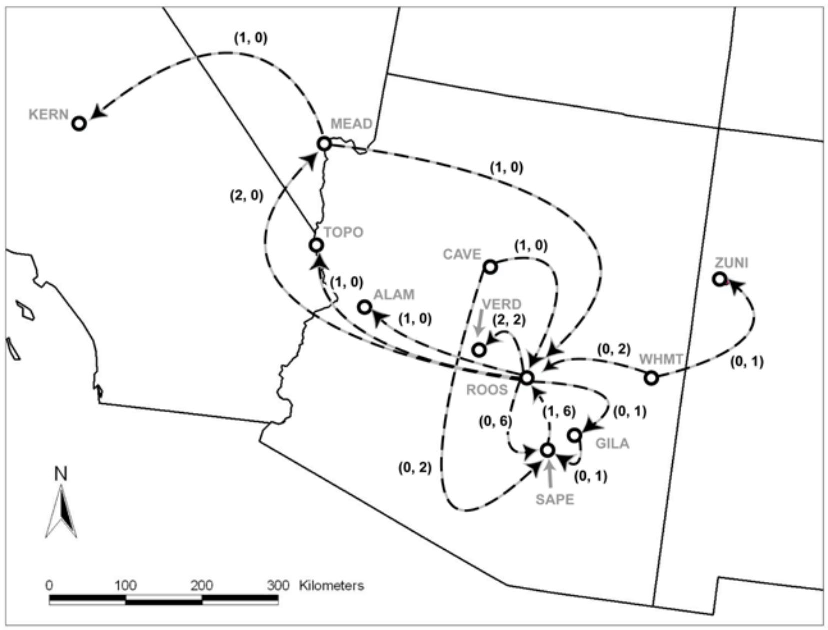

Figure 14. Banded adult and young-of-the-year flycatcher between-drainage movements (49 km to 444 km) between 1996 and 2005 by USGS (Paxton *et al*. 2007a, p. 61). Diagram courtesy of USGS (Paxton *et al*. 2007a, p. 61).

When considering that the overall flycatcher breeding population is comprised mostly of breeding groups possessing few territories, the impact of small and/or isolated populations is currently a moderate threat, which may increase its significance in the future. Preventing this threat from having a greater impact is the current widespread distribution of the flycatcher territories (Durst *et al.* 2008, pp. 12-13) and the bird's ability to move great distances and quickly colonize habitat. Additionally, the large number of known flycatcher territories (865 of 1,299) on three rivers (Gila River, San Pedro River, and Rio Grande) (Durst *et al*. 2008, p. 11) improves the stability of flycatcher populations along those streams and nearby areas. However, future impacts to habitat quality and abundance from the introduction of the tamarisk leaf beetle and climate change (see discussions above) may further decrease population size and increase isolation.

Genetic Effects
Because the flycatcher exists in mostly small populations distributed across a broad area, low genetic variation within populations and effects from inbreeding are potential issues (Marshall and Stoleson 2000, p. 14). Low genetic variation can result in reduced fecundity and survival, lowered resistance to parasites and disease, and/or physiological abnormalities (Allendorf and Leary 1986, pp. 57-76).

Genetic and field data collected from the flycatcher suggest that the current level of flycatcher movement is sufficient to provide for widespread gene flow and maintenance of high genetic variation (Busch *et al*. 2000, p. 593). Even though there are many small and disjunct breeding locations, between-drainage movement (see discussion above) appears adequate to sustain genetic connectivity because there was substantial genetic variation within and among flycatcher breeding groups, and within and between watersheds (Busch *et al*. 2000, p. 592). Another positive result from the flycatcher genetic analysis was that no biologically significant structuring was found, or in other words, no single population was found to be genetically more important than any other (Busch *et al.* 2000, p. 593). Multiple lines of genetic evidence suggest that disjunct breeding groups function as a metapopulation and regularly exchange genetic material (Busch *et al*. 2000, p. 592).

Busch (*et al.* 2000, p. 593) concluded that their flycatcher genetic analysis did not reveal any highly differentiated breeding groups of special management concern. Therefore, combine these positive genetic results with the improved known distribution and abundance of flycatcher territories detected since listing, and genetic impacts to the flycatcher populations appear to currently be a minor threat. However, future impacts to flycatcher habitat associated with the leaf beetle and climate change can further reduce and isolate breeding populations, potentially reducing genetic diversity and causing a greater threat to the flycatcher.

2.4 Synthesis

The flycatcher's status has improved (due to an overall increase in known estimated territories) since the 1995 listing, but ongoing threats associated with land and water management combined with the introduction and spread of the leaf beetle create significant challenges toward downlisting or delisting and are likely to cause population declines. Much of the initial increase in known territories is likely attributed to improved survey effort (Durst *et al*. 2007, p. 4), combined with associated conservation efforts. The recent increase in flycatcher breeding sites/territories has been more modest since completion of the 2002 Recovery Plan (Table 2). Yet, while some specific known flycatcher populations have grown very large (i.e. Elephant Butte Reservoir along the Rio Grande, NM, and San Pedro/Gila River confluence, AZ), broad geographic areas, such as the Coastal California and Basin and Mohave Recovery Units and along the Lower Colorado River have declined. Survey effort has declined reducing our ability to more precisely track known breeding sites and detect new or developing breeding sites. Plus, the introduced tamarisk leaf beetle has entered the flycatcher's breeding range, threatening to impact vegetation that is an important part of about 50% of all known territories. As a result, the flycatcher should remain classified as endangered primarily because of ongoing threats from land and water management; a decline in rangewide distribution of the flycatcher; the anticipated future adverse effects to its habitat and population from the tamarisk leaf beetle; and the potential impacts associated with climate change, all described in this review's five-factor analysis.

The Recovery Plan (and its detailed appendices) describes recovery management strategies and methodologies which correspond to the specific threats discussed within this assessment. All the currently relevant listing factors are considered in the recovery criteria. The tamarisk leaf beetle is mentioned in the Recovery Plan and strategies to manage for possible effects are described (not in response to the beetle itself, but in the form of native/exotic habitat management). Similarly, the identification of climate change is not specified in the Recovery Plan, but the impact of loss of suitable habitat through drought, land and water regulation/management/use, and conservation measures to offset those effects are addressed. This does not diminish the adequacy of the recovery criteria or the thoroughness of the Recovery Plan in addressing the abundance, distribution, quality, and protection of habitat.

Since listing and the completion of the Recovery Plan, there has been an overall increase in the distribution and numbers of flycatcher sites and territories (Table 2). When the 2002 Recovery Plan was completed, 225 breeding sites and an estimated 1,000 flycatcher territories were recorded (USFWS 2002, p.29, Durst *et al.* 2008, p.4). The most recent 2007 rangewide assessment described a modest increase to 288 breeding sites with an estimated 1,299 territories (Durst *et al.* 2008, p.4). Since listing, a collection of efforts associated with biological opinions, HCP, management plans, private land acquisition, and others has helped increase the amount of long-term protected habitat specifically for the flycatcher along streams such as the lower Colorado, Kern, San Pedro, Gila, Verde, Rio Grande, Virgin, and Owens rivers in states such as CA, NV, UT, AZ, and NM. Also, voluntary actions by Federal, state, tribal, and private landowners have helped increase the quality of flycatcher habitat.

Even with these conservation efforts, there have been changes in flycatcher rangewide territory distribution and configuration that generates concern. There have been declines in known territories across broad geographic areas within the Coastal CA Recovery Unit, the Basin and Mohave Recovery Unit, and along the Lower Colorado River within the Lower Colorado Recovery Unit. While there have been continued increases or maintenance of flycatcher territories at sites with large numbers, having about 60% (approximately 800 of the 1,299 territories) of the subspecies located at four general locations increases the risk of catastrophic losses. The general recovery strategy is not to concentrate large numbers of flycatchers at a few locations, but to have a more balanced abundance of breeding sites distributed throughout their range.

Exacerbating these concerns is the steady decline in the number of annual presence/absence breeding flycatcher surveys and the increasing reliance on estimating population size. Up until about the year 2000, nearly all known flycatcher breeding sites were being surveyed (Durst *et al.* 2008, p.5). But since, there has been a downward trend in the amount of breeding sites surveyed annually (Durst *et al.* 2008, p.5). Additionally, rangewide data compilation, entry, and reporting have become more challenging due the subspecies large range, amount of data (even with reduced annual effort), and lack of dedicated funding. As a result, range-wide numbers can only estimate the current population size based on the survey data, which for some sites, may have occurred years prior to the estimate (Durst *et al.* 2008, p.5). Understanding the distribution and abundance of the flycatcher is the most basic and essential task in managing for the subspecies' recovery, yet decreasing survey effort hinders this understanding.

During the past five years, the newest threat to the flycatcher is the introduction and spread of the tamarisk leaf beetle. Tamarisk is an important habitat component used by the flycatcher, occurring in just over 50% of their known territories and providing shelter and food at migration stop-over areas. Flycatcher territories with tamarisk mostly occur in the center of the subspecies' range in AZ, southern NV and UT, and western NM. In contrast to our initial thoughts about flycatchers breeding in tamarisk, flycatcher survivorship, health, and productivity are not affected by using tamarisk-dominated habitats. It is now believed that the tamarisk leaf beetle (and its different varieties) is capable of spreading, persisting, and impacting the quality of tamarisk habitat for nesting and migrating flycatchers throughout the southwestern United States and into Mexico. Therefore, if tamarisk is degraded by the leaf beetle without replacement by suitable vegetation desired by the flycatcher, as expected, we can anticipate exacerbating the impact of existing threats, resulting in a marked decrease in flycatcher distribution and abundance.

It is not well understood throughout the scientific community, government agencies, and other land management entities that tamarisk flourishes in much of the southwestern United States largely due to water and land management changes/stressors to river ecosystem function (Gelt 2008, pp 1-3, Stromberg 2009, pp. 177-178). In addition to water management from dams, diversions, and groundwater pumping, land uses such as overgrazing, channelization, agricultural return flow, or off-road vehicles in river floodplains can also impact the growth of native trees and creates conditions favorable for tamarisk. Yet there is the misconception that simply removing tamarisk and/or planting native trees will restore native riparian forests. There are additional misconceptions, such as the long-held belief that removing tamarisk will increase water availability for urban or agricultural use. Improving the understanding of the relationship between river flow, groundwater, soil chemistry, and the growth of native trees will be important to implement effective actions to enhance ecosystem function and offset the potential impacts of the leaf beetle on the flycatcher and other riparian habitat dependent wildlife. Even with this understanding, there are likely some streams or portions of streams where essential water uses and management actions (such as the dam operations of the lower Colorado River) will prevent the changes necessary to offset beetle-related impacts.

Downlisting the flycatcher to threatened status requires meeting the definition of a threatened species as based upon the five-factor analysis per section 4(a)(1) of the ESA. Recovery criteria helps to indicate when we would anticipate an analysis of the five threat factors under section 4(a)(1) would result in a determination that the species is no longer an endangered species or threatened species because of any of the five statutory factors.

Thus, while recovery plans provide important guidance to the Service, States, and other partners on methods of minimizing threats to listed species and measurable objectives against which to measure progress towards recovery, they are not regulatory documents and cannot substitute for the determinations and promulgation of regulations required under section 4(a)(1) of the ESA. A decision to revise the status of or remove a species from the Federal List of Endangered and Threatened Wildlife (50 CFR 17.11) is ultimately based on an analysis of the best scientific and commercial data then available to determine whether a species is no longer an endangered species or a threatened species, regardless of whether that information differs from the Recovery Plan.

Still though, as a measurable objective, the overall increase in flycatcher territories (to an estimated 1,299 territories) and their current distribution does not yet meet the numerical and geographical downlisting or delisting goals established in the Recovery Plan. As identified in the Recovery Plan, criterion A requires a flycatcher population of at least 1,950 territories, with each Management Unit reaching 80% of its goal and each Recovery Unit 100% of its goal (for at least 5 years). Criterion B requires a population of 1,500 territories, with each Management Unit reaching 50% and each Recovery Unit 75% of the numeric goal (for at least three years). The reduced numbers associated with Criterion B are countered with an increased requirement of long-term protection of these habitats through conservation management agreements.

Based on ongoing and anticipated threats to the flycatcher discussed in this five-factor analysis, we recommend the flycatcher still be classified as an endangered species under the ESA. While the known status of the flycatcher has improved since listing as a result of improved surveys, studies, and conservation, declines have begun to occur across broad portions of the flycatcher’s range and more are anticipated. Complex, inter-related, and ongoing water and land management threats (such as dams, groundwater pumping, water diversions, development, cattle grazing, etc.), exacerbated by the potential impacts from climate change discussed in this review, exert powerful influence and limitations to the expansion of flycatcher habitat and populations, and at known breeding sites. Combine these ongoing threats with the anticipated habitat and population impacts from the tamarisk leaf beetle, and we can anticipate a marked decline in the distribution and abundance of flycatcher territories (50% of known territories include important amounts of tamarisk).

3.0 RESULTS

3.1 Recommended Classification: No change, remain as endangered with critical habitat.

_____ Downlist to Threatened
_____ Uplist to Endangered
_____ Delist:
_____ *Extinction*
_____ *Recovery*
_____ *Original data for classification in error*
__X__ No change is needed

3.2 New Recovery Priority Number: No change, remain as 3C.

Brief Rationale: The southwestern willow flycatcher continues to face a high degree of threat, has a high potential for recovery, is a subspecies, and experiences conflict with economic development, particularly from impacts associated with aquatic and riparian habitats. As a 3, the flycatcher remains highly threatened by land and water management, a decline in rangewide distribution of the flycatcher, the anticipated future adverse effects to its habitat and population from the tamarisk leaf beetle, and the potential impacts associated with climate change. Changes in the flycatcher's distribution, increases in abundance in some areas, and the bird's ability to adapt to newly-formed aquatic habitats indicate that the subspecies has a high potential to recover. Because the flycatcher is a riparian/aquatic obligate, requiring nesting and feeding habitats and migratory pathways in vegetation communities adjacent to rivers or associated bodies of water, conflict with human activities and economic development over water resources and availability of natural habitat adjacent to fresh water sources remains, thus maintaining the status of C.

3.3 Listing and Reclassification Priority Number: N/A

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

In addition to the steps described in the stepdown outline and narrative in the Recovery Plan (USFWS 2002, pp. 96-136), the following recommendations reinforce existing recovery strategies and introduce new recommendations.

- Develop and convene Recovery Implementation Subgroups across the flycatcher's range (include the following topics into the agendas) (USFWS 2002, pp. 93-94). Subgroup organization by Recovery Unit, as described in the Recovery Plan, is likely too large a geographical area to be effective. As a result, smaller collections of Management Units may be a more appropriate size.

- Collect existing and develop new conservation plans, easements, and other documents that provide flycatcher habitat protection that meet and track the goals described in Recovery Plan (USFWS 2002, p. 96, 1.1.1).

- Continue to develop and improve statewide and rangewide data management collection, entry, and reporting (USFWS 2002, p. 101, 5.1.3). In particular, explore possible internet online reporting and integration into databases. Simplify existing databases for easier data entry. Improve reporting requirements in CA to ensure surveyors submit completed survey forms to USGS and/or the Service.

- Expand the satellite-based flycatcher habitat suitability model to be able to evaluate habitat across the breeding range of the flycatcher. This model may be helpful to evaluate rangewide actions; assess impacts from the tamarisk leaf beetle; establish baseline for Safe Harbor Agreements; determine recovery plan based habitat goals, etc.

- Seek out breeding sites/territories in Management Units with few territories to improve knowledge of flycatcher distribution and abundance. Continue to track the presence, absence, distribution, and abundance of flycatcher territories at well-established breeding sites and at others that have not been surveyed recently (USFWS 2002, p.101, 5.1.2).

- Develop and implement a multi-state rangewide survey and sampling effort, using habitat and occupancy models, to better track and estimate the overall rangewide distribution and abundance of territorial flycatchers. This effort could be similar to statewide breeding bird atlases (using a collection of agency and private volunteers). The existing satellite-based habitat suitability model could prioritize surveys in known breeding areas, identify new locations to survey where searches have not been conducted, and provide estimates on habitat quality. An occupancy model can be developed (incorporating factors such as persistence as functions of patch size, time, and proximity of other flycatcher populations) and in conjunction with sampling, help estimate rangewide populations.

- Inform partners and the public about tamarisk leaf beetle issues. Continue to improve the overall understanding about tamarisk using the latest science (Shafroth *et al.* 2010b).

- Implement strategies described in Recovery Plan Habitat Restoration Appendix in order to improve the quality and abundance of native vegetation in areas that may be affected by tamarisk leaf beetle defoliation. These strategies will likely center on reducing existing stressors (water and land management actions) that create conditions that will allow native vegetation to grow and flourish, recycle, and overall be self-sustaining (USFWS 2002, p. 98, 1.1.3.2.3).

- While potentially challenging due to limited known territories, continue to explore and analyze essential genetic information from the northern boundary of the flycatcher in UT, AZ, CO, and NM to help refine the northern subspecies boundary (UFWS 2002, p. 102, 6.8). Concurrently, continue to pursue Service policy on how to select boundaries for subspecies with intergradations zones.

- More studies are needed to establish exactly how conditions on the flycatcher's breeding and winter grounds, and the stopover migratory habitats in between, influence one another so the limitations and challenges for the flycatcher's recovery can be understood fully. Additional studies of migrating and wintering flycatchers, including stopover habitat selection and use, foraging ecology, and physiology, can help identify factors that may be amenable to conservation and management activities aimed at increasing flycatcher survivorship on migration. Also, partnerships with international cooperators toward management of key wintering locations may facilitate implementation of management actions which can aid in flycatcher survivorship.

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U.S. **FISH AND WILDLIFE SERVICE**
5-YEAR REVIEW of
Southwestern Willow Flycatcher (Empidonax traillii extimus)

Current Classification: Endangered, 3C, with Critical Habitat

Recommendation resulting from the 5-Year Review:

_____ Downlist to Threatened
_____ Uplist to Endangered
_____ Delist
__X__ No change needed

Appropriate Listing/Reclassification Priority Number, if applicable: N/A

Review Conducted By: Greg Beatty, Fish and Wildlife Biologist, Arizona Ecological Services Field Office

FIELD OFFICE APPROVAL:

Lead Field Supervisor, U.S. Fish and Wildlife Service, Arizona Ecological Services Field Office

Approve ________________________ Date 8/13/14

REGIONAL OFFICE APPROVAL:

Assistant Regional Director, Ecological Services, U.S. Fish and Wildlife Service, Region 2

Approve Michelle Shaughnessy Date 8/15/14

Cooperating Assistant Regional Director, Fish and Wildlife Service, Region 6 Acting

✓ Concur _____ Do Not Concur

Signature ________________________ Date 9/4/14

Cooperating Assistant Regional Director, Fish and Wildlife Service, Region 8

X Concur _____ Do Not Concur

Signature ________________________ Date 8/24/14