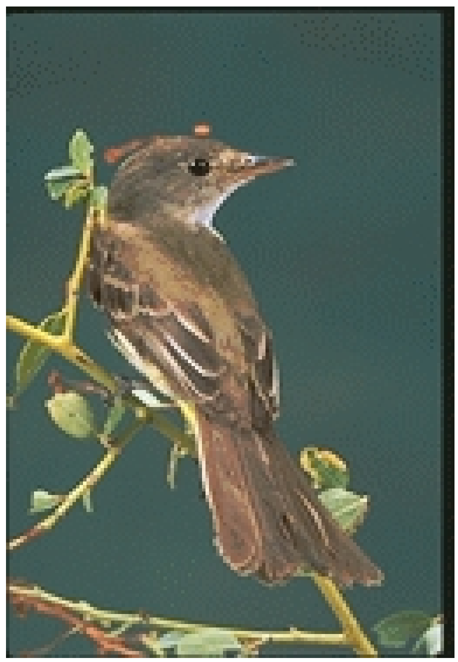
Final Recovery Plan
Southwestern Willow Flycatcher
(*Empidonax traillii extimus*)

August 2002

Prepared By

Southwestern Willow Flycatcher Recovery Team
Technical Subgroup



For

Region 2
U.S. Fish and Wildlife Service
Albuquerque, New Mexico 87103

Approved: H Dale Hall

Date: 8/30/02

Disclaimer

Recovery Plans delineate reasonable actions that are believed to be required to recover and/or protect listed species. Plans are published by the U.S. Fish and Wildlife Service, sometimes prepared with the assistance of recovery teams, contractors, State agencies, and others. Objectives will be attained and any necessary funds made available subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities. Recovery plans do not necessarily represent the views nor the official positions or approval of any individuals or agencies involved in the plan formulation, other than the U.S. Fish and Wildlife Service. They represent the official position of the U.S. Fish and Wildlife Service only after they have been signed by the Regional Director or Director as approved. Approved Recovery plans are subject to modification as dictated by new findings, changes in species status, and the completion of recovery tasks.

Some of the techniques outlined for recovery efforts in this plan are completely new regarding this subspecies. Therefore, the cost and time estimates are approximations.

Citations

This document should be cited as follows:

U.S. Fish and Wildlife Service. 2002. Southwestern Willow Flycatcher Recovery Plan. Albuquerque, New Mexico. i-ix + 210 pp., Appendices A-O

Additional copies may be purchased from:
Fish and Wildlife Service Reference Service
5430 Governor Lane, Suite 110
Bethesda, Maryland 20814
301/492-6403 or 1-800-582-3421

This Recovery Plan was prepared by the Southwestern Willow Flycatcher Recovery Team, Technical Subgroup:

Deborah M. Finch (Team Leader)
U.S. Forest Service, Rocky Mountain Research Station, Albuquerque, New Mexico

Stephen I. Rothstein (Vice Team Leader)
University of California at Santa Barbara, Santa Barbara, California

Jon C. Boren
New Mexico State University, Las Cruces, New Mexico

William L. Graf
University of South Carolina, Columbia, South Carolina

Jerry L. Holechek
New Mexico State University, Las Cruces, New Mexico

Barbara E. Kus
USGS Western Ecological Research Center, San Diego State University, San Diego, California

Robert M. Marshall
The Nature Conservancy, Tucson, Arizona

Molly M. Pohl
San Diego State University, San Diego, California

Susan J. Sferra
U.S. Bureau of Reclamation, Phoenix, Arizona

Mark K. Sogge
USGS Forest & Rangeland Ecosystem Science Center, Colorado Plateau Field Station, Flagstaff, Arizona

Julie C. Stromberg
Arizona State University, Tempe, Arizona

Bradley A. Valentine
California Department of Fish and Game, Santa Rosa, California

Mary J. Whitfield
Southern Sierra Research Station, Weldon, California

Sartor O. Williams III
New Mexico Department of Game and Fish, Santa Fe, New Mexico

With assistance from:

Stuart C. Leon (Recovery Team Liaison)
Gregory Beatty (Technical Assistant)
Tracy A. Scheffler (Technical Assistant)
U.S. Fish and Wildlife Service, Region 2

Steven Albert (Tribal Liaison)
Zuni Fish and Wildlife Department, Zuni, New Mexico

Acknowledgments

Many people provided assistance, information, and other technical and logistical help in developing this Recovery Plan and related materials. These included: Bryan Arroyo (USFWS), Jim Baily (NMDGF), Bill Berry (USMC Camp Pendleton), Bryan Brown (SWCA), Wendy Brown (USFWS), Slader Buck (USFWS), Steve Chambers (USFWS), Bill Cosgrove (USBR), Charles Drost (USGS CPFS), Matt Farnsworth (CSU), Jackie Ferrier (USFWS), Noah Greenwald (SWCBD), John Gustafson (CDFG), Bruce Haffenfeld, Loren Hays (USFWS), William Haas (Varanus Biological Services), David Harlow (USFWS), Dave Harris (TNC), Frank Howe (UDWR), Peter Jenkins (Biopolicy Consulting), Kris Karas (USBR), Nancy Kaufman (USFWS), Tom Koronkiewicz (CPFS), Jeri Krueger (USFWS), Dave Krueper (USFWS), Roland Lamberson (CSU), Susan MacMullin (USFWS), Tracy McCarthey (AGFD), Robert McKernan (San Bernardino County Museum), Suzanne McMullin (UDWR), Marty Meisler (MWD), Barry Noon (CSU), Bruce Palmer (USFWS), Charles Paradzick (AGFD), Eben Paxton (CPFS), David Pereksta (USFWS), Al Pfister (USFWS), Barbara Raulston (USBR), Jim Reichman (NCEAS), Laura Romin (USFWS), Jay Rourke (AGFD), Kenneth Sanchez (USFWS), Jim Sedgwick (USGS), Cliff Shackelford (TPWD), Gary Skiba (CDW), Sam Spiller (USFWS), Scott Stoleson (USFS), Mike Sumner (AGFD), John Swett (USBR), Justin Tade (DOI Regional Solicitor), Cris Tomlinson (NDW), Jim Travis (NMOS), Charles van Riper III (USGS CPFS), Philip Unitt (SDNHM), Bill Werner (AGFD), Mike Wickersham (NDW), Tim Wilmoth (ADWR), Helen Yard (SWCA), and Patricia Zenone (USFWS). A special thanks is extended to Timothy Tibbitts (NAU; Organ Pipe Cactus National Monument) for providing technical writing and editing assistance during the development of the draft Recovery Plan.

The Tribal Working Group assisted in identifying issues on Native American lands. Participants included: Steven Albert (Pueblo of Zuni), John Algots (Fort Mojave Tribe), Todd Caplan (Santa Ana Pueblo), Kerry Christensen (Hualapai Tribe), Michael Francis (Colorado River Indian Tribe), Matt Hopkins, Jr. (San Carlos Apache Tribe), Norman Jojola (BIA-Northern Pueblo Agency), Charles R. Mahkewa (Hopi Tribe), Morris Pankgana (Salt River Pima-Maricopa Indian Community), Les Ramirez (Santa Ana Pueblo), Mary Jo Stegman (USFWS-Pinetop Office), Terence Stroh (Southern Ute Indian Tribe), and John Swenson (Cocopah Indian Tribe). Amy Heuslein (BIA), Joseph Jojola (BIA), and John Antonio (USFWS) were instrumental in organizing Tribal briefings for purposes of reviewing the draft Recovery Plan.

The following institutions generously contributed staff, facilities, and other assistance: Arizona Department of Water Resources, Arizona Game and Fish Department, Arizona State University, Audubon California/Kern River Preserve, Bureau of Indian Affairs-Western Regional Office and Southern Pueblos Agency, California Department of Forestry, Colorado State University, National Center for Ecological Analysis and Synthesis, National Park Service, The Nature Conservancy, New Mexico Department of Game and Fish, New Mexico State University, Northern Arizona University, Pacific Western Land Company, Pueblo Indian Cultural Center, San Diego State University, University of California at Santa Barbara, U.S. Bureau of Reclamation (Phoenix Area Office, Upper and Lower Colorado River Regional Offices), USDA Forest Service (Rocky Mountain Research Station, Gila National Forest, Sequoia National Forest), USGS (Colorado Plateau Field Station, Western Ecological Research Center). The U.S. Bureau of Reclamation, Upper Colorado River Regional Office and Phoenix Area Office, contributed financial assistance.

Executive Summary
Southwestern Willow Flycatcher Recovery Plan

Current Status of the Species

The southwestern willow flycatcher (*Empidonax traillii extimus*) breeds in dense riparian habitats in southwestern North America, and winters in southern Mexico, Central America, and northern South America. Its breeding range includes far western Texas, New Mexico, Arizona, southern California, southern portions of Nevada and Utah, southwestern Colorado, and possibly extreme northern portions of the Mexican States of Baja California del Norte, Sonora, and Chihuahua. The subspecies was listed as endangered effective March 29, 1995. Approximately 900 to 1100 pairs exist.

Habitat Requirements, Threats, and Other Limiting factors

The southwestern willow flycatcher breeds in relatively dense riparian tree and shrub communities associated with rivers, swamps, and other wetlands, including lakes (e.g., reservoirs). Most of these habitats are classified as forested wetlands or scrub-shrub wetlands. Habitat requirements for wintering are not well known, but include brushy savanna edges, second growth, shrubby clearings and pastures, and woodlands near water. The southwestern willow flycatcher has experienced extensive loss and modification of breeding habitat, with consequent reductions in population levels. Destruction and modification of riparian habitats have been caused mainly by: reduction or elimination of surface and subsurface water due to diversion and groundwater pumping; changes in flood and fire regimes due to dams and stream channelization; clearing and controlling vegetation; livestock grazing; changes in water and soil chemistry due to disruption of natural hydrologic cycles; and establishment of invasive non-native plants. Concurrent with habitat loss have been increases in brood parasitism by the brown-headed cowbird (*Molothrus ater*), which inhibit reproductive success and further reduce population levels.

Recovery Objectives

1. Recovery to the point that reclassification to "threatened" is warranted.
2. Recovery to the point that delisting is warranted.

Recovery Criteria

Reclassification from endangered to threatened may be considered when either of the following criterion have been met:

Criterion 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*.

Criterion 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.

The southwestern willow flycatcher may be removed from the list of threatened and endangered species when both of the following criteria have been met:

Criterion 1. Meet and maintain, at a minimum, the population levels and geographic distribution specified under reclassification to threatened Criterion 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, as presented in Table 10.

Criterion 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 (e.g., public land management planning process for Federal lands, habitat conservation plans (under Section 10 of the ESA), conservation easements, and land acquisition agreements for private lands, and inter-governmental conservation agreements with Tribes). Prior to delisting, the USFWS must confirm that the agreements have been created and executed in such a way as to achieve their role in flycatcher recovery, and individual agreements for all areas within all Management Units (public, private, and Tribal) that are critical to metapopulation stability (including suitable, unoccupied habitat) must have demonstrated their effectiveness for a period of at least 5 years.

Actions Needed

Recovery actions in the Plan are categorized into nine types:

1. Increase and improve occupied, suitable, and potential breeding habitat; 2. Increase metapopulation stability; 3. Improve demographic parameters; 4. Minimize threats to wintering and migration habitat; 5. Survey and monitor; 6. Conduct research; 7. Provide public education and outreach; 8. Assure implementation of laws, policies, and agreements that benefit the flycatcher; 9. Track recovery progress.

Estimated Cost of Recovery ($1000s)

Costs associated with recovery are estimated for each of the nine categories listed above, based on the years in which specific actions are scheduled to occur. These costs are further detailed in the Implementation Schedule.

Year	Action 1	Action 2	Action 3	Action 4	Action 5	Action 6	Action 7	Action 8	Action 9	**Total**
FY01	8182*	1629	0*	225	835	2147	30*	183*	30	13261
FY02	8182*	1629	0*	225	835	2147	30*	183*	30	13261
FY03	7816*	4951	390*	225	835	2773	30*	183*	30	17233
FY04	7216*	4951	390*	225*	835	2348	30*	183*	50	16228
FY05	7216*	4951	390*	225*	850	2348	30*	183*	190	16383
FY 6-20	25430*	6300	1950*	0*	0	860*	25*	25*	0	34590
FY 21-30	16210*	0	0	0*	0	0*	50*	250*	0	16510
Total	80252*	24411	3120*	1125*	4190	12623*	225*	1190*	330	127466

*Does not represent total potential funds due to inability to estimate costs for specific recovery actions at this time. See Section V. Implementation Schedule for detailed estimate of funds and potential partners.

Date of Recovery

Reclassification to threatened could be initiated in 2020, or earlier.

Delisting could be accomplished within 10 years of reclassification.

TABLE OF CONTENTS

SOUTHWESTERN WILLOW FLYCATCHER RECOVERY PLAN

IV. RECOVERY

V. IMPLEMENTATION SCHEDULE

VII. APPENDICES

LIST OF FIGURES

LIST OF TABLES

I. INTRODUCTION

A. Overview

The Endangered Species Act of 1973 (ESA) calls for preparation of recovery plans for threatened and endangered species likely to benefit from the effort, and authorizes the Secretary of the Interior to appoint recovery teams to prepare the plans. A recovery plan must establish recovery goals and objectives, describe site-specific management actions recommended to achieve those goals, and estimate the time and cost required for recovery. A recovery plan is not self-implementing, but presents a set of recommendations for managers and the general public, which are endorsed by an approving official of the Department of Interior. Recovery plans also serve as a source of information on the overall biology, status, and threats of a species. It is the intent of the U.S. Fish and Wildlife Service (USFWS) to modify this Recovery Plan in response to management, monitoring, and research data, at 5-year intervals.

This Recovery Plan is comprised of the following major sections:

I. Introduction and Background

This section provides summary background information on the southwestern willow flycatcher's sensitive species status, and the general approach to recovery.

II. Biology, Ecology, and Status

This section provides background information on the biology, status, and reasons for decline of the southwestern willow flycatcher.

III. Conservation Measures

This section discusses current programs, measures, and legal mechanisms that contribute, or could contribute to conservation and recovery of the southwestern willow flycatcher and/or its habitat.

IV. Recovery

This section presents the details of the objectives, approach, criteria, and specific actions for recovering the flycatcher.

V. Implementation Schedule

This section outlines tasks, assigns responsibility for task implementation, and estimates the cost of the recovery program.

VI. Literature Cited

Full citations for all literature referenced in this Recovery Plan and associated Issue Papers (see Appendices) are listed.

VII. Appendices

The 13 Appendices to this Recovery Plan comprise this section. These Appendices include Issue Papers (see Section I.C.; Recovery Team Subgroup and "Issue Paper" Approach, below), data compilations, lists, a summary of comments on the draft plan, and other background information. Appendix B provides a key to all acronyms and abbreviations used in this Recovery Plan.

In this Recovery Plan, unless otherwise noted, the terms 'southwestern willow flycatcher,' 'flycatcher,' '*E. t. extimus*,' and 'the bird' all refer to the endangered southwestern subspecies of the willow flycatcher, *Empidonax traillii extimus*. The term 'willow flycatcher' is used to refer to the species level (*E. traillii*), or one or more of the other willow flycatcher subspecies, as noted in each use.

B. Ecosystem and Watershed Approaches

As directed in the ESA, the purpose of this Recovery Plan, and the ESA's other provisions, are to conserve the *ecosystems* upon which the southwestern willow flycatcher depends. The southwestern willow flycatcher depends upon one of the most critically endangered habitats in North America: southwestern riparian ecosystems. Southwestern riparian ecosystems have always comprised a very small portion of the landscape. Yet even in their current decimated state they are disproportionately important to wildlife and plants, typically supporting far greater species diversity than the surrounding upland ecosystems. Therefore, in addition to the flycatcher, many other species of birds, mammals, fish, plants, reptiles, amphibians, and invertebrates are imperiled by the destruction of southwestern riparian habitats brought about by regional high levels of human populations.

This Recovery Plan recognizes that not all riparian habitats are potential southwestern willow flycatcher habitat, and that flycatcher habitat may not be the same as, or compatible with, riparian and aquatic habitats for some other plant and wildlife species. Southwestern riparian habitats are by nature diverse, heterogeneous, and dynamic, providing a wide spectrum of habitats for a myriad of species. In addition to general drying of riparian habitats, a major impact of human developments has been elimination or modification of the natural processes that establish and maintain these natural levels of dynamism, diversity, and heterogeneity in riparian ecosystems. This Recovery Plan does not seek to make all riparian habitats into southwestern willow flycatcher habitat at the expense of other species. To do so would be ecologically impossible, and would constitute irresponsible conservation biology. This Recovery Plan seeks in part to protect, re-establish, mimic, and/or mitigate for the loss of the natural processes that establish, maintain, and recycle riparian ecosystems relevant to the flycatcher.

Due to the broad geographic range of the flycatcher, this Recovery Plan uses a watershed approach to organize recovery. Six Recovery Units, further subdivided into Management Units, are designated (see Section IV.A.; Recovery Strategy). These Recovery and Management Units are based on watershed and hydrologic units (Seaber et al. 1994) within the breeding range of the flycatcher. This provides a strategy to characterize flycatcher populations, structure recovery goals, and facilitate effective recovery actions that should closely parallel the physical, biological, and logistical realities on the ground. Further, using Recovery and Management Units assures that populations will be well distributed when recovery criteria are met.

Riparian habitats have high potential for restoration. They are by nature dynamic and fairly resilient, adapted to the dynamism of natural stream systems. Where natural or near-natural conditions of water flow, water chemistry, and sedimentation can be re-established, near-natural riparian ecosystems have a high likelihood of re-establishment. However, restoration ecology is a new science. Until we improve our ability to restore degraded riparian ecosystems, conservation of existing healthy riparian systems should be a high priority (USFWS 1998).

C. Recovery Team Subgroup and "Issue Paper" Approach

The Southwestern Willow Flycatcher Recovery Team is composed of a Technical Subgroup (pg. ii), six Implementation Subgroups (Appendix A), and a Tribal Working Group. The Technical Subgroup consists of 14 academic scientists, researchers, and resource managers with a wide range of expertise in avian biology and ecology, southwestern willow flycatcher ecology, cowbird ecology, riparian ecology, hydrology, range management, and conservation planning. The Implementation Subgroups consist of more than 200 community representatives across the Southwest including ranchers, environmental representatives, water and power interests, State and Federal land managers, and local governments. Each Implementation Subgroup is associated with a particular recovery unit (see Section IV. Recovery). The Technical Subgroup's function is to compile and review extensive scientific information and develop recovery goals, strategies and recommended actions. The role of the Implementation Subgroups is to advise the Regional Director and Technical Subgroup on the feasibility of recovery strategies and actions recommended by the Technical Subgroup, and to implement recovery actions in the United States portion of the flycatcher's geographic range.

The Technical Subgroup met 22 times between March 1998 and September 2000, to assimilate information and develop recovery strategies and goals. As part of that process, an additional five meetings between the Technical and Implementation Subgroups were held. The Tribal Working Group met with the Technical Subgroup on two occasions to discuss potential Tribal involvement and collaboration in the recovery process. Communication between the subgroups was facilitated by a USFWS Recovery Team Liaison, and a mutually-accessible Internet website. For each of the major issues involved in recovering the flycatcher, the Technical Subgroup developed in-depth "Issue Papers", which were submitted to the Implementation Subgroups for review. The Issue Papers were finalized incorporating feedback from the Implementation Subgroups, and are presented in Appendices D through M. An Issue Paper developed by the Tribal Working Group is presented in Appendix N. In some cases, synthesized information from an appendix has been brought forward to the body of the Recovery Plan, as it constitutes a crucial link between the biology/ecology of the flycatcher, threats to the flycatcher, and the management actions recommended in the Recovery Plan. In other cases, the appendix contains information that is useful for understanding the context of a threat, but may not be directly applicable to management recommendations. For all aspects of flycatcher recovery discussed in this Recovery Plan, these Issue Papers may be referred to for greater detail. Overall, the Subgroup and Issue Paper approach was used to incorporate the best possible science, and address the major technical and logistical challenges to recovery, before a draft of this Recovery Plan was circulated for full public review. For a conservation and recovery effort of this scope and complexity, this approach proved to be of great value.

On May 3, 2001, the completed draft Recovery Plan was made available to the Implementation Subgroups and Tribal Working Group. On June 6, 2001, the USFWS published in the Federal Register (66 FR 30477) an announcement of the availability of the draft Recovery Plan, and opened a 120-day comment period. The comment period was subsequently reopened for a period of 60 days extending through December 10, 2001 (66 FR 51683). During this period, the Technical Subgroup held an additional five meetings with Implementation Subgroup members, and participated in two official briefings for interested Tribes sponsored by the Bureau of Indian Affairs (BIA) and the Native American Fish and Wildlife Society. All comments received were reviewed by the Technical Subgroup and USFWS, significant and substantive issues identified, and changes to the draft Recovery Plan were made accordingly (see also Appendix O).

D. Species Description

The southwestern willow flycatcher (*Empidonax traillii extimus*) is a small Neotropical migratory bird, whose nesting habitat is restricted to relatively dense growths of trees and shrubs in riparian ecosystems in the arid southwestern United States and possibly extreme northwestern Mexico. These riparian habitats are associated with rivers, swamps, and other wetlands, including lakes and reservoirs (Bent 1960). Most of these habitats are classified as wetlands in the legal sense: palustrine and lacustrine forested wetlands and scrub-shrub wetlands (Cowardin et al. 1979). Some are non-wetland riparian forests. Surface water or saturated soil are typically, but not always, present year-round or seasonally and ground water is generally at a depth of less than 2 or 3 meters (6.5 to 9 ft) within or adjacent to nesting habitat.

The flycatcher is approximately 15 cm (5.75 in) long, and weighs about 12 g (0.42 oz). It has a grayish-green back and wings, whitish throat, light grey-olive breast, and pale yellowish belly. Two wingbars are visible; the eye ring is faint or absent. The upper mandible is dark, the lower is light with a yellowish tone. The song is a sneezy “fitz-bew," the call a repeated “whitt.” Other vocalizations, usually given by flycatchers in close interactions with one another, include “wheek-a-dee,” “wheeo” and rolling “brrrt” notes. Although males are the primary singers, females also sing occasionally (Seutin 1987, Paxton et al. 1997, Sogge et al. 1997b, SWCA 2000, M. Whitfield unpubl. data.).

E. Listing History

The USFWS included the southwestern willow flycatcher on its Animal Notice of Review as a category 2 candidate species on January 6, 1989 (USFWS 1989). The candidate category 2 designation has been discontinued, but at that time the designation identified a species for which listing may have been appropriate but additional biological information was needed. After conducting a status review for the flycatcher, the USFWS elevated it to candidate category 1 status on November 21, 1991 (USFWS 1991). A category 1 species is one for which the USFWS has substantial information to support a proposal to list, but publishing a proposal is precluded by other listing activity.

On January 25, 1992, a coalition of conservation organizations petitioned the USFWS under section 4 of the ESA, requesting listing of the flycatcher as an endangered species (Suckling et al. 1992). The USFWS found that the petition presented substantial information, and requested public comments and additional biological data on the prospective listing (USFWS 1992). After reviewing additional information, on July 23, 1993 the USFWS proposed to list the flycatcher as an endangered species, with 1,038 km (643 mi) of riparian habitats proposed for critical habitat designation (USFWS 1993). The USFWS again requested public comments and scientific information, and held six public hearings. After reviewing the additional information received, the USFWS designated the southwestern willow flycatcher as endangered, effective March 29, 1995 (USFWS 1995). Designation of critical habitat was deferred (see below).

F. Critical Habitat Designation History

When the USFWS listed the southwestern willow flycatcher as endangered, a decision was deferred regarding the 1,038 km (643 mi) of riparian habitats proposed as critical habitat (USFWS 1995). The USFWS determined it was necessary to consider additional comments, reconsider the prudence of designating critical habitat, and reconsider the boundaries of critical habitat. A second period for public comment was opened from February 17 to April 28, 1995. After considering the additional comments and scientific information received, on July 22, 1997 the USFWS finalized critical habitat designation for 964 km (599 mi) of riparian habitats (USFWS 1997a), with a correction made August 20, 1997 (USFWS 1997b). On May 11, 2001, the 10th Circuit Court of Appeals set aside the southwestern willow flycatcher critical habitat designation and instructed the USFWS to issue a new critical habitat designation in compliance with the Court's ruling. The USFWS is currently in the process of re-proposing critical habitat for the flycatcher. Unless otherwise instructed by the Court, the USFWS anticipates final designation in June, 2004. For a more detailed discussion of the physical and biological features of southwestern willow flycatcher habitat, see Appendix D.

II. BIOLOGY, ECOLOGY, AND STATUS

A. Taxonomy

The willow flycatcher is one of 11 flycatchers in the genus *Empidonax* (Order Passeriformes, Family Tyrannidae) breeding in North America. Although the *Empidonax* flycatchers are notoriously difficult to distinguish by sight in the wild, each has unique morphological features, vocalizations, habitats, behaviors and/or other traits that allow biologists to distinguish them.

The willow flycatcher was described by J.J. Audubon from a specimen taken along the Arkansas River in the early 1800s (Audubon 1831); he named it *Muscicapa traillii.* Since then, the species has undergone a series of name changes and species/subspecies designations (see Aldrich 1951, Browning 1993). Prior to 1973, the willow flycatcher and alder flycatcher (*E. alnorum*) were treated together as the Traill's flycatcher (*E. traillii*) (AOU 1957). Subsequent work established that they are two separate species (Stein 1958, 1963, Seutin and Simon 1988, Winker 1994), and the American Ornithologists' Union accepted that classification (AOU 1973). Some sources (AOU 1983, McCabe 1991) also treat *E. traillii* and *E. alnorum*, and all their subspecies, as a "superspecies," the "*traillii* complex." However, the two flycatchers are distinguishable by morphology (Aldrich 1951, Unitt 1987), song type, habitat use, structure and placement of nests (Aldrich 1953, Gorski 1969), eggs (Walkinshaw 1966), ecological separation (Barlow and McGillivray 1983), and genetics (Seutin and Simon 1988, Winker 1994, Paxton and Keim unpubl. data). The breeding range of the alder flycatcher generally lies north of the willow flycatcher's range.

The southwestern willow flycatcher is one of four subspecies of the willow flycatcher (Figure 1) currently recognized (Hubbard 1987, Unitt 1987), though Browning (1993) posits a fifth subspecies (*E. t. campestris*) in the central and midwestern U.S. The willow flycatcher subspecies are distinguished primarily by subtle differences in color and morphology, and by habitat use. The southwestern subspecies *E. t. extimus* was described by Phillips (1948), and its taxonomic status has been accepted by most authors (Aldrich 1951, Bailey and Niedrach 1965, Behle and Higgins 1959, Hubbard 1987, Phillips et al. 1964, Oberholser 1974, Monson and Phillips 1981, Unitt 1987, Schlorff 1990, Browning 1993, USFWS 1995). Recent research (Paxton 2000) concluded that *E. t. extimus* is genetically distinct from the other willow flycatcher subspecies.

The southwestern willow flycatcher is generally paler than other willow flycatcher subspecies, and also differs in morphology, e.g., wing formula, bill length, and wing:tail ratio (Unitt 1987 and 1997, Browning 1993). These differences require considerable experience, training, and reference study skins to distinguish, and are not reliable characteristics for field identification. Evidence also suggests song form differences among some willow flycatcher subspecies (Sedgwick 2001); these differences may serve as another parameter to distinguish the subspecies, although variations within subspecies may occur as well (Travis 1996, Sedgwick 1998).

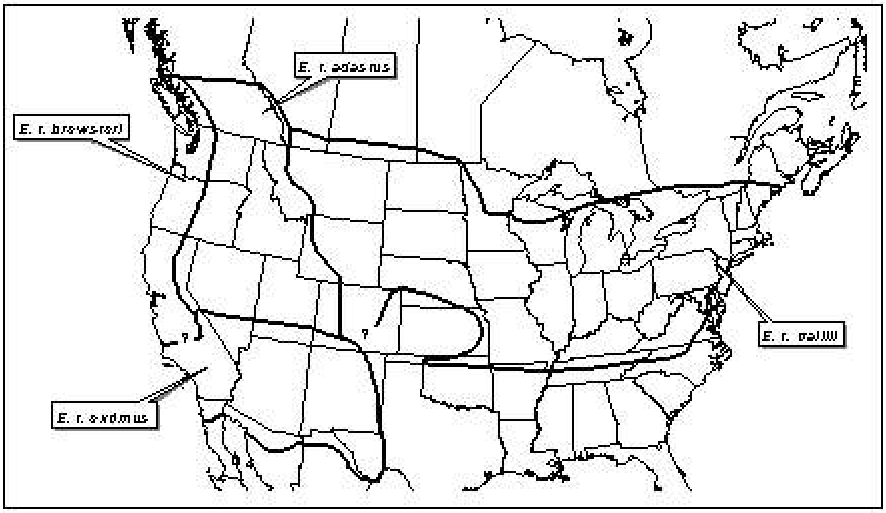


Figure 1. Breeding ranges of the subspecies of the willow flycatcher (*Empidonax traillii*).
From Sogge et al. (1997b), adapted from Unitt (1987), Browning (1993).

B. Range and Distribution

The historical breeding range of the southwestern willow flycatcher included southern California, southern Nevada, southern Utah, Arizona, New Mexico, western Texas, southwestern Colorado, and extreme northwestern Mexico (Figures 1 and 3[Fig. 3 follows page 68]; Hubbard 1987, Unitt 1987, Browning 1993). The flycatcher's current range is similar to the historical range, but the quantity of suitable habitat within that range is much reduced from historical levels. The flycatcher occurs from near sea level to over 2600 m (8500 ft), but is primarily found in lower elevation riparian habitats. Throughout its range, the flycatcher's distribution follows that of its riparian habitat; relatively small, isolated, widely dispersed locales in a vast arid region. Marshall (2000) found that 53% of southwestern willow flycatchers were in just 10 sites (breeding groups) rangewide, while the other 47% were distributed among 99 small sites of ten or fewer territories. In some parts of its northern range, questions of range boundaries between other willow flycatcher subspecies exist, including possible intergradations between subspecies. In California (see Figures 1 and 3), individuals of *E. t. extimus* and *E. t. brewsteri* are morphologically fairly distinct, even where their ranges are near one another (Unitt 1987). However, in southern Utah, southwestern Colorado, and perhaps northern New Mexico, there may be fairly broad clinal gradations between the southwestern willow flycatcher and the Great Basin/Rocky Mountain race *E. t. adastus* (Unitt 1987). Phillips et al. (1964)

suggested that *E. t. extimus* may be typical of lower elevations, noting that willow flycatchers from high elevations in eastern Arizona had some characteristics of *E. t. adastus*. Therefore in northern parts of the southwestern willow flycatcher's range, clinal gradations with *E. t. adastus* may exist with increasing elevation, as well as latitude. Recent genetic work by Paxton (2000) verified *extimus* genetic stock in south-central Colorado (i.e., San Luis Valley) and southwestern Utah (e.g., Virgin River). Overall, Paxton (2000) showed that the northern boundary for extimus was generally consistent with that proposed by Unitt (1987) and Browning (1993). This recovery plan adopts a range boundary that reflects these results. However, because of the absence of flycatchers in the lower to mid elevations of the Colorado Plateau in southern Utah and Southwestern Colorado, Paxton (2000) did not address potential sub-specific differences resulting from elevation or habitat differences and watershed boundaries. The Service recognizes that future data may result in refinements to the northern boundary. Records of probable breeding flycatchers in Mexico are few and are restricted to extreme northern Baja California del Norte and northern Sonora (Unitt 1987, Wilbur 1987). The flycatcher's wintering range includes southern Mexico, Central America, and probably South America (Stiles and Skutch 1989, Howell and Webb 1995, Ridgely and Gwynne 1989, Unitt 1997, Koronkiewicz et al. 1998, Unitt 1999). State-by-State summaries follow:

1. California

Historically, the southwestern willow flycatcher was common in all lower elevation riparian areas of the southern third of California (Wheelock 1912, Willett 1912 and 1933, Grinnell and Miller 1944), including the Los Angeles basin, the San Bernardino/Riverside area, and San Diego County (Unitt 1984, 1987). River systems where the flycatcher persists include the Colorado, Owens, Kern, Mojave, Santa Ana, Pilgrim Creek, Santa Margarita, San Luis Rey, San Diego, San Mateo Creek, San Timoteo Creek, Santa Clara, Santa Ynez, Sweetwater, San Dieguito, and Temecula Creek (Whitfield 1990, Holmgren and Collins 1995, Kus 1996, Kus and Beck 1998, Whitfield et al. 1998, McKernan and Braden 1999, L. Hays unpubl. data, Griffith and Griffith in press, W. Haas pers. comm., B. Kus pers. comm. and unpubl. data, McKernan unpubl. data).

2. Arizona

The historical range of the flycatcher in Arizona included portions of all major watersheds (H. Brown 1902 unpubl. data, Willard 1912, Swarth 1914, Phillips 1948, Unitt 1987). Contemporary investigations (post-1990) show the flycatcher persists, probably in much reduced numbers, along the Big Sandy, Bill Williams, Colorado, Gila, Hassayampa, Little Colorado, Salt, San Francisco, San Pedro, Santa Cruz, Santa Maria, Tonto Creek, and Verde river systems (Sferra et al. 1997, Sogge et al. 1997a, McKernan and Braden 1999, Paradzick et al. 1999, Tibbitts and Johnson 1999, Smith et al. 2002).

3. New Mexico

The historic breeding range of the flycatcher is considered to have been primarily from the Rio Grande Valley westward, including the Rio Grande, Chama, Zuni, San Francisco, and Gila watersheds (Bailey 1928, Ligon 1961, Hubbard 1987); breeding was unconfirmed in the San Juan and Pecos drainages (Hubbard 1987). Contemporary surveys documented that flycatchers persist in the Rio Grande, Chama, Zuni, San Francisco, and Gila watersheds and that small breeding populations also occur in the San Juan drainage and along Coyote Creek in the Canadian River drainage, but breeding remains unconfirmed in the Pecos watershed (Maynard 1995, Cooper 1996, Cooper 1997, Williams and Leal 1998, S. Williams, pers. comm.). The Gila Valley was identified by Hubbard (1987) as a stronghold for the taxon, and recent surveys have confirmed that area contains one of the largest known flycatcher populations (Skaggs 1996, Stoleson and Finch 1999). The subspecific identity (*E. t. extimus*. vs. *E. t. adastus*) of willow flycatchers in northern New Mexico has been problematical (Hubbard 1987, Unitt 1987, Maynard 1995, Travis 1996), but recent genetic research supports affiliation with *E.t. extimus* (Paxton 2000).

4. Texas

The eastern limit of the southwestern willow flycatcher's breeding range is considered to be in the Trans-Pecos region of western Texas (Unitt 1987), where presumably breeding flycatchers were reported from Fort Hancock on the Rio Grande (Phillips 1948), the Davis Mountains, including a reported nest with young in July 1890 (Oberholser 1974), Big Bend National Park (Wauer 1973, 1985), and possibly the Guadalupe Mountains (Phillips, pers. comm., cited in Unitt 1987). Current status in Texas is essentially unknown; no recent survey data are available.

5. Utah

The north-central limit of the flycatcher’s breeding range is in southern Utah. Historically, the bird occurred in the following river systems: Colorado, Kanab Creek, San Juan (Behle et al. 1958, Behle and Higgins 1959, Behle 1985, Browning 1993), Virgin (Phillips 1948, Wauer and Carter 1965, Whitmore 1975), and perhaps Paria (BLM, unpubl. data). Behle and Higgins (1959) suggested that extensive habitat likely existed along the Colorado River and its tributaries in Glen Canyon. Contemporary investigations verified probable breeding flycatchers along the upper Virgin River, and Panguitch Creek (Langridge and Sogge 1998, Peterson et al. 1998, USFWS unpubl. data), but failed to locate breeders along the San Juan (Johnson and Sogge 1997, Johnson and O’Brien 1998). The subspecific identity (*E. t. extimus* vs. *E. t. adastus*) of willow flycatchers in high elevation/central Utah remains somewhat unresolved (Behle 1985, Unitt 1987, Browning 1993), and requires additional research.

6. Nevada

The historical status of the flycatcher at its range limit in southern Nevada is unclear; Unitt (1987) reported only three records, all before 1962. Contemporary investigations (post-1990) have verified breeding flycatchers on the Virgin River and Muddy River, the Amargosa River drainage at Ash Meadows NWR, Meadow Valley Wash, and the Pahranagat River drainage (McKernan and Braden 1999, Micone and Tomlinson 2000, USFWS unpubl. data).

7. Colorado

The historic and current breeding status of the southwestern willow flycatcher in Colorado is unclear (USFWS 1995). Hubbard (1987) believed the subspecies ranged into extreme southwestern Colorado, Browning (1993) was noncommittal, and Unitt (1987) tentatively used the New Mexico-Colorado border as the boundary between *E. t. extimus* and *E. t. adastus*. Several specimens taken in late summer have been identified as *E. t. extimus*, but nesting was not confirmed (Bailey and Niedrach 1965). Breeding willow flycatchers with genetic characteristics of the southwestern subspecies occur at Alamosa National Wildlife Refuge and McIntire Springs, but flycatchers from Beaver Creek and Clear Creek (Andrews and Righter 1992, Owen and Sogge 1997) did not have the southwestern subspecies genetic characteristics (Paxton 2000). There is much riparian habitat in southwestern Colorado that has not yet been surveyed for willow flycatchers; additional populations may be found with increased survey effort.

8. Mexico

The breeding status of the flycatcher in Mexico is unclear. Russell and Monson (1998) accepted no evidence that willow flycatchers ever nested in Sonora. However, several specimens from Sonora and Baja California del Norte are accepted as breeding evidence by others (Unitt 1987, Wilbur 1987, Browning 1993). In the more general treatments of field guides, where supporting evidence is not cited, the willow flycatcher is described as breeding in northern portions of Baja California del Norte and Sonora (Blake 1953, Peterson and Chalif 1973, Howell and Webb 1995). Based on the apparent historical abundance on the lower Colorado River near the U.S. - Mexico border before construction of dams, and current presence, it is likely that the flycatcher was present, perhaps abundant, in the Colorado River's delta in Mexico. Given the presence of flycatchers along the Rio Grande in southern New Mexico and the existence of riparian habitat along some drainages in northern Mexico, southwestern willow flycatchers may also breed in northern Chihuahua.

C. Habitat Characteristics

1. Overview and General Habitat Composition

The breeding habitat of the southwestern willow flycatcher is discussed in depth in Appendix D, and in Sogge and Marshall (2000). The flycatcher breeds in different types of dense riparian habitats, across a large elevational and geographic area. Although other willow flycatcher subspecies in cooler, less arid regions may breed more commonly in shrubby habitats away from water (McCabe 1991), the southwestern willow flycatcher usually breeds in patchy to dense riparian habitats along streams or other wetlands, near or adjacent to surface water or underlain by saturated soil. Common tree and shrub species comprising nesting habitat include willows (*Salix* spp.), seepwillow (aka mulefat; *Baccharis* spp.), boxelder (*Acer negundo*), stinging nettle (*Urtica* spp.), blackberry (*Rubus* spp.), cottonwood (*Populus* spp.), arrowweed (*Tessaria sericea*), tamarisk (aka saltcedar; *Tamarix ramosissima*), and Russian olive (*Eleagnus angustifolia*) (Grinnell and Miller 1944, Phillips et al. 1964, Hubbard 1987, Whitfield 1990, Brown and Trosset 1989, Brown 1991, Sogge et al. 1993, Muiznieks et al. 1994, Maynard 1995, Cooper 1996, Skaggs 1996, Cooper 1997, McKernan and Braden 1998, Stoleson and Finch 1999, Paradzick et al. 1999). Habitat characteristics such as plant species composition, size and shape of habitat patch, canopy structure, vegetation height, and vegetation density vary across the subspecies' range. However, general unifying characteristics of flycatcher habitat can be identified. Regardless of the plant species composition or height, occupied sites usually consist of dense vegetation in the patch interior, or an aggregate of dense patches interspersed with openings. In most cases this dense vegetation occurs within the first 3 - 4 m (10-13 ft) above ground. These dense patches are often interspersed with small openings, open water, or shorter/sparser vegetation, creating a mosaic that is not uniformly dense. In almost all cases, slow-moving or still surface water and/or saturated soil is present at or near breeding sites during wet or non-drought years.

Thickets of trees and shrubs used for nesting range in height from 2 to 30 m (6 to 98 ft). Lower-stature thickets (2-4 m or 6-13 ft) tend to be found at higher elevation sites, with tall stature habitats at middle and lower elevation riparian forests. Nest sites typically have dense foliage from the ground level up to approximately 4 m (13 ft) above ground, although dense foliage may exist only at the shrub level, or as a low dense canopy. Nest sites typically have a dense canopy, but nests may be placed in a tree at the edge of a habitat patch, with sparse canopy overhead. The diversity of nest site plant species may be low (e.g., monocultures of willow or tamarisk) or comparatively high. Nest site vegetation may be even- or uneven-aged, but is usually dense (Brown 1988, Whitfield 1990, Muiznieks et al. 1994, McCarthey et al. 1998, Sogge et al. 1997a, Stoleson and Finch 1999).

Historically, the southwestern willow flycatcher nested in native vegetation such as willows, buttonbush, boxelder, and *Baccharis*, sometimes with a scattered overstory of cottonwood (Grinnell and Miller 1944, Phillips 1948, Whitmore 1977, Unitt 1987). Following modern changes in riparian plant communities, the flycatcher still nests in native vegetation where available, but also nests in thickets dominated by the non-native tamarisk and Russian olive and in habitats where native and non-native trees and shrubs are present in essentially even mixtures (Hubbard 1987, Brown 1988, Sogge et al. 1993, Muiznieks et al. 1994, Maynard 1995, Sferra et al. 1997, Sogge et al. 1997a, Paradzick et al. 1999). The number of nests in different broad habitat types (e.g., dominated by native, exotic, and mixed native-exotic plant associations) is presented in Table 1.

Table 1 . Number of known southwestern willow flycatcher territories located within major vegetation/habitat types, by Recovery Unit. Data are from Sogge et al. 2002, based on last reported habitat and survey data for all sites where flycatchers were known to breed, 1993-2001. See Section IV.A. for definition of Recovery Units.

	Recovery Unit						
Vegetation Type	Basin & Mojave	Coastal California	Gila	Lower Colorado	Rio Grande	Upper Colorado	Total
Native (>90%)	63	109	188	37	68	3	468
Mixed native/exotic (>50% native)	3	49	77	56	46		231
Mixed exotic/native (>50% exotic)			108	50	3		161
Exotic (>90%)			77	2	11		90
Not reported	3	28	4	1			36
Total	69	186	454	146	128	3	986

<u>Habitats Dominated by Native Plants</u>

Occupied sites dominated by native plants vary from single-species, single-layer patches to multi-species, multi-layered strata with complex canopy and subcanopy structure. Site characteristics differ substantially with elevation. Low to mid-elevation sites range from single plant species to mixtures of native broadleaf trees and shrubs including willows, cottonwood, boxelder, ash (*Fraxinus* sp.), alder (*Alnus* sp.), blackberry, and nettle. Average canopy height can be as short as 4 m (13 ft) or as high as 30 m (98 ft). High-elevation nest sites dominated by native plants are more similar to each other than low elevation native sites. Most known high elevation (>1,900 m / 6,230 ft) breeding sites are comprised completely of native trees and shrubs, and are dominated by a single species of willow, such as coyote willow (*Salix exigua*) or Geyer's willow (*S. geyeriana*). However, Russian olive is a major habitat component at some high elevation breeding sites in New Mexico. Average canopy height is generally only 3 to 7 m (10-23 ft). Patch structure is characterized by a single vegetative layer with no distinct overstory or understory. There is usually dense branch and twig structure in the lower 2 m (6.5 ft), with high live foliage density from the ground to the canopy. Tree and shrub vegetation is often associated with sedges, rushes, nettles and other herbaceous wetland plants. These willow patches are usually found in mountain meadows, and are often associated with stretches of stream or river that include beaver dams and pooled water.

Habitats of Mixed Native and Exotic Plants

Southwestern willow flycatchers also breed in sites comprised of dense mixtures of native trees and shrubs mixed with exotic/introduced species such as tamarisk or Russian olive. The exotics are often primarily in the understory, but may be a component of overstory. At several sites, tamarisk provides a dense understory below an upper canopy of gallery willows or cottonwoods, forming a habitat that is structurally similar to the cottonwood-willow habitats in which flycatchers historically nested. A particular site may be dominated primarily by natives or exotics, or be a more-or-less equal mixture. The native and exotic components may be dispersed throughout the habitat or concentrated in distinct, separate clumps within a larger matrix. Generally, these habitats are found below 1,200 m (3,940 ft) elevation.

Habitats Dominated by Exotics Plants

Southwestern willow flycatchers also nest in some riparian habitats dominated by exotics, primarily tamarisk and Russian olive. Most such exotic habitats range below 1,200 m (3940 ft) elevation, and are nearly monotypic, dense stands of tamarisk or Russian olive that form a nearly continuous, closed canopy with no distinct overstory layer. Canopy height generally averages 5 to 10 m (16 - 33 ft), with canopy density uniformly high. The lower 2 m (6.5 ft) of vegetation is often comprised of dense, often dead, branches. However, live foliage density may be relatively low from 0 to 2 m (6.5 ft) above ground, but increases higher in the canopy. The flycatcher does not nest in all of the exotic species that can dominate riparian systems. For example, flycatchers rarely use giant reed (*Arundo donax*) and are not known to use tree of heaven (*Ailanthus altissima*).

Forty-seven percent of willow flycatcher territories occur in mixed native/exotic habitat (> 10% exotic) and twenty-five percent are at sites where tamarisk is dominant (Sogge et al. 2000). Flycatchers nest in tamarisk at many river sites, and in many cases, use tamarisk even if native willows are present (Table 2) (Sferra et al. 2000). Southwestern willow flycatchers nest in tamarisk at sites along the Colorado, Verde, Gila, San Pedro, Salt, Bill Williams, Santa Maria, and Big Sandy rivers in Arizona (McCarthey et al. 1998), Tonto Creek in Arizona (McCarthey et al. 1998), the Rio Grande and Gila rivers in New Mexico (Hubbard 1987, Maynard 1995, Cooper 1995, Williams, unpubl. data), and the San Dieguito, lower San Luis Rey, and Sweetwater rivers in California (Kus, unpubl. data), Meadow Valley Wash (Tomlinson, unpubl. data), and Virgin River in Nevada (McKernan and Braden 1999). Rangewide, 86% of nests were in tamarisk in mixed and exotic habitats. In Arizona, 93% of the 758 nests documented from 1993 - 1999 in mixed and exotic habitats were in tamarisk. This distribution is similar on an annual basis in Arizona, where in 1999, 92% of the 303 nests in mixed and exotic habitats were in tamarisk (Paradzick et al. 2000). In addition to the tamarisk, three other exotics have been used as nesting substrates. Two nests were documented in giant reed (Greaves, pers. comm.) in California, 26 nests were documented in Russian olive and one nest was documented in Siberian elm (*Ulmus pumila*) in New Mexico (Stoleson and Finch, unpubl. data).

Table 2. Relative abundance of southwestern willow flycatcher nests, by substrate for rangewide data compiled from 1993 - 1999, including some data from 2000 (Sferra et al. 2000). Percents are expressed in relation to total number of nests for each habitat type. Number of nests is shown in parentheses. Native habitats are those with < 10% cover of exotic plant species. Mixed and exotic habitats have >10% exotic plant species. Coast live oak and boxelder nests are not representative of distribution across the range: coast live oak nests only occur on the upper San Luis Rey in California and boxelder nests only occur in the Cliff-Gila area on the Gila River in New Mexico. Few tamarisk nests were found in native habitat.

	Percent (number of nests)	
Nest substrate	Native	Mixed and exotic
Tamarisk	-	86 (768)
Willow[1]	41 (459)	11 (103)
Coast live oak	10 (116)	0
Boxelder	33 (371)	0
Other[2]	15 (165)	3 (26)

[1] *Salix gooddingii, Salix exigua, Salix geyerana, Salix lasiolepis, Salix laevigata, Salix taxifolia.*

[2] Other nest substrates used in descending order of frequency: buttonbush *(Ceanothus occidentalis*), cottonwood (*Populus fremontii*), Russian olive (*Elaegnus angustifolia*), stinging nettle (*Urtica dioica*), alder (*Alnus rhombifolia, Alnus oblongifolia, Alnus tenuifolia*), velvet ash (*Fraxinus velutina*), poison hemlock (*Conium maculatum*), blackberry (*Rubus ursinus*), seep willow (*Baccharis salicifolia, Baccharis glutinosa*), canyon live oak (*Quercus chrysolepis*), rose *(Rosa californica, Rosa arizonica, Rosa multiflora*), sycamore (*Platinus wrightii*), giant reed (*Arundo donax*), false indigo (*Amorpha californica*), Pacific poison ivy (*Toxicodendron diversilobum*), grape (*Vitus arizonica*), Virginia creeper (*Parthenocissus quinquefolia*), Siberian elm (*Ulmus pumila*), walnut (*Juglans hindsii*).

Sferra et al. 2000 compiled the nesting success of 84% of the 2,008 nests documented primarily between 1993 - 1999, and some nests documented in 2000. Nest productivity in tamarisk-dominated sites is 23 -54%, which is similar to native willow-dominated sites (Table 3). Tamarisk nest success averaged 45% in New Mexico and 54% in Arizona, indicating that tamarisk nests are at least as successful as nests in other substrates.

However, because the physical and structural characteristics of tamarisk stands vary widely, not all have the same value as flycatcher breeding habitat. Among sites with tamarisk, suitable flycatcher breeding habitat usually occurs where the tamarisk is tall and dense, with surface water and/or wet soils present, and where it is intermixed with native riparian trees and shrubs. However, flycatchers breed in a few patches comprised of >90 % tamarisk, with dry soils and surface water >200 m away from some of their territories.

Tamarisk eradication can be detrimental to willow flycatchers in mixed and exotic habitats, especially in or near occupied habitat or where restoration is unlikely to be successful. Risks to the flycatcher increase if the tamarisk control projects are implemented in the absence of a plan to restore suitable native riparian plant species or if site conditions preclude the re-establishment of native plant species of equal or higher functional value. Threats also increase if the eradication projects are large-scale in nature, thus possibly setting the stage for large-scale habitat loss.

Table 3. Southwestern willow flycatcher nest success, by substrate, for data compiled from 1993 - 1999 in California, Arizona, and New Mexico, including some data from 2000 (Sferra et al. 2000). Nest success is calculated as the percent of nests fledging at least one flycatcher. Number of nests is in parentheses. Native habitats are those with < 10% cover of exotic plant species. Mixed and exotic habitats have > 10% cover of exotic plant species. Coast live oak and boxelder represent only two areas: the upper San Luis Rey in California and the Cliff-Gila area on the Gila River in New Mexico. Sample size is too small to calculate percent nest success for some categories, indicated by "-" notation. Data in mixed and exotic habitats in California have not yet been compiled.

	Percent nest success (number of nests)					
	California		Arizona		New Mexico	
Plant substrate	Native	Mixed and exotic	Native	Mixed and exotic	Native	Mixed and exotic
Tamarisk	0	N/A	0	54 (585)	-	45 (49)
Willow	47 (240)	N/A	36 (77)	39 (36)	42 (65)	23 (35)
Coast live oak	72 (116)	0	0	0	0	0
Boxelder	0	0	0	0	47 (289)	0
Other	55 (62)	N/A	44 (18)	-	53 (60)	-

2. Suitable, Potential, and Unsuitable Habitat

<u>Definitions.</u> The definition of the two commonly used terms - "currently suitable habitat" and "potentially suitable habitat " – are important for managers to understand for the recovery of the flycatcher. These terms encompass all the habitat components thought to influence reproductive success, including foraging habitat, micro-climate, vegetation density and distribution throughout the home range, presence of water, patch size, presence of other southwestern willow flycatchers, or other factors as they become identified.

Currently suitable habitat (hereafter "suitable habitat") is defined as a riparian area with all the components needed to provide conditions suitable for breeding flycatchers. These conditions are generally dense, mesic riparian shrub and tree communities 0.1 ha or greater in size within floodplains large enough to accommodate riparian patches at least 10 m wide (measured perpendicular to the channel); see Appendix D for more details. Currently, this definition of suitability is based solely on habitat characteristics, not on measures of flycatcher productivity or survival. Suitable habitat may be occupied or unoccupied; any habitat in which flycatchers are found breeding is, by definition, suitable. **Occupied suitable habitat** is that in which flycatchers are currently breeding or have established territories. **Unoccupied suitable habitat** appears to have physical, hydrological, and vegetation characteristics within the range of those found at occupied sites, but does not currently support breeding or territorial flycatchers. Some sites that appear suitable may be unoccupied because they may be missing an important habitat component not yet characterized. Other sites are currently suitable but unoccupied because the southwestern willow flycatcher population is currently small and spatially fragmented, and flycatchers have not yet colonized every patch where suitable habitat has developed.

Potentially suitable habitat (= "potential habitat") is defined as a riparian system that does not currently have all the components needed to provide conditions suitable for nesting flycatchers (as described above), but which could - if managed appropriately – develop these components over time. **Regenerating potential habitats** are those areas that are degraded or in early successional stages, but have the correct hydrological and ecological setting to be become, under appropriate management, suitable flycatcher habitat. **Restorable potential habitats** are those areas that could have the appropriate hydrological and ecological characteristics to develop into suitable habitat if not for one or more major stressors, and which may require active abatement of stressors in order to become suitable. Potential habitat occurs where the flood plain conditions, sediment characteristics, and hydrological setting provide potential for development of dense riparian vegetation. Stressors that may be preventing regenerating and restorable habitats from becoming suitable include, but are not limited to, de-watering from surface diversion or groundwater extraction, channelization, mowing, recreational activities, overgrazing by domestic livestock or native ungulates, exotic vegetation, and fire.

Unsuitable habitats are those riparian and upland areas which do not have the potential for developing into suitable habitat, even with extensive management. Examples of unsuitable habitat are found far outside of flood plain areas, along steep-walled and heavily bouldered canyons, at the bottom of very narrow canyons, and other areas where physical and hydrological conditions could not support the dense riparian shrub and tree vegetation used by breeding flycatchers even with all potential stressors removed.

Knowledge of the habitat components necessary for nesting flycatchers (Appendix D) will improve as additional studies are undertaken, allowing for more quantitative and possibly regionalized habitat descriptions in the future.

Specifying locations where nesting habitat is or could develop for flycatchers should not be confused with the overall management goal of rehabilitating and/or improving entire watersheds for southwestern willow flycatcher recovery. The health of riparian ecosystems and the development, maintenance, and regeneration of flycatcher nesting habitat depends on appropriate management of uplands, headwaters, and tributaries, as well as the main stem river reaches. All of these landscape components are inter-related. As a result, nesting habitat is only a small portion of the larger landscape that needs to be considered when developing management plans, recovery actions, biological assessments for section 7 consultations with the USFWS, or other documents defining management areas or goals for flycatcher recovery.

<u>The Importance of Unoccupied Suitable Habitat and Potentially Suitable Habitat</u>. Because riparian vegetation typically occurs in flood plain areas that are prone to periodic disturbance, suitable habitats will be ephemeral and their distribution dynamic in nature. Suitable habitat patches may become unsuitable through maturation or disturbance (though this may be only temporary, and patches may cycle back into suitability). Therefore, it is not realistic to assume that any given suitable habitat patch (occupied or unoccupied) will remain continually occupied and/or suitable over the long-term. Unoccupied suitable habitat will therefore play a vital role in the recovery of the flycatcher, because it will provide suitable areas for breeding flycatchers to: (a) colonize as the population expands (numerically and geographically), and (b) move to following loss or degradation of existing breeding sites. Indeed, many sites will likely pass through a stage of being suitable but unoccupied before they become occupied. Potential habitats that are not currently suitable will also be essential for flycatcher recovery, because they are the areas from which new suitable habitat develops as existing suitable sites are lost or degraded; in a dynamic riparian system, all suitable habitat starts as potential habitat. Furthermore, potential habitats are the areas where changes in management practices are most likely to create suitable habitat. Not only must suitable habitat always be present for long-term survival of the flycatcher, but additional acreage of suitable habitat must develop to achieve full recovery. Therefore, habitat management for recovery of the flycatcher must include developing and/or maintaining a matrix of riparian patches - some suitable and some potential - within a watershed so that sufficient suitable habitat will be available at any given time.

3. Patch Size and Shape

The riparian patches used by breeding flycatchers vary in size and shape. They may be relatively dense, linear, contiguous stands or irregularly-shaped mosaics of dense vegetation with open areas. Southwestern willow flycatchers nest in patches as small as 0.1 ha (0.25 ac) along the Rio Grande (Cooper 1997), and as large as 70 ha (175 ac) in the upper Gila River in New Mexico (Cooper 1997). Based on patch size values given in publications and agency reports (see Appendix D), mean size of flycatcher breeding patches is 8.5 ha (21.2 ac) (SE = 2.0 ha; range = 0.1 - 72 ha; 95% confidence interval for mean = 4.6 - 12.6; n = 63 patches). The majority of sites are toward the smaller end, as evidenced by a median patch size of 1.8 ha. Mean patch size of breeding sites supporting 10 or more flycatcher territories is 24.9 ha (62.2 ac) (SE = 5.7 ha; range = 1.4 - 72 ha; 95% confidence interval for mean = 12.9 - 37.1; n = 17 patches). Aggregations of occupied patches within a breeding site may create a riparian mosaic as large as 200 ha (494 ac) or more, such as at the Kern River (Whitfield 2002), Roosevelt Lake (Paradzick et al. 1999) and Lake Mead (McKernan 1997).

Flycatchers are generally not found nesting in confined floodplains where only a single narrow strip of riparian vegetation less than approximately 10 m (33 ft) wide develops, although they may use such vegetation if it extends out from larger patches, and during migration (Sogge and Tibbitts 1994, Sogge and Marshall 2000, Stoleson and Finch 2000z).

Flycatchers often cluster their territories into small portions of riparian sites (Whitfield and Enos 1996, Paxton et al. 1997, Sferra et al. 1997, Sogge et al. 1997b), and major portions of the site may be occupied irregularly or not at all. Most flycatcher breeding patches are larger than the sum total of the flycatcher territory sizes at that site. Flycatchers typically do not pack their territories into all available space within a habitat. Instead, territories are bordered by additional habitat that is not defended as a breeding territory, but may be important in attracting flycatchers to the site and/or in providing an environmental buffer (from wind or heat) and in providing post-nesting use and dispersal areas. Recent habitat modeling based on remote sensing and GIS data has found that breeding site occupancy at reservoir sites in Arizona is influenced by vegetation characteristics of habitat adjacent to the actual occupied portion of a breeding site (Arizona Game and Fish Dept, unpubl. data); therefore, unoccupied areas can be an important component of a breeding site. It is currently unknown how size and shape of riparian patches relate to factors such as flycatcher site selection and fidelity, reproductive success, predation, and brood parasitism.

4. Hydrological Conditions

In addition to dense riparian thickets, another characteristic common to most occupied southwestern willow flycatcher sites is that they are near lentic (quiet, slow-moving, swampy, or still) water. In many cases, flycatcher nest plants are rooted in or overhang standing water (Whitfield and Enos 1996, Sferra et al. 1997). Occupied sites are typically located along slow-moving stream reaches; at river backwaters; in swampy abandoned channels and oxbows; marshes; and at the margins of impounded water (e.g., beaver ponds, inflows of streams into reservoirs). Where flycatchers occur along moving streams, those streams tend to be of relatively low gradient, i.e., slow-moving with few (or widely spaced) riffles or other cataracts. The flycatcher's riparian habitats are dependent on hydrological events such as scouring floods, sediment deposition, periodic inundation, and groundwater recharge for them to become established, develop, be maintained, and ultimately to be recycled through disturbance.

5. Other Habitat Components

Other potentially important aspects of southwestern willow flycatcher habitat include landscape features (distribution and isolation of vegetation patches), physical features (micro-climate temperature and humidity) and biotic interactions (prey types and abundance, parasites, predators, interspecific competition). Population dynamics factors such as demography (i.e., birth and death rates, age-specific fecundity), distribution of breeding groups across the landscape, flycatcher dispersal patterns, migration routes, site fidelity, philopatry, and conspecific sociality also influence where flycatchers are found and what habitats they use. Most of these factors are poorly understood at this time, but may be critical to understanding current population dynamics and habitat use. Refer to Wiens (1985, 1989a, 1989b) for additional discussion of habitat selection and influences on bird species and communities.

6. Migration and Wintering Habitat

The migration routes used by southwestern willow flycatcher are not well documented. *Empidonax* flycatchers rarely sing during fall migration; therefore, distinguishing species is difficult. However, willow flycatchers (all subspecies) sing during spring migration. As a result, willow flycatcher use of riparian habitats along major drainages in the southwest has been documented (Sogge et al. 1997b, Yong and Finch 1997, Johnson and O'Brien 1998, McKernan and Braden 1999). Migrant southwestern willow flycatchers may occur in non-riparian habitats and/or be found in riparian habitats unsuitable for breeding. Such migration stopover areas, even though not used for breeding, may be critically important resources affecting productivity and survival.

The flycatcher winters in Mexico, Central America, and northern South America (Phillips 1948, Gorski 1969, McCabe 1991, Ridgely and Tudor 1994, Koronkiewicz et al. 1998, Unitt 1999). Popular literature on the birds of Mexico, Central, and South America describes willow flycatcher wintering habitat as humid to semi-arid, partially open areas such as woodland borders (Ridgely and Gwynne 1989, Stiles and Skutch 1989, Howell and Webb 1995). Second growth forest, brushy savanna edges, and scrubby fields and pastures are also used (Ridgely and Tudor 1994). In Panamá, Gorski (1969) found them in transitional and edge areas, often near a wetland. Similarly, in Costa Rica and Panamá, Koronkiewicz et al. (1998 and pers. comm) found willow flycatchers defending winter territories in areas with standing water, sluggish-moving streams with floating or emergent vegetation and adjacent seasonally inundated savanna, dense woody shrubs, patches or stringers of trees, and open grassy areas. They observed willow flycatchers most often along the edges of wetland areas, in dense woody shrubs bordering and extending into drier portions of the wetland, and in forest edge along open areas of the wetland. The most commonly used vegetation was patches of dense woody shrubs (*Mimosa* sp.) approximately 1-2 m (3-7 ft) tall, bordering and extending into wet areas. See Appendix E for detailed discussion of migration and wintering habitat and ecology.

D. Breeding Biology

The willow flycatcher (all subspecies) breeds across much of the conterminous United States and in portions of northern Mexico and extreme southern Canada (Figure 1). This section discusses the breeding-season ecology of the southwestern willow flycatcher. Relatively few ecological studies have been published on the southwestern subspecies, and much of what is known is presented in unpublished literature (e.g., technical reports). The following discussion uses ecological information from other subspecies where it is appropriate, and qualifies such information where it is extrapolated to the southwestern willow flycatcher.

1. Vocalizations

The willow flycatcher's primary song, "*fitz-bew*," distinguishes it from all other *Empidonax* flycatchers and other bird species (refer to Stein 1963 for a detailed discussion). This is the primary territorial song of male willow flycatchers. Singing bouts are usually comprised of a series of *fitz-bews*, sometimes interspersed with *britt* notes, lasting from less than a minute to over a half-hour. Males sing to advertise their territory to prospective mates and other nearby males. Female willow flycatchers also sing, although not as often as do males, and/or sometimes more quietly (Seutin 1987, Sedgwick and

Knopf 1992, Paxton et al. 1997, Sogge et al. 1997b, SWCA 2000, M. Whitfield unpubl. data). Migrant willow flycatchers often sing from tall song perches during spring migration, in much the way that territorial birds do (Johnson and Sogge 1997, Sogge et al. 1997b).

Male willow flycatchers sing most persistently early in the breeding season and early in each nesting cycle. Song rate declines as the season progresses, particularly once the male finds a mate and nesting efforts begin (Braden and McKernan 1998). Territorial flycatchers often begin singing well before dawn, and song rate is generally highest early in the morning. Short periods of pre-dawn singing often continue as late as July (Sogge et al. 1997b). In breeding groups with many territorial males, morning song rate may remain high throughout most of the breeding season. Unmated males and males with territories near other willow flycatchers tend to vocalize more than males in isolated territories (M. Whitfield, pers. comm.), which may make detection of isolated flycatchers more difficult.

Another common vocalization used by flycatchers is the "*whitt*" call, given by both sexes. *Whitts* are uttered during various activities, including foraging, perching, collecting nesting material, during interactions between flycatchers, as an alarm call, and on wintering grounds. *Whitt*s are often the most common vocalization used during mid- and late breeding season (Braden and McKernan 1998). Many other bird species have similar *whitt* calls, so unlike the *fitz-bew*, the *whitt* is not generally considered unique to willow flycatchers. Willow flycatchers also use an array of varied vocalizations, usually produced by paired adults interacting in close proximity to a nest and/or offspring. These include *wheeo*, *wheep*, *wheek-a-dee*, and *brrrt* phrases. See McCabe (1991) and Sedgwick (2000) for a detailed discussion of willow flycatcher vocalizations.

2. Breeding Chronology

A Neotropical migrant, southwestern willow flycatchers spend only three to four months on their breeding grounds. The remainder of the year is spent on migration and in wintering areas south of the United States. Figure 2 presents a generalized breeding chronology for the southwestern willow flycatcher, and is based on Unitt (1987), Brown (1988), Whitfield (1990), Skaggs (1996), Sogge (1995), Maynard (1995), Sferra et al. (1997), and Sogge et al. (1997b). Record or extreme dates for any stage of the breeding cycle may vary as much as a week from the dates presented. In addition, flycatchers breeding at higher elevation sites or more northerly areas usually begin breeding several weeks later than those in lower or southern areas.

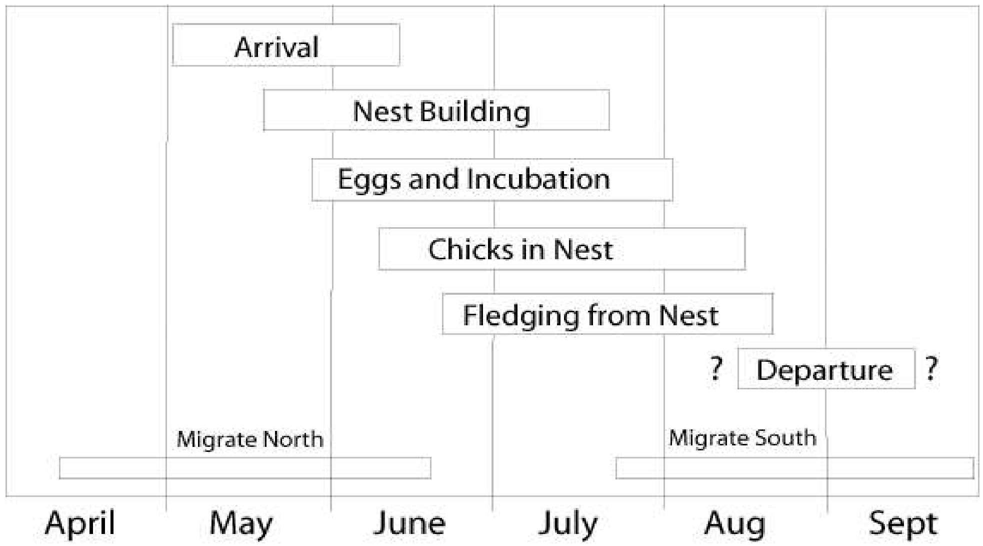


Figure 2. Generalized breeding chronology of the southwestern willow flycatcher (modified from Sogge et al. 1997a). Dates for a given stage may vary a week or more at a given site or during a given year.

Southwestern willow flycatchers typically arrive on breeding grounds between early May and early June, although a few individuals may establish territories in very late April (Willard 1912, Ligon 1961, Maynard 1995, Skaggs 1996, Sferra et al. 1997). Because arrival dates vary geographically and annually, northbound migrant willow flycatchers (of all subspecies) pass through areas where *E.t. extimus* have already begun nesting. Similarly, southbound migrants (of all subspecies) in late July and August may occur where southwestern willow flycatchers are still breeding (Unitt 1987). Therefore, it is only during a short period of the breeding season (approximately 15 June through 20 July) that one can assume that a willow flycatcher seen within *E.t. extimus* range is probably of that subspecies.

Relatively little is known regarding movements and ecology of adults and juveniles after they leave their breeding sites. Males that fail to attract or retain mates, and males or pairs that are subject to significant disturbance (such as repeated cowbird parasitism, predation, etc.) may leave territories by mid-July (Sogge 1995, Sogge et al. 1997b). Fledglings probably leave the breeding areas a week or two after adults, but few details are known.

3. Mating and Territoriality

Male flycatchers generally arrive first at a breeding site, and establish a territory by singing and interacting aggressively with other flycatchers. Willow flycatchers are strongly territorial, and will sing almost constantly when establishing territories. Females tend to arrive later (approximately a week or two). It is not known exactly what factors a female uses to select a territory, though it may be related to habitat quality or potential quality of the male. Second-year males arrive at about the same time as females (M. Whitfield, unpubl. data).

Males are usually monogamous, but polygyny rates of 5% - 20% have been documented (Whitfield and Enos 1996, Sferra et al. 1997, Paradzick et al. 2000, McKernan and Braden 2001). Polygynous males typically have two females in their territory. Genetic evidence shows that territorial males mate with females in other territories (i.e., engage in extra-pair copulations; Pearson 2002, E. Paxton unpubl. data). Data from color-banded populations (Whitfield 1990 and unpubl. data; Paxton et al. 1997, Kenwood and Paxton 2001) show that between-year mate fidelity is low, and that during a breeding season some flycatcher pairs break up and subsequently pair and breed with other individuals.

Southwestern willow flycatchers are strongly territorial. Flycatcher territories are often clumped together, rather than spread evenly throughout a habitat patch. This has led some authors to label willow flycatchers as "semi-colonial" (McCabe 1991), although they do not fit the strict definition of a colonial species and regularly breed at sites with only one or a few pairs (Sferra et al. 1997, Sogge et al. 1997a and 1997b, Paradzick et al. 1999). Territory size varies greatly, probably due to differences in population density, habitat quality, and nesting stage. Estimated breeding territory sizes generally range from approximately 0.1 ha to 2.3 ha (0.25-5.7 ac), with most in the range of approximately 0.2 - 0.5 ha (0.5-1.2 ac) (Sogge 1995, Whitfield and Enos 1996, Skaggs 1996, Sogge et al. 1997b). Territories of polygynous males are often larger than those of monogamous males. Whitfield (unpubl. data) observed instances of individual polygynous males using multiple singing perches several hundred meters (>600 ft) apart. Flycatchers may use a larger area than their initial territory after their young are fledged, and use non-riparian habitats adjacent to the breeding area. Even during the nesting stage, adult flycatchers sometimes fly outside of their territory, often through an adjacent flycatcher territory, to gather food for their nestlings.

4. Site Fidelity

Evidence gathered during multi-year studies of color-banded populations shows that although most southwestern willow flycatchers return to former breeding areas, flycatchers regularly move among sites within and between years (Netter et al. 1998, Kenwood and Paxton 2001, M. Whitfield unpubl. data). From 1997 through 2000, 66% to 78% of flycatchers known to have survived from one breeding season to the next returned to the same breeding site; conversely, 22% to 34% of returning birds moved to different sites (Luff et al. 2000). Both males and females move within and between sites, with males showing slightly greater site fidelity (Netter et al. 1998). Within-drainage movements are more common than between-drainage movements (Kenwood and Paxton 2001). Typical distances moved range from 2 to 30 km (1.2 - 18 mi); however, long-distance movements of up to 220 km have been observed on the lower Colorado River and Virgin River (McKernan and Braden 2001). In some cases, willow flycatchers are faced with situations that force movement, such as when catastrophic habitat loss occurs from fire or flood. Several such cases have been documented, with some of the resident willow flycatchers moving to remaining habitat within the breeding site, some moving to other sites 2 to 28 km (1.2 - 16.8 mi) away (Paxton et al. 1996, Owen and Sogge 1997), and others disappearing without being seen again.

5. Nests, Eggs, and Nestling Care

The flycatcher builds a small open cup nest, constructed of leaves, grass, fibers, feathers, and animal hair; coarser material is used in the nest base and body, and finer materials in the nest cup (Bent 1960). Nests are approximately 8 cm (3.15 in) high and 8 cm wide (outside dimensions), and have 2 to 15 cm (1-6 in) of loose material dangling from the bottom (or none, in tamarisk-dominated habitats). Females build the nest over a period of four to seven days, with little or no assistance from the male. Most nests are used only once, although females will often use some fibers and materials (particularly the lining) from the original nest when constructing a subsequent nest during the same season (McCabe 1991). Although uncommon, re-use of nests has been documented at several breeding sites in Arizona (Yard and Brown 1999, Arizona Game and Fish unpubl. data). Typical nest placement is in the fork of small-diameter (e.g., ≤1 cm or 0.4 in), vertical or nearly vertical branches. Occasionally, nests are placed in down-curving branches. Nest height varies considerably, from 0.5 m to 18 m (1.6 to 60 ft), and may be related to height of nest plant, overall canopy height, and/or the height of the vegetation strata that contain small twigs and live growth. Most typically, nests are relatively low, e.g., 2 to 7 m (6.5 to 23 ft) above ground.

Willow flycatcher eggs are buffy or light tan, with brown markings circling the blunt end. Eggs are approximately 18 mm long and 14 mm wide (0.45 x 0.35 in), and weigh about 1.6 g (0.05 oz) (McCabe 1991). Females typically lay one egg per day, until the nest contains 3 or 4 eggs. Incubation begins after the last egg is laid, and lasts 12 to 13 days. Most incubation is by the female, although male incubation is also known (Gorski 1969, H. Yard, B. Brown, and Arizona Game and Fish Department unpubl. data). Most eggs in a nest hatch within 48 hours of each other (McCabe 1991).

The female provides most of the initial care of the young. As demand for food increases with nestling growth, the male also brings food to the nest. Generally, only the female broods the young. Nest attendance decreases with nestling age, with females spending less than 10 percent of their time at the nest after nestling day 7 (Arizona Game and Fish Department unpubl. data). Nestlings fledge 12 to 15 days after hatching.

Fledglings stay close to the nest and each other for 3 to 5 days, and may repeatedly return to and leave the nest during this period (Spencer et al. 1996). Fledglings typically stay in the general nest area a minimum of 14 to 15 days after fledging, possibly much longer. Both parents feed the fledged young, though in some cases one parent may do all of the feeding (M. Whitfield unpubl. data). Dispersal distances and interactions with parents after this period are not well known.

6. Renesting

Second clutches within a single breeding season are uncommon if the first nest is successful. Most attempts at renesting occur if the young fledge from the first nest by late June or very early July. Renesting is regularly attempted if the first nest is lost or abandoned due to predation, parasitism, or disturbance; a female may attempt as many as four nests per season (Smith et al. 2002). Replacement nests are built in the same territory, and may be close to (even in the same plant) or far from (up to 20 m/65 ft) the previous nest (McCabe 1991, Sogge et al. 1997b). Clutch size decreases with each nest attempt (Holcomb 1974, McCabe 1991, Whitfield and Strong 1995). Some flycatchers may move hundreds of meters or even several kilometers to renest (Netter et al. 1998).

7. Post-Breeding Dispersal

Dispersal after the nesting cycle is poorly understood. Adults that are successful in raising young may remain at breeding sites through mid-August to early September. Pairs with unsuccessful first and/or second nests sometimes abandon their territories midway through the breeding season. Some of these birds are known to attempt renesting, either nearby or at another site, with movements of up to 30 km (18.6 mi) documented (Netter et al. 1998). Unpaired males may remain on territory through the early part of the breeding season but leave by mid-July (Sogge 1995, Sogge et al. 1997b).

8. Demography

Demography is the science of the interrelated life history factors that determine how populations grow, shrink, or change in other ways. Some basic understanding of the overall demography of a species is usually needed to interpret or estimate trends in any single parameter, such as population size, reproduction rates, or age class distributions. For example, to know that extremely high mortality of the young is normal for a species of tree helps explain why each adult may produce thousands of young annually. For imperiled species like the southwestern willow flycatcher, knowledge of demography often reveals that certain factors are of particular importance in conservation. For the flycatcher, many key demographic parameters are only beginning to be understood in detail. However, the current level of knowledge is sufficient to identify several parameters that should receive attention in recovery efforts. As our knowledge of demography increases, we will be better equipped to estimate and evaluate population trends. Key demographic factors for the flycatcher are discussed below, with comments regarding their relevance to recovery, and to evaluating and estimating population trends. This discussion draws heavily on Stoleson et al. (2000); see that publication for more information.

Age Classes

The importance of the relative proportions of birds of various ages (age class distribution) to population dynamics is not known for the flycatcher. Several observations are relevant to its significance as a demographic factor. Flycatchers breed the next spring after hatching, i.e., all flycatchers arriving on the breeding grounds are potential breeders, including those hatched the prior year (Paxton et al. 1997, Whitfield unpubl. data). Age may affect breeding success or productivity, though preliminary data from the Kern River showed no differences in the number of young fledged between yearling females and older females (Whitfield unpubl. data).

Sex Ratios

The ratio of males to females can have obvious importance in a population, as it determines what proportion is truly reproducing. However, with the flycatcher this is confused by known instances of polygyny, extra-pair copulation, and mate reshuffling (Paradzick et al. 1999, Netter et al. 1998, McKernan and Braden 2001, Pearson 2002). Unpaired males are present in the breeding season in some areas (Parker 1997, Sogge et al. 1997b, Paradzick et al. 1999, Whitfield unpubl. data).

Fecundity

Fecundity is the reproductive performance of an individual or population. For the southwestern willow flycatcher, fecundity is a product of probability of breeding, clutch size, hatching success, nesting success, and number of nesting attempts per season. Flycatcher fecundity is reduced, to varying degrees across its range, by factors such as nest predation and brood parasitism by the brown-headed cowbird. In some areas, probability of breeding may be diminished by skewed sex ratios (Stoleson et al. 2000). As is often the case with rare species, increasing fecundity of the flycatcher could be important to recovery. This might be accomplished through increasing habitat availability and quality, reducing brood parasitism, and if suitable techniques can be developed, decreasing rates of nest predation.

Longevity

Based on observations and recaptures of banded southwestern willow flycatchers, it is likely most live 1 to 3 years, with many living 4 years, and some individuals surviving 5 to at least 8 years (E. Paxton and M. Whitfield, unpubl. data). Sedgwick (2000) documented an *adastus* willow flycatcher surviving at least 11 years in the wild. Extensions of survivorship should increase populations by keeping individuals present in the population longer, and by gaining more reproductive years from those individuals. Increasing adult survivorship may be difficult, but possibilities include decreasing unnaturally high levels of predation, and improving the quality of breeding, migration, and wintering habitat.

Immigration and Emigration

Recent studies suggest immigration and emigration among flycatcher breeding sites may be fairly common. Using color-banded birds, movements among breeding sites have been documented, both within and between drainages, and within and between years (Langridge and Sogge 1997, Paxton et al. 1997, Netter et al. 1998). In east-central Arizona, Netter et al. (1999) reported that 13% of banded birds present in 1997 had moved to new sites in 1998. Distances moved range from 0.4 to 190 km (0.25 to 118 mi). Movements within drainages were most common, with a mean distance moved of 14 km (8.7 mi). Banding studies along the lower Colorado River and Virgin River drainages (McKernan and Braden 2001) have documented between-year adult movements of 13 - 100 km (8 - 62 miles); returning birds banded as nestlings moved 14 - 220 km (9 - 138 miles) from their natal sites. Between-year movements between drainages may be less common, but distances moved are considerable. Examples (from Netter et al. 1998): from the San Francisco River 40 km (25 mi) to the headwaters of the Little Colorado River; and to a site 90 km (56 mi) to the northeast; from the Verde River 190 km (118 mi) to the Gila River; from Tonto Creek 94 km (58 mi) to the Gila River.

E. Foraging Behavior and Diet

The willow flycatcher is an insectivore. It catches insects while flying, hovers to glean them from foliage, and occasionally captures insects on the ground. Flycatchers forage within and above the canopy, along the patch edge, in openings within the territory, above water, and glean from tall trees as well as herbaceous ground cover (Bent 1960, McCabe 1991, B. Valentine pers. comm., M. Whitfield pers. comm.). Willow flycatchers employ a "sit and wait" foraging tactic, with foraging bouts interspersed with longer periods of perching (Prescott and Middleton 1988). Southwestern willow flycatcher foraging rates are highest early and late in the day, and during the nestling period (SWCA 2001).

All North American *Empidonax* flycatchers appear to have generally similar diets during the breeding season, consisting of small to medium-sized insects (Beal 1912). The willow flycatcher is somewhat of a generalist. Wasps and bees (Hymenoptera) are common food items, as are flies (Diptera), beetles (Coleoptera), butterflies/moths and caterpillars (Lepidoptera), and spittlebugs (Homoptera) (Beal 1912, McCabe 1991). Plant foods such as small fruits have been reported (Beal 1912, Roberts 1932, Imhof 1962), but are not a significant food during the breeding season (McCabe 1991). Diet studies of adult southwestern willow flycatchers (Drost et al. 1997, DeLay et al. 2002) found a wide range of prey taken. Major prey items were small (flying ants) to large (dragonflies) flying insects, with Hymenoptera, Diptera and Hemiptera (true bugs) comprising half of the prey items. Willow flycatchers also took non-flying species, particularly Lepidoptera larvae. Plant material was again negligible.

F. Competitors

The extent to which competition affects southwestern willow flycatcher distribution and abundance is unknown. Resources for which competition might exist include nest sites and food. The flycatcher may experience competition from other species (interspecific), or from other willow flycatchers (intraspecific).

The greatest potential for interspecific competition might be expected from other *Empidonax* flycatchers, being closely related and similar in morphology and food habits. Where willow flycatchers (subspecies other than *extimus*) and other *Empidonax* flycatchers breed in the same habitats, they often maintain mutually exclusive territories (Frakes and Johnson 1982, McCabe 1991). However, Gorski (1969) concluded that "competition is almost lacking" between the closely related willow and alder (*E. alnorum*) flycatchers. In its breeding range, the southwestern willow flycatcher is often the only *Empidonax* flycatcher breeding in its nesting habitat. Competition also has not been demonstrated between the southwestern willow flycatcher and other flycatchers that commonly occur in or near to its habitat, e.g., the pacific-slope flycatcher (*E. difficilis*), ash-throated and brown-crested flycatchers (*Myiarchus cinerascens* and *M. tyrannulus*), black phoebe (*Sayornis nigricans*), and western wood-pewee (*Contopus sordidulus*). Other, less-related species are even less likely to be significant competitors, e.g., yellow warblers (*Dendroica petechia*) (McCabe 1991). Although willow flycatchers and other riparian species experience degrees of overlap in diet and nest site selection, interspecific territoriality is rarely observed, and many cases of overlapping territories are known.

As is often true, within-species (intraspecific) competition is likely the most intense. One resource for which intraspecific competition may exist is mates. Male willow flycatchers exhibit strong intraspecific territoriality. At many breeding sites, some males are polygynous (i.e., mate with more than one female in their territory) while others fail to secure mates (Stoleson et al. 1999, Smith et al. 2002). This implies that females may be limited at some sites, and that males compete for reproductive opportunities, with some (paired) being more successful than others (unpaired) . The ecological, evolutionary, and demographic effects of this competition are not well known.

G. Predation and Predators

Southwestern willow flycatchers are probably influenced by predation, but predation rates are within the typical range for open-cup nesting passerine birds (Newton 1998). However, for an endangered bird "normal" predation rates may exert disproportionately greater stresses on populations. Nest success may be particularly affected, and most of what is known about flycatcher predation involves nest predation. Predation can be the single largest cause of nest failure in some years (Whitfield and Enos 1996, Paradzick et al. 1999). In a New Mexico population, Stoleson and Finch (1999) attributed 37.3% of 110 nest failures to predation. Predation of southwestern willow flycatcher eggs and nestlings is documented for the common kingsnake (*Lampropeltis getulus*) (Paxton et al. 1997, McKernan and Braden 2001, Smith et al. 2002), gopher snake (*Pituophis melanoleucus affinis*) (Paradzick et al. 2000, McKernan and Braden 2001), Cooper's hawk (*Accipiter cooperii*) (Paxton et al. 1997), red-tailed hawk (*Buteo jamaicensis*) (Whitfield and Lynn 2000), great horned owl (*Bubo virginianus*) (Stoleson and Finch 1999), western screech owl (*Otus kennicottiii*) (Smith et al. 2002), yellow-breasted chat (*Icteria virens*) (Paradzick et al. 2000), and Argentine ants (*Linepithema humili*) (Famolaro 1998, B. Kus pers. comm.). Other potential predators of flycatcher nests include other snakes, lizards, chipmunks, weasels, racoons, ringtailed cats, foxes, and domestic cats (McCabe 1991, Sogge 1995, Langridge and Sogge 1997, Paxton et al. 1997, Sferra et al. 1997, McCarthey et al. 1998, Paradzick et al. 2000). Predatory birds such as jays, crows, ravens, hawks (especially accipiters), roadrunners, and owls may hunt in flycatcher habitat. Brown-headed cowbirds effectively function as predators if they remove flycatcher eggs during parasitism. Cowbirds are also known to kill nestlings of other songbirds (Sheppard 1996, Tate 1967, Beane and Alford 1990, Scott and McKinney 1994), and may act as predators on southwestern willow flycatcher chicks (M. Whitfield and AGFD unpubl. data). Although acts of nest predation by cowbirds have been documented on other species, available evidence indicates that cowbirds are not frequent predators of flycatcher nests; rates of nest predation have not declined in response to cowbird control (Whitfield et al. 1999, Whitfield 2000; Appendix F).

Predation of adults of most passerine birds is not often observed, and virtually no data of this kind of predation exists for the southwestern willow flycatcher. However, adult (and fledgling) flycatchers are vulnerable to predation by many of the animals discussed above, especially by predatory birds. Incubating females are particularly vulnerable, especially at night. Although no data are available, flycatchers are also likely to be exposed to predation during migration and on their tropical wintering grounds.

H. Disease and Parasites

1. Disease and Invertebrate Parasites

Although all 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 (Karstad 1971, Atkinson and van Riper 1991, van Riper 1991). The willow flycatcher (various subspecies) is known to be a host to a variety of internal and external parasites. These include blood parasites such as *Haemoproteus*, *Leucocytozoon*, *Microfilaria*, *Tyrpanosoma* and *Plasmodium* (Bennett et al. 1982, C. van Riper and M. Sogge, unpubl. data); blow fly (*Protocalliphora* sp.) (Boland et al. 1989, Sabrosky et al. 1989, McCabe 1991, AGFD unpubl. data); and nasal mites (Pence 1975). Most bird species, including *Tyrannid* flycatchers, are susceptible to viral pox (Karstad 1971). Although these parasites likely occur in southwestern willow flycatchers, there is no information on what impact they have on infected birds or populations. McCabe (1991) identified mites *(Ornithonyssus sylviarum*) in 43% of flycatcher nests, and blowfly larvae in 32% of nests, but noted no significant negative effects from either. Conversely, Whitfield and Enos (1998) documented mortality of nestlings (southwestern willow flycatchers) due to severe mite infestation.

2. Cowbird Brood Parasitism

The southwestern willow flycatcher also experiences brood parasitism by the brown-headed cowbird (*Molothrus ater*) and cowbird impacts on some (but not all) populations are sufficiently large to warrant management efforts (See Appendix F). The cowbird lays its eggs in the nests of other species. The "host" species then incubate the cowbirds eggs and raise the young. Because cowbird eggs hatch after relatively short incubation and hatchlings develop quickly, they often outcompete 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. Cowbirds can therefore have negative effects on reproductive success of flycatcher females and populations. Various factors have increased the range and numbers of the brown-headed cowbird, and potentially its impacts on hosts, over the pre-European condition, although these effects may have peaked several decades ago. Factors facilitating increased cowbird impacts include increased cowbird numbers through expansion of suburban and agricultural areas, and increases in cowbird access to riparian habitat via narrowed riparian zones and fragmentation. These issues are dealt with in depth in Appendix F.

Besides possibly contributing to the endangerment of the southwestern willow flycatcher and several other songbirds (e.g., least Bell's vireo, golden-cheeked warbler, black-capped vireo), brood parasitism is a potential impediment to recovery. However, it is important to be aware that the presence of cowbird parasitism does not necessarily mean it is having critical or even significant effects on a given flycatcher population. Several factors influence the degree to which cowbird parasitism is a problem, including: parasitism rate; flycatcher response to parasitism (e.g., abandonment and renesting); and net reproductive success per female flycatcher. Once these factors are considered, the effect of parasitism is typically less than what seemed to be the case initially. See additional discussion below, in "Reasons for Decline and Current Threats" and Appendix F.

I. Status and Trends of Populations and Habitat

1. Current Flycatcher Populations

Developing a current population estimate is challenging. The population presents a moving target, both spatially and temporally. Because not all sites are re-surveyed in every year, the estimate generated here is a composite of known populations for different years at different sites. In each case, the most recent or more thorough year's data were used as the "current" population. This estimate is qualified by the knowledge that numbers of birds at a given site fluctuate from year to year, that inter-site dispersal takes place, and that some occupied sites have been destroyed or damaged in recent years, causing the former residents to relocate and forego breeding. Also, survey and monitoring effort has increased substantially from 1993 to the present, but varies among regions. Another confounding factor is the taxonomic identity of willow flycatchers at the edge of the range of the southwestern subspecies.

When the southwestern willow flycatcher was listed as endangered in 1995, approximately 350 territories were known to exist (Sogge et al. 2001). As of the 2001 breeding season, the minimum known number of southwestern willow flycatchers was 986 territories (Table 4). The numbers in Table 4 do not include flycatchers suspected to occur on some Tribal and private lands. Though much suitable habitat remains to be surveyed, the rate of discovery of new nesting pairs has recently leveled off (Sogge et al. 2001). A coarse estimate is that an additional 200 to 300 nesting pairs may remain undiscovered, yielding an estimated total population of 1,200 to 1,300 pairs/territories. Unitt (1987) estimated that the total flycatcher population may be 500 to 1000 pairs; thus, nearly a decade of intense survey efforts have found little more than slightly above the upper end of Unitt's estimate. The surveys of the 1990s have been valuable in developing a rangewide population estimate, but cannot identify a rangewide trend over that period. However, some local trends may be evident, as discussed below.

Table 4. Known numbers of southwestern willow flycatcher territories by State. Data are from Sogge et al. 2002, based on last reported survey data for all sites where flycatchers were known to breed, 1993-2001.

	State							
	Arizona[1]	California[1]	Colorado	Nevada	New Mexico	Utah	Texas	Total
Number of Territories	359	256	37	73	258	3	0	986

[1]Flycatchers on the lower Colorado River are all included in Arizona's total.

2. Trends in Habitat and Flycatcher Distribution

<u>*California*</u>

Unitt (1984, 1987) concluded the flycatcher was once fairly common in the Los Angeles basin, where habitat is virtually absent now. The South Fork of the Kern River is one of the few places where riparian habitat has increased substantially over the last 20 years. Approximately 250 ha of riparian habitat has regenerated along the South Fork Kern River since the early 1980s (Whitfield et al. 1999). However, despite an apparent abundance of suitable habitat and cowbird trapping, the flycatcher population on the South Fork Kern River has fluctuated from 38 territories in 1997 to 23 in 1999 (Whitfield et al. 1999). Downstream from the South Fork Kern River, willow flycatchers were common breeders in the extensive riparian habitat along the Kern River and Buena Vista Lake in the early 1900s (Linton 1908). Today, essentially all of the riparian habitat is gone and there are no recent reports of breeding willow flycatchers. However, it is uncertain whether the *E.t. extimus* subspecies bred there. Outside of the Kern River, the three largest flycatcher populations in California reside along the Owen's River from below Pleasant Valley Reservoir to Warm Springs Road, along the San Luis Rey River downstream of Lake Henshaw, and along the Santa Margarita River at Camp Pendleton. Limited willow flycatcher surveys have been conducted on the Owen's River in the early and mid 1990s, the most recent survey conducted in 2001 documented a minimum of 24 territories (Whitfield unpubl. data). Changes in land use along the San Luis Rey River, including the removal of grazing from Forest Service lands in the early 1990s, have improved the extent and quality of riparian habitat for southwestern willow flycatchers, which have increased from 12 territorial males in the late 1980s (Unitt 1987) to over 40 in 1999 (Kus et al. 1999, W. Haas, pers. comm.). In contrast, the flycatcher population at Camp Pendleton has remained fairly constant at under two dozen territories for the past two decades, despite the availability of additional apparently suitable habitat to support population expansion. The remaining flycatcher populations in southern California, most of which number fewer than five territories, occur at scattered sites along drainages that have changed little during the past 15 years.

<u>*Arizona*</u>

All of Arizona's major rivers and their tributaries where southwestern willow flycatchers were known to have bred have changed, often dramatically (Tellman et al. 1997). Rivers such as the Colorado, Gila, Santa Cruz, San Pedro, and Verde rivers have suffered extensive dewatering, and loss and fragmentation of riparian habitats. Consequently, many areas where the flycatcher was formerly locally abundant now support few or none. Following are just a few examples. The flycatcher was once abundant near the confluence of the Gila and Colorado rivers (T. Huels in litt., transcripts of H. Brown's field notes), but is now rare (McKernan and Braden 1999 and 2001, Paradzick et al. 1999 and 2000). Historically known along the Santa Cruz River near Tucson (Swarth 1914, Phillips 1948), flycatchers no longer breed there and suitable habitat is essentially lacking. The Verde Valley once hosted large amounts of dense, mesic riparian habitats in which flycatchers bred (E.A. Mearns historical field notes, Swarth 1914). Conversion to agriculture and phreatophyte control programs dramatically reduced riparian vegetation, and fewer than 10 flycatcher territories persist on the Verde River (Paradzick et al. 1999). Recently, newly developed habitat supporting a relatively large breeding population at the

Colorado River inflow to Lake Mead was inundated, and flycatchers no longer breed at that site (McKernan and Braden 1998, 1999, 2001). Two riparian areas continue to support substantial numbers of flycatchers. Over 150 flycatcher territories have been found along the lower San Pedro River and nearby portions of the Gila River (AGFD unpubl. data), where flycatchers have been known since the early 1900s (Willard 1912, Phillips 1948). Riparian habitat at the Tonto Creek and Salt River inflows to Roosevelt Lake hosts approximately 140 territories (Smith et al. 2002); these habitats probably developed only recently and are subject to inundation and possible destruction when reservoir levels are raised. The largest breeding population (21 territories) currently known along the lower Colorado River is found at Topock Marsh (McKernan and Braden 2002).

New Mexico

Loss of flycatcher populations and habitat likely has been most severe in the Rio Grande Valley, where the taxon may have been widespread and fairly common, including in the vicinities of Espanola and Las Cruces (Hubbard 1987), two areas where suitable habitat and flycatchers are no longer found; a remnant population found in upper Elephant Butte Reservoir in the early 1970s was lost to rising lake levels (Hubbard 1987). Along the San Francisco River, habitat degradation likely lead to the loss of breeding flycatchers in the vicinity of Glenwood. The large population along the Gila River reported by Egbert (1981) and Montgomery et al. (1985), and identified by Hubbard (1987) as a stronghold remains one of the largest known southwestern willow flycatcher population rangewide (Skaggs 1996, Stoleson and Finch 1999, Sogge et al. 2001).

Texas

In Trans-Pecos Texas, loss of suitable habitat and presumed breeding flycatcher populations almost certainly has been severe along the Rio Grande, especially the now-dry reach from below El Paso to the confluence with the Rio Conchos at Presidio. The last reported nesting in the region occurred in the Davis Mountains in 1890 (Oberholser 1974). In this century, there are few if any reports of occurrence between the dates 18 June and 21 July (Phillips 1948, Wauer 1973 and 1985, Oberholser 1974, Unitt 1987), implying breeding flycatchers are scarce or absent. However, no formal surveys have been conducted in recent years to determine presence or absence of breeding flycatcher populations or to evaluate potential flycatcher habitat.

Utah

Although Behle (1985) describes the willow flycatcher as a common summer resident statewide, there are few historical or current records in the southern portion of the State within the range of *E. t. extimus*. Historically, southern Utah's largest flycatcher populations may have been those along the Colorado River and its tributaries in Glen Canyon (Behle and Higgins 1959); these are now inundated by Lake Powell. The flycatcher also bred along the Virgin River in the St. George area (Behle et al. 1958), and along the San Juan River (Unitt 1987). Recent surveys have found the flycatcher absent as a breeding species on the Green and Colorado Rivers in the Canyonlands National Park area (M. Johnson unpubl.

data), on the San Juan River (west of the New Mexico border; Johnson and O'Brien 1998), and portions of the Manti-La Sal National Forest (Johnson 1998). Flycatchers have recently bred in small numbers along the Virgin River near St. George (Langridge and Sogge 1998, F. Howe unpubl. data), and single territories have been located at sites in the Panguitch Lake area (U.S. Forest Service unpubl. data) and within Bryce Canyon National Park (Schreier 1996).

Nevada

Southern Nevada is predominantly an arid region with few riparian areas, and nearly all rivers in the State empty into lakes that have no outlet or lose their waters by absorption and evaporation as they spread over valley floors (Linsdale 1936). Riparian habitat, and therefore breeding flycatchers, were probably found primarily along portions of major drainages such as the lower Colorado River, the Virgin River and its major tributaries, and areas where spring-fed riparian and wetland habitat flourished. Although some portions of the Virgin River retain substantial amounts of riparian vegetation, riparian habitats in most areas have been severely reduced and degraded, such that suitable flycatcher breeding habitat is even more rare than in the pre-settlement past. Unitt (1987) reported only three historical southwestern willow flycatcher breeding locations: Indian Springs, Corn Creek, and the Colorado River at the southern tip of the State. Recent surveys have discovered mostly small breeding populations along the Virgin River, Muddy River, Amargosa River, Meadow Valley Wash, and Pahranagat River drainages (McKernan and Braden 1998, 1999, 2001; Micone and Tomlinson 2000). Some of the flycatchers breeding at the Virgin River inflow to Lake Mead are subject to inundation by fluctuating lake levels (McKernan and Braden 1999 and 2001). At two breeding sites (Key Pittman Wildlife Management Area and Mesquite West), breeding habitat has recently become established and occupied (McKernan and Braden 2001, Gallagher et al. 2001).

Colorado

Southwestern Colorado hosts the headwaters of several major drainages, including the San Juan River and the Rio Grande, which flow through relatively broad valleys and once supported extensive riparian habitats. There are also many smaller streams which were once heavily wooded. However, much of the riparian habitat in these areas has been reduced and heavily impacted. Statewide, willow flycatchers were locally common (Bailey and Niedrach 1965), but it is difficult to reconstruct the historical distribution and abundance of *E. t. extimus*. Phillips (1948) makes no mention of flycatchers from the southwest portion of the State. Bailey and Niedrach (1965) describe two willow flycatchers collected in San Juan County, but these are not confirmed as breeders. Recent surveys suggest that willow flycatchers are very localized and uncommon within the probable range of *E. t. extimus* in southwestern Colorado. Within the range of *E. t. extimus*, breeding flycatchers have been confirmed only on tributaries to the San Juan (Williams Creek Reservoir, Los Pinos River, and Piano Creek) and at Alamosa National Wildlife Area and McIntire Springs, within the Rio Grande drainage in the San Luis Valley (Owen and Sogge 1997, Sogge et al. 2001). However, much riparian habitat remains unsurveyed, and additional breeding populations may be present. Recent genetics research (Paxton 2000) affirms that flycatchers in the San Luis Valley are affiliated with *E. t. extimus*, but uncertainties remain about the subspecies status of willow flycatchers elsewhere in extreme southwestern Colorado.

Mexico

As discussed above ("Range and Distribution"), it is possible the flycatcher was abundant on the delta of the Colorado River in Mexico prior to establishment of numerous dams upstream. Currently, surface water delivery to the delta is minimal or absent for long periods; habitat is much reduced and altered. Similarly, the flycatcher is likely to have occurred in northern Chihuahua along the Rio Grande, where habitat is now reduced and altered due to upstream dams. Historic record of breeding flycatchers on the Rio Grande at Fort Hancock, Texas, suggests occurrence in adjacent Chihuahua; the Rio Grande now is typically dry in that region.

J. Reasons for Listing and Current Threats

Section 4(a)(1) of the ESA lists five factors that must be considered when determining if a species should be designated as threatened or endangered. These factors are: A. The present or threatened destruction, modification, or curtailment of its habitat or range; B. Overutilization for commercial, recreational, scientific, or educational purposes; C. Disease or predation; D. The inadequacy of existing regulatory mechanisms; and E. Other natural or manmade factors affecting its continued existence. A species may be determined to be an endangered or threatened species due to one or more of the five factors. The southwestern willow flycatcher was determined to be endangered by numerous threats causing extensive loss of habitat (factor A), lack of adequate protective regulations (factor D; see Section III.), and other natural or manmade factors including brood parasitism by the brown-headed cowbird (factor E) (USFWS 1995).

The reasons for the decline of the southwestern willow flycatcher and current threats it faces are numerous, complex, and inter-related. The major factors are summarized below by categories, in approximate order of their significance. For additional discussions see USFWS (1995) and Marshall and Stoleson (2000). However, these factors vary in severity over the landscape and at any given locale, 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. And because of their inter-relatedness, distinctions between different types of impacts are sometimes ambiguous or artificial. This is true even for divisions presented here, "Habitat Loss and Modification" and "Changes in Abundance of Other Species." For example, urban and agricultural development may cause both habitat degradation and changes in the abundance of cowbirds, domestic cats, and non-native vegetation. When assessing and addressing the impacts to any riparian ecosystem, the cumulative and inter-related impacts of all potential factors should be considered.

1. 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, and widely dispersed. Historically, these habitats have always been dynamic and unstable in place and time, due to natural disturbance and regeneration events such as floods, fire, and drought. With increasing human populations and the related industrial, agricultural, and urban developments, these habitats have been modified, reduced, and destroyed by various mechanisms. Riparian ecosystems have declined from reductions in water flow, interruptions in natural hydrological events and cycles, physical modifications to streams, modification of native plant communities by invasion of exotic species, and direct removal of riparian vegetation. Wintering habitat has also been lost and modified for this and other Neotropical migratory birds (Finch 1991, Sherry and Holmes 1993). The major mechanisms resulting in loss and modification of habitat involve water management and land use practices, and are discussed below.

Dams and Reservoirs

Most of the major and many of the minor southwestern streams that likely supported southwestern willow flycatcher habitat are now dammed (Appendix D Table 2). Operation of dams modifies, reduces, destroys, or increases riparian habitats both downstream and upstream of the dam site. Below dams, natural hydrological cycles are modified. Maximum and minimum flow events both can be altered. Flood flows are reduced in size and frequency below many dams. Base flows can be increased or decreased depending on how the dam is operated. High flows are often reduced or shifted from that of the natural hydrograph below dams managed for downstream water supply. 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 lost. In so doing, dams inhibit the natural cycles of flood-induced sediment deposition, floodplain hydration and flushing, 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 increasing the frequency of fires. Because of evapoconcentration, natural levels of salt and other minerals are often artificially elevated in downstream flow and in downstream alluvial soils. These changes in soil and water chemistry can affect plant community makeup (see below). Upstream of dam sites, riparian habitats are inundated by reservoirs, as beneath Lake Powell, where Behle and Higgins (1959) considered the flycatcher to be common. In some locales, this effect is partially mitigated by temporary development of riparian habitats at inflow deltas, where source streams enter the reservoirs. However, these situations tend to be vulnerable, often inundated or desiccated as reservoir management raises and lowers the water level, resulting in unstable flycatcher populations, such as at Elephant Butte Reservoir in New Mexico, Roosevelt Lake in Arizona, Lake Mead on the Colorado River, and Lake Isabella on the Kern River in California. Although large flycatcher populations do occupy reservoir habitat, they may not be as numerous or as persistent as those that occupied miles of pre-dammed rivers. For further discussion, see Appendices H and I.

Diversions and Groundwater Pumping

Surface water diversions and groundwater pumping for agricultural, industrial, and municipal uses are major factors in the deterioration of southwestern willow flycatcher habitats (Briggs 1996) (Appendix D Table 2). The principal effect of these activities is simple reduction of water in riparian ecosystems and associated subsurface water tables. Examples: (1) Of the Colorado River's approximate flow of 16 million acre-feet (maf) per year, human consumptive use accounts for almost 11 maf and reservoirs evaporate 1.5 maf, leaving little for riparian and aquatic ecosystems. Agriculture uses over two-thirds of the water diverted or pumped from the lower Colorado River basin, with at least 40% of this share used to grow livestock feed (Morrison et al. 1996); (2) Pacific River Institute's report on Colorado River Water, including statistics on magnitude of groundwater overdraft in AZ, NV, and CA, population and water consumption projections, and proportion of water used by agriculture; (3) CEC report's conclusion about the impacts of groundwater overdraft on the San Pedro Riparian National Conservation area; (4) Explanation of Arizona Department of Environmental Quality's declaration of groundwater mining in the Prescott Active Management Area and the potential ramifications on the Verde River. Chemistry, especially salinity, of water and soils may also be significantly affected by these activities (see Appendix I).

Channelization and Bank Stabilization

Southwestern riparian ecosystems have also been modified through physical manipulation of stream courses. Channelization, bank stabilization, levees, and other forms of flow controls are carried out chiefly for flood control. These engineering activities affect riparian systems by separating a stream from it’s floodplain. These control structures 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 generally reduce the volume and width of wooded riparian habitats (Szaro 1989, Poff et al. 1997, see also Appendices H and I).

Phreatophyte Control

In some areas riparian vegetation is removed from streams, canals, and irrigation ditches to increase watershed yield, remove impediments to streamflow, and limit water loss through evapotranspiration (Horton and Campbell 1974). Methods include mowing, cutting, root plowing, and application of herbicides. The results are that riparian habitat is eliminated or maintained at very early successional stages not suitable as breeding habitat for willow flycatchers (Taylor and Littlefield 1986). Clearing or mowing habitat can also result in establishment of exotic plants species, which can further reduce suitability.

Livestock Grazing

Overgrazing by domestic livestock has been a significant factor in the modification and loss of riparian habitats in the arid western United States (USDA Forest Service 1979, Rickard and Cushing 1982, Cannon and Knopf 1984, Klebenow and Oakleaf 1984, General Accounting Office 1988, Clary and Webster 1989, Schultz and Leininger 1990, Belsky et al. 1999). If not properly managed, livestock grazing can significantly alter plant community structure, species composition, relative abundance of species, and alter stream channel morphology. The primary mechanism of effect is by livestock feeding in and on riparian habitats. Overutilization of riparian vegetation by livestock also can reduce the overall density of vegetation, which is a primary attribute of southwestern willow flycatcher breeding habitat. 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. Livestock may also physically contact and destroy nests. This impact is documented for nests of *E.t. brewsteri* in California (Stafford and Valentine 1985, Valentine et al. 1988). Southwestern willow flycatcher nests in low-stature habitats could be vulnerable to this impact, e.g., nests in *Salix geyeriana* at higher elevation near Greer, AZ. Livestock also physically degrade nesting habitat by trampling and seeking shade and by creating trails that nest predators and people (see Recreation subsection below) may use. 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. Because the impact of herbivory can be highly variable both geographically and temporally, proper grazing management strategies must be developed locally. For further discussion, see Appendix G.

Recreation

In the warm, arid Southwest, recreation is often concentrated in riparian areas because of the shade, water, aesthetic values, and opportunities for fishing, boating, swimming, and other activities. As regional human populations grow, the magnitude and cumulative effects of these activities is 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 invasion by 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 which fragment habitat (i.e., verandas, picnic areas, etc.). Effects of these activities on southwestern willow flycatchers certainly vary with different situations. Reductions in density and diversity of bird communities, including willow flycatchers (*E. t. adastus*), has been associated with recreational activities (Aitchison 1977, Blakesley and Reese 1988, Szaro 1980, Taylor 1986, Riffell et al. 1996). For additional discussion see Appendix M.

Fire

Fire is an imminent threat to occupied and potential southwestern willow flycatcher breeding habitat. Although fires occurred to some extent in some of these habitats historically, many native riparian plants are neither fire-adapted nor fire-regenerated. Thus, fires in riparian habitats are typically catastrophic, causing immediate and drastic changes in riparian plant density and species composition. Busch (1995) 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 and dominance of the highly-flammable tamarisk. Tamarisk and arrowweed (*Tessaria sericea*) recover more rapidly from fire than do cottonwood and willow. In recent years riparian wildfires destroyed occupied southwestern willow flycatcher sites on the Rio Grande in New Mexico, the San Pedro and Gila rivers in Arizona, and in the Escalante Wildlife Area in Colorado. For further discussion, see Appendix L.

Agricultural Development

The availability of relatively flat land, rich soils, high water tables, and irrigation water in southwestern river valleys has spawned wide-scale agricultural development. These areas formerly contained extensive riparian habitats. Agricultural development entails not only direct clearing of riparian vegetation, but also re-engineering floodplains (e.g., draining, protecting with levees), diverting water for irrigation, groundwater pumping, and applications of herbicides and pesticides, which may also affect the flycatcher and its habitat (Appendix D Table 2). For example, as recently as 1996, since the flycatcher's listing as endangered, up to 2 km (1.2 mi) of occupied flycatcher habitat was lost to agricultural development on the Santa Ynez River in California (USFWS in litt.). Agricultural development can also increase the likelihood or severity of cowbird parasitism, by creating foraging sites (e.g., short-grass fields, grain storage, livestock concentrations) in proximity to flycatcher nesting habitat (See Appendices E and F).

In many river reaches, the flood plain riparian habitat that is utilized by flycatchers is partly sustained by agricultural return flows (Appendix D Table 2). Natural functioning ecosystems would be more likely to sustain flycatcher populations over the long-term than artificial agricultural systems. With reductions in irrigated agriculture, additional water and land could be made available for restoration of flycatcher habitat. However, in the short-term, reductions in the agricultural return flows themselves can pose a threat to some flycatcher populations.

Strips of riparian vegetation that develop along drainage ditches or irrigation canals also potentially provide habitat for the flycatcher. Benefits are greatest when the vegetation is left undisturbed, as opposed to being periodically cleared, and where the riparian vegetation strips are dense, abundant, and relatively near natural flood plain habitat. However, riparian bird populations in small or temporary habitats may be population sinks, producing a net drain on the overall population; additional data are needed on source-sink dynamics of small and large flycatcher breeding sites.

Urbanization

Urban development results in many impacts to riparian ecosystems and southwestern willow flycatcher habitat. Urbanization in or next to flycatcher habitat provides the catalyst for a variety of related and inter-related direct and indirect effects which can cause loss and/or the inability to recover habitat.

At the broad perspective, urban development creates demands for domestic and industrial water use. These demands are satisfied by diverting water from streams and groundwater pumping, which de-water streams and aquifers. Municipal water management often involves constructing reservoirs, structures to control floods, and structures to control and alter stream courses and washes to protect floodplain development. These alter stream hydrology.

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 increased transportation systems that include bridges, roads, and vehicles detrimental to riparian habitat and riparian inhabitants. In recent years, placement of bridges have resulted in the loss of seven known flycatcher territories in New Mexico and Arizona, and the possible road-kill of a southwestern willow flycatcher in Arizona (Marshall and Stoleson 2000). Developments can also cause nearby private landowners that previously promoted conservation of their land to sell for development purposes. Also, as a result of dense riparian vegetation in proximity to development, some communities may choose to remove brush and/or other mid-story or sub-canopy vegetation to reduce or remove the risk of fire. Increased urbanization tends to promote a greater need for commercial development, which subsequently results in increased growth. Furthermore, urban development also increases the demand for recreational use of remaining riparian areas (see Recreation section above, and Appendix M).

Establishing housing developments near rivers promotes additional risks to the health of rivers, riparian habitat, and persistence of nesting flycatchers. Developments increase trash, bird feeders, and people, and as a result, the increased presence of predators such as cowbirds (see section 2., "Brood Parasitism," below), house cats, and possibly a proliferation/concentration of other natural predators of flycatchers (i.e., great-tailed grackles, common ravens). Developers may remove habitat nearest the floodplain which provides sound and visual barriers, possible fledgling dispersal habitat, and plants which may provide food, sheltering, perching, and foraging for the flycatcher. Urban development can also produce pollutants to the environment through run-off, waste, and other chemicals. Urbanization can also increase the presence of non-native vegetation in the riparian area from the planting of grasses, shrubs, and trees that out-compete native plants.

Treated municipal wastewater presently sustains several of the riparian habitat patches upon which the flycatcher depends (Appendix D Table 2). At sites where the alluvial aquifer has not been severely depleted, discharge of treated water into the river channel has allowed for restoration or rehabilitation of large expanses of riparian vegetation. Concentrations of nutrients and other pollutants can be high in the effluent, but the presence of functional riparian ecosystems or constructed wetlands at the discharge site generally serves to improve the water quality.

Release of municipal effluent into a stream channel or alluvial aquifer does not automatically produce or sustain high quality riparian habitat. Regional planning efforts throughout the flycatcher's range can help to maximize the environmental benefits of reclaimed water. Hydrogeologic assessments can identify sites where shallow water tables and thus phreatophytic riparian vegetation are likely to develop; landscape studies can identify sites likely to have high wildlife habitat value by virtue of proximity and connectivity to existing riparian patches. Ecological input can delineate appropriate temporal and spatial patterns for the water release.

2. Changes in Abundance of Other Species

Exotic Species

Several exotic (non-native) plant species have become established in southwestern willow flycatcher riparian habitats, with varying effects on the bird. Tamarisk is widespread and often dominant in southwestern riparian ecosystems, often forming dense monotypic stands. Southwestern willow flycatchers do nest in some riparian habitats containing and even dominated by tamarisk (McKernan and Braden 1999, Paradzick et al. 2000), and available data suggest that flycatcher productivity and survivorship are similar between native and tamarisk habitats. However, native riparian plant communities may be of greater recovery value than tamarisk, because tamarisk in some settings facilitates a periodic fire regime, can be detrimental to native riparian plants in other ways (Busch and Smith 1993), and may in some cases be of lesser value to bird communities overall (Rosenberg et al. 1991). However, this does not diminish the value of maintaining currently suitable and occupied tamarisk habitat. Tamarisk can mimic many of the ecological functions of native riparian plant species (Stromberg 1998), and in many cases supports a riparian obligate bird community that would not occur in areas where habitat conditions can no longer support native riparian vegetation. This is significant, because where tamarisk is strongly dominant, replacement with native species may be difficult or impossible without changes in current hydrologic regimes. Unlike some native tree species, tamarisk also maintains the fine branching structure as it grows to maturity, which may make it attractive to nesting flycatchers for a longer period of time. 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.

Throughout the western U.S., large tracts of tamarisk are being cleared for purposes including water salvage, flood water conveyance, and/or wetland restoration. Such actions pose a threat to southwestern willow flycatchers when conducted in areas of suitable habitat (occupied or unoccupied) and when conducted in the absence of restoration plans to ensure replacement by vegetation of equal or higher functional value.

Russian olive is also well-established in southwestern riparian systems, and is present in some current flycatcher nest sites. 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 (*Ulmus pumilis*) and tree of heaven occur in southwestern riparian ecosystems but do not appear to have value as nesting habitat for the flycatcher. Because their distributions are highly localized, their impacts on the flycatcher may be limited to very local, perhaps minor changes in riparian community composition. In California, giant reed (*Arundo donax*) is spreading rapidly, and forms dense monotypic stands unsuitable for willow flycatchers. Also, many exotic herbs are established in southwestern riparian ecosystems, including bermudagrass (*Cynodon dactylon*) and rabbitfoot grass (*Polypogon monspeliensis*). For further discussion, see Appendices G and J.

Brood Parasitism

As summarized above in "Disease and Parasites," brood parasitism negatively affects the flycatcher, by reducing reproductive performance. Parasitism typically results in reductions in number of flycatcher young fledged per female per year. Brown-headed cowbirds have probably occurred naturally in much of the flycatcher's range, for thousands of years (Lowther 1993). However, they likely increased in abundance with European settlement, and established in southern California only since 1900 (Rothstein 1994b, Appendix F). It is possible that cowbird abundance has peaked, and may be declining in recent decades (Sauer et al. 1997). At normal levels, parasitism is rarely an impact on host species at the population level. However, for a rare host, parasitism may be a significant impact on production of young at the population level, especially with the high predation rates flycatchers and other small passerines experience. When combined with negative influences of predation, habitat loss, and overall rarity, parasitism can be a significant contributor to population decline.

The effects and management of cowbird parasitism with respect to the flycatcher are complex. Cowbird parasitism levels vary widely across the flycatcher's range (Table 5). A given intensity of cowbird parasitism may or may not have significant influence on the trend of a given flycatcher population. Similarly, cowbird control may or may not result in significant, or even measurable benefits to a population. 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 significant, even critical.

Table 5. Rates of parasitism by brown-headed cowbirds on the southwestern willow flycatcher at selected locations. (Adapted from Whitfield and Sogge 1999; no cowbird control at these sites for these years.)

Region	Years	# of Nests	Mean Annual Parasitism
South Fork Kern River, CA	1987, 1989-1992	163	66%
Mesquite, NV	1997	5	40%
Virgin River Delta, NV	1997	14	21%
Mormon Mesa, NV	1997	3	0%
Grand Canyon, AZ	1982-1986, 1992-1996	25	48%
White Mountains, AZ	1993-1996	36	19%
San Pedro River, AZ	1995-1996	61	3%
Roosevelt Lake, AZ	1995-1996	17	18%
Verde River, AZ	1996	13	46%
Gila River Valley, AZ	1995, 1997	49	18%
Other sites, NM	1995	10	40%

Cowbird management may prove to be an important tool in recovering the flycatcher, because it can be ameliorated more easily than other threats such as habitat loss or nest predation. But cowbird control actions such as trapping programs should not be viewed as a reflexive panacea. Because of local conditions, even intensive control may not result in increasing a flycatcher population. For example, on the Kern River, a flycatcher population has decreased from 34 pairs in 1993 to 23 in 1999, despite trapping having decreased parasitism from an average of 65% prior to trapping to an average of 22% with trapping (Whitfield et al. 1999). This does not mean that trapping is a wasted effort here; it may be preventing more serious declines. Evidently other influences are at work, which should also be addressed. Although effects of cowbird parasitism can be ameliorated with management, cowbird control has both benefits and downsides, some of which may be significant (see Appendix F), so cowbird control should be instituted only when impacts exceed certain levels. Given that parasitism rates of 20-30% have barely detectable effects on host recruitment because of renesting after desertion or predation of parasitized nests (see Appendix F), managers should in most cases consider cowbird control only when adequate data show that parasitism on a local population exceeds these rates for two or more years (see Appendix F). Trapping exerts strong selective pressures on local cowbird populations to develop resistance to trapping. Such resistance could reflect a true evolved behavior based on genetic variation or a learned tradition. Resistance could take the form of a lessened attraction to groups of cowbirds (as are used to attract birds to the decoy traps), a reluctance to enter traps, and an ability to escape from the decoy traps commonly used in cowbird control programs (see Appendix F, Section d: Potential Downsides or Negative Aspects of Cowbird Control).

3. Vulnerability of Small Populations

Demographic Effects

The total number of southwestern willow flycatchers is small, with an estimated 1100-1200 territories rangewide (see section II.I., "Current Population and Trends"). These territories are distributed in a large number of very small breeding groups, and only a small number of relatively large breeding groups. These isolated breeding groups are vulnerable to local extirpation from floods, fire, severe weather, disease, and shifts in birth/death rates and sex ratios. Marshall and Stoleson (2000) noted that "Even moderate variation in stochastic factors that might be sustained by larger populations can reduce a small population below a threshold level from which it cannot recover. The persistence of small populations depends in part on immigration from nearby populations, at least in some years (Stacey and Taper 1992). The small, isolated nature of current southwestern willow flycatcher populations exacerbates the risk of local extirpation by reducing the likelihood of immigration among populations." The vulnerability of the few relatively large populations makes the above threats particularly acute. In recent years, several of the few larger populations have been impacted by fire (San Pedro River) and inundation by impounded water (Lake Mead, Lake Isabella). Also, the flycatcher appears to be a quasi-colonial species (McCabe 1991). At its few large breeding sites, many territories are often packed into relatively small areas, with significant levels of polygyny, extra-pair copulation, and pair re-shuffling (Paxton et al. 1997, Netter et al. 1998, Paradzick et al. 1999). These may be significant factors in maintaining genetic interchange. The presence of a threshold "colony size" may be an important catalyst for successful breeding sites to function.

Genetic Effects

Because the flycatcher exists in small populations, there has been concern over potential low genetic variation within populations, and possible inbreeding (Marshall and Stoleson 2000). If low genetic variation did exist, it could result in reduced fecundity and survival, lowered resistance to parasites and disease, and/or physiological abnormalities (Allendorf and Leary 1986, Hartl 1988). However, recent research has found substantial genetic variation within and among flycatcher breeding groups, and within and between watersheds (Sogge et al. 1998, Busch et al. 2000). The flycatcher may also be threatened by low effective population size, which is an index of the actual numbers of individuals breeding in a population and the number of offspring they produce. A species' effective population size may be much smaller than the absolute population size because of uneven sex ratios, uneven breeding success among females, polygyny, and low population numbers which exacerbate these factors (Marshall and Stoleson 2000).

4. Migration and Winter Range Stresses

As a neotropical migrant, the flycatcher spends more time in migration and on the wintering grounds each year than it does on its North American breeding grounds (Sedgwick 2000). Migrant and wintering flycatchers face a number of known and potential threats. For example, migration is a period of high energy demands, and migrating individuals must find suitable “stopover” habitat at which to replenish energy reserves needed for the next step of migration flight (Finch et al. 2000). Insufficient stopover habitat, and destruction or degradation of existing 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). Recent winter surveys in portions of Central America (Koronkiewicz et al. 1998, Koronkiewicz and Whitfield 1999, Lynn and Whitfield 2000) have found that willow flycatcher wintering habitat is often located in lowland areas that are subject to heavy agricultural uses, many of which negatively impact key habitat components at wintering sites. We do not know if winter habitat is currently limiting for willow flycatchers (nor exactly how much habitat is needed overall), but we do know that the amount of native lowland forest and wet areas (e.g., lagunas, esteros, etc.) - habitats in which flycatchers currently overwinter - has decreased dramatically over the last 100 years (Koronkiewicz et al. 1998). Furthermore, agri-chemicals and pesticides are still widely used in many regions through which flycatchers migrate, and in wintering sites (Koronkiewicz et al. 1998, Lynn and Whitfield 2000), thereby exposing flycatchers to potential environmental contaminants during much of the year.

III. CONSERVATION MEASURES

A. Regulatory Protection

1. Federal Laws Protecting the Southwestern Willow Flycatcher

Endangered Species Act

Listing under the ESA affords the southwestern willow 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. All agencies of the United States government are therefore authorized and obligated to proactively promote conservation and recovery of the southwestern willow flycatcher. Section 4 of the Act requires the Department of Interior and the Department of Commerce 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 USFWS 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 permitted through this consultation process. Section 9 provides protection for the southwestern willow 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.

Section 10 of the ESA gives the authority to issue permits to non-Federal and private entities for "take," as long as such taking is incidental to, and not the purpose of, carrying out otherwise lawful activities. Often, these permits are issued for "habitat conservation plans" (HCP) developed under §10(a)(1)(B). Take permits issued for HCPs authorize incidental take, but not the underlying activities that result in take. This process ensures that the effects of the authorized incidental take will be adequately minimized and mitigated. Congress intended that the HCP process would be used to reduce conflicts between listed species and economic development activities. HCPs are used to develop creative partnerships between the public and private sectors in the interest of conserving listed species. In 1999, the USFWS issued a new policy under Section 10(a)(1)(A) of the ESA, for Safe Harbor Agreements (SHA) through enhancement of survival permits for listed species. The standard for an 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 sometime in the future back to an agreed upon baseline; if several SHAs were implemented simultaneously or sequentially, these efforts could assist in species' recovery.

Migratory Bird Treaty Act

The Migratory Bird Treaty Act (16 U.S.C. 701-711) was enacted in 1916 between the governments of the United States and Great Britain (representing Canada), subsequently Mexico in 1936, Japan in 1972, and the Union of Soviet Socialist Republics in 1976. The Migratory Bird Treaty Act expanded the definition of migratory birds to include virtually all birds found in the United States. It establishes provisions regulating take, possession, transport, and import of migratory birds, including nests and eggs.

Federal Land Policy and Management Act of 1976

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 . . ." Furthermore, it is the policy of the Bureau of Land Management "to manage habitat with emphasis on ecosystems to ensure self-sustaining populations and a natural abundance and diversity of wildlife, fish, and plant resources on public lands" (BLM manual 6500.06).

National Forest Management Act

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." Additionally, sec. 219.12(g) requires the maintenance of viable populations of native vertebrates in national forests.

Clean Water Act

Congress passed the Federal Water Pollution Control Act Amendments of 1972 and the Clean Water Act (CWA) of 1977 to provide for the restoration and maintenance of the chemical, physical, and biological integrity of the nation's lakes, streams, and coastal waters. Primary authority for the implementation and enforcement of the CWA now rests with the U.S. Environmental Protection Agency (EPA) and to a lesser extent, the U.S. Army Corps of Engineers (COE). In addition to the measures authorized before 1972, the CWA implements a variety of programs, including: Federal effluent limitations and state water quality standards, permits for the discharge of pollutants and dredged and fill materials into navigable waters, and enforcement mechanisms.

Section 404 of the CWA is the principal Federal program that regulates activities affecting the integrity of wetlands. Section 404 prohibits the discharge of dredged or fill material in jurisdictional waters of the United States, unless permitted by COE under § 404 (a) (individual permits), 404 (e) (general permits), or unless the discharge is exempt from regulation as designated in § 404 (f).

There is controversy in administration of the COE's permit system and their responsibilities pursuant to the ESA. The limits of jurisdictional waters of the United States (the area covered under § 404) are determined by: 1) in the absence of adjacent wetlands, jurisdiction extends to the ordinary high water mark; or 2) when adjacent wetlands are present, jurisdiction extends beyond the ordinary high water mark to the limit of the adjacent wetlands; or 3) when the water of the United States consists only of wetlands, jurisdiction extends to the limit of the wetland. Riparian habitat in the Southwest is usually above the ordinary high water mark and often does not meet the definition of jurisdictional wetlands of the United States.

Section 402 of the CWA is the principal Federal program that regulates activities affecting water quality. One of the most significant features of the 1972 CWA is the creation of a national pollutant discharge elimination system (NPDES). Except as otherwise provided in the CWA, industrial sources and publicly owned treatment works may not discharge pollutants into navigable waters without a permit. The EPA may issue a permit for discharge upon condition that the discharge meets applicable requirements, which are outlined extensively in the CWA and which reflect, among other things, the need to meet Federal effluent limitations and state water quality standards.

2. State Laws Protecting the Southwestern Willow Flycatcher

Arizona

The State of Arizona is in the process of developing a list of "Wildlife of Special Concern in Arizona," which identifies species whose occurrence in Arizona is or may be in jeopardy, or those with known or perceived threats or population declines. The southwestern willow flycatcher is included in the most current (1996) draft of the list of "Wildlife of Special Concern in Arizona." This list will replace the previous list of "Threatened Native Wildlife in Arizona" (AGFD 1988) which categorized the willow flycatcher as "endangered." Both lists are informative and nonregulatory, serving mainly as policy guides for wildlife management. Under Arizona Revised Statutes, for a nongame passerine bird like the southwestern willow flycatcher, permits are required to take (R12-4-304), possess, sell, transport, import, and export carcasses (R12-4-305), and collect for scientific purposes (R12-4-418).

California

Three subspecies of willow flycatcher occur in California: the southwestern (*Empidonax traillii extimus*), the "little" willow flycatcher (*E.t. brewsteri*) and the Great Basin form (*E.t. adastus*). The State of California classifies willow flycatchers breeding within the state (all subspecies) as endangered (California Department of Fish and Game 1992). Under the California Endangered Species Act of 1984 (Fish and Game Code Sections 2050-216), the southwestern willow flycatcher therefore has the following protections: unless permitted by the California Department of Fish and Game (CDFG), a listed species shall not be imported into California or exported from California, and shall not be taken, possessed, purchased, or sold within California (Summary of Fish and Game Code Section 2080). Section 86 of the Fish and Game Code defines take as "hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill".

The following restrictions and regulations from the CDFG Code apply to a nongame passerine bird like the southwestern willow flycatcher: All birds occurring naturally in California that are not resident game birds, migratory game birds, or fully-protected birds are nongame birds. It is unlawful to take any nongame bird except as provided in the Fish and Game Code or in accordance with regulations of the Fish and Game Commission or in a mitigation plan for a mining operation approved by the CDFG (Fish and Game Code Section 3800). It is unlawful to take or possess any bird except as provided in the code or in regulations adopted by the commission pursuant to the Code (Summary of Section 2000). It also is unlawful to take, possess, or needlessly destroy the nest or eggs of any bird (§3503). Further, it is unlawful to take or possess any migratory nongame bird designated in the Migratory Bird Treaty Act except as provided by rules and regulations adopted by the U.S. Secretary of the Interior (§3513).

The California Environmental Quality Act (CEQA [Public Resources Code Sections {PRC}] 21000-21178.1) and the regulations enacting it (California Code of Regulations [CCR] 15000-15387) are important tools for protecting biological resources in California. CEQA, which is similar to the National Environmental Policy Act (NEPA), 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. With the exception of a few exempt actions, CEQA must be followed by all state and local public agencies for discretionary projects. Projects are defined as those actions carried out, funded, or permitted by the agencies.

CEQA is effected by completing documentation appropriate for the level of impact. Documentation ranges from a Negative Declaration for low-no impact projects to Environmental Impact Reports (EIR) for larger, more complex, or more impacting projects. Review and opportunity to comment by the public, and agencies other than the action agency, is mandatory. There is no enforcement agency for CEQA compliance; its intents are realized by the good-faith efforts of the decision-making agency, or through litigation. The California Department of Fish and Game is entitled, under certain circumstances involving noncompliance with CEQA, to replace another state or local public entity as lead agency.

The impacts of a project on biological resources are considered to be significant if the project has the potential to substantially reduce the habitat of fish and wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, and/or reduce the number or restrict the range of an endangered, rare or threatened species. Further, it directs that threats be viewed as both those posed directly by the project and those posed cumulatively by the project and other projects together. CEQA defines endangered, rare, or threatened species as those listed under the Federal and state Endangered Species Acts and also any other species that meet the definition under those acts, even if no listing action has been taken.

Decision-making agencies may deny projects which may cause a significant impact after mitigation, or for which the proponent is unwilling to accept mitigation conditions attached to the permit. On the other hand, if after applying feasible mitigation measures, the project still will result in significant impacts, the decision-making agency may still approve the action by adopting a "Statement of Overriding Considerations." In this, the decision-making body must describe in writing the specific reasons (economic, legal, social, technological, or other benefits) which override the adverse environmental effects.

Colorado

The State of Colorado listed the southwestern willow flycatcher as endangered in May 1998. The flycatcher is therefore protected under Colorado Revised Statutes (C.R.S.) 33-2-105. Section 3 of this statute states that ". . it is unlawful for any person to take, possess, transport, export, process, sell or offer for sale, or ship and for any common or contract carrier to knowingly transport or receive for shipment any species or subspecies of wildlife appearing on the list of wildlife indigenous to this state determined to be endangered within the state pursuant to subsection (1) of this section." Section 4 contains identical language for taxa listed as threatened. Penalties for the take of state-listed endangered species are established in C.R.S. 33-6-109(3)(a). These penalties are ". .a fine of not less than two thousand dollars and not more than one hundred thousand dollars, or by imprisonment for not more than one year in the county jail, or by both such fine and such imprisonment, and an assessment of twenty points." The Colorado Division of Wildlife is also authorized to pursue civil action to recover the value of wildlife. C.R.S. 33-6-110(1)(a) establishes a minimum value of $1,000 for any endangered species. Colorado Wildlife Commission Regulation #1315 (a) provides that a ". . Scientific Collecting License may be issued for the purpose of marking or banding or temporary or permanent possession of wildlife specimens outside of established seasons."

Nevada

The southwestern willow flycatcher was proposed for re-classification from state Protected to Endangered status in the State of Nevada in 1997. As of 1999 the flycatcher has not been re-classified to state Endangered status. However, the flycatcher is currently a protected bird under the Nevada Administrative Code (NAC) §503.050. This protection means "...there is no open season and a person shall not capture or kill this wildlife or possess any part thereof, without first obtaining the appropriate license, permit, or written authorization from the Nevada Division of Wildlife." (NAC §503.090, §503.093). Penalties for violation include fines up to $500 and/or up to six months in prison (Nevada Revised Statute §501.385). There are no state habitat designations that govern land use practices or are analogous to the designation of critical habitat, under the ESA.

New Mexico

The State of New Mexico listed the southwestern willow flycatcher as Threatened (then called 'Group 2') in 1988 (NMDGF 1988), then re-classified the subspecies to Endangered status in 1996. The flycatcher is therefore protected under New Mexico's Wildlife Conservation Act (WCA) (17-2-37 to 17-2-46 NMSA 1978) of 1974. This protection means "except as otherwise provided in the WCA, it is unlawful for any person to take (including 'harass, hunt, capture or kill, or attempt to do so'), possess, transport, export, sell or offer for sale, or ship" the flycatcher in New Mexico. Penalties for violation include fines up to $1,000 or up to one year in prison. The WCA provides for no habitat designations analogous to the designation of critical habitat, and does not govern land use practices. The WCA provides for the issuance of permits for take, possession, transport, export or shipment for scientific, zoological or educational purposes, or for propagation in captivity.

Texas

The southwestern willow flycatcher is listed as an endangered species in Texas Parks and Wildlife Code (TPWC), §65.180. This designation affords the flycatcher the protections of TPWC §68.015, which prohibit capture, trapping, take, or killing, or attempting any of these acts. Also prohibited are possession, sale, distribution, or offering or advertising for sale any goods made from endangered fish or wildlife unless the goods were made from fish or wildlife that were lawfully born and raised in captivity for commercial purposes, or were made from fish or wildlife lawfully taken in another state. Also, TPWC §68.006 prohibits possession, taking, or transportation for zoological gardens or scientific purposes, and take or transportation from its natural habitat for propagation for commercial purposes. A permit for these activities may be issued under TPWC §43.022. Violation of the above provisions constitutes a TPWC Class B misdemeanor; multiple convictions constitute a Class A misdemeanor. The above provisions afford no protections for the habitat of state-listed endangered species.

Utah

The State of Utah lists the southwestern willow flycatcher as an endangered species on its Utah Sensitive Species List (Utah Division of Wildlife Resources 1998). This list, compiled pursuant to Policy Number W2NAT-1 (State Sensitive Species), is intended to stimulate management actions (e.g., conservation strategies) to benefit listed species. The list carries no regulatory authority. However, under Title 23, Wildlife Resources Code of Utah, the flycatcher may not be collected and possessed (R657-3-21), or imported and possessed (R657-3-32). The flycatcher may be transported live through Utah, and imported to a State or Federally regulated establishment (R657-3-37 and 38).

B. Actions to Offset Impacts, and Mitigation Efforts

The following are examples of some, but not all, actions to offset habitat impacts, and mitigation efforts directed at benefitting the flycatcher.

1. Marine Corps Base, Camp Pendleton, California

Annual cowbird trapping has been conducted since 1983 at Marine Corps Base, Camp Pendleton, California, in compliance with a Biological Opinion addressing impacts of Marine training operations on riparian habitat used by least Bell's vireos and southwestern willow flycatchers. In addition, annual surveys for flycatchers, and since 1999, nest monitoring, have been conducted, providing information on flycatcher population size, distribution, and productivity at the Base.

2. Prado Basin, California

In conjunction with efforts to conserve and recover the endangered least Bell's vireo and southwestern willow flycatcher, species monitoring, cowbird trapping and habitat restoration and conservation efforts have been undertaken in the Prado Basin and contiguous reaches of the Santa Ana River since1996. Although the local management effort, funded largely by the Orange County Water District pursuant to several Biological Opinions, originally emphasized monitoring and management of the vireo, the conservation of the small breeding population of the flycatcher has been the top priority of the management team since the species was Federally listed as endangered. Given the past creation and present supervision of species management and habitat restoration endowments, management efforts will be sustained in perpetuity at current levels.

3. Lake Isabella, California

The construction of Isabella Dam on the Kern River (near Weldon, CA) and subsequent filling of the reservoir resulted in the development of a riparian woodland at the inflow of the South Fork of the Kern River. In 1997, the USFWS and COE convened a team of scientific experts to assist in resolution of issues relating to the operation of Isabella Reservoir and potential impacts to southwestern willow flycatchers that were breeding in dense willow habitat at the inflow area. The team determined that future reservoir operations were likely to continue impacting the flycatcher and its breeding habitat, and recommended the development and protection of an additional 1,000 ac of floodplain habitat (approximately 500 of which would be dense willow habitat) upstream in the Kern River Valley, continued cowbird trapping (to maximize local breeding productivity), and continued monitoring and research (del Nevo et al. 1998). To date, the COE has funded continued flycatcher monitoring and research, cowbird trapping, and efforts are still underway to identify and secure the needed floodplain habitat.

4. Clark County, Nevada, Habitat Conservation Plan

Clark County and its Desert Conservation Plan Implementation and Monitoring Committee is responsible for the implementation of the provisions of Section 10(a)(1)(B) Incidental Take permit, issued by the USFWS, pursuant to the ESA of 1973. Clark County administers the plan by assuming responsibility for the collection of mitigation fees, ensuring adherence to all compliance measures associated with the permit as well as overseeing implementation of the Plan. The Desert Conservation Plan is intended to promote a balance between economic stability and environmental integrity in Clark County, Nevada. Clark County is also responsible for the preparation of the Multiple Species Habitat Conservation Plan which, upon approval, will supercede the Desert Conservation Plan. The Plan will initially provide coverage for approximately 79 species and may include coverage for additional species as more information becomes available for these taxa over time, thereby assuring that clearly established conservation measures are not jeopardized alongside a vibrant local economy and the sustained appreciation of our natural resources.

5. Lower Colorado River Multi-Species Conservation Program

The objectives of the Lower Colorado River Multi-Species Conservation Program (LCR MSCP) are to:
1) Conserve habitat and work toward the recovery of "included species" within the 100-year floodplain of the Lower Colorado River, pursuant to the ESA, and attempt to reduce the likelihood of additional species listings under the ESA;
2) Accommodate current water diversions and power production and optimize opportunities for future water and power

development, to the extent consistent with the law; and 3) provide the basis for take authorizations pursuant to the Federal ESA and California ESA. The LCR MSCP contains Federal project elements (U.S. Bureau of Reclamation (USBR) operations and maintenance) as well as State and private projects.

It is anticipated that the LCR MSCP will preserve existing habitat, create new riparian habitat, and restore damaged or degraded areas in order to provide habitat suitable for the southwestern willow flycatcher and yellow-billed cuckoo. To the extent practicable, these habitat areas will be managed as an integrated mosaic with wet sloughs and marshes designed to support the Yuma clapper rail and other marsh and aquatic wildlife. Conservation measures are being designed with the goal of distributing habitat for the southwestern willow flycatcher throughout the LCR MSCP planning area, to the extent consistent with the morphology of the river and floodplain, in order to maintain or establish connectivity.

The LCR MSCP will build on the ongoing implementation of the USFWS biological and conference opinion on LCR operations and maintenance, dated April 30, 1997, that directed Reclamation to implement Reasonable and Prudent Alternatives (RPAs) to: 1) protect approximately 1400 ac (565 ha) of currently unprotected occupied or potential southwestern willow flycatcher habitat through acquisition, easements, partnerships, and other means; 2) provide protective management for willow flycatchers and suitable habitat on the LCR through fire prevention planning, fencing, cowbird control, public education; 3) conduct five years of willow flycatcher research and monitoring on the LCR, and conduct other studies or projects that contribute to willow flycatcher conservation; 4) identify historical willow flycatcher habitat on the LCR that no longer exists and is unrestorable, and develop management recommendations for the MSCP to compensate for loss of habitat, through acquisition, easements; and 5) evaluate effectiveness of modified or removed channels on comparable river systems, assess how and where to modify or remove channels to restore riparian habitat on the LCR, and evaluate the success of different habitat restoration demonstration projects on the LCR (USFWS 1997c). Endangered Species Act coverage for USBR's LCR operations and maintenance was extended from April 30, 2002, to April 30, 2005. Some of the RPAs USBR was directed to do were completed (numbers 1, 4, and 5 described above). USBR will continue to conduct research, monitoring, and other conservation actions through 2005, or until the completion date of the LCR MSCP, whichever comes first.

6. Roosevelt Lake, Arizona

The USFWS biological opinion on the operation of the modified Roosevelt Dam, dated July 23, 1996, directed USBR to implement an RPA that would allow the use of the newly developed water conservation space within the reservoir. To partially fulfill requirements of the RPA, USBR was required to: 1) acquire occupied willow flycatcher habitat on the lower San Pedro River, now owned and managed by The Nature Conservancy as the San Pedro River Preserve; 2) establish a $1.25 million Management Fund to conduct management activities that benefit the willow flycatcher through habitat acquisition, fencing, restoration, cowbird trapping, and other projects; 3) create a Southwestern Willow Flycatcher Conservation Coordinator position to assist the USFWS in initiating recovery and conservation planning, and to implement activities required by the Biological Opinion; 4) implement a 10-year program of willow flycatcher research and monitoring at Roosevelt Lake and the lower San Pedro River; 5) implement a cowbird trapping program on the lower San Pedro River; and, 6) fund a variety of research and monitoring programs range-wide (USFWS 1996).

In addition to the above, the public is currently reviewing the Salt River Project's incidental take application, draft Environmental Impact Statement and draft Roosevelt Lake Habitat Conservation Plan (HCP) for the continued operation of the reservoir. The goals of the Roosevelt HCP are to "minimize and mitigate incidental take (due to continued operation of Roosevelt) of flycatchers, Yuma clapper rails, bald eagles, and cuckoos, to the maximum extent practicable, and to not appreciably reduce the likelihood of survival and recovery...in the wild." If the Roosevelt HCP is approved, the Salt River Project commits to implementing the following measures for the southwestern willow flycatcher in Gila and Maricopa counties, Arizona: (1) creating and managing riparian habitat at Roosevelt Lake; (2) acquiring and managing riparian habitat in several basins in central Arizona to provide a diversity of geographic locations; and, (3) focusing acquisition of riparian land in locations that birds are expected to occupy (i.e., in proximity to existing populations of flycatchers). This commitment will entail protection in perpetuity of a minimum of 1,500 acres of riparian habitat either on-site or near-site of Roosevelt reservoir, as well as 750 acres of riparian habitat management, water rights acquistion, and/or providing of benefits.

7. Sonoran Desert Multi-Species Conservation Plan

In Pima County, Arizona, the Sonoran Desert Conservation Plan's multi-species habitat conservation component includes the southwestern willow flycatcher as a "Priority Vulnerable Species." Recently identified in the Empire Cienega watershed in Pima County, it is anticipated that the Sonoran Desert Conservation Plan will preserve existing habitat, restore habitat, and manage lands consistent with conservation efforts for the flycatcher and up to 50 other species.

C. Conservation Efforts

1. Pro-Active Conservation Efforts Directed at the Flycatcher

A number of pro-active efforts, not driven by legal requirements, are being directed at conservation and recovery of the southwestern willow flycatcher. Several of these are discussed below, as examples of the range of beneficial programs that can be implemented.

Habitat Protection and Restoration

Kern River, California

The 456 ha (1127 ac) Kern River Preserve (KRP) was purchased in 1981 by The Nature Conservancy (TNC). The land had been operated as a cattle ranch since the mid-1800s. TNC removed cattle from the riparian areas shortly after they purchased the property in order to enhance the riparian habitat. However, some riparian areas are lightly to moderately grazed during the winter. The change in management resulted in the regeneration of at least 150 ha (370 ac) of riparian forest. In addition, TNC has planted over 125 ha (309 ac) of riparian habitat. In 1997, Audubon California took over management of the KRP and continues to manage the property for riparian values. One of California's largest populations of the southwestern willow flycatcher nests on the KRP.

Virgin River, Utah

Washington County, Utah, which is home to more than half of the Virgin River’s length, has ranked among the nation’s ten fastest-growing counties for the last four years. This growth in human community is facilitating detrimental uses of the Virgin River and its riparian resources. For example, a current proposal calls for a 60% reduction of the river’s winter flow in the last reach where two endangered fish maintain relatively healthy populations.

According to the Natural Heritage Programs in Utah, Arizona, and Nevada, the Virgin River Basin supports 32 species which are globally rare and of pressing conservation concern. The USFWS lists six of these species as endangered; two more are threatened and an additional 24 are being monitored. Many of these species rely on the Virgin River’s riparian habitat which occurs on only 1% of the entire Basin’s land base.

The Grand Canyon Trust has responded by launching a two-pronged effort: first, an extensive information gathering effort to prepare for reasonable discussions regarding management decisions, and second, an effort to regularly participate in key management processes which are determining the river’s future. The Trust’s vision is a healthy, accessible river with self-sustaining native plant and animal populations for the children of 2097 and beyond.

Gila River, New Mexico

In the Cliff-Gila Valley, The Nature Conservancy has initiated habitat enhancement on its lands, including reducing levees to allow controlled flooding and subsequent establishment of riparian vegetation for nesting flycatchers. Also in the same area, the Gila National Forest and the U-Bar Ranch have used the construction of artificial oxbows as a means to stabilize eroded banks while simultaneously creating wetland habitats of slack water surrounded by native riparian vegetation. These sites were constructed by digging down to the water table in linear troughs parallel to the Gila River course. The banks were then pole-planted with willows, cottonwoods, and sycamores. Southwestern willow flycatchers occupied the Gila Bird Area project on the Gila National Forest in 1997, within three years of its construction. Several pairs bred in the U-Bar project in 1999. Farther downstream, in the vicinity of the Lower Gila Box, the Bureau of Land Management has enhanced riparian patches by reducing or eliminating livestock grazing and by controlling off-road vehicles.

Monitoring and Research

Prior to approximately 1990, research regarding southwestern willow flycatchers was limited, consisting primarily of one regional and one State-based status and taxonomic review, and a handful of localized survey and breeding ecology efforts. Research was carried out by several independent researchers, in a few local areas, with little communication of data or regional data compilation. As the southwestern willow flycatcher drew increasing regulatory and management attention (starting with the proposed listing in 1991), survey, monitoring, and research efforts grew from minimal in 1992 to extensive by 1999. Since the early 1990s, statewide surveys have been initiated in Arizona, New Mexico, and Utah, generally as part of the Partners In Flight program. Standardized survey protocols were developed in 1994 and updated in 1997, and statewide survey data integration and reporting have been instituted in some States. In the mid-1990s, intensive breeding and migration ecology, demography, and habitat research was being conducted at several sites in Arizona, California, Nevada, and New Mexico. Range-wide population genetics work was also initiated at this time. Collaborative research is now being conducted throughout the flycatcher's range. Collectively, this body of inventory, monitoring, and research has provided sound quantitative data addressing key questions relative to the recovery and conservation of the southwestern willow flycatcher. Work has recently begun on the presence and potential impacts of environmental contaminants at selected flycatcher breeding sites in Arizona. Recent research has also investigated the status, distribution, habitat use and ecology of the willow flycatcher on its wintering grounds in Central America. Much of this valuable work is expected to continue into the future (given continued funding), and will yield valuable insights on flycatcher status, distribution, and ecology - with the overall goal of better designing, executing, and evaluating flycatcher conservation and management actions. As this occurs, it will be critical to continue local, statewide, and rangewide data synthesis and reporting, and the collaborative sharing of research needs, ideas, and information.

2. Other Efforts of Riparian Conservation That May Benefit the Flycatcher

Throughout the southwest, there are numerous private, local, State and regional efforts aimed at improving and/or reducing the degradation of riparian and wetland habitats. Specific examples include, but are not limited to: the Santa Clara River Enhancement and Management Plan; the Cascabel Community Conservation Plan; the San Pedro Riparian and Las Cienegas National Conservation Areas; the Verde River Management Plan; riparian habitat development downstream of the Nogales International Waste Water Treatment Plant; Las Vegas Wash wetlands restoration program; willow riparian restoration at Key Pittman Wildlife Management Area; San Juan Pueblo post-fire riparian restoration program; Santa Ana Pueblo riparian restoration project; Pueblo of Zuni riparian restoration program; restoration of instream flows on the Agua Fria below Lake Pleasant; water (effluent) releases into the Gila River below Phoenix; experimental releases of beaver on the San Pedro River; and, riparian fuels reduction research on the Rio Grande. These projects are at varying stages of development and implementation.

The USFWS applauds the agencies and groups involved in these and other efforts intended to increase the amount of, and improve the condition of, ecologically valuable riparian habitats. Similar projects are underway in virtually every flycatcher Recovery Unit (see Section IV.A.1.). While all such projects are welcome, it is important to recognize that not all of these efforts will directly benefit breeding southwestern willow flycatchers. The flycatcher breeds only in dense, mesic riparian patches - a subset of the types of riparian likely to be developed as a result of the above programs. It is quite possible, if not likely, that the basic objectives of many of these projects could be met without the development and maintenance of suitable flycatcher breeding habitat. Therefore, the USFWS encourages the groups responsible for these projects to work with flycatcher biologists to include, where possible, specific objectives and design criteria for development, enhancement, and protection of the types of habitats in which flycatchers breed. In this way, these myriad projects have the potential to contribute greatly to the recovery of the flycatcher.

D. Conservation of Listed, Proposed, Candidate, and Species of Special Concern

1. Listed Species Occupying The Same Ecosystem As The Flycatcher

A large number of species are listed as threatened or endangered, which inhabit the riparian and/or aquatic habitats to which the flycatcher also is tied (Table 6; also see http://endangered.fws.gov/wildlife.html#Species). This underscores that southwestern riparian and aquatic habitats, while supporting disproportionately high levels of biodiversity, have also been degraded at a landscape scale. The presence of so many threatened and endangered species within this broad ecosystem type does not mean that difficult decisions must be made of managing for one listed species rather than, or at the expense of, another. Rather, this situation illustrates that if riparian and aquatic ecosystems are restored to their natural, dynamic, heterogenous conditions, many imperiled species will benefit.

Table 6. Listed vertebrate species occupying the same ecosystems as the southwestern willow flycatcher. (E = Endangered, T = Threatened, P = Proposed, NA = Not Applicable, MX = Mexico)

Species/Status	Range, Habitat, Comments	Recovery Plan	Critical Habitat
Fox, San Joaquin kit (E) *Vulpes macrotis mutica*	Central CA: Various habitats, grassland and scrubland. May have benefitted from riparian habitats. Overlap with flycatcher hypothetical. Threats: habitat loss due to agricultural, industrial, urban development.	Yes	No
Jaguar (E) *Panthera onca*	AZ, NM, TX, MX: Various habitats; oak-pine woodlands in U.S., riverbottom jungle and thickets in tropics. May have benefitted from riparian habitats. Overlap with flycatcher hypothetical, possibly San Pedro and Santa Cruz rivers.	No	No
Jaguarundi, Sinaloan (E) *Herpailurus (=Felis) yagouaroundi tolteca*	TX, AZ(?): Tropical bottomland thickets. AZ reports unconfirmed. Overlap with flycatcher hypothetical, possibly San Pedro and Santa Cruz rivers.	Yes	No
Owl, Mexican spotted (T) *Strix occidentalis lucida*	UT, AZ, CO, NM, MX: Steep, wooded mountain slopes and rocky canyons, some wintering in lowland riparian woodlands. Threats: habitat loss - possibly including loss of wintering riparian habitat.	Yes	Yes
Pygmy-owl, cactus ferruginous (E) *Glaucidium brasilianum cactorum*	So. AZ: Riparian woodlands and desertscrub. Probably once sympatric along San Pedro, lower Gila, possibly Santa Cruz rivers. Threats: loss of riparian woodlands.	No	No (to be finalized in 2003)
Rails, light-footed clapper (E) *Rallus longirostris levipus* and Yuma clapper (E) *R. l. yumanensis*	CA, AZ, MX: Cattail-bulrush marshes. Local habitats dissimilar, but ranges likely include substantial flycatcher habitat. Threats: loss of habitat due to dewatering, channelization, loss of floods, contaminants.	Yes (Yuma)	No
Vireo, least Bell's (E) *Vireo bellii pusilis*	So. CA: Riparian thickets. Habitat similar to flycatcher's. Threats also similar: loss of habitat due to dewatering, loss of floods, channelization, cowbird parasitism.	Draft	Yes
Snake, giant garter (T) *Thamnophis gigas*	Central CA: Streams and sloughs, usually with mud bottoms. Threats: dewatering, agricultural conversion, urbanization.	No	No

Table 6, continued. Listed vertebrate species occupying the same ecosystems as the southwestern willow flycatcher . (E = Endangered, T = Threatened, P = Proposed)

Species/Status	Range, Habitat, Comments	Recovery Plan	Critical Habitat
Salamander, Sonoran tiger (E) *Ambystoma tigrinum stebbinsi*	AZ, MX: Ponds and marshes. Possibly once sympatric with flycatchers in San Pedro and upper Santa Cruz rivers. Threats: habitat alteration, climatic trends, isolation of small populations.	Yes	No
Salamander, California tiger (E) *Ambystoma californiense*	CA: Santa Barbara County lowland wetlands. Threats: severe degradation of breeding sites and associated uplands.	No	No
Toad, arroyo (E) *Bufo californicus*	CA, MX: Streams with shallow gravelly pools adjacent to sandy terraces. Sympatric with much of So. CA flycatcher populations. Threats: loss and degradation of riparian habitat, predation.	Yes	Yes
Leopard frog, Chiricahua (T) *Rana chiricahuensis*	AZ, NM, MX: Lowland cienegas, pools, livestock tanks, lakes, reservoirs, streams, most abundant in Gila and San Francisco drainages. Threats: habitat loss and predation by introduced predators.	No	No
Catfish, Yaqui (T) *Ictalurus pricei*	AZ, MX (Rio Yaqui drainage basin): In large rivers in areas of medium to slow current. Threats: habitat loss and non-native species.	Yes	Yes
Chub, Chihuahua (T) *Gila nigrescens*	NM, MX (Mimbres River NM): In deep pools bordered by undercut banks or with downed trees. Threats: riparian degradation	Yes	No
Chub, Pahranagat roundtail (E) *Gila robusta jordani*	NV: Pahranagat River drainage	Yes	No
Chub, humpback(E) *Gila cypha*	CA, AZ, UT, WY, CO: Strong, continuous water flow in the Colorado River between Nevada and Arizona, the Moapa and Virgin Rivers and the Pahranagat Valley. Threats: dewatering of rivers, flow control, migration and dispersal routes blocked by dams.	Yes	Yes
Chub, Virgin river (E) *Gila seminuda*	AZ, NV, UT: Pools and runs over sand and other sediment in the Virgin river. Threats: water diversion, exotic fish.	Yes	Yes
Chub, Owens tui (E) *Gila bicolor snyderi*	CA: Owens River system. Schools in weedy shallows of quiet waters. Threats: water diversion, exotic fish.	Yes	Yes

Table 6, continued. Listed vertebrate species occupying the same ecosystems as the southwestern willow flycatcher . (E = Endangered, T = Threatened, P = Proposed)

Species/Status	Range, Habitat, Comments	Recovery Plan	Critical Habitat
Chub, Sonora (T) *Gila ditaenia*	AZ, MX (Rio de la Concepcion drainage): In pools. Threats: habitat loss, dewatering of rivers.	Yes	Yes
Chub, Yaqui (E) *Gila purpurea*	AZ, MX: Rio Yaqui system and adjacent southeastern AZ. Sympatry with flycatchers questionable. Threats: riparian habitat degradation, possibly predation by exotic fish.	Yes	Yes
Dace, Ash Meadows speckled (E) *Rhinichthys osculus nevadensis*	NV: Amargosa River system. Flycatchers in area. Threats: exotic fish, earlier channelization and pumping.	Yes	Yes
Gambusia, Big Bend (E) *Gambusia gaigei*	TX: Springs in Big Bend National Park. Sympatry hypothetical. Threats: reduction in springflow	Yes	No
Minnow, loach (T) *Rhinichthys (=Tiaroga) cobitis*	AZ, NM, MX: Inhabits turbulent, rocky riffles of rivers and tributaries up to approximately 2200 m. Endemic to Gila River basin. Threats: modification of rivers, streams, and landscapes through dewatering &/or impoundment of streams, loss of natural flooding, livestock grazing, and non-native fishes.	Yes	Yes
Minnow, Rio Grande silvery (E) *Hybognathus amarus*	NM, TX, MX: Rio Grande. Sympatric with Rio Grande corridor flycatchers. Threats: Dewatering of river system, changes in flood regimes, and barriers(dams) to migration and dispersal.	Yes	No (to be finalized in 2003)
Pupfish, Ash Meadows Amargosa (E) *Cyprinodon nevadensis mionectes*	NV, Ash Meadows NWR and Amargosa River. Threats: exotic fish and dewatering.	Yes	Yes
Pupfish, Warm Springs (E) *Cyprinodon nevadensis pectoralis*	NV, Ash Meadows NWR. Threats: exotic fish and dewatering.	Yes	No
Pupfish, desert (E) *Cyprinodon macularius*	AZ, CA, MX:. Lower CO River system. Threats: dewatering.	Yes	Yes
Spikedace (T) *Meda fulgida*	AZ, NM: Gila and Verde river systems. Variable habitats, young at stream margins and adults in main channels, in clear, year-round streams. Formerly sympatric with much of flycatcher's central range; remaining spikedace occur with or near flycatchers on Verde and Gila Rivers, including Cliff-Gila area.	Yes	Yes

Table 6, continued. Listed vertebrate species occupying the same ecosystems as the southwestern willow flycatcher . (E = Endangered, T = Threatened, P = Proposed)

Species/Status	Range, Habitat, Comments	Recovery Plan	Critical Habitat
Moapa Dace (E) *Moapa coriacea*	Muddy River, NV: Spring pools, spring outflows, and the main stem. Threats: habitat degradation, exotic fish.	Yes	No
Spinedace, Little Colorado (T) *Lepidomeda vittata*	AZ: Headwaters of Little CO River. Sympatric with flycatchers. Threats: habitat degradation, exotic fish.	Yes	Yes
Topminnow, Gila & Yaqui (E) *Poeciliopsis occidentalis*	AZ, NM: Ephemeral flooded habitats in lowland Gila basin, stenothermal springs, and natural lentic habitats, primarily in shallow areas with aquatic vegetation and debris. Threats: loss of springs, river backwaters, and small stream habitat due to water impoundment and diversion, water pollution, introduction and spread of exotic predatory and competitive fish species.	Yes	No
Trout, Apache (=Arizona) (T) *Oncorhynchus (Salmo) apache*	AZ: Lakes and streams in White Mts	Yes	No
Trout, Gila (E) *Oncorhynchus (Salmo) gilae*	AZ, NM: Upper Gila River system	Yes	No
Chub, bonytail (E) *Gila elegans*	CA, AZ, NV, UT, CO, WY: Larger swiftwater channels of Colorado River system. Threats: changes in water temp, quality, availability, flood regimes; migration and dispersal routes blocked by dams.	Yes	Yes
Razorback sucker (E) *Xyrauchen texanus*	CA, AZ, NV, UT, CO, NM, WY, MX: CO and Gila River basins. Threats: changes in water temp, quality, availability, flood regimes; migration and dispersal routes blocked by dams.	Yes	Yes
Sucker, Santa Ana (T) *Catastomus santaanae*	CA: Los Angeles, San Gabriel, and Santa Ana rivers. Threats: water diversions, channelization, exotic fishes.	No	No
Pikeminnow (squawfish), Colorado (E) *Ptychocheilus lucius*	CA, AZ, NV, UT, CO, NM, WY, MX: CO River system except Salt and Verde rivers. Threats: changes in water temp, quality, availability, flood regimes; migration and dispersal routes blocked by dams.	Yes	Yes
Woundfin (E) *Plagopterus argentissimus*	AZ, NV, UT: Virgin River system, formerly in Gila system. Threats: water diversion, exotic fish.	Yes	Yes

2. Species of Special Concern Occupying The Same Ecosystem As The Flycatcher

A large number of riparian and aquatic species are listed by the States comprising the flycatchers breeding range as threatened, endangered, sensitive, or species of concern (For lists see AGFD 1988 and 1996, CDFG 1992, Colorado Revised Statutes 33-2-105, Nevada Administrative Code §503.050, NMDGF 1988, Texas Parks and Wildlife Code §65.180, UDWR 1998). These species are dependent on habitats that are similar to, and/or ecologically and hydrologically connected to the breeding and migration habitat of the flycatcher. Where they take the approach of restoring or mimicking natural hydrological processes, conservation efforts directed at the flycatcher or these species should be mutually beneficial.

IV. RECOVERY

A. Recovery Strategy

This section describes the approaches and strategies for recovering the southwestern willow flycatcher. These include the geographic approach in the following discussion, followed by the information and rationales used to identify recovery goals.

1. Recovery Units

The breeding range of the flycatcher encompasses all or portions of seven States. Habitat and breeding site characteristics, potential threats, management responsibilities and status, and recovery options vary widely among the breeding sites across this broad geographic area. Because of this broad geographic range and site variation, recovery is approached by dividing the flycatcher's range into six Recovery Units, which are further subdivided into Management Units. This provides a strategy to characterize flycatcher populations, structure recovery goals, and facilitate effective recovery actions that should closely parallel the physical, biological, and logistical realities on the ground. Further, using Recovery and Management Units assures that populations will be well distributed when recovery criteria are met.

Recovery Units are defined based on large watershed and hydrologic units. Advantages of this approach are: (1) there are clear relationships between watershed characteristics and the riparian habitats on which flycatchers depend; (2) current data show that flycatchers move among breeding sites within watersheds more often than between watersheds; (3) watershed boundaries are geographically based and thus can be clearly delineated; (4) standard watershed boundaries have been defined for other purposes (e.g., Hydrologic Unit Codes [HUCs]; Seaber et al. 1994) and can be readily applied within the flycatcher's range; (5) watershed-based management builds on recent trends for agencies to cooperatively approach recovery and general resource planning at ecosystem, watershed, and landscape levels.

The "Hydrologic Units" (Seaber et al. 1994) used in this process depict standardized boundaries of river basin units of the United States. They are widely accepted by Federal, regional, State, and local water resource agencies for use in planning and describing water use and related land use activities, and in geographically organizing hydrologic data. "Accounting Units" are the third of the four levels of classification of hydrologic units. Accounting Units may be a subdivision of an area drained by a river system, a reach of a river and its tributaries in that reach, a closed basin(s), or a group of streams forming a coastal drainage area. In this plan, Accounting Units were aggregated into Recovery Units, except where they are truncated by the northern subspecies boundary.

Recovery Unit boundaries were defined using the following decision process:

1. Wherever possible, Recovery Unit boundaries coincide with watershed boundaries to facilitate management of water and land resources, critical to flycatcher recovery, using watershed principles.

2. Most Recovery Unit boundaries were defined by watershed boundaries at the Accounting Unit level, as defined by USGS and Water Resource Council "Hydrologic Accounting Units."

3. In areas where an Accounting Unit boundary extended beyond the historic or currently known distribution of the flycatcher (e.g., along the northern and eastern edges of the subspecies' range), the subspecies' range (as derived from published and unpublished literature) defined the outer boundary. Approximate subspecies boundaries are represented by smoothed lines. Where subspecies boundaries are known, they are represented by the more detailed Accounting Unit boundaries.

4. In a few cases, flycatcher breeding sites were more closely related (from geographic, ecological, and management perspectives) to nearby sites in a neighboring Recovery or Management Unit than to other sites (typically quite distant) in their own Hydrologic Accounting Unit. In such cases, Recovery or Management Unit boundaries were altered. In one case, a breeding site along the lower Gila River near its confluence with the Colorado River was assigned to the Colorado River Recovery Unit, even though the site is physically located within the Gila Recovery Unit. This decision was made because the site was geographically close to other ecologically similar Colorado River sites, and very distant from all other Gila sites. In another case, a site in the upper Canadian River drainage in New Mexico, part of the Mississippi River system, was included with nearby Sangre de Cristo Mountains sites in the Rio Grande Recovery Unit.

2. Management Units

Within each Recovery Unit, Management Units were delineated following the same general decision process, but were based on watershed or major drainage boundaries at the HUC Cataloging Unit level. Cataloging Units are the fourth and smallest level in the hierarchy of hydrologic units. They may be a geographic area representing part or all of a surface drainage basin, a combination of drainage basins, or a distinct hydrologic feature. Most Management Units identified here are Cataloging Units. In some cases, a single (usually large) Cataloging Unit was divided into multiple Management Units, based on (a) local small-scale drainages, or (b) distinct geographic or man-made features (e.g., confluences, smaller watersheds, dams). In other cases, two Cataloging Units were combined to form one Management Unit: (a) based on the distribution and abundance of occupied flycatcher habitat; (b) where no flycatcher breeding sites exist in one of the Cataloging Units; and (c) where watershed divisions were indistinct. As with Recovery Units, the "outer" boundaries of some Management Units were defined by the flycatcher's range boundaries.

Using this approach, the Service defines six Recovery Units, each with four to seven Management Units (Tables 7 and 8, also Figures 4 through 11. Management actions (e.g., urban development, water withdrawal, grazing, mining) occurring within a particular Recovery Unit or Management Unit, or even outside the subspecies' range, may have an impact farther downstream within a nearby Unit. Managers must understand the watershed properties "upstream" in order to decide whether a particular action may have an impact elsewhere within the range of the subspecies. Conversely, managers throughout and "upstream" of the flycatcher's range must consider the downstream effects their actions may have, within an adjacent Recovery or Management Unit. This necessitates ecosystem and watershed management approaches to evaluating threats to, and developing recovery actions for, the flycatcher.

Table 7. Recovery Units and Management Units for the southwestern willow flycatcher. See also Figures 4 through 10.

Recovery Unit	Management Units
Coastal California	Santa Ynez, Santa Clara, Santa Ana, San Diego
Basin and Mojave	Owens, Kern, Amargosa, Mojave, Salton
Upper Colorado	San Juan, Powell
Lower Colorado	Little Colorado, Middle Colorado, Virgin, Pahranagat, Hoover - Parker, Bill Williams, Parker - Southerly International border
Gila	Upper Gila, San Francisco, Middle Gila/San Pedro, Santa Cruz, Roosevelt, Verde, Hassayampa/Agua Fria, Lower Gila
Rio Grande	San Luis Valley, Upper Rio Grande, Middle Rio Grande, Lower Rio Grande, Texas, Pecos

3. Recovery Unit Descriptions

Following are general descriptions of the location of each Recovery Unit, and selected characteristics of the known flycatcher breeding sites associated with each Unit. Data regarding the number and location of flycatcher territories, and their habitat and management characteristics, represent the best available information *at this time* (See also Figures 5-11and Tables 8-9). Because (a) no Recovery Unit has received 100% survey coverage, (b) flycatcher numbers vary annually at each site, and (c) other site characteristics change over time, the values reported below will change with each survey year and as new information becomes available.

Coastal California

This unit stretches along the coast of southern California from just north of Point Conception south to the Mexico border. There are 186 known flycatcher territories in this Recovery Unit (19% of the rangewide total), distributed along 15 relatively small watersheds, mostly in the southern third of the Recovery Unit. Most breeding sites are small (<5 territories); the largest populations are along the San Luis Rey, Santa Margarita, and Santa Ynez rivers. All territories occur in native or native-dominated habitats; over 60% are on government (Federal, State, and/or local) managed lands.

Basin and Mojave

This unit is comprised of a broad geographic area including the arid interior lands of southern California and a small portion of extreme southwestern Nevada. The 69 known flycatcher territories (7% of the rangewide total) are distributed among five widely-separated drainages. Almost all sites have <5 territories; the largest populations occur in the Kern and Owens river drainages. All territories are in native or native-dominated riparian habitats, and approximately 70% are on privately-owned lands.

Upper Colorado

This unit covers much of the Four-corners area of southwestern Colorado, southern Utah, northeastern Arizona, and northwestern New Mexico. The northern boundary of this unit is delineated by the northern range boundary of the flycatcher. Ecologically, this may be an area of intergradation between the southwestern willow flycatcher and the Great Basin form. Flycatchers are known to breed at only four sites in this unit, with only three flycatcher territories (<1% of the rangewide total) documented as of the most recent surveys. However, these low numbers of known flycatchers are probably a function of the relatively low survey effort in this unit, rather than an accurate reflection of the bird's numbers and distribution. Much willow habitat occurs along drainages throughout this Recovery Unit, and remains to be surveyed. All occupied sites occur in native (willow) habitats between 1,400 to 2,420 m elevation.

Lower Colorado River

This is a geographically large and ecologically diverse Recovery Unit, encompassing the Colorado River and its major tributaries, from Glen Canyon Dam downstream to the Mexico border. Despite its size, the unit includes only 146 known flycatcher territories (15% of the rangewide total), most of which occur away from the mainstem Colorado River. Most sites include <5 territories; the largest populations (most of which are <10 territories) are found on the Bill Williams, Virgin, and Pahranagat drainages. Approximately 69% of territories are found on government-managed lands, and 8% on

Tribal lands. Habitat characteristics range from purely native (including high-elevation and low-elevation willow) to exotic (primarily tamarisk) dominated stands.

Gila

This unit includes the Gila River watershed, from its headwaters in southwestern New Mexico downstream to near the confluence with the Colorado River. The 454 known flycatcher territories (46% of the rangewide total) are distributed primarily on the Gila and lower San Pedro rivers. Many sites are small (<5 territories), but sections of the upper Gila River and lower San Pedro River (including its confluence with the Gila River), and the inflows to Roosevelt Lake, support larger sites. Private lands host 50% of territories, including one of the largest known flycatcher populations, in the Cliff-Gila Valley, New Mexico. Approximately 50% of the territories are on government-managed lands. Although 58% of territories are in native-dominated habitats, flycatchers in this Recovery Unit make extensive use of exotic (77 territories) or exotic-dominated (108 territories) habitats (primarily tamarisk).

Rio Grande

This unit encompasses the Rio Grande watershed from its headwaters in southwestern Colorado downstream to the Pecos River confluence in southwestern Texas, although no flycatcher breeding sites are currently known along the Rio Grande in Texas. Also included is the Pecos River watershed in New Mexico and Texas (where no breeding sites are known) and one site on Coyote Creek, in the upper Canadian River watershed. The majority of the 128 territories (13% of the rangewide total) are found along the Rio Grande itself. Only three sites contain more than 5 territories. Most sites are in native-dominated habitats; exotic-dominated sites include primarily tamarisk or Russian olive. Of 56 nests that have been described in the middle and lower Rio Grande in New Mexico, 43 (77%) used tamarisk as the nest substrate. Government-managed lands account for 63% of the territories in this unit; Tribal lands support an additional 23%.

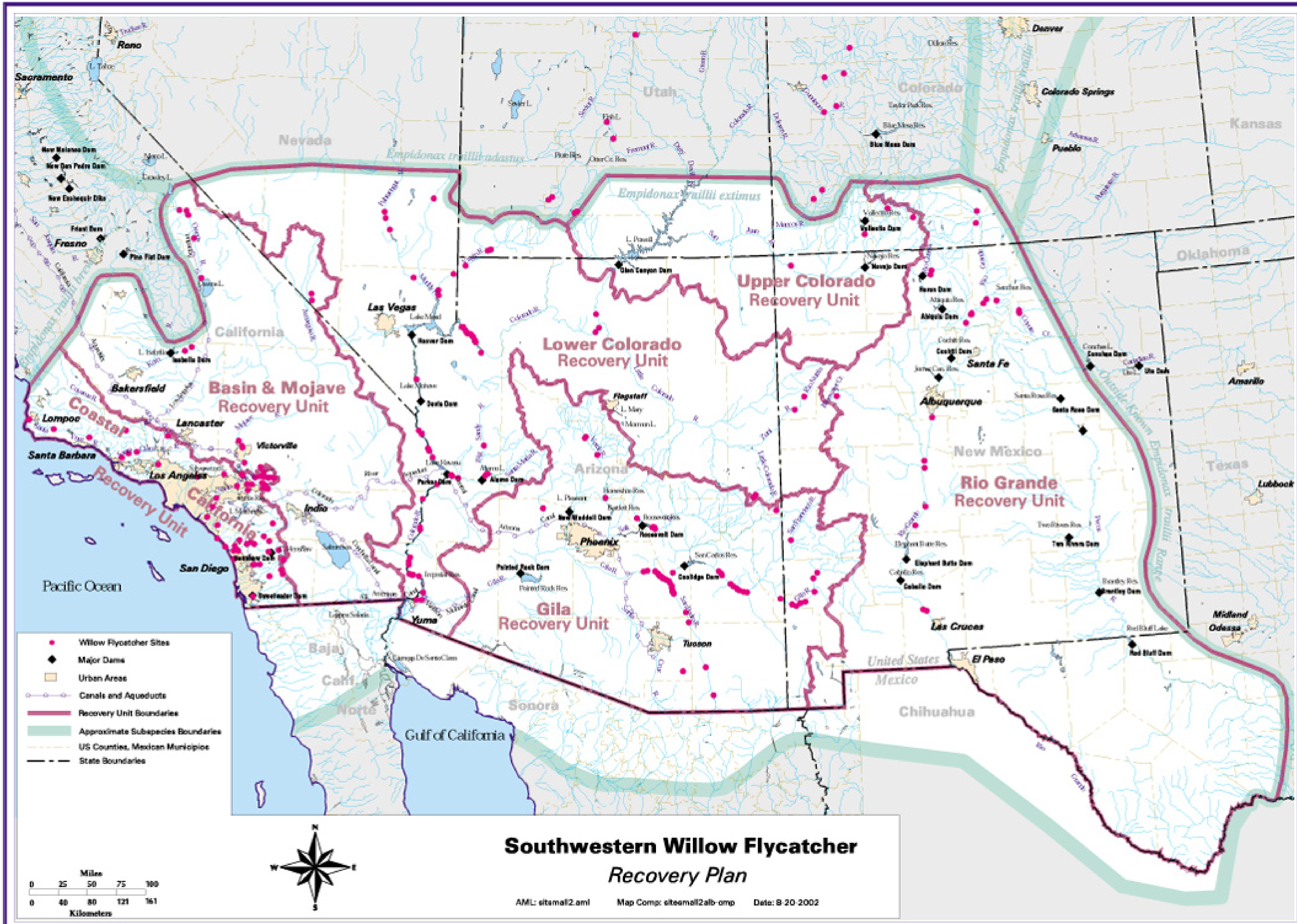


Figure 3. Breeding range of the southwestern willow flycatcher

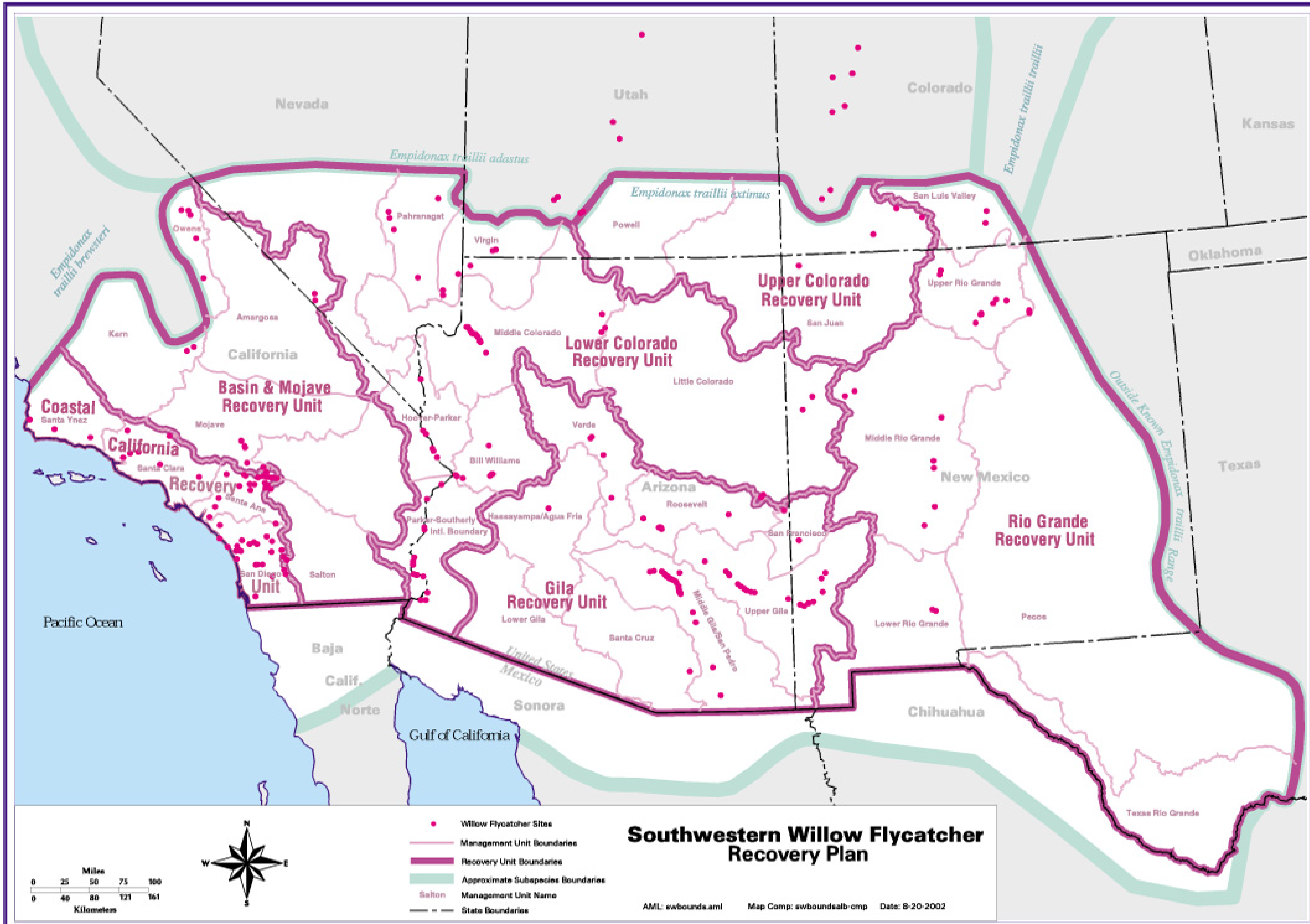


Figure 4. Recovery and Management Units for the southwestern willow flycatcher

Figure 5. Coastal California Recovery Unit

Figure 6. Basin & Mojave Recovery Unit

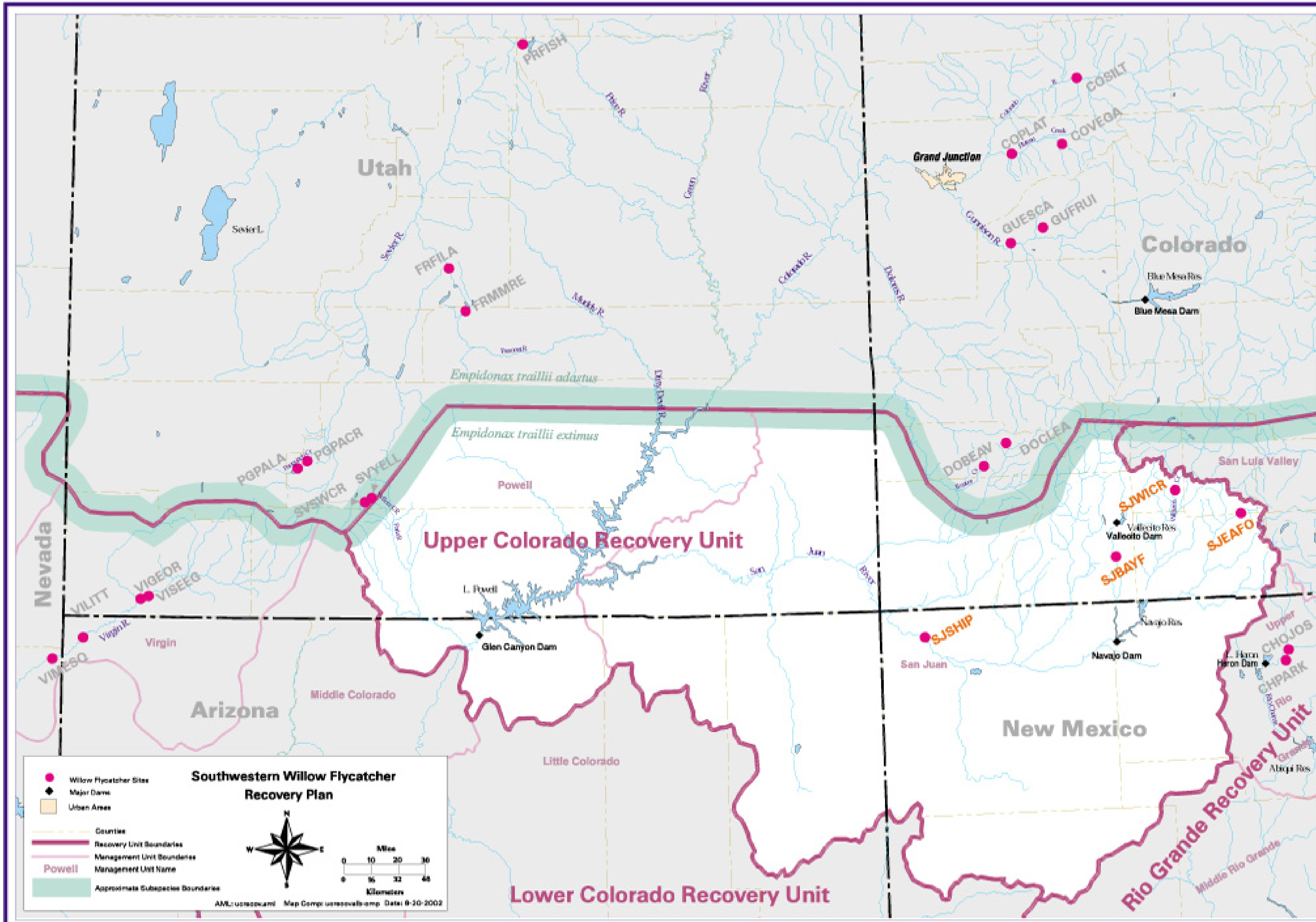


Figure 7. Upper Colorado Recovery Unit

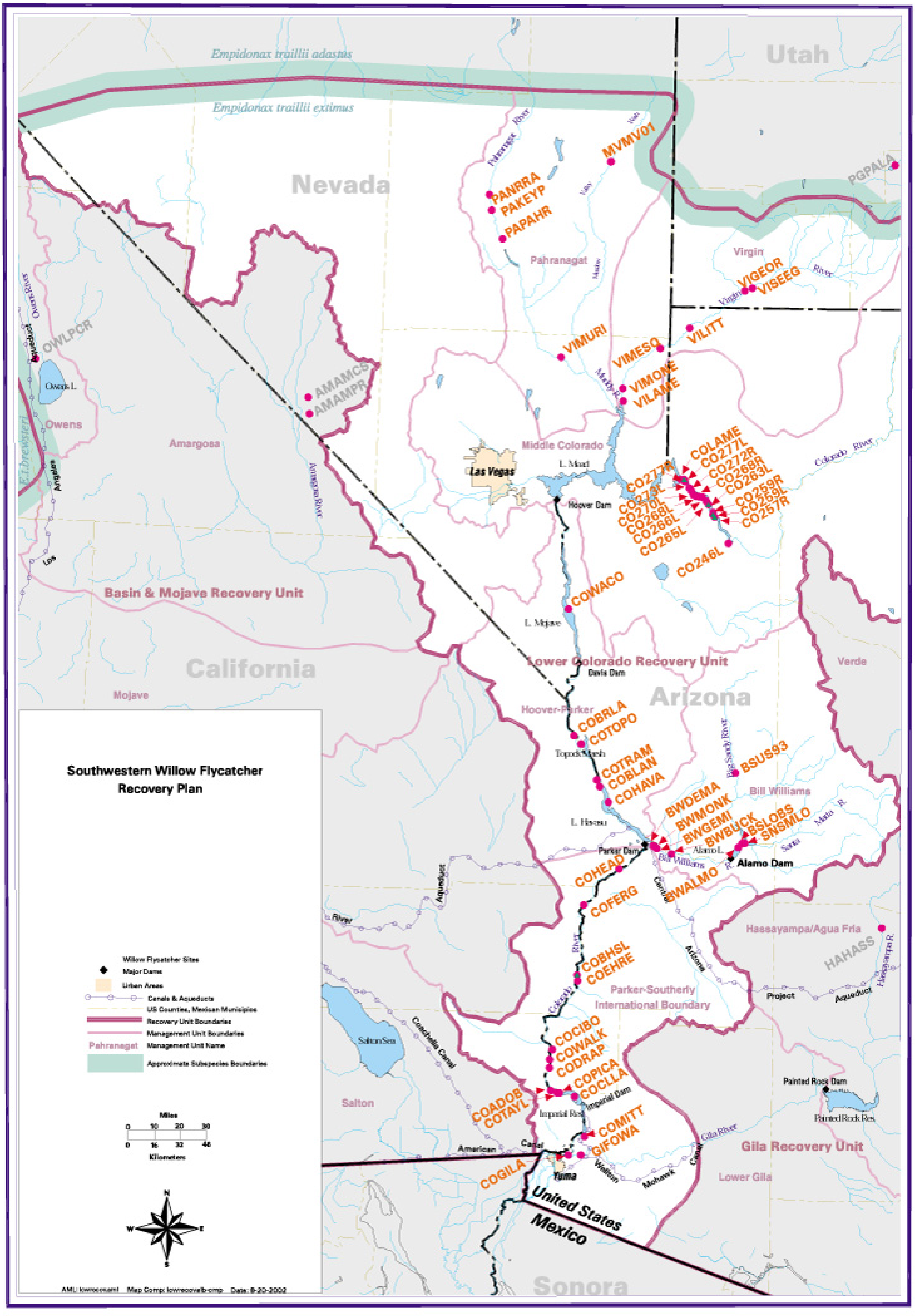


Figure 8. Lower Colorado Recovery Unit, western part

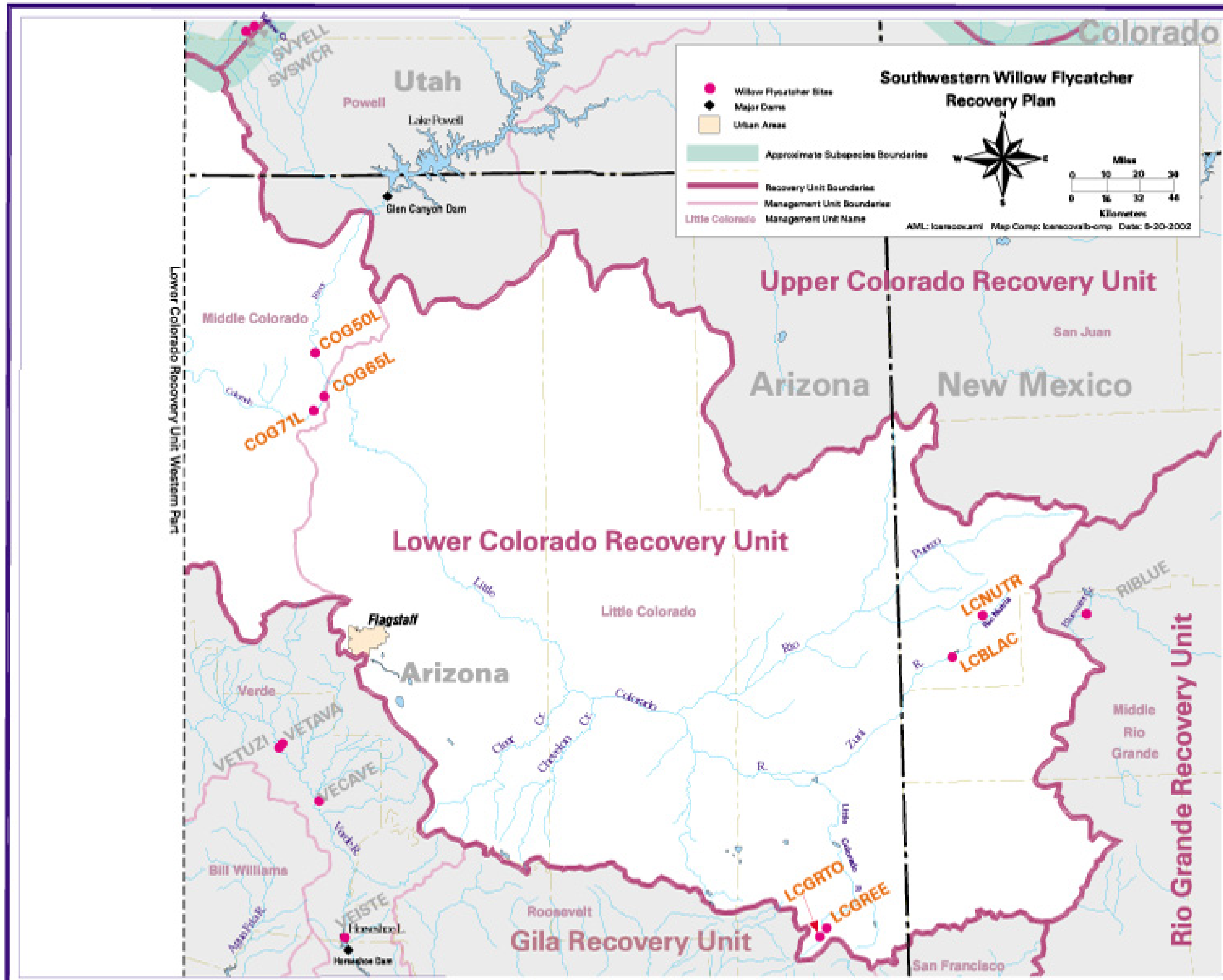


Figure 9. Lower Colorado Recovery Unit, eastern part

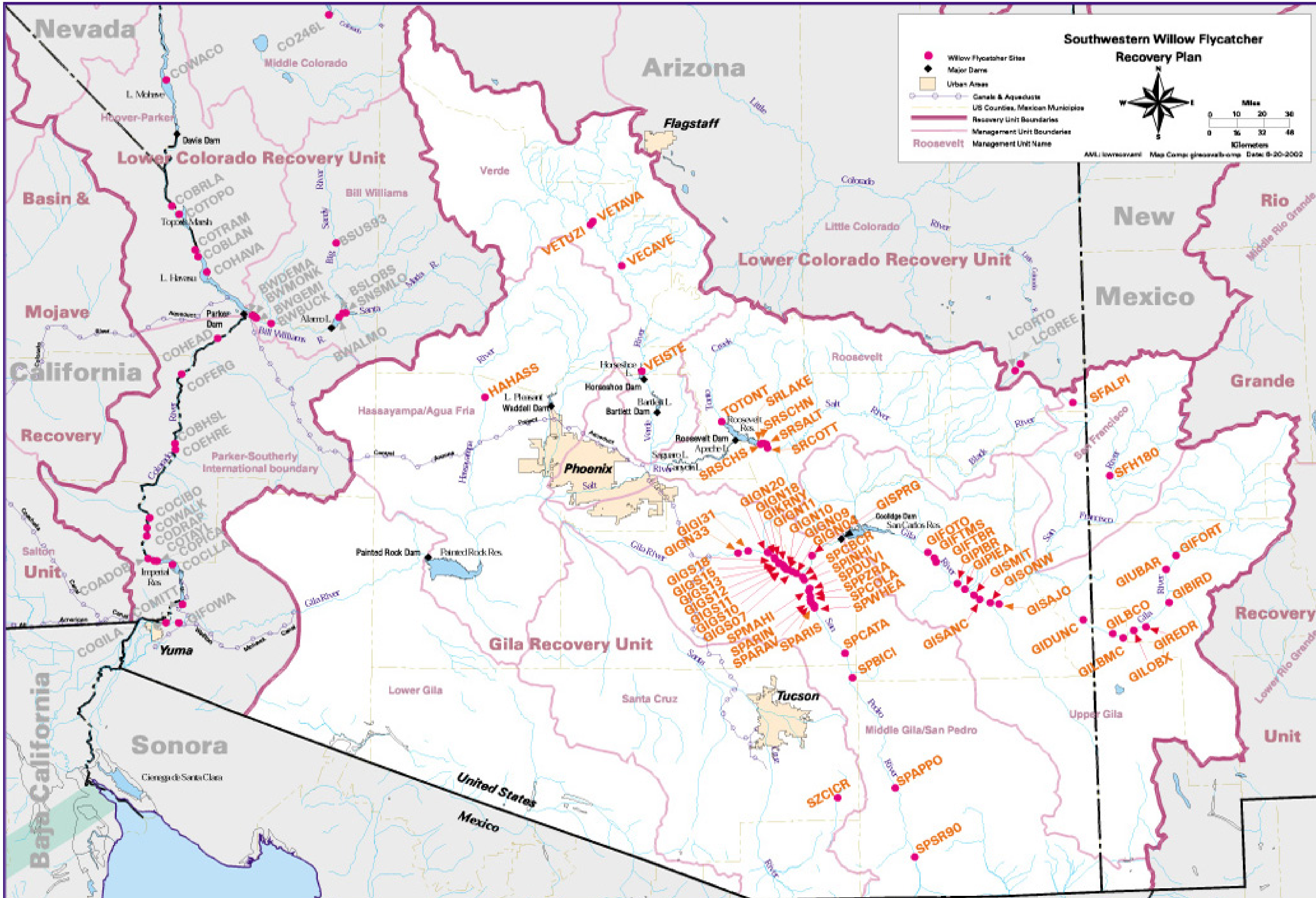


Figure 10. Gila Recovery Unit

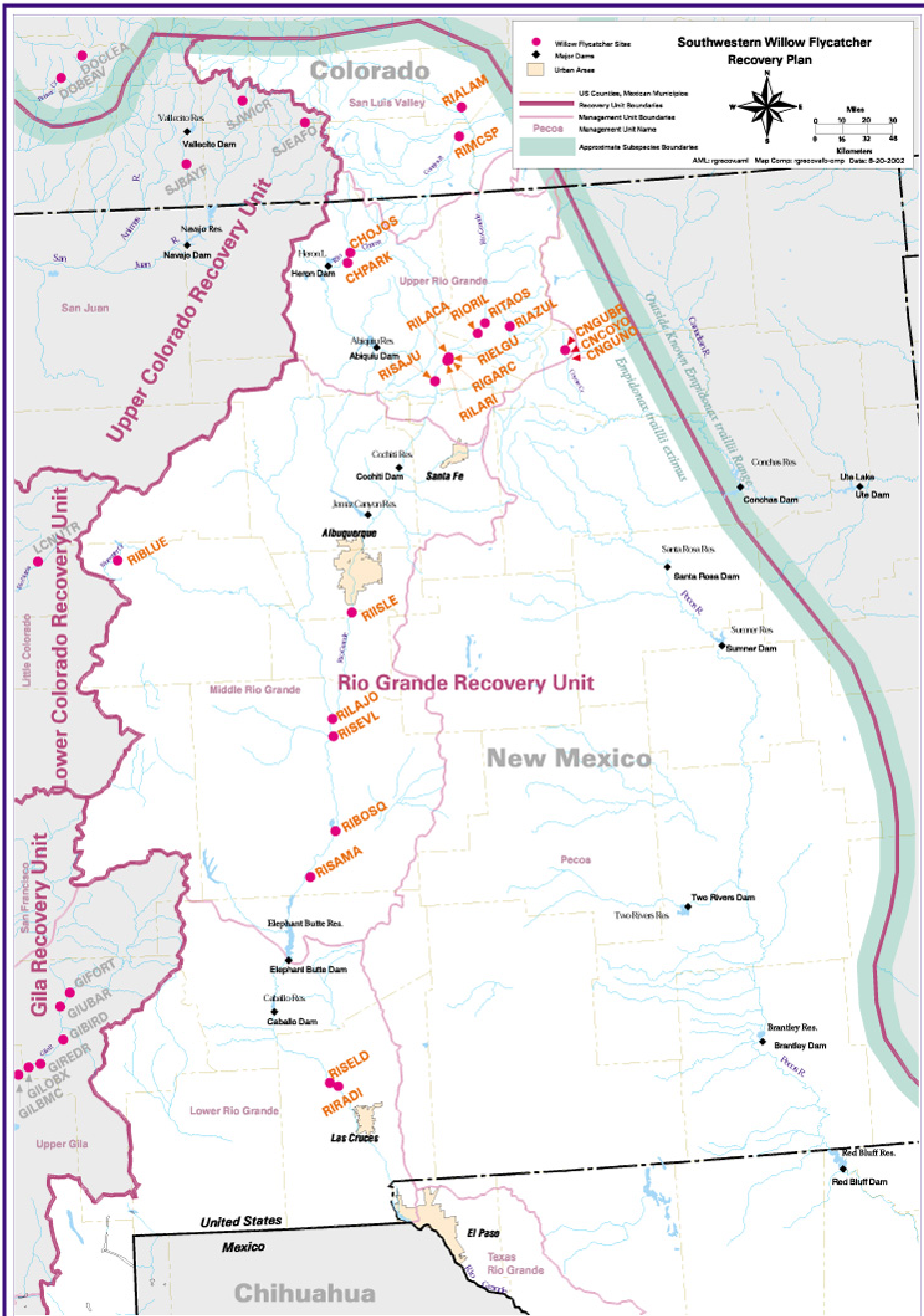


Figure 11. Rio Grande Recovery Unit

Table 8. Southwestern willow flycatcher site codes and names, by Recovery Unit. Site codes match those shown in figures 5 - 11.

Recovery Unit	Site Code	Site Name
Coastal California	AHMACA	Agua Hedionda - Macario Canyon
	LFLAFL	Las Flores Creek
	SACIEN	Santa Ana River - Cienega Seca
	SADAYC	Santa Ana River - Day Canyon
	SAJNKS	Santa Ana River - Jenk's Meadow
	SALACA	Santa Ana River - La Cadena to Waterman
	SAMILL	Santa Ana River - Mill Creek
	SAPRAD	Santa Ana River - Prado Basin
	SARTSN	Santa Ana River - Rattlesnake Creek
	SASNTI	Santa Ana River - San Timoteo Creek
	SASNCR	Santa Ana River - Sand Creek
	SAWACR	Santa Ana River - Waterman Creek
	SASTCR	Santa Ana River - Strawberry Creek
	SAMTNH	Santa Ana River - Mtn. Home Village
	SAOAGL	Santa Ana River - Oak Glen
	SAGRTH	Santa Ana River - Greenspot Thicket
	SAFOFA	Santa Ana River - Forest Falls
	SA38BC	Santa Ana River - SR 38 Bridge Cross
	SAMECR	Santa Ana River - Metcalf Creek
	SABANN	Santa Ana River - Banning Canyon
	SAVDCA	Santa Ana River - Van Dusen Canyon
	SADEER	Santa Ana River - Deer Creek
	SABEAR	Santa Ana River - Bear Creek
	SABAUT	San Jacinto River - Bautista Canyon
	SDSADI	San Dieguito River
	SDTICA	Santa Ysabel Creek - Tim's Canyon
	SDBATT	Santa Ysabel Creek- Battlefield
	SLCOUS	San Luis Rey River - Couser Canyon
	SLGUAJ	San Luis Rey River - Guajome Lake
	SLPILG	San Luis Rey River - Pilgrim Creek
	SLSLUP	San Luis Rey River - Upper
	SLAGTI	San Luis Rey River - Agua Tibia
	SLACCR	San Luis Rey River - Agua Caliente
	SLPALA	San Luis Rey River - Pala
	SLI5CO	San Luis Rey River - I5 to College
	SLCI15	San Luis Rey River - College to I15
	SMCAPE	Santa Margarita River - Camp Pendelton
	SMFALL	Santa Margarita River - Fallbrook Creek
	SGLALA	San Diego Creek - Laguna Lakes
	SDELCA	San Diego River - El Capitan
	SDWHPA	San Diego River - William Heise Park
	SOSMCR	San Mateo Creek
	STSAPA	Santa Clara River - Santa Paula
	STSATI	Santa Clara River - Saticoy
	STSFCR	Santa Clara River - San Francisquito Creek
	STUPPI	Santa Clara River - Upper Piru Creek
	STSOCA	Santa Clara River - Soledad Cyn
	STFILL	Santa Clara River - Fillmore Fish Hatchery
	SBSAGA	San Gabriel River
	SUCAGO	San Juan Creek - Canada Gobernadora
	SYBUEL	Santa Ynez River - Buellton

Table 8. Southwestern willow flycatcher site codes and names, by Recovery Unit. Site codes match those shown in figures 5 - 11.

Recovery Unit	Site Code	Site Name
Coastal California, cont.	SYGIBR	Santa Ynez River - Gibralter
	SYVAND	Santa Ynez River - Vandenberg AFB
	SWCUYA	Sweetwater Creek - Cuyamaca Lake
	SWSWRE	Sweetwater Creek - Sweetwater Reservoir
	TEAGUA	Temecula Creek - Aguanga
	TEOAKG	Temecula Creek - Oak Grove
Basin & Mojave	AMAMCS	Ash Meadows National Wildlife Refuge - Carson Slough
	AMAMPR	Ash Meadows National Wildlife Refuge - Point of Rocks
	MOLBRS	Holcomb Creek - Little Bear
	KECANE	Kern River - Canebrake Preserve
	KEKERN	Kern River - Kern River Preserve
	MOMOFR	Mojave River -Mojave Forks
	MOORGR	Mojave River - Oro Grande
	MOUPNA	Mojave River - Upper Narrows
	MOVICT	Mojave River - Victorville I-15
	OWBIGP	Owen's River - Big Pine
	OWCHBL	Owen's River - Chalk Bluff to 5 Bridges
	OWHWY6	Owen's River - Hwy 6
	OWLPCR	Owen's River - Lone Pine Creek
	OWPOLE	Owen's River - Poleta Road
	SESAFE	San Felipe Creek - San Felipe
Upper Colorado	SJSHIP	San Juan River - Shiprock
	SJWICR	San Juan River - Williams Creek Reservoir
	SJBAYF	San Juan River - Bayfield
	SJEAFO	San Juan River - East Fork (Piano Creek)
Lower Colorado	BSLOBS	Big Sandy River, Lower
	BSUS93	Big Sandy River - US 93
	BWALMO	Bill Williams River - Alamo Lake
	BWBUCK	Bill Williams River - Buckskin
	BWDEMA	Bill Williams River - Delta Marsh Edge
	BWGEMI	Bill Williams River - Gemini
	BWMONK	Bill Williams River - Monkey's Head
	COBHSL	Colorado River - Big Hole Slough
	COADOB	Colorado River - Adobe Lake
	COBLAN	Colorado River - Blankenship
	COBRLA	Colorado River - BR Lagoon
	COCIBO	Colorado River - Cibola Lake
	COCLLA	Colorado River - Clear Lake
	CODRAP	Colorado River - Draper Lake
	COEHRE	Colorado River - Ehrenberg
	COFERG	Colorado River - Ferguson Lake
	COGILA	Colorado River - Gila Confluence
	COHAVA	Colorado River - Lake Havasu - Neptune
	COHEAD	Colorado River - Headgate Dam
	COLAME	Colorado River - Lake Mead Delta
	COMITT	Colorado River - Mittry Lake
	COPICA	Colorado River - Picacho East (Is. Lk)
	COTAYL	Colorado River - Taylor Lake

Table 8. Southwestern willow flycatcher site codes and names, by Recovery Unit. Site codes match those shown in figures 5 - 11.

Recovery Unit	Site Code	Site Name
Lower Colorado, cont.	COTOPO	Colorado River - Topock Marsh
	COTRAM	Colorado River - Trampas Wash
	COWACO	Colorado River - Waterwheel Cove
	COWALK	Colorado River - Walker Lake
	COG50L	Colorado River - Grand Canyon RM 50-51 L
	COG65L	Colorado River - Grand Canyon RM 65.3 L
	COG71L	Colorado River - Grand Canyon RM 71 L
	CO246L	Colorado River - Grand Canyon RM 246 L
	CO257R	Colorado River - Grand Canyon RM 257.5 - 257.0 R
	CO259R	Colorado River - Grand Canyon RM 259 R
	CO259L	Colorado River - Grand Canyon RM 259.5 L
	CO263L	Colorado River - Grand Canyon RM 263-262
	CO265L	Colorado River - Grand Canyon RM 265-263L
	CO266L	Colorado River - Grand Canyon RM 266 L
	CO268R	Colorado River - Grand Canyon RM 268-264 R
	CO268L	Colorado River - Grand Canyon RM 268-265 L
	CO270L	Colorado River - Grand Canyon RM 270-268 L
	CO272R	Colorado River - Grand Canyon RM 272-268 R
	CO273L	Colorado River - Grand Canyon RM 273-270 L
	CO277L	Colorado River - Grand Canyon RM 277-273 L
	CO277R	Colorado River - Grand Canyon RM 277-274 R
	GIFOWA	Gila River - Fortuna Wash
	LCBLAC	Zuni/Black Rock
	LCNUTR	Zuni/Nutria Diversion Reservoir
	LCGREE	Little Colorado - Greer River Reservoir
	LCGRTO	Little Colorado - Greer Township
	MVMVO1	Meadow Valley Wash - Site 1
	PAKEYP	Key Pittman Wildlife Management Area
	PAPAHR	Pahranagat Lake National Wildlife Refuge
	PANRRA	Pahranagat River - North River Ranch
	SNSMLO	Santa Maria River, Lower
	VILAME	Virgin River Delta - Lake Mead
	VILITT	Virgin River - Littlefield
	VIGEOR	Virgin River - St. George
	VIMOME	Virgin River - Mormon Mesa
	VIMURI	Muddy River Delta - Overton Wildlife Area
	VISEEG	Virgin River - Seegmiller
Gila	GIBIRD	Gila River - Bird Area
	GIDUNC	Gila River - Duncan
	GIFORT	Gila River - Fort West Ditch
	GIFOTO	Gila River - Fort Thomas, Geronimo
	GIGN04	Gila River - GRN004
	GIGN09	Gila River - GRN009
	GIGN10	Gila River - GRN010
	GIGN11	Gila River - GRN011
	GIGN18	Gila River - GRN018
	GIGN20	Gila River - GRN020 (Kelvin Bridge)
	GIGN33	Gila River - GRN033
	GIGI31	Gila River - GRSN031
	GIGS07	Gila River - GRS007

Table 8. Southwestern willow flycatcher site codes and names, by Recovery Unit. Site codes match those shown in figures 5 - 11.

Recovery Unit	Site Code	Site Name
Gila, cont.	GIGS10	Gila River - GRS010
	GIGS11	Gila River - GRS011
	GIGS12	Gila River - GRS012
	GIGS13	Gila River - GRS013
	GIGS15	Gila River - GRS015
	GIGS18	Gila River - GRS018
	GIKRNY	Gila River - Kearny Sewage Ponds
	GILBCO	Gila River - Lower Box, Cottonwood
	GILOBX	Gila River - Lower Box
	GILBMC	Gila River - Lower Box; Main Canyon
	GIFTBR	Gila River - Fort Thomas Bridge
	GIFTMS	Gila River - Fort Thomas MS
	GIPIBR	Gila River - Pima Bridge
	GIPIEA	Gila River - Pima East
	GIREDR	Gila River - Redrock
	GISAJO	Gila River - San Jose
	GISANC	Gila River - Sanchez Road
	GISMIT	Gila River - Smithville Canal
	GISONW	Gila River - Solomon NW
	GISPRG	Gila River - Dripping Springs Wash
	GIUBAR	Gila River - U Bar Ranch
	HAHASS	Hassayampa River Preserve
	SFALPI	San Francisco Creek - Alpine Horse Pasture
	SFH180	San Fransisco River - Hwy 180
	SPAPPO	San Pedro River - Apache Powder Rd
	SPARAV	San Pedro River - Aravaipa Cr Confluence
	SPARIN	San Pedro River - Aravaipa Inflow North
	SPCBCR	San Pedro River - CB Crossing
	SPCOLA	San Pedro River - Cooks Lake
	SPDUVI	San Pedro River - Dudleyville Crossing
	SPINHI	San Pedro River - Indian Hills
	SPMAHI	San Pedro River - Malpais Hill
	SPPZRA	San Pedro River - PZ Ranch
	SPSR90	San Pedro River - SR 90
	SPWHEA	San Pedro River - Wheatfields
	SPARIS	San Pedro River - Aravaipa Inflow South
	SPBICI	San Pedro River - Bingham Cienega
	SPCATA	San Pedro River - Catalina Wash
	SZCICR	Santa Cruz River - Cienega Creek
	SRCOTT	Salt River - Cottonwood Acres I
	SRSALT	Salt River Inflow - Roosevelt Lake
	SRLAKE	Salt River Inflow - Roosevelt Lake; Lakeshore
	SRSCHN	Salt River - School House Point North
	SRSCHS	Salt River - School House Point South
	TOTONT	Tonto Creek Inflow - Roosevelt Lake
	VECAVE	Verde River - Camp Verde
	VEISTE	Verde River - Ister Flat
	VETAVA	Verde River - Tavasci Marsh
	VETUZI	Verde River - Tuzigoot Bridge

Table 8. Southwestern willow flycatcher site codes and names, by Recovery Unit. Site codes match those shown in figures 5 - 11.

Recovery Unit	Site Code	Site Name
Rio Grande	CHOJOS	Los Ojos Highway 95 Bridge
	CHPARK	Parkview Fish Hatch
	CNCOYO	Coyote Creek
	CNGUBR	Coyote Creek - Guadalupita Bridge
	CNGUNO	Coyote Creek - Guadalupita North
	RIALAM	Alamosa National Wildlife. Refuge
	RIAZUL	Tierra Azul (Rio Grande del Rancho)
	RIBLUE	Bluewater Creek
	RIBOSQ	Rio Grande - Bosque del Apache
	RIELGU	Rio Grande - Velarde-El Guique
	RIGARC	Rio Grande - Velarde-Garcia Acequia
	RIISLE	Rio Grande - Isleta
	RILACA	Rio Grande - Velarde-La Canova Acequia
	RILARI	Rio Grande - Velarde-La Rinconada
	RILAJO	Rio Grande - La Joya
	RIMCSP	McIntire Springs (Conejos River)
	RIORIL	Rio Grande - Orilla Verde
	RIRADI	Rio Grande - Radium Springs
	RISAJU	Rio Grande - San Juan Pueblo Bridge
	RISAMA	Rio Grande - San Marcial
	RISELD	Rio Grande - Selden Canyon
	RISEVL	Rio Grande - Sevilleta National Wildlife Refuge
	RITAOS	Rio Grande - Taos Junction Bridge
Outside currently known range of *E.t. extimus*		
	COPLAT	Colorado River - Plateau Creek
	COVEGA	Colorado River - Vega Reservoir
	COSILT	Colorado River - Silt
	DOBEAV	Dolores River - Beaver Creek
	DOCLEA	Dolores River - Clear Creek
	FRFILA	Fremont River - Fish Lake
	FRMMRE	Fremont River - Mill Meadow Reservoir
	GUESCA	Gunnison River - Escalante State Wildlife Area
	GUFRUI	Gunnison River - Fruit Growers Reservoir
	PGPACR	Panguitch Creek - Panguitch Creek
	PGPALA	Panguitch Creek - Panguitch Lake
	PRFISH	Price River - Fish Creek (above Scofield Reservoir)
	SVSWCR	Sevier River - Swamp Creek - Bryce Canyon National Park
	SVYELL	Sevier River - Yellow Creek - Bryce Canyon National Park

4. Population Viability Analysis

A population viability analysis (PVA), conducted to provide guidance for setting recovery objectives, was composed of two parts: a demographic analysis (Noon and Farnsworth 2000) and an incidence function analysis (Lamberson et al. 2000). Following is a brief summary of the most relevant PVA results.

Demographic analysis

The demographic analysis identifies the life history aspect (fecundity, juvenile survival, adult survival) that has the greatest effect on population growth. The model concluded that management focused on increasing fecundity (number of fledglings per female), followed closely by first year survival, will have the most influence on increasing the population (Noon and Farnsworth 2000). Analysis was based primarily on data from the Kern River in California (Whitfield unpubl. data, 1989–1999), with comparisons from some Arizona populations (Paxton et al. 1997, Netter et al. 1998). The demographic analysis was limited by the unavailability of long-term reproductive data at most sites, therefore results may not be applicable across the entire range of the bird.

Incidence Function Analysis

The incidence function analysis (Hanski 1994, Lamberson et al. 2000), which estimates population persistence over time within an existing network of occupied willow flycatcher sites, was based on data from 143 sites surveyed between 1994 - 1998 (USGS, unpubl. data). Separate models were developed for each of the six Recovery Units, assuming each may function as a metapopulation. A metapopulation is a group of spatially disjunct local willow flycatcher populations connected to each other by immigration and emigration. Results showed that the status of the southwestern willow flycatcher varies geographically. Metapopulations are most stable where many connected sites and/or large populations exist (Coastal California, Gila, Rio Grande Recovery Units). The model results predict greatest stability when sites can be established <15 km apart, each with 10 - 25 territories. Sites <15 km apart assures a high likelihood of connectivity. Once a threshold of about 25 territories/site is reached, the benefit of increasing the number of birds diminishes. Instead, metapopulation persistence (stability) is more likely to increase by adding more sites rather than adding more territories to existing sites. In addition to maximizing the colonization potential of sites within the metapopulations, this risk-spreading strategy reduces the likelihood that catastrophic events (e.g. fire, flood, disease) will negatively impact all sites.

In establishing population targets for recovery, the Technical Subgroup strove to identify a distribution and abundance of flycatchers that would minimize the distance between populations, connect isolated sites to other breeding populations, and increase population sizes to achieve metapopulation stability. The goal of the Recovery Plan is to assure long-term persistence of the species throughout its range, rather than maximize the number of birds or achieve historical pre-European settlement population levels.

Incidence Function Model Limitations

Although the incidence function model provided some insight into the current status of each metapopulation, it has some limitations. The main limitations are summarized below:

1) If the maximum number of territories detected in any one year between 1994 - 1998 does not truly represent each site in a dynamic colonization-extinction equilibrium, the model results will overestimate or underestimate occupancy rates. Equilibrium at many sites is unknown, because the number of territories varies annually.

2) Differences in how sites are designated can make a difference in model output. For example, what is considered a single large site in one drainage might be treated as several small sites at another. The model calculates greater enhancement potential (increase in population) for small sites near each other than for one large site of the same area and the same number of birds.

3) Insufficient survey effort or absent data may be responsible for low occupancy rates for some metapopulations (Basin and Mojave, Upper Colorado, Lower Colorado). Additional data have been collected at new and existing sites since the population viability analysis was conducted.

4) The incidence function analysis does not include catastrophic events. However, they were simulated in separate analyses by increasing and decreasing number of territories in all or a subset of sites within a metapopulation.

5) The model can underestimate the enhancement and colonization potential of a site because it assumes all sites are known and does not allow for colonization of new areas. New areas continue to be colonized or discovered.

6) It is unknown whether parameters derived from a subset of populations (Gila and Rio Grande Recovery Units) to calculate constants relating extinction and colonization probabilities to patch size and migration rates are applicable rangewide.

7) A rangewide analysis, pooling all data, was not conducted because of the absence of evidence that flycatchers belong to a single large metapopulation.

Therefore, the model should not be used to:

1) estimate the number of territories needed for population persistence. Instead, model recommendations for distance between sites and number of birds/site were used to develop the number of territories needed for recovery.

2) make predictions about persistence for more than five years into the future, especially if there are significant changes in pattern of site occupancy, site area, or costs to dispersal among sites.

3) predict extinction and recolonization rates of individual sites. Annual variation in number of territories/site, site inconsistencies in site designations, and inability of the model to allow for colonization of new sites limit the model's ability to predict site-specific events. Instead, model results were assessed at the metapopulation level.

5. Approach to Identifying Recovery Criteria

Within the Recovery Units and Management Units, the next issues to address are how many flycatchers are needed, and in what geographical distribution, to achieve recovery. The following text summarizes the USFWS' approach in determining recovery criteria (goals).

Rationale for Downlisting Criteria

The recovery criteria identified below and in Table 9 were developed based on information in published and unpublished sources including the population viability analysis (Lamberson et al. 2000, Noon and Farnsworth 2000), and the Technical Subgroup's collective knowledge and information relating to: distribution of current and potential flycatcher nesting areas; flycatcher dispersal and settlement patterns; and information on genetic variation and exchange.

The central points used in developing recovery criteria for downlisting were:

1. Territory is the unit of measure. Southwestern willow flycatchers are a territorial species, where males select and defend exclusive breeding territories in which they attempt to attract a mate and breed. Because it can be difficult to determine whether a particular male is paired with a female, the Service selected "territory" as the unit of measure for recovery goals (rather than "pairs"), recognizing that overall one territory generally equates to two flycatchers (one male and one female).

2. Populations should be distributed throughout the bird's range. Southwestern willow flycatcher populations should be geographically distributed throughout the bird's range in order to provide for sustainable metapopulations, minimize risk of simultaneous catastrophic loss, and avoid genetic isolation of breeding groups.

3. Populations should be distributed close enough to each other to allow for movement. Flycatcher populations should be spaced so that there is a likelihood of movement of individuals between populations, providing for genetic exchange and recolonization of other sites in the same and other Recovery Units. Therefore, breeding populations should be distributed among different Management Units within a Recovery Unit.

4. Large populations contribute most to metapopulation stability. Large populations (>10 territories), centrally located, contribute most to metapopulation stability, especially if other breeding populations are nearby. Such populations persist longer than small ones, and produce more dispersers emigrating to other populations or

colonizing new areas.

5. Smaller populations can contribute to metapopulation stability when arrayed in a matrix with high connectivity. Within a Management Unit or portion thereof, a matrix of smaller populations may provide as much or more stability than a single isolated population with the same number of territories because of the potential to disperse colonizers throughout the network of sites.

6. As the population of a site increases, the potential to disperse and colonize increases. As number of territories in a population increases, the potential to colonize nearby areas also increases, although in a non-linear fashion. Based on preliminary PVA data, the rate of increase in colonization potential (likelihood that birds will emigrate to new or existing sites) as population size increases is greatest between 4-10 territories, is less steep above 10 territories, and flattens out completely above 25 territories. Thus, numerically small increases in small populations may have a disproportionately large effect on colonization potential, and may be more beneficial than adding the same small number of territories to a large site, particularly when sites are close together. Therefore, 25 territories is used as a minimum recovery goal for each Management Unit. Where more than the minimum number (25) of territories is desired (because of habitat potential, isolation, and/or contribution to metapopulation stability), goals are set in multiples of 25. Spatial distribution within some of these Management Units is not specified, but it is likely that flycatchers will occupy more than one site within a Management Unit. Therefore, a Management Unit with a recovery goal of 25 territories could be distributed as one or several sites with varying distances between sites. Twenty-five territories distributed among several sites within close proximity to one another may function ecologically as one large site.

7. Increase/decrease in one population affects other populations. In functioning metapopulations, increases or decreases in one population may affect other populations. Thus, it is important to meet and maintain recovery objectives in each Recovery and Management Unit, each of which may influence adjacent units.

8. Some Recovery/Management Units have stable metapopulations; others do not. Some Recovery Units and/or Management Units currently have large and well distributed populations such that, with continued appropriate management, recovery goals for these units can be met and maintained. Other units require large increases in the number and distribution of breeding populations.

9. Maintaining/augmenting existing populations is a greater priority than allowing loss and replacement elsewhere. Maintaining and augmenting existing breeding populations is a faster, easier, and more reliable way to achieve and maintain population goals than to allow loss of existing populations with the hopes of replacement elsewhere. Thus, maintenance and protection of existing breeding populations is a priority.

10. Establishing habitat close to existing breeding sites increases the chance of colonization.

11. Additional survey effort is critically needed in some Management Units. Recent survey data are limited

or absent in some parts of the flycatcher's range, even regarding the presence of suitable flycatcher breeding habitat. Therefore, additional survey effort is most critically needed in Recovery Units and Management Units where recent survey efforts have been minimal or absent (e.g., portions of the Basin and Mojave, Upper Colorado, and Lower Colorado Recovery Units). These surveys will determine if flycatchers and/or breeding habitat are present, and to what degree they may be contributing to local populations and/or metapopulation stability.

In developing specific downlisting criteria, a methodology was sought that would produce an increase in the total number of individuals and of occupied sites sufficient to minimize the chances of extinction over the course of several centuries or more. Although there is a great deal of uncertainty in any assessment of population stability, there is general agreement among ecologists and conservation biologists that large populations are more secure than small ones. Just how large a population has to be to have a minimal chance of extinction over a long time period depends on many factors but those that have a size of 2,000 to 5,000 individuals are generally considered secure if their habitat is protected and obvious threats are removed (Haig et al. 1993, Pulliam and Dunning 1994, Lande 1995, Hanski et al. 1996, Wiens 1996). Populations in this size range are unlikely to be affected seriously, in the short-term at least (several thousand years), by random events such as genetic drift and demographic stochasticity (consecutive years with poor reproduction, heavily skewed sex ratios, etc.).

A population of 2,000 to 5,000 can still be devastated or even extinguished by catastrophic events, but for populations distributed over a large range, such as the flycatcher's, no single natural catastrophe or even several co-occurring natural catastrophes would likely cause the extinction of the entire taxon. Each flycatcher Recovery Unit occupies so large an area that catastrophes are unlikely to impact even all of the flycatchers within a unit. Nevertheless, catastrophes, whose effects are nearly impossible to model, could affect most individuals in Recovery Units where large proportions of territories are in the same Management Unit, river reach, or site.

Given these various uncertainties, the Technical Subgroup decided the best course was to determine goals for both the number of territories and the number of separate populations in each Recovery Unit. Rather than assume that a minimum overall population of X number of individuals is needed (based on conservation biology theory), the Technical Subgroup considered every Management Unit where flycatchers now occur, or could potentially occur given feasible management actions, and developed population targets (based on a minimum of, and multiples of, 25 territories). Population goals differed among some Management Units. Targets for Management Units centrally located within a particular Recovery Unit were sometimes higher than for less centrally located units. Goals were set higher for some Management Units with a greater potential for development or improvement of flycatcher habitat than for those with limited potential. If a Management Unit currently supports more than 25 territories, the goal for that unit was set *no lower than the current population level.* Thus, the recovery goals maintain *at least* the current number of territories in each Management Unit (and hence, each Recovery Unit).

It was assumed, a priori, that any substantial increase in overall flycatcher numbers projected by this method would result in a substantially decreased probability of extinction (given current data on persistence of flycatcher populations and current theory on metapopulations). With this method, the Technical Subgroup arrived at an overall target population of about 1,950 territories, which is an approximate doubling of the roughly 990 territories now documented to exist. These 1,950 territories infer a population size of about 3,900 individuals, assuming that most territories include monogamous pairs. Thus the current recovery goal of 1,950 territories is within the theoretical "secure range" of a population size of 2,000 to 5,000 individuals (approximately 1,000 to 2,500 territories).

B. Recovery Objectives and Criteria

1. Recovery Objectives

The overall recovery objective for the flycatcher is to attain a population level and an amount and distribution of habitat sufficient to provide for the long-term persistence of metapopulations, even in the face of local losses (e.g., extirpation). This requires that the threats that led to listing the flycatcher as an endangered species are ameliorated. The specific objectives are to recover the southwestern willow flycatcher to the point that it warrants reclassification to "threatened" status, and then further to the point where it is removed from the list of threatened and endangered species. The estimated date for downlisting is 2020. The estimated date for delisting is 2030.

2. Recovery Criteria

The recovery criteria (or goals) to achieve the above objectives are presented in the following discussion. These recovery criteria will be re-evaluated at least once every 5 years, and may be modified in the future in light of new scientific or technical information.

Reclassification: from Endangered to Threatened

There are two alternative sets of criteria that will allow for reclassifying the southwestern willow flycatcher from endangered to threatened. Neither set of criteria equate to achieving approximate historical, pre-European settlement population levels. Reclassification can occur if either set of criteria are met.

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.* Specific reclassification/downlisting criteria for each Recovery and Management Unit are presented in Table 9.

Each Management Unit must meet and hold *at least 80%* of its minimum population target, yet each Recovery Unit must at least meet its goal, as listed in Table 9. Therefore, if one Management Unit targeted for 50 territories reaches 40 territories, its shortage of 10 territories may be offset by a overage of 10 territories in another Management Unit *within that same Recovery Unit*. This flexibility is based on the fact 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 rangewide 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.

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, listed in Table 9. 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 rangewide goal of 1,500 territories, some Recovery Units will need to exceed 75% of their goals.

The habitats supporting these flycatchers must be provided sufficient protection 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. USFWS must be satisfied that the agreements provide adequate protection and/or enhancement of habitat.

****

By providing two sets of criteria, the USFWS 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 towards 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 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 (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.

Removal from the Federal Endangered Species List

The following criteria must be achieved to remove the southwestern willow flycatcher from the Federal list of threatened and endangered species:

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, as presented in Table 9.

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 land acquisition agreements for private lands, and inter-governmental conservation agreements with Tribes. The flycatcher may be considered for

delisting when (a) the USFWS 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 5 years prior to delisting.

The current distribution of flycatcher breeding populations includes public, private, and Tribal lands in at least six of the seven States comprising its historical range. Given the dynamic nature of Southwestern riverine systems, 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 of this bird, it is likely that a network of conservation areas 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 (page 78) and presented in Table 9.

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. 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, within each Management Unit, double the amount of breeding habitat needed to support the target number of flycatchers 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 (Appendix D), a patch has an average of 1.1 (± 0.1 SE) ha 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) 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 (50 territories x 1.1 ha 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 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 were higher or lower for a given Management Unit, the amount of breeding habitat required, within that unit, to meet delisting criteria 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 (see Section II. C. 3; Patch Size and Shape); this situation inhibits recovery. Following the central points identified under the Rationale for Downlisting Criteria (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 acres) (see Section II. C. 3; Patch Size and Shape). Alternatively, along the lower San Pedro River and nearby Gila River confluence, smaller, occupied habitat patches with an average nearest-neighbor distance of approximately 1.5 km (USGS unpubl. data; Appendix D) show substantial between-patch movement by flycatchers (English et al. 1999, Luff et al. 2000) 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) within management units and/or to minimize the distance between smaller occupied patches so that they function ecologically as a larger patch.

Measures To Minimize Take and Offset Impacts

To ensure achievement of recovery criteria, the following guidelines apply to designing projects, while minimizing impacts to the southwestern willow flycatcher.

1) Research, monitoring and survey projects should be used to evaluate the efficacy of measures intended to minimize or reduce impacts from project-related effects, but should not be used to offset actions that may result in loss, fragmentation, or modification of designated critical habitat, or areas not officially designated but that contain occupied habitat, or potential habitat.

2) Cowbird trapping should not be used to offset actions that may result in loss, fragmentation, or modification of designated critical habitat, occupied habitat, or potential habitat. Rather, cowbird control should be implemented at a site only after data collection shows that at least 20-30% of flycatcher nests are parasitized for two or more successive years as described in Section IV.E.; Narrative Outline for Recovery Actions.

3) All efforts should focus on preventing loss of flycatcher habitat. However, where occupied, unoccupied suitable, or unoccupied potential habitat is to be lost, modified, fragmented, or otherwise degraded, habitat should be replaced, permanently protected and managed within the same Management Unit. All efforts should strive to acquire, protect, restore and manage compensation habitat prior to project initiation. Recent research explores adequate replacement of both the land area and functional values of riparian and other wetland systems (National Research Council 2001, Wilson and Mitsch 1996, Briggs et al. 1994). Field data collected at flycatcher sites show that currently-suitable habitat patches on free flowing rivers occupy up to 20% of the floodplain in any given year and change in spatial location over time (Stromberg et al, 1997; Hatten and Paradzick, in review). Given the flycatcher's endangered status and typically small population sizes, there is a high degree of uncertainty as to whether flycatchers will colonize compensation habitat. There also is uncertainty regarding the comparability of ecological values between affected lands and compensation lands and regarding the long-term success of compensation lands. Given these uncertainties and the available data, specific analyses must be conducted on a project-by-project basis to determine the amount of compensation habitat required to approach no net loss. For instance, a relatively high compensation ratio may be required if the affected habitat has a higher than average population density; if the habitat has been occupied consecutively over the long-term; if the habitat contains a large population [>25 territories]; or if compensation lands are not proximate to affected habitat or metapopulation.

4) Permanent habitat loss, modification, or fragmentation resulting from agency actions should be offset with habitat that is permanently protected, including adequate funding to ensure the habitat is managed permanently for the protection of the flycatcher.

5) Habitat loss, modification, or fragmentation on Federal lands should not be offset with protection of Federal lands that would otherwise qualify for protection if the standards set forth in the Recovery Plan or other agency guidance were applied to those lands.

6) Areas slated for protection as a means of offsetting impacts should be identified using existing documents that have evaluated habitat conservation priorities rangewide (e.g., USBR 1999c); and should be conserved based on the following priorities: (1) occupied, unprotected habitat; (2) unoccupied, suitable habitat that is currently unprotected; (3) unprotected, potential habitat.

7) Modifying or converting occupied habitat dominated by exotic vegetation to habitat dominated by native vegetation does not constitute reduction or minimization of effects.

8) Occupied habitat is considered occupied year-round for project-related effects that degrade habitat quality.

Table 9. Recovery Criteria, by Recovery and Management Units: Minimum number of southwestern willow flycatcher territories needed to achieve reclassification to Threatened. Values for current number of known territories are based on the most recent available survey data for all breeding sites known to be occupied for at least one year between 1993 and 2001.

Recovery Unit	Management Unit	Current Number of Known Territories	Minimum Number of Territories for Reclassification
Coastal California	Santa Ynez	33	75
	Santa Clara	13	25
	Santa Ana	39	50
	San Diego	101	125
	Recovery Unit Total	**186**	**275**
Basin & Mojave	Owens	28	50
	Kern	23	75
	Amargosa	3	25
	Mojave	13	25
	Salton	2	25
	Recovery Unit Total	**69**	**200**
Upper Colorado	San Juan	3	25
	Powell	0	25
	Recovery Unit Total	**3**	**50**
Lower Colorado	Little Colorado	6	50
	Middle Colorado	16	25
	Virgin	40	100
	Pahranagat	34	50
	Hoover - Parker	15	50
	Bill Williams	32	100
	Parker - Southerly International Boundary	3	150
	Recovery Unit Total	**146**	**525**

Table 9, Continued. Recovery Criteria, by Recovery and Management Units: Minimum number of southwestern willow flycatcher territories needed to achieve reclassification to Threatened. Values for current number of known territories are based on the most recent available survey data for all breeding sites known to be occupied for at least one year between 1993 and 2001.

Recovery Unit	Management Unit	Current Number of Known Territories	Minimum Number of Territories for Reclassification
Gila	Upper Gila	187	325
	San Francisco	3	25
	Middle Gila/San Pedro	120	150
	Santa Cruz	1	25
	Roosevelt[1]	140	50
	Verde	3	50
	Hassayampa/Agua Fria	0	25
	Lower Gila	0	0
	Recovery Unit Total	**454**	**625**
Rio Grande	San Luis Valley	34	50
	Upper Rio Grande	37	75
	Middle Rio Grande	51	100
	Lower Rio Grande	6	25
	Texas	0	0
	Pecos	0	0
	Recovery Unit Total	**128**	**250**
	Rangewide Total	***986***	***1,950***

[1] This net reduction in the number of territories in the Roosevelt Management Area is based on the expected inundation of habitat resulting from increasing the surface elevation of Roosevelt Reservoir. The target for minimum number of territories will be re-evaluated after 5 years.

Table 10. Specific river reaches, within Management Units, where recovery efforts should be focused. Substantial recovery value exists in these areas of currently or potentially suitable habitat. Additional reaches may also contribute toward recovery goals.

Recovery Unit	Management Unit	Reach
Coastal California	Santa Ynez	Santa Ynez River from headwaters and tributaries to Pacific Ocean (CA)
	Santa Clara	Santa Clara River from Bouquet Canyon Road to Pacific Ocean (CA)
		Ventura River from Matilaja Hot Springs to Pacific Ocean (CA)
		Piru Creek from headwaters to Santa Clara River (CA)
		San Francisquito Creek from 3 miles upstream of Drinkwater Reservoir to Drinkwater Reservoir (CA)
		Soledad Canyon from Soledad Campground to Agua Dulce (CA)
		Big Tujunga Creek (CA)
		San Gabriel River from San Gabriel Reservoir to Santa Fe Flood Control Basin (CA)
	Santa Ana	Santa Ana River and its tributaries from headwaters on the San Bernardino National Forest to Prado Flood Control Basin Dam, including Waterman Creek, City Creek, Thurman Flats, Bautista Creek, and Day Canyon (CA)
		Mill Creek, San Bernardino National Forest (CA)
		Bear Creek and its tributaries to Santa Ana River, San Bernardino National Forest, including Van Dusen Canyon – Caribou Creek, Big Bear Lake, and Metcalf Creek (CA)
		San Timoteo Creek and its tributaries on the San Bernardino National Forest to Santa Ana River (CA)
		San Gorgonio Creek at Sawmill Canyon (part of Banning Canyon) (CA)
		San Diego Creek from Interstate Route 405 to Lake Forest Drive, including Laguna Lakes (CA)

Table 10. Specific river reaches, within Management Units, where recovery efforts should be focused. Substantial recovery value exists in these areas of currently or potentially suitable habitat. Additional reaches may also contribute toward recovery goals.

Recovery Unit	Management Unit	Reach
	San Diego	San Juan Creek Watershed, including Canada Gobernadora and Trabuco Creek (CA)
		San Mateo Creek from San Mateo Road crossing to Pacific Ocean (CA)
		San Onofre Creek from below Camp Horno to Pacific Ocean (CA)
		Las Flores Creek from Basilone Road to Pacific Ocean (CA)
		Fallbrook Creek from the Naval Weapons Station boundary to Santa Margarita River (CA)
		Santa Margarita River from confluence with DeLuz Creek to Pacific Ocean (CA)
		DeLuz Creek from De Luz Road to Santa Margarita River (CA)
		Temecula Creek from Oak Grove to Dripping Springs (CA)
		Pilgrim Creek from Vandegrift Road to confluence with San Luis Rey River (CA)
		San Luis Rey from Lake Henshaw Dam to Interstate Route 5, including Whelan Lake and Guajome Lake (CA)
		Agua Hediodonda from State Route 11 to Pacific Ocean (CA)
		San Diego River from 1 km north of Cedar Creek (32.999925 N, 116.3097 W, WGS 84) to El Capitan Reservoir (CA)
		San Dieguito River from Battlefield State Historic Park to Interstate Route 15 (CA)
		San Diego River from Magnolia Avenue to Mission Trails (CA)
		Sweetwater River from Rancho San Diego Golf course to Sweetwater Reservoir (CA)
		Tijuana River from Dairy Mart Road to Tijuana River Estuary (CA)

Table 10. Specific river reaches, within Management Units, where recovery efforts should be focused. Substantial recovery value exists in these areas of currently or potentially suitable habitat. Additional reaches may also contribute toward recovery goals.

Recovery Unit	Management Unit	Reach
Basin & Mojave	Owens	Owens River and tributaries from below Pleasant Valley Reservoir to Owens Lake (CA)
	Kern	South Fork Kern River from Canebrake Ecological Preserve to Rabbit Island and south to T26 S R34 E NE 1/4 Section 19 (CA)
	Amargosa	Ash Meadows National Wildlife Refuge (NV)
		Amargosa River from Spanish Trail Highway to T19N R7E N ½ Section 10 (CA)
	Mojave	Deep Creek from its headwaters to Mojave Forks Dam (CA)
		Mojave River from Spring Valley Lake to Bryman (CA)
		West Fork of the Mojave River from its headwaters to Mojave Forks Dam (CA)
	Salton	San Felipe Creek from San Felipe to Hwy 78 (CA)
Upper Colorado	San Juan	Los Pinos River from Vallecito Reservoir to LaBoca (CO)
		Animas River from Bodo State Wildlife Area to Colorado/New Mexico State line (CO)
		San Juan River from Malpais Arroyo one mile upstream to one mile downstream, near Shiprock (NM)
		San Juan River from two river miles upstream from State Route 262 bridge at Montezuma Creek (T41S R24E Section 3) to Chinle Creek (UT)
		East Fork of the San Juan River from Silver Creek to Treasure Creek (CO)
		San Juan River from West Fork confluence to Navajo River (CO)
	Powell	Tributaries to the Sevier River on the Markagunt Plateau (UT)
		Paria River from confluence with Cottonwood Wash (T41S R1W Section 20) to Highway 89 (T43S R1W Section 4) (UT)

Table 10. Specific river reaches, within Management Units, where recovery efforts should be focused. Substantial recovery value exists in these areas of currently or potentially suitable habitat. Additional reaches may also contribute toward recovery goals.

Recovery Unit	Management Unit	Reach
Lower Colorado	Little Colorado	Rio Nutria from Nutria Diversion Dam to confluence with Zuni River (NM)
		Zuni River from confluence with Nutria River (NM) to Arizona / New Mexico State line
		Nutrioso Creek from T7N R30E Section 9 north to Apache-Sitgreaves National Forest boundary (AZ)
		Little Colorado River from the diversion ditch at T8N R28E Section 16 upstream to Forest Road 113 on the West Fork (T7N R27E Section 33), upstream to Forest Road 113 on the East Fork (T6N R27E Section 10), and upstream to Joe Baca Draw on the South Fork (T8N R28E Section 34) (AZ)
		Little Colorado River from Springerville to St. Johns (AZ)
		Chevelon Creek from Gauging Station in T18N R27E Section 23 to confluence with Little Colorado River, including Chevelon Creek Wildlife Area (AZ)
	Middle Colorado	Colorado River from Spencer Canyon (river mile 246) to Lake Mead delta (AZ)
		Kanab Creek from one river mile north of confluence with Red Canyon (T42S R2W Section 5) (UT) to Colorado River (AZ)
	Virgin	Santa Clara River from Pine Valley to Virgin River (UT)
		North Fork of the Virgin River from Telephone Canyon in Zion National Park (T40S R10W Section 34) to East Fork of the Virgin River (T42S R10W Section 5) (UT)
		Virgin River from Rockville to Beaver Dam Wilderness Area (T43S R16W Section 29) (UT)
		Virgin River from Littlefield (AZ) to Lake Mead delta (NV)
	Pahranagat	Pahranagat River from Key Pittman Wildlife Management Area through Pahranagat National Wildlife Refuge to Maynard Lake (NV)
		Meadow Valley Wash from Caliente to Lincoln / Clark County line (NV)
		Muddy River from headwaters to Interstate Route 15 (NV)

Table 10. Specific river reaches, within Management Units, where recovery efforts should be focused. Substantial recovery value exists in these areas of currently or potentially suitable habitat. Additional reaches may also contribute toward recovery goals.

Recovery Unit	Management Unit	Reach
	Pahranagat (cont.)	Muddy River from Overton Wildlife Management Area to Lake Mead (NV)
	Hoover - Parker	Waterwheel, Pot, and Cottonwood Valley coves on Lake Mojave (AZ, CA)
		Colorado River in Havasu National Wildlife Refuge from river mile 245 to 213, including Topock Marsh (AZ, CA)
	Bill Williams	Big Sandy River from Wikieup to 4 miles south of U.S. Route 93 bridge (AZ)
		Big Sandy River from 5 miles north of the confluence with the Santa Maria River to Alamo Lake (AZ)
		Santa Maria River at Palmerita Ranch (AZ)
		Santa Maria River from Date Creek to Alamo Lake (AZ)
		Bill Williams River from Centennial Wash to confluence with Colorado River (AZ)
	Parker - Southerly International Border	Colorado River from Headgate Dam to Southerly International Border, including Cibola and Imperial National Wildlife Refuges, agricultural districts, and agricultural leases (AZ, CA)
		Confluence of Gila and Colorado rivers (AZ)
		Wellton-Mohawk Irrigation and Drainage District on Gila River (AZ)
Gila	Upper Gila	Eagle Creek from Honeymoon to the boundary of Apache-Sitgreaves National Forest and San Carlos Indian Reservation (AZ)
		Gila River from Mogollon Creek (NM) to Duncan (AZ)
		Gila river from Bonita Creek to Coolidge Dam (AZ)
	San Francisco	San Francisco River from junction of Forest Road 249 and U.S. Route 191 (AZ) to the confluence of Centerfire (NM)
		San Francisco River from Deep Creek (upstream from U.S. Route 180 bridge) to San Francisco Hot Springs (NM)

Table 10. Specific river reaches, within Management Units, where recovery efforts should be focused. Substantial recovery value exists in these areas of currently or potentially suitable habitat. Additional reaches may also contribute toward recovery goals.

Recovery Unit	Management Unit	Reach
	San Francisco (cont.)	San Francisco River from the Arizona / New Mexico border in T2S R32E to west boundary of Apache-Sitgreaves National Forest T3S R30E (AZ)
		Blue River from Dry Blue Creek to San Francisco River (AZ)
		Tularosa River from Apache Creek to San Francisco River (NM)
	Middle Gila / San Pedro	San Pedro River from international border to St. David (AZ)
		San Pedro River from The Narrows (near Pomerene) to Winkelman (AZ)
		Gila River from Winkelman to Kelvin Bridge (AZ)
	Santa Cruz	Santa Cruz River from Nogales Wastewater Treatment Plant to Chavez Siding Road (AZ)
		Cienega Creek from Empire Ranch to Pantano Road (AZ)
	Roosevelt	West Fork of Black River from West Fork Campground east to crossing at Forest Road 25
		West Fork of Black River near Thompson Ranch, T6N R27E Sections 25, 26, 36
		East Fork of Black River from Deer Creek to Buffalo Crossing
		Tonto Creek from Gisela to Roosevelt Lake (AZ)
		Roosevelt Lake (AZ)
		Salt River from State Route 88 to Roosevelt Lake (AZ)
	Verde	Verde River from Sycamore Canyon to confluence with Salt River (AZ)
	Hassayampa / Agua Fria	Hassayampa River from State Route 60 bridge in Wickenburg to San Domingo Wash (AZ)
		Gila River from Salt River to Gillespe Dam (AZ)
	Lower Gila	No reaches identified due to upstream diversions.

Table 10. Specific river reaches, within Management Units, where recovery efforts should be focused. Substantial recovery value exists in these areas of currently or potentially suitable habitat. Additional reaches may also contribute toward recovery goals.

Recovery Unit	Management Unit	Reach
Rio Grande	San Luis Valley	Rio Grande and tributaries within the San Luis Valley from Baxterville (CO) to the Colorado/New Mexico State line, including Alamosa National Wildlife Refuge
		Conejos River from Fox Creek to the Rio Grande (CO)
	Upper Rio Grande	Chama River from U.S. Routes 64/84 (bridge below town of Chama) to El Vado Reservoir (NM)
		Rio Grande from Taos Canyon (Taos Junction bridge on State Route 520) to Otowi Bridge (State Route 502) (NM)
		Rio Grande del Rancho from confluence of Sarco Canyon to confluence of Arroyo Miranda (NM)
		Coyote Creek in the vicinity of Coyote Creek State Park (NM)
	Middle Rio Grande	Rio Grande from Interstate Route 25 bridge at Exit 213 – 215 to Elephant Butte Dam (NM)
		Bluewater Creek from headwaters to Bluewater Dam (NM)
	Lower Rio Grande	Rio Grande from Elephant Butte Dam (NM) to New Mexico / Texas State line
	Texas	No reaches identified
	Pecos	No reaches identified

C. Recovery Implementation Oversight

Continuing Duties of the Recovery Team

During the formulation of the Recovery Plan, the Recovery Team consisted of a Technical Subgroup, six regional Implementation Subgroups, and a Tribal Working Group (see Section I. C., page 3). The Technical Subgroup compiled and reviewed scientific information, and developed recovery goals, strategies, and recommended actions. The Implementation Subgroups and the Tribal Working Group met with the Technical Subgroup, reviewed the draft Recovery Plan, and advised the Technical Subgroup as to the feasibility of recovery strategies and actions.

The recovery of the southwestern willow flycatcher will require continued active participation by the Technical Subgroup, Implementation Subgroups, and Tribal Working Group. Each of these groups will play a crucial role in the implementation of this Recovery Plan, as outlined below.

1. Implementation Subgroups. During development of the Recovery Plan, the role of the six Implementation Subgroups of the Southwestern Willow Flycatcher Recovery Team, as discussed in meetings and reiterated in the website-based comment forum hosted by the USFWS' Southwest Region, was to review the species data and recovery needs described by the Technical Subgroup, including the proposed implementation schedule and task priorities, and expand on the implementation schedule to determine alternative methods to accomplish the needed tasks while minimizing costs. Following completion of the Recovery Plan, the Implementation Subgroups will help determine which participants will implement recovery tasks, when, and with what resources, and will work with the USFWS to coordinate accomplishment of these tasks based on their priority. Previous and continuing participation of Implementation Subgroup members in activities of the Southwestern Willow Flycatcher Recovery Team, either in meetings or within the website comment forum, is covered by the recovery team exemption to the Federal Advisory Committee Act.

The Implementation Subgroups will be the focal points for the implementation of the Recovery Plan, and will take on an expanded and central role in flycatcher recovery. Ideally, each Implementation Subgroup will help plan, coordinate, and implement recovery actions within and among the Management Units within it's geographic area. Furthermore, the six Implementation Subgroups will communicate, and where possible coordinate, recovery actions rangewide. Representatives of the Implementation Subgroups will meet annually or biannually with the Technical Subgroup and/or the USFWS' southwestern willow flycatcher recovery coordinators (see below).

Specific functions of the Implementation Subgroups should include the following: (a) promote communication between various local interests within each Management and Recovery Unit; (b) work cooperatively to promote, plan, and initiate recovery actions; (c) provide data to help monitor Recovery Plan implementation within each Recovery Unit, and report problems, successes, and general recovery progress to the USFWS and the Technical Subgroup; and (d) recommend to the Technical Subgroup recovery plan revisions. The Implementation Subgroups will remain active as long as the recovery plan is in place.

2. Tribal Working Group. The responsibilities of the Tribal Working Group will be to: (a) provide the Technical Subgroup with recommendations regarding flycatcher recovery on Tribal lands; (b) facilitate actions (including the development of Memorandums of Agreement or Statements of Relationship with the USFWS) that will contribute to the recovery of the flycatcher; and (c) facilitate flycatcher surveys and monitoring on participating Tribal lands. A Tribal Liaison will participate in all Technical Subgroup meetings and functions. This position will remain active as long as the recovery plan is in place.

3. Technical Subgroup. The Technical Subgroup should continue to meet on an annual basis, in order to: (a) review new survey, monitoring, and research results; (b) monitor the progress of recovery actions; (c) address or clarify scientific or technical issues relating to flycatcher recovery; (d) provide guidance and interpretation to Implementation Subgroups regarding recovery actions and recommendations; and (e) oversee the adaptive management aspects of the plan, including revision of recovery actions and recommendations. Furthermore, the Technical Subgroup will take the lead in updating and revising the Recovery Plan, within 5 years of its adoption. The Technical Subgroup will remain active as long as the recovery plan is in place.

4. Southwestern Willow Flycatcher Recovery Coordinators. Because the recovery of the flycatcher is dependent upon goals and actions across a wide geographic area, across many political boundaries, and involving many different agencies and partners, a southwestern willow flycatcher recovery coordinator should be appointed by each of the three affected USFWS Regions, with lead coordination responsibilities remaining in the Southwest Region. These coordinators would: (a) provide technical assistance to agencies and land owners on such issues as project designs, land owner grant proposals, flycatcher management plan development, and Recovery Plan implementation; (b) promote communication among the various Recovery Units and agencies; (c) monitor range-wide Recovery Plan implementation, and report problems, successes, and general recovery progress to the USFWS and the Technical Subgroup; (d) help coordinate the meetings of the Implementation and Technical Subgroups; and (e) serve as advocates for flycatcher recovery and conservation issues. These positions will remain active as long as the Recovery Plan is in place. At the discretion of USFWS's Regional Directors, coordinators may be appointed and the most appropriate ways to coordinate recovery will be determined.

Centralized Southwestern Willow Flycatcher Information Repository

In order to track recovery progress, it will be important to collect, synthesize, and analyze annual survey and monitoring information from across the flycatcher's range. This is best done as a coordinated effort, by (a) requiring standardized reporting of all southwestern willow flycatcher survey efforts, and (b) managing these data in a centralized database in conjunction with Geographical Information Systems. Such a system has been maintained by the USGS and the BOR, based on information provided by State and Federal agencies, Tribes, and non-governmental organizations. This system should be continued, and updated annually, by the USGS, BOR and/or the USFWS Southwest Region's southwestern willow flycatcher recovery coordinator. Furthermore, annual recovery progress reports should be prepared and made readily available to all interested parties, including dissemination via the USFWS web site.

Adaptive Management

The recovery goals and recommended actions contained in the Recovery Plan are based on the best available scientific data that provide the foundation of our current understanding of southwestern willow flycatcher biology and riparian ecology. Over time, new information and understandings will emerge that will reinforce or revise what we currently know. Also, this Recovery Plan includes certain sections that encourage well-designed studies to answer important questions regarding the response of flycatchers and/or their habitats to various land use practices and regimes, as well as a section specifically identifying needed research (Section IV. F., page 130). It will be important to use adaptive management practices to assure that recovery goals and actions are consistent with these new data, and with any new or improved management tools. Adaptive management is dependent upon timely collection and reporting of information; this is especially true for monitoring data. The Technical Subgroup, Implementation Subgroups, Tribal Working Group, and recovery coordinators will work together to assure that the necessary information is collected, analyzed, and disseminated so that the value and effectiveness of recovery actions can be evaluated and, where needed, goals, actions, and techniques modified.

D. Stepdown Outline of Recovery Actions

The stepdown outline of actions needed to recover the southwestern willow flycatcher is presented below. Individual actions are discussed in the Narrative Outline (Section IV. E.) and in Appendices E through N.

1. Increase and improve currently suitable and potentially suitable habitat.

    1.1. Secure and enhance currently suitable and potentially suitable habitat on Federal lands, lands affected by federal actions, and cooperating non-Federal and Tribal lands.

        1.1.1. Develop management plans to reduce threats and promote processes that secure, restore, and enhance currently suitable and potentially suitable habitat.

        1.1.2. Manage physical elements and processes to reduce threats and promote processes that secure, restore, and enhance currently suitable and potentially suitable habitat.

            1.1.2.1. Restore the diversity of fluvial processes.

                1.1.2.1.1. Identify dams where modification of dam operating rules will benefit recovery of the flycatcher.

                1.1.2.1.2. Identify dams where modification of dam operations will benefit recovery of the flycatcher by taking advantage of system flexibility and water surpluses/flood flows.

                1.1.2.1.3. Determine feasibility of simulating the natural hydrograph to restore/enhance riparian systems.

                1.1.2.1.4. Determine feasibility of managing reservoir levels to establish and maintain lake fringe and inflow habitat.

                1.1.2.1.5. Determine feasibility of using surplus and/or flood flows to increase or add water to marsh areas between levees and on flood plains.

                1.1.2.1.6. Determine feasibility of keeping daily ramping rates and daily fluctuations for dam releases as gradual as possible to prevent bank erosion and loss of riparian vegetation, except when mimicking flood flows.

                1.1.2.1.7. Determine feasibility of augmenting sediment in sediment-depleted systems.

                1.1.2.1.8. Implement 1.1.2.1.3. – 1.1.2.1.7., where determined feasible.

                1.1.2.1.9. Monitor 1.1.2.1.3. – 1.1.2.1.7., and provide feedback to the Technical Subgroup.

            1.1.2.2. Restore adequate hydrogeomorphic elements to expand habitat, favor native over exotic plants, and reduce fire potential.

                1.1.2.2.1. Increase water available for recovery.

                    1.1.2.2.1.1. Increase efficiency of groundwater management to expand habitat, favor native over exotic plants, and reduce fire potential.

1.1.2.2.1.2. Use urban waste water outfall and rural irrigation delivery and tail waters for habitat restoration to expand habitat, favor native over exotic plants, and reduce fire potential.

1.1.2.2.1.3. Provide (reestablish) instream flows to expand habitat, favor native over exotic plants, and reduce fire potential.

1.1.2.2.2. Expand the active channel area that supports currently suitable and potentially suitable flycatcher habitat by increasing the width of levees and using available flows to mimic overbank flow.

1.1.2.2.3. Reactivate flood plains to expand native riparian forests.

1.1.2.2.4. Restore more natural channel geometry (width, depth, bank profiles) where the return of the natural hydrograph will be insufficient to improve habitat.

1.1.2.3. Manage fire to maintain and enhance habitat quality and quantity.

1.1.2.3.1. Develop fire risk and management plans.

1.1.2.3.2. Suppress fires.

1.1.2.3.3. Restore ground water, base flows, and flooding.

1.1.2.3.4. Reduce incidence of flammable exotics.

1.1.2.3.4.1. Manage/reduce exotic species that contribute to increased fire incidence.

1.1.2.3.4.2. Use water more efficiently and reduce fertilizer applications.

1.1.2.3.5. Reduce recreational fires.

1.1.3. Manage biotic elements and processes.

1.1.3.1. Restore biotic interactions, such as herbivory, within evolved tolerance ranges of the native riparian plant species.

1.1.3.1.1. Manage livestock grazing to restore desired processes and increase habitat quality and quantity.

1.1.3.1.1.1. If livestock grazing is a major stressor implement conservative livestock grazing guidelines. Implement general livestock grazing guidelines from Appendix G (see also Section IV. E.; Narrative Outline for Recovery Actions) in occupied, suitable, or potential habitat (potential habitats are riparian systems that have the appropriate hydrologic and ecologic setting to be suitable flycatcher habitat).

1.1.3.1.1.2. Determine appropriate use areas for grazing.

1.1. 3.1.1.3. Reconfigure grazing management units.

1.1.3.1.1.4. Improve documentation of grazing practices.

1.1.3.1.2. Manage wild ungulates.

1.1.3.1.3. Manage keystone species.

1.1.3.2. Manage exotic plant species.

1.1.3.2.1. Develop exotic species management plans.

1.1.3.2.2. Coordinate exotic species management efforts.

1.1.3.2.3. Restore ecosystem conditions that favor native plants.

1.1.3.2.3.1. Eliminate physical stresses, such as high salinity or reduced stream flows, that favor exotic plants.

1.1.3.2.3.2. Create or allow for a river hydrograph that restores the natural flood disturbance regime.

1.1.3.2.3.3. Restore ungulate herbivory to intensities and types under which native plant species are more competitive.

1.1.3.2.4. Retain native riparian vegetation in floodplains or channels.

1.1.3.2.5. Retain exotic species at sites dominated by native riparian vegetation.

1.1.3.2.5.1. At native dominated sites, retain tamarisk in occupied flycatcher habitat and, where appropriate, in suitable but unoccupied habitat, unless there is a trend for steady increase of tamarisk.

1.1.3.2.5.2. If needed, increase habitat quality within stands of exotic plants by implementing restorative actions such as seasonal flooding.

1.1.3.2.6. Remove exotics in occupied, suitable but unoccupied, and potentially suitable habitats dominated by exotics only if: 1) underlying causes for dominance of exotics have been addressed, 2) there is evidence that the exotic species will be replaced by vegetation of higher functional value, and 3) the action is part of an overall restoration plan.

1.1.3.2.6.1. In suitable and potential habitats where exotic species are to be removed through chemical or mechanical means, use a temporally staged approach to clear areas so some suitable or mature habitat remains throughout the restoration period for potential use by flycatchers.

1.1.3.2.6.2. Release habitat-targeted biocontrol agents only outside the occupied breeding range of the flycatcher.

1.1.3.3. Provide areas protected from recreation.

1.1.3.3.1. Reduce impacts from recreationists.

1.1.3.3.2. Confine camping areas.

1.1.3.3.3. Restore habitat impacted by recreation.

1.1.3.3.4. Place designated recreation shooting areas away from riparian areas.

1.1.3.3.5. Minimize attractants to scavengers, predators, and brown-headed cowbirds.

1.1.3.3.6. Provide on-site monitors where recreation conflicts exist.

1.2. Work with private landowners, State agencies, municipalities, and nongovernmental organizations to conserve and enhance habitat on non-Federal lands.

1.2.1. Evaluate and provide rangewide prioritization of non-Federal lands.

1.2.2. Achieve protection of occupied habitats.

1.2.3. Provide technical assistance to conserve and enhance occupied habitats on non-Federal lands.

1.2.4. Pursue joint ventures toward flycatcher conservation.

1.3. Work with Tribes to develop conservation plans and strategies to realize the potential for conservation and recovery on Tribal lands.

1.3.1. Work with Tribes to establish a regular system of surveys and monitoring, and train Tribal staff in the flycatcher survey protocol.

1.3.2. Determine protocols for information sharing.

1.3.3. Maintain an incumbent in the position of Tribal Liaison to the Technical Subgroup.

1.3.4. Provide technical assistance to Tribes that have flycatchers on their lands.

1.3.5. Support Tribal efforts to improve currently suitable and potentially suitable habitat.

1.3.6. Work with Tribes to determine the extent to which Tribal water rights might or might not be available to aid in conservation and recovery of the flycatcher.

1.3.7. Provide aid to Tribes for development of educational programs and opportunities that further flycatcher recovery.

2. Increase metapopulation stability.

2.1. Increase size, number, and distribution of populations and habitat within Recovery Units.

2.1.1. Conserve and manage all existing breeding sites.

2.1.2. Secure, maintain, and enhance largest populations.

2.1.3. Develop new habitat near extant populations.

2.1.3.1. Use existing habitat acquisition/conservation priorities.

2.1.4. Enhance connectivity to currently isolated occupied sites.

2.1.5. Facilitate establishment of new, large populations in areas where none exist, through habitat restoration.

2.1.6. Increase population sizes at small occupied sites.

3. Improve demographic parameters.

3.1. Increase reproductive success.

3.1.1. Manage brown-headed cowbird parasitism after collection of baseline data shows high rates of parasitism.

3.1.1.1. Increase the amount and quality of riparian habitat to increase habitat patch sizes and local flycatcher population sizes thereby minimizing levels and impacts of cowbird parasitism.

3.1.1.2. Develop cowbird management programs if warranted by baseline data on parasitism rates.

3.1.1.3. Implement cowbird management programs if warranted by baseline data on parasitism rates.

3.1.1.4. Pursue long-term landscape objectives for cowbird reduction.

3.1.2. Reduce direct impacts that topple or otherwise destroy nests.

3.1.3. Reconsider assessments of habitat quality or other threats if cowbird control and/or other measures increase reproductive output but not the number of breeding flycatchers.

4. Minimize threats to wintering and migration habitat.

   4.1. Identify, for purposes of protection, riparian habitats in the U.S. that provide essential migration and stopover habitat.

   4.2. Restore, protect, and expand riparian migration and stopover habitats in the U.S..

   4.3. Pursue international partnerships to identify migration and winter habitats and threats.

   4.4. Encourage programs that preserve habitats used by wintering and migrating flycatchers.

   4.5. Encourage programs that minimize threats to wintering and migrating flycatchers.

5. Survey and monitor.

   5.1. Facilitate and institute effective survey and monitoring programs.

      5.1.1. Adopt standardized protocols for surveying and monitoring.

      5.1.2. Institute appropriate monitoring of all reaches within management units.

      5.1.3. Integrate survey data at State and rangewide levels.

   5.2. Monitor effects of management and restoration practices.

      5.2.1. Review data to improve effectiveness of management and restoration practices.

   5.3. Survey to determine dispersal movements and colonization events.

   5.4. Expand survey efforts in wintering habitat.

6. Conduct research.

   6.1. Determine habitat characteristics that influence occupancy and reproductive success.

      6.1.1. Determine plant species / structure that determines occupancy and reproductive success.

      6.1.2. Determine habitat area needed for breeding birds.

      6.1.3. Determine effects of conspecifics on site occupancy and reproductive success.

      6.1.4. Determine use vs. availability of exotics in occupied sites.

      6.1.5. Determine long-term ecological productivity of native habitats vs. exotic habitats.

      6.1.6. Refine understanding of effects of physical microclimate on site occupancy and reproduction.

6.1.7. Determine influence of environmental toxins on breeding, survival, and prey base.

6.2. Investigate dam and reservoir management for maximizing downstream and delta habitat.

6.3. Investigate surface and groundwater management scenarios to determine thresholds for habitat suitability and to maximize habitat quality.

6.4. Investigate grazing systems, strategies, and intensities for riparian recovery and maintenance.

6.4.1. Investigate grazing systems, strategies, and intensities for riparian recovery and maintenance.

6.4.2. Investigate direct effects of livestock grazing on the flycatcher.

6.4.3. Investigate impacts of native ungulates on riparian recovery and maintenance.

6.5. Conduct research on cowbird parasitism and control.

6.5.1. Collect baseline data on cowbird parasitism.

6.5.2. Experimentally test the efficacy of cowbird trapping programs.

6.6. Determine the most successful techniques for creating or restoring suitable habitat to degraded or former riparian lands, such as abandoned agricultural fields in riparian corridors.

6.7. Refine methods for determining distribution and population status and trends.

6.7.1. Acquire demographic and dispersal information.

6.7.2. Conduct limiting factor analyses.

6.7.3. Explore new methods and data needs for population viability analyses.

6.7.4. Develop methodologies, which can be site specific if necessary, for determining year-to-year trends in population sizes at breeding sites.

6.7.5. Establish and refine protocols for addressing flycatcher distribution.

6.8. Determine present and historical distribution of the subspecies through genetic work.

6.9. Determine migration and wintering distribution, habitat, and threats.

6.9.1. Investigate migration ecology, habitat selection and use.

6.9.2. Investigate wintering distribution, status, ecology, and habitat selection.

6.9.3. Determine influence of environmental toxins on wintering flycatchers and their prey base.

6.10. Conduct research on means of increasing reproductive success by approaches other than, or in addition to, cowbird management, such as reducing losses of flycatcher eggs and nestlings to general nest predators.

6.11. Conduct research to determine why increases in reproductive success due to cowbird control or other measures may not lead to increases in numbers of breeding birds in populations experiencing improved reproductive success or in populations that could receive emigrants from such populations.

6.12. Investigate feasibility of reducing or eliminating habitat fire hazards.

6.12.1. Evaluate fuel reduction techniques in riparian habitats, especially tamarisk types.

6.12.2. Test modifying flammability for fuels to modify fire risks.

6.12.3. Test prescribed fire to achieve desired fire hazard reduction, habitat protection, and habitat improvement.

7. Provide public education and outreach.

7.1. Hold annual Implementation Subgroup meetings.

7.2. Maintain updated website.

7.3. Prepare brochures and make available to public.

7.3.1. Educate the public about landscaping with native plants.

7.3.2. Educate the public about recreational impacts, especially about fire hazards.

7.3.3. Educate the public that cowbird parasitism is a natural process but may require management efforts in some instances due to high levels or other stressors that have endangered flycatchers.

7.4. Post and maintain signs at some protected flycatcher breeding locations.

7.5. Conduct information exchange programs with foreign governments and publics.

7.6. Conduct symposia and workshops.

7.7. Continue survey training.

8. Assure implementation of laws, policies and agreements that benefit the flycatcher.

8.1. Fully implement §7(a)(1) of the ESA.

8.2. Fully implement all Biological Opinions resulting from ESA §7(a)(2) consultations.

8.3. Monitor, support, and evaluate compliance with laws, policies and agreements that provide conservation benefits.

8.3.1. Support compliance with ESA §7(a)(1) of the ESA.

8.3.2. Provide resource managers with training in conservation benefits.

8.3.3. Monitor compliance with ESA §7(a)(2) of the ESA.

8.3.4. Ensure consistency among ESA §7(a)(2) consultations.

8.3.5. Monitor compliance with existing Biological Opinions.

8.4. Integrate recovery efforts with those for other species.

8.5. Monitor compliance and effectiveness of agreements and other mechanisms used as delisting criteria.

8.6. Continue implementation of Secretarial Order 3206.

8.6.1. Effectively communicate with Tribes.

9. Track recovery progress.

9.1. Maintain collaborative structure of Recovery Team.

9.2. Annual review of survey and monitoring data.

9.3. Review and synthesis of current flycatcher research and other pertinent research.

9.4. Repeat Population Viability Analysis.

9.5. Develop recommendations for survey and monitoring strategies.

9.6. Update Recovery Plan every 5 years.

E. Narrative Outline for Recovery Actions

The southwestern willow flycatcher is endangered because of a variety of factors, the chief of which is loss and degradation of breeding habitat. Not only has extensive habitat loss severely reduced flycatcher populations, but it exacerbates other threats, such as cowbird parasitism and the demographic vulnerability inherent in a rare species that exists mainly in small, isolated populations. Recovery of the flycatcher will require preserving currently suitable and occupied habitat and substantially increasing the quantity of suitable nesting habitat. Loss and modification of flycatcher habitat has resulted from many negative influences. Recovery of this habitat would be most assured, and most quickly accomplished, by reversing all negative impacts rather than selective elimination or mitigation of just a few. But the negative impacts on riparian systems are formidable; they are the result of over 200 years' evolution of land-use practices, regional explosion in human population, physical re-engineering of whole river systems, and the complexities and restrictions of water-allocation law. Therefore the recovery actions outlined here attempt to steer a course through what is feasible, what is legal, and what will be effective. Because of the biological and logistical complexities of riparian habitat restoration, different locales and circumstances will require significantly different recovery approaches.

This outline categorizes recovery actions into nine types:

1. Increase and improve currently suitable and potentially suitable habitat.
2. Increase metapopulation stability.
3. Improve demographic parameters.
4. Minimize threats to wintering and migration habitat.
5. Survey and monitor.
6. Conduct research.
7. Provide public education and outreach.
8. Assure implementation of laws, policies, and agreements that benefit the flycatcher.
9. Track recovery progress.

1. Increase and improve currently suitable and potentially suitable habitat.

1.1. Secure and enhance currently suitable and potentially suitable habitat on Federal lands, lands affected by Federal actions, and cooperating non-Federal and Tribal lands. Secure and enhance all suitable and potential breeding habitat on Federal lands and/or on lands affected by Federal action, within the framework of recovery criteria identified in Section IV. B., above.

1.1.1. Develop management plans to reduce threats and promote processes that secure, restore, and enhance currently suitable and potentially suitable habitat. Recognizing that "an ounce of prevention is worth a pound of cure," management plans should focus on removing threats more than engineering elaborate cures, mitigation, or contrived restoration. Where feasible and effective, conserve and restore natural processes and elements by removing stressors or, secondarily, modify the stressors by naturalizing flow regimes, modifying grazing regimes, removing exotics, and/or removing barriers between channels and floodplains, to allow for natural recovery.

1.1.2. Manage physical elements and processes to reduce threats and promote processes that secure, restore, and enhance currently suitable and potentially suitable habitat. Reestablish physical integrity of rivers first, then proceed to biological integrity of flycatcher habitat. Physical integrity for rivers implies restoration and maintenance of their primary functions of water and sediment dynamics. The vegetation communities needed for flycatcher habitat require specific hydrologic and geomorphic conditions, primarily floods, sediments, and persistent water. Set reasonable restoration and maintenance targets for physical integrity, recognizing the restored system will be a combination of natural and artificial processes, designed to achieve or mimic pre-development conditions, although at a limited scale. Recognizing the amount of water presently available for habitat restoration and maintenance is far below the optimal amount, the primary objective is to use the least amount of water possible to restore a sustainable southwestern willow flycatcher population. See Appendices I and J for detailed discussions.

1.1.2.1. Restore the diversity of fluvial processes. Restore the natural diversity of fluvial processes such as movement of channels, deposition of alluvial sediments, and erosion of aggraded flood plains, that allow a diverse assemblage of native plants to establish.

1.1.2.1.1. Identify dams where modification of dam operating rules will benefit recovery of the flycatcher. Dam operations focus on direct economic goals, and treat rivers as water and power commodities, leaving little administrative space for endangered species and other broader objectives. Although legal and economic considerations limit operational flexibility, environmental restoration and maintenance are part of the operating strategies of many large, multi-purpose structures, and habitat considerations should be a part of decision-making for dam operating rules. Where feasible, dam operating rules should be changed to treat rivers as landscapes and ecosystems functioning in support of diverse species including the southwestern willow flycatcher. Include these broadened objectives in revisions of the laws of the river, as well as interstate water compacts and administrative rule decisions. Include endangered species recovery as one of the multiple objectives in dam operating rules. An example of Congressionally mandated changes to the Law of the River for the Colorado River is the 1992 Grand Canyon Protection Act which brought about changes in the operation of Glen Canyon Dam to benefit downstream environmental resources.

1.1.2.1.2. Identify dams where modification of dam operating rules will benefit recovery of the flycatcher by taking advantage of system flexibility and water surpluses / flood flows. Dam operations have greatly simplified downstream geomorphic systems, resulting in loss of the ecological complexity needed for flycatcher habitat. To restore the complexity of hydrodiversity and geodiversity which will lead to biodiversity, dam operations should allow occasionally complex flow regimes with a wide range of discharge levels, and flood or spike flows. In many years, this new regime would not necessarily result in increased water releases, but rather releases on a schedule different from the present. Where feasible, high or spike flows should be released in months that will most benefit native vegetation and native fishes, taking advantage of system flexibility and water surpluses / flood flows to create and maintain flycatcher habitat.

1.1.2.1.3. Determine feasibility of simulating the natural hydrograph to restore / enhance riparian systems. For those structures that have operating rules that include environmental values, use the same analytic techniques for assessing options to maintain flycatcher habitat that are used for other water resource objectives. Operate dams systematically to attempt to mimic natural river processes at least occasionally. Consider distributing flood storage capacity differentially between dams in various years so the intervening watercourses will occasionally experience floods while the system's flood protection integrity is maintained. Release flows for purposes that will better simulate natural hydrology and/or specifically to enhance riparian systems, e.g., release water for recharge purposes along with peak flows to enhance the flood-like processes between the dam and point of diversion.

1.1.2.1.4. Determine feasibility of managing reservoir levels to establish and maintain lake fringe and inflow habitat. Sequences of flood inflows, sediment deposition, and subsequent exposure of sediments often create extensive riparian habitat at reservoir inflows and margins. To the greatest extent feasible, reservoir levels should be managed to preserve this serendipitous "delta" habitat. Avoid desiccating drawdowns or extended, extreme inundation of these habitats. Because laws and regulations also control reservoir levels, this objective must be fit into existing operating rules and priorities, because it may conflict with water delivery or flood control responsibilities. The objective should be included in formal operating rules, however, and recognized as a benefit that dam operations provide.

1.1.2.1.5. Determine feasibility of using surplus and/or flood flows to increase or add water to marsh areas between levees and on flood plains. Additional flows above common allocations are of two types: 1) surplus flows that are formally declared as such and that are allocated to specific users, and 2) flood flows that represent spills or releases from storage and that are not allocated to specific users. Rather than conducting surpluses and/or flood flows through a system as quickly as possible, they should be used gradually, in part for habitat creation and maintenance. This should not conflict with other important uses of these flows such as hydrating downstream areas, e.g., hydrating the Colorado River delta in Mexico. Flood releases occur on an occasional basis which limits their usefulness, but they offer some opportunity for habitat maintenance which is not now fully exploited. Management of additional flows should be within a context of available habitat and suitable water chemistry. Pre-flood flow manipulations including lowering river banks, removing levees, and/or removing tamarisk may be necessary to achieve restoration at some sites.

1.1.2.1.6. Determine feasibility of keeping daily ramping rates and daily fluctuations for dam releases as gradual as possible to prevent bank erosion and loss of riparian vegetation, except when mimicking flood flows. Ramping rates, the rates at which releases are increased or decreased, should be kept as gradual as possible to prevent bank erosion and loss of riparian vegetation through mechanical processes at the margins of downstream channels.

1.1.2.1.7. Determine feasibility of augmenting sediment in sediment-depleted systems. Generally, dams trap sediments and release erosive clear-water discharges. As a result, downstream areas are both deprived of natural sediment input and stripped of what sediments remain. This process eliminates the native vegetation and habitats that were developed on the deposits, including flycatcher habitat. To help correct this trend, augment the sediment supply of river reaches downstream to replace the fine sediments artificially removed in upstream reservoirs, but insuring that sediments containing hazardous levels of heavy metals, pesticides, and herbicides are not re-mobilized, and that downstream fish habitats are not adversely affected. Sediment augmentation should be undertaken with due regard for downstream navigation and water quality values. Sediment augmentation in some cases may relieve sedimentation problems in reservoirs by piping dredged sediment past the dam to points downstream for reintroduction. Adaptive management approaches should be in place to make adjustments or stop sediment augmentation if adverse results appear. Dams in areas with low sediment inflows to reservoirs probably do not have sedimentation problems, and they also probably have had lesser effects on downstream sediment loads.

1.1.2.1.8. Implement 1.1.2.1.3. – 1.1.2.1.7., where determined feasible.

1.1.2.1.9. Monitor 1.1.2.1.3. – 1.1.2.1.7., and provide feedback to the Technical Subgroup.

1.1.2.2. Restore adequate hydrogeomorphic elements to expand habitat, favor native over exotic plants, and reduce fire potential. Restore the necessary elements such as shallow water tables, surface water flow, movement of sediments and nutrients, consistent with the natural flow regime. This will aid expansion of habitat, favor native over exotic plants, and reduce fire potential.

1.1.2.2.1. Increase water available for recovery. Many solutions for improving flycatcher habitat require increased availability of water in active channels or in near-channel areas. This issue is important throughout the flycatcher's range (e.g., lower Colorado River near Yuma, lower San Pedro River, Gila River below Coolidge Dam, Middle Rio Grande). Water purchases or other acquisition procedures, as well as other water management strategies, are likely to be required in a comprehensive recovery of the species. In some areas construction of new projects to provide water for both agriculture and development threaten the limited remaining flycatcher habitat. Because agricultural withdrawals from rivers and groundwater are much larger than any other economic sector, the agricultural community must be part of any long-term solution. Engage agricultural interests in all major watersheds in the range of the flycatcher to consult with agencies and other parties to take proactive measures to provide more water in rivers throughout the range of the flycatcher.

1.1.2.2.1.1. Increase efficiency of groundwater management to expand habitat, favor native over exotic plants, and reduce fire potential. Integrated, watershed-based approaches to water management may suffice to reverse some of the changes resulting from overdrafting ground water in some river reaches. All water users, whether municipal, agricultural, or industrial, need to work together and bear their share of water overdraft problems to achieve results. Approaches should focus on reducing withdrawals (e.g., xeriscaping, replacing high-water-use crops with high water-use-efficiency crops) and increasing recharge (e.g., recharge of aquifers with effluent). In cases of extreme dewatering, restoration of water tables may require importation of water from other basins.

1.1.2.2.1.2. Use urban waste water outfall and rural irrigation delivery and tail waters for habitat restoration to expand habitat, favor native over exotic plants, and reduce fire potential. These areas have the potential to support suitable flycatcher habitat (native willows) and often have open water surfaces. When using return flows to support or create flycatcher habitat, it may be necessary to periodically flush the soils to reduce the concentrations of salts below the levels that are toxic to willows. Success also will be enhanced if water level fluctuations do not exceed tolerance ranges of the plant species (see Appendix K). Restoration efforts in waste-water systems need to monitor water quality and contaminant levels to minimize risks.

1.1.2.2.1.3. Provide (reestablish) instream flows to expand habitat, favor native over exotic plants, and reduce fire potential. Maintain instream flow releases below dams at suitable levels to conserve or enhance instream values and public trust resources. For dams that are primarily flood control structures, release storage volumes to achieve both flood scouring processes and slower trickle flows over long periods to maximize groundwater recharge and maintain some surface flow downstream. Modify dam operations, diversions, and groundwater pumping to provide low level instream flows (enough merely to establish a wetted perimeter and a visible surface flow) during low flow periods downstream. Measure these flows at stream gages at the appropriate times to assure the water flows are of the magnitude and frequency intended to positively influence flycatcher habitat. Many gages do not provide resolution adequate for monitoring changes in base flows that are important for habitat. There is an ongoing effort in the Verde River basin to install additional gages to monitor changes to base flow. The sensitivity and sufficiency of the existing gage network should be considered, and modified to provide the necessary data for management decisions. In those river reaches downstream from diversion structures that desiccate the channels, procure water rights for delivery at desired times to hydrate flycatcher habitat.

1.1.2.2.2. Expand the active channel area that supports currently suitable and potentially suitable flycatcher habitat by increasing the width of levees and using available flows to mimic overbank flow. Reservoir storage and diversions have caused river channels and their associated landscapes to become drastically more narrow. Levees with narrow spaces between them have stabilized the restricted widths. As a result, the original natural riparian forest and potential flycatcher habitat have also shrunk, and become discontinuous. To correct this trend, increase the distance between levees. This will result in both increased flood conveyance potential and more space for dense riparian vegetation outside the low flow channel. Flood conveyance channels should be designed to provide adequate flood-flow capacity with a large portion of the width in riparian vegetation. For example, doubling the width of a channel dedicated to flood conveyance could free half the width from the necessity of channel clearing or dredging. If channel clearing must be done, schedule activities in such a way that riparian habitat is continuously available in the area, e.g., do not mow or grade entire flood control systems simultaneously. Sizing the channel width using the "meanderbelt" concept has potential for yielding both flood control and aquatic/riparian values. Discourage other land-uses, e.g., cultivated agriculture, within flood conveyance facilities when they are detrimental to riparian vegetation growth. Improve the along-channel connectivity of rivers by insuring continuous instream flows and allowing occasional minor floods with peak flows large enough to expand channel systems.

1.1.2.2.3. Reactivate flood plains to expand native riparian forests. Flood plains, oxbows on single-thread channels, and secondary channels on braided streams have become inactive due to flood suppression by dams, entrenchment, isolation by levees, and elimination of beaver, all of which have reduced or eliminated native riparian forests. To reverse this effect, permit overbank flows in selected locations to expand wetlands and riparian forests by larger releases from dams when excess water is available, or manage conveyance to include peak flows. Install gates in levees and temporarily (permanently where possible) breach selected levees to reactivate flood plains and abandoned channels behind the structures. Pump, syphon, or divert water to flood plains abandoned by channel entrenchment. Along some channels where the flood plain marshes can be maintained, construct additional levees around them, and install gates or valves to connect them through the main river levees to the channel to facilitate occasional diversions into them. Abandoned channels and oxbows can be excavated to remove sediment and can be reconnected to the main river channel through artificial channels with gates or valves to supply temporary flows.

1.1.2.2.4. Restore more natural channel geometry (width, depth, bank profiles) where the return of the natural hydrograph will be insufficient to improve habitat.

1.1.2..3. Manage fire to maintain and enhance habitat quality and quantity. See Appendix L (especially Table 2) for a complete discussion of fire issues and management.

1.1.2.3.1. Develop fire risk and management plans. Develop a fire plan for all current flycatcher breeding sites, and for sites where flycatcher-related riparian restoration is planned. A comprehensive fire evaluation and response plan should include these components: (1) Evaluation of the degree of fire threat for that particular site; (2) Identification of short-term preventative actions that will be taken to reduce the risk of fire; (3) Direction for quick response for fire suppression; (4) Post-fire remediation/restoration; (5) Identification of long-range efforts to reduce risk of fire; (6) Development of long-term monitoring of conditions in the riparian zone and watershed that maintain flood regimes and reduce fire susceptibility. This section of the fire plan should consider efforts such as monitoring regional water use patterns; water level trends in the regional and flood plain aquifers; fire-related recreational activities; and fuels loading (See Appendix L).

1.1.2.3.2. Suppress fires. Suppress fires in habitat and adjacent buffer zones. Fire suppression should make use of current, updated maps of occupied habitat and buffer zones that are part of each breeding site's fire plan.

1.1.2.3.3. Restore ground water, base flows, and flooding. Restoring water availability will reduce fire risks in several ways. Shallow ground water (i.e., no lower than 3 m below the flood plain surface for mature forests and within 0.5 to 1 m of the flood plain for younger forests measured during the peak water-demand periods) should restore or maintain native cottonwood-willow forests in non-water stressed, less flammable, condition. Shallow depth to ground water also will allow tamarisk stands to be more fire resistant than if water is deeper because they maintain higher internal water content. If a stream has become intermittent, perennial surface flows should be restored. In lieu of restoring the preferable option of natural hydrology, water in adequate amounts to raise plant water content and raise water tables could be supplied through flood irrigation, sprinklers, or agricultural tail water. To reduce fire size and frequency, allow floods sufficiently large to remove accumulated forest floor debris and moisten the surface soils and tree bases. Ideally, floods should be released in a fashion that mimics the natural flow regime.

1.1.2.3.4. Reduce incidence of flammable exotics.

1.1.2.3.4.1. Manage/reduce exotic species that contribute to increased fire incidence. Some exotic plant species (e.g., tamarisk, red brome) are more flammable than the native species they replace. Altered hydrology and livestock grazing are significant factors that can favor exotic plants. Following the livestock grazing guidelines in Appendix G should also favor natives over exotics. Where the consequences of fire are high due to fine fuel loads, livestock grazing might be used as a tool to reduce the risks, as long as such grazing follows the grazing guidelines detailed in Appendix G.

1.1.2.3.4.2. Use water more efficiently and reduce fertilizer applications. Manage flood plains and watersheds to keep salinity levels within the tolerance ranges of the native plant species. Some agricultural practices amplify the amount of salt and its delivery into rivers, which contributes to favorable conditions for exotic plants like tamarisk, which are more fire-tolerant and fire-prone than natives like willows. More efficient use of water and less reliance on fertilizers will help reduce salt loads.

1.1.2.3.5. Reduce recreational fires. Prohibit fires and fire-prone recreation uses in habitat and in large buffer strips surrounding habitat during high fire-risk periods. Manage the numbers and/or distribution of recreationists to concentrate them into locations where fire suppression efforts can be most effectively deployed. Some areas may need to be closed to recreational use during high-risk periods, such as 4th of July weekends or drought periods. Increase patrolling by enforcement personnel to enforce restrictions.

1.1.3. Manage biotic elements and processes.

1.1.3.1. Restore biotic interactions, such as herbivory, within evolved tolerance ranges of the native riparian plant species. Like flood-driven regeneration, herbivory of vegetation is a process with which riparian ecosystems and flycatchers have evolved. However, like hydrological processes, herbivory now is outside the realm of the natural historical norm due to reductions of some native species (beaver), intensive management of others (deer, elk), and introduction of non-natives (domestic livestock). As a result, riparian ecosystems have been altered in extent, composition, and fire potential. Please refer to Appendix G for discussion of domestic livestock.

1.1.3.1.1. Manage livestock grazing to restore desired processes and increase habitat quality and quantity.

1.1.3.1.1.1. If livestock grazing is a major stressor implement general livestock grazing guidelines from Appendix G in currently suitable or potentially suitable habitat (potentially suitable habitats are riparian systems that have the appropriate hydrological and ecological setting to be suitable flycatcher habitat). If a particular grazing system is not preventing the recovery of flycatcher habitat (e.g., regeneration of woody and herbaceous riparian vegetation), then that particular grazing system should be allowed to continue provided it is appropriately monitored and documented. Flexibility through adaptive management must be an integral component of the grazing system in order to continue to improve flycatcher habitat.

The following grazing recommendations, excerpted from Table 2 in Appendix G, should be interpreted as guidelines that must be applied according to site-specific conditions:

- During the **growing season** (of woody riparian vegetation), no livestock grazing in **taller stature** occupied flycatcher habitat (e.g., below 6,000 ft or 1,830 m) until research in comparable unoccupied habitats demonstrates no adverse impacts from grazing. If unoccupied habitat becomes occupied habitat, continue existing management (grazing should not exceed 35% of palatable, perennial grasses and grass-like plants in uplands and riparian habitats, and extent of alterable stream banks showing damage from livestock use not to exceed 10%).

- During the **non-growing season** (of woody riparian vegetation) in **taller stature** occupied flycatcher habitat (e.g., below 6,000 ft or 1,830 m), there may be conservative grazing with average utilization not to exceed 35% (± 5%) of palatable, perennial grasses and grass-like plants in uplands and riparian habitats, and extent of alterable stream banks showing damage from livestock use not to exceed 10%. Utilization of woody plants not to exceed an average of 40% (±10%) of current year's growth. Grazing must be accompanied by monitoring to ensure allowable use guidelines for vegetation are not exceeded. Livestock use of annual plants indicates overuse of grasses and grass-like plants.

- During the **growing season** (of woody riparian vegetation) in **low stature** occupied flycatcher habitat (e.g., 3-4 m monotypic shrubby willow at elevations > 6,000 ft or 1,830 m), no livestock grazing.

- During the **non-growing season** (of woody riparian vegetation) in **low stature** occupied flycatcher habitat (e.g., 3-4 m monotypic shrubby willow at elevations > 6,000 ft or 1,830 m), no livestock grazing.

- During the **growing season** (of woody riparian vegetation) in unoccupied but suitable flycatcher habitat in **taller stature** habitats (e.g., below 6,000 ft or 1,830 m), no grazing. However, a limited number of small-scale, well-designed experiments may be initiated in some areas, at the discretion of the USFWS, to determine levels of pre-breeding season grazing (not to exceed 35% (±5%) of palatable perennial grass or grass-like plants in uplands and riparian habitats, and extent of alterable stream banks showing damage from livestock use not to exceed 10%) that do not adversely affect flycatcher habitat attributes.

- During the **non-growing season** (of woody riparian vegetation) in unoccupied but suitable flycatcher habitat in **taller stature** habitats (e.g., below 6,000 ft or 1,830 m), conservative grazing with average utilization not to exceed 35% (±5%) of palatable perennial grass or grass-like plants in uplands and riparian habitats, and extent of alterable stream banks showing damage from livestock use not to exceed 10%. Utilization of current year's growth on woody species not to exceed 40% (±10%). Grazing must be accompanied by monitoring to ensure that guidelines for allowable use of vegetation are not exceeded.

- During the **growing season** (of woody riparian vegetation) in unoccupied but suitable flycatcher habitat in **low stature** habitat (e.g., 3-4 m monotypic shrubby willow at elevations >6,000 ft or 1,830 m), no livestock grazing.

- During the **non-growing season** (of woody riaprian vegetation) in unoccupied but suitable flycatcher habitat in **low stature** habitat (e.g., 3-4 m monotypic shrubby willow at elevations > 6,000 ft or 1,830 m), conservative grazing with average utilization not to exceed 35% (±5%) of palatable perennial grass or grass-like plants in uplands and riparian habitats, and extent of alterable stream banks showing damage from livestock use not to exceed 10%. Utilization of current year's growth on woody species not to exceed 40% (±10%). Grazing must be accompanied by monitoring to ensure that guidelines for allowable use of vegetation are not exceeded.

- During the growing and non-growing season (of woody riparian vegetation) in restorable (or regenerating) habitat in tall and short stature flycatcher habitat, no grazing. However, provisional grazing in non-growing season (of woody riparian vegetation) is allowable in sites below 6,000 ft or 1,830 m if grazing is not a major stressor.

1.1.3.1.1.2. Determine appropriate use areas for grazing. Identify the most appropriate areas for permitting livestock grazing given the biodiversity concerns for the particular land management unit.

1.1. 3.1.1.3. Reconfigure grazing management units. Reconfigure grazing pasture boundaries and numbers of permitted livestock to reflect the true productivity of rangelands associated with important flycatcher recovery areas, and allow differential management of units of varying ecological sensitivity and significance. This reconfiguration should establish an adequate number of ungrazed areas at different elevations, habitat conditions, and geomorphic settings, to provide land management agencies and researchers with much-needed reference sites against which to compare the condition of grazed watersheds.

1.1.3.1.1.4. Improve documentation of grazing practices. Institute and/or improve record-keeping and documentation of grazing practices, retroactively where possible, so that the ecological effectiveness of various grazing practices can be monitored and scientifically evaluated.

1.1.3.1.2. Manage wild ungulates. Manage wild and feral ungulates to restore desired processes and increase habitat quality and quantity. Restore ungulate herbivory levels to those under which the native riparian species evolved, or at least under which the native plant species retain competitive dominance. Manage wild ungulates so that excessive utilization of herbaceous and woody vegetation does not occur and structure and composition of flycatcher habitat is maintained.

1.1.3.1.3. Manage keystone species. Manage keystone species such as beaver, within their historic ranges, to restore desired processes, increase habitat quality and quantity, reduce fire potential, and favor native over exotic plants. Beaver activity creates still waters by impoundment and aids sediment storage. Reintroduce or supplement populations where appropriate. Several issues must be considered before releasing beavers as a habitat restoration tool. The site should be assessed to ensure that there is an adequate food base of preferred foods, so that the natural successional dynamics are in place that will allow these plant species to regenerate over time. Otherwise, beaver activity can reduce habitat quality by reducing densities of wetland herbs and riparian trees and shrubs below replacement levels. The site should also be assessed to determine whether beaver were historically present. Finally, the effects on other locally rare or endangered fish or amphibians should be considered. For example, beaver activity could provide favorable conditions (especially perennial ponds) for unwanted species, such as the introduced bullfrog (*Rana catesbeiana*).

1.1.3.2. Manage exotic plant species. Manage exotic species as summarized below and as explained in more detail in Appendix H. To a large extent, abundance of exotic plants is a symptom of the ways riparian lands and waters have been managed. The solution requires a shift of emphasis, away from demonizing exotics and toward: (1) reducing the conditions that have allowed the exotics to be so successful, and (2) re-establishing a functional semblance of the conditions that allow native plants to thrive. It is unlikely that exotics can be completely driven out of southwestern riparian systems. But it is also unlikely that simply removing exotics (mechanically, chemically, or through biocontrol) will allow natives to thrive if conditions of hydrology, soil chemistry, grazing, and disturbance regime no longer favor them.

1.1.3.2.1. Develop exotics species management plans. Develop exotic species management plans as part of site restoration plans as detailed in Appendix H. The plans should consider the need for action (e.g., is the exotic species dominating the canopy layer or is it subdominant?), address the root causes for the dominance of the exotics, and assess the feasibility and need for passive vs. active restoration measures. Where possible, remove stressors, restore natural process, and patiently allow for natural recovery.

1.1.3.2.2. Coordinate exotics management efforts. Because the spread of exotics in riparian systems is a drainage-wide issue, effective management requires coordination among multiple landowners and users with diverse interests and management goals. In the absence of such coordination, management efforts are likely to fail as individual sites are reinvaded by exotics present elsewhere in the drainage.

1.1.3.2.3. Restore ecosystem conditions that favor native plants.

1.1.3.2.3.1. Eliminate physical stresses, such as high salinity or reduced stream flows, that favor exotic plants. Stresses such as dewatering and increased salinity favor a new assemblage of stress-tolerant exotic plant species. Tamarisks have high water-use efficiency, root deeply, and tolerate prolonged drought. Russian olive is drought tolerant at both the seedling and adult stages, relative to cottonwoods and willows. Tamarisks are adapted to salt levels that would stress or kill most native willows and Russian olive is more salt tolerant than many cottonwoods and willows.

To reduce drought stresses, reduce diversions and groundwater pumpage and otherwise increase instream flow and raise groundwater levels. If needed, remove aggraded sediments or excavate side channels to create cottonwood-willow seed beds that are within one meter of the ground water table. Reduce salt levels in floodplain soils by modifying agricultural practices and restoring periodic flushing flood flows.

1.1.3.2.3.2. Create or allow for a river hydrograph that restores the natural flood disturbance regime. Alteration of natural disturbance regimes or imposing new disturbances increases the chances that exotic plants will dominate a site. Some types of disturbance, e.g., soil disturbance from vehicles, livestock, and recreationists, have increased in riparian habitats. In contrast, flood disturbance has been reduced on many rivers. Natural flood regimes have been altered by dams, diversions, urbanization effects, and watershed degradation. As floods have decreased, fire disturbance has increased, which favors some exotics (e.g., tamarisk, giant reed) over natives. To counteract all these effects, restore flood regimes that are as close to natural as possible in timing, magnitude, and frequency; reduce livestock trampling and heavy recreational use; and reduce unnatural fire regimes by re-establishing natural floods where possible, or by intervention where this is not possible.

For below-dam reaches, release flood waters to coincide with the spring-season seed dispersal of cottonwoods and willows, creating conditions that favor these species. When restoring off-channel sites, release flows onto bare soil in a fashion that mimics the natural spring flood pulse. For above-dam reaches, time reservoir drawdowns to coincide with the early spring seed dispersal of cottonwoods and willows; this will favor establishment of the native species if moist bare soil is present.

1.1.3.2.3.3. Restore ungulate herbivory to intensities and types under which the native riparian species are more competitive. Domestic livestock grazing has altered vegetation composition throughout the Southwest by favoring unpalatable or grazing-tolerant plant species, many of which are exotic. Among the riparian plant species that appear to increase under grazing are exotic bermuda grass, annual brome grasses, tamarisks and Russian olive, and native seep-willow. Livestock grazing should be managed so as to eliminate browsing on young, palatable riparian shrubs and trees (such as willows), consistent with the general livestock grazing guidelines provided in Appendix G.

1.1.3.2.4. Retain native riparian vegetation in flood plains and channels. Clearing channels for water salvage or increased flood water conveyance, plowing flood plain fields, and channel-narrowing caused by flow-regulation have all provided large-scale opportunities for establishment of exotics. Eliminating projects involving clearing of native riparian vegetation will help to ensure that the desired native species persist in the watershed.

1.1.3.2.5. Retain exotic species at sites dominated by native riparian vegetation.

1.1.3.2.5.1. At native dominated sites, retain tamarisk in occupied flycatcher habitat and, where appropriate, in suitable but unoccupied habitat, unless there is a trend for steady increase of tamarisk. Removing tamarisk and other species from occupied sites may harm the flycatchers, as may removing tamarisk from suitable unoccupied sites. For example, clearing the tamarisk understory from mixed stands of native and exotic trees and shrubs may reduce habitat quality. If habitat assessment reveals sustained increase in tamarisk abundance, conduct an evaluation of underlying causes and pursue restoration following the guidelines in Appendix H.

1.1.3.2.5.2. If needed, increase habitat quality within stands of exotic

plants by implementing restorative actions such as seasonal flooding. Seasonal inundation of tamarisk stands, for example, may improve habitat quality by improving the thermal environment or increasing the insect food base.

1.1.3.2.6. Remove exotics in occupied, suitable but unoccupied, and potentially suitable habitats dominated by exotics only if: 1) underlying causes for dominance of exotics have been addressed, 2) there is evidence that the exotic species will be replaced by vegetation of higher functional value, and 3) the action is part of an overall restoration plan. Before implementing control of exotic plants, correct the underlying causes for their dominance, such as changed flood regime, lowered groundwater level, or increased soil salinity. There are risks to the flycatcher if stands of exotic plants (such as tamarisk stands) are not replaced by plant species of equal or higher value, or if the stands lose quality (for example, by losing foliage density).

When clearing patches of undesirable exotics using fire, earth- and vegetation-moving equipment, or approved herbicides, make sure that the site conditions and timing of clearing are favorable for the establishment of the desired native species. If there is a high probability that replacement vegetation (e.g., younger stands of the same exotic, or facultative riparian species such as quailbrush, *Atriplex lentiformis*), will have lower habitat quality that the initial vegetation, then do not remove the exotic.

If exotic clearing is planned in areas near occupied territories, make sure that the areas targeted for clearing do not have any endangered species nest sites, and areas are at least 100m away from the closest nest site. This buffer zone should be enlarged if the method of clearing (e.g. herbicide drift, fire spread) is one that could have impacts well beyond the application area. Clearing activities (e.g. earthmoving) should be timed to avoid the breeding season of the flycatcher and other sensitive species (i.e., late March-September).

1.1.3.2.6.1. In suitable but unoccupied and potentially suitable habitats where exotic species are to be removed through chemical or mechanical means, use a temporally staged approach to clear areas so some mature habitat remains throughout the restoration period for potential use by flycatchers. This staggered approach will create a mosaic of different aged successional stands. In addition, it will allow the benefits of an adaptive management approach to be realized: if the restoration effort fails, one will be able to learn from the mistakes and prevent failure on a grand scale.

1.1.3.2.6.2. Release habitat-targeted biocontrol agents only outside the occupied breeding range of the flycatcher. The U.S. Department of Agriculture (APHIS) has received approval for release of three biocontrol insects designed to reduce the abundance of tamarisk. However, in recognition of the functional role that tamarisk provides to flycatchers, the release was approved only for areas at least 200 miles from their occupied breeding range. This criteria should be adhered to for these approved biocontrol insects and similar criteria should be applied should new such biocontrol insects be submitted for approval.

1.1.3.3. Provide areas protected from recreation. Keep trails, campsites, and heavily used day use areas away from areas to be developed or maintained for flycatchers. Ensure protected areas are large enough to encompass breeding, foraging, and post-fledgling habitat. Direct vehicles, boating, swimming, tubing, and fishing away from occupied suitable habitat, especially during the breeding season, where impacts are likely to negatively impact habitat or flycatcher behavior. Where potentially suitable habitat has been identified as future flycatcher habitat, these incompatible recreation activities should be minimized to allow habitat to develop.

1.1.3.3.1. Reduce impacts from recreationists. Manage recreation by instituting recreation user control. Recreation control involves altering visitor behavior to minimize impacts, and ranges from complete restriction to some acceptable level of use. Recreation user control can be accomplished in a number of ways, including requiring permits, collecting user fees, limiting number of visitors, constraining visitor access or activities, instituting zoning or periodic closures, limiting the frequency and duration of use, providing visual barriers, and reducing motorboat impacts. See Appendix M for detailed discussion of recreation impacts.

1.1.3.3.2. Confine camping areas. Evaluate whether confining camping to a small concentrated number of campsites is less detrimental to wildlife and habitat than dispersal over a wide area. Institute fire bans when danger is high or where habitat is vulnerable. If campfires are authorized, confine them to fire boxes. Limit or prohibit fuelwood collecting in riparian areas.

1.1.3.3.3. Restore habitat impacted by recreation. Where needed, post signs that explain the importance of habitat restoration, fence habitat, and/or temporarily close trails and use areas.

1.1.3.3.4. Place designated recreation shooting areas away from riparian areas. Designated shooting areas used for target practice should be located away from riparian areas to minimize physical destruction of habitat and noise disturbance, and lead contamination.

1.1.3.3.5. Minimize attractants to scavengers, predators, and brown-headed cowbirds. Where recreation users congregate, provide adequate waste facilities (covered trash receptacles, restrooms) and regular collection service. Place horse stables away from the riparian area. Avoid use of bird seed feeders containing seeds preferred by cowbirds.

1.1.3.3.6. Provide on-site monitors where recreation conflicts exist. Where recreation conflicts exist and total closure is not practical, provide on-site monitors to educate users and control use.

1.2. Work with private landowners, State agencies, nongovernmental organizations, and municipalities to conserve and enhance habitat on non-Federal lands. Work toward conserving occupied, suitable but unoccupied, and potential flycatcher habitat on non-Federal lands.

1.2.1. Evaluate and provide rangewide prioritization of non-Federal lands. Evaluate and provide rangewide prioritization of non-Federal lands considered critical for conservation and recovery of the flycatcher, in cooperation with landowners (see USBR 1999c).

1.2.2. Achieve protection of occupied habitats. Achieve protection of occupied habitats through Habitat Conservation Plans, Safe Harbor Agreements, partnerships, cooperative agreements, conservation easements, or acquisition of sites from willing landowners.

1.2.3. Provide technical assistance to conserve and enhance occupied habitats on non-Federal lands. Make technical assistance and, where possible funding, available to non-Federal owners of occupied habitats, to conserve and enhance habitat.

1.2.4. Pursue joint ventures toward flycatcher conservation. Pursue joint ventures toward flycatcher conservation. For example, in 1999, the USFWS initiated its Sonoran Desert Joint Venture Program. This is a binational program with the primary goal of developing and maintaining a broad range of avian conservation efforts (e.g., research, habitat preservation and restoration, and education) throughout the Sonoran desert in the United States and Mexico. A priority project will be to initiate flycatcher surveys in the riparian habitats of Sonora, Mexico.

1.3. Work with Tribes to develop conservation plans and strategies to realize the considerable potential for conservation and recovery on Tribal lands. Develop partnerships between Tribes and Federal, State, and private agencies.

1.3.1. Work with Tribes to establish a regular system of surveys and monitoring, and train Tribal staff in the flycatcher survey protocol. Assist in securing funding, as available, to implement the survey and monitoring system, or assist Tribes with grant solicitation or grant writing to agencies that fund or manage watershed/wetland or riparian restoration initiatives.

1.3.2. Determine protocols for information sharing. All Tribes have serious concerns about what will happen with any information that is gathered concerning the location and numbers of endangered species, habitat, or water quantities. Protocols for information sharing must be collaboratively developed and agreed upon between Federal agencies and individual Tribes participating in flycatcher survey and recovery efforts.

1.3.3. Maintain an incumbent in the position of Tribal Liaison to the Technical Subgroup. The Tribal Liaison is necessary to effectively promote flycatcher survey and recovery efforts on Tribal lands. Support Tribal efforts to do surveys for flycatchers and monitor occupied sites. Provide technical assistance and funding as available.

1.3.4. Provide technical assistance to Tribes that have flycatchers on their lands. Assist Tribes in developing watershed management plans, securing funding, and grant solicitation or grant writing to agencies that fund or manage watershed/wetland or riparian restoration initiatives.

1.3.5. Support Tribal efforts to improve currently suitable and potentially suitable habitat. Assist in securing fencing, off-site livestock drinkers, scientific and technical assistance in developing fire plans, post-fire restoration plans, cowbird management plans, and habitat monitoring programs.

1.3.6. Work with Tribes to determine the extent to which Tribal water rights might or might not be available to aid in conservation and recovery of the flycatcher. In all but a few instances in the Southwest, Indian water rights are senior to those of nearly all other users. Proposing changes in water use requires thorough evaluation of Tribal water rights and water resources. Federal agencies should consult with Tribes to determine the extent to which Tribal water rights are available, or not, to aid flycatcher recovery efforts.

1.3.7. Provide aid to Tribes for development of educational programs and opportunities that further flycatcher recovery.

2. Increase metapopulation stability.

2.1. Increase size, number, and distribution of populations and habitat within Recovery Units.

2.1.1. Conserve and manage all existing breeding sites. Conservation of all existing breeding sites and occupied habitats is crucial to recovery.

2.1.2. Secure, maintain, and enhance largest populations. Conservation and enhancement of the largest local flycatcher populations, now and as the species recovers, are key elements of recovering the bird. These local populations will serve as source populations, providing emigrating individuals to colonize new habitat as it develops. Sites that have 10 or more nesting pairs, and/or are near other suitable habitats or smaller populations, are capable of serving this recovery function. Current sites that are of particular importance are:

Rio Grande in the San Marcial area (NM);

Gila River in the Cliff-Gila Valley (NM);

Gila River from Bonita Creek to San Carlos Reservoir and from Winkleman to Ashurst-Hayden Dam (AZ);

San Pedro River from Aravaipa Creek to Gila Confluence (AZ);

Roosevelt Lake, Tonto Creek and Salt River Inflows (AZ);

Colorado River at Topock Marsh (CA);

Alamo Lake, Brown's Crossing (headwaters of Bill Williams River), and lower Santa Maria River (AZ);

South Fork of the Kern River (CA);

Upper San Luis Rey River (CA);

Santa Ynez River (CA);

Santa Margarita River on Camp Pendleton (CA); and

Alamosa National Wildlife Refuge (CO).

2.1.3. Develop new habitat near extant populations. Using the habitat restoration techniques described above, increase the extent, distribution, and quality of habitat close ($\leq$15 km) to extant populations. This will increase the stability of local metapopulations by providing new habitat that will serve dual functions: (1) replacement habitat in the event of destruction of some habitat in the current population, and (2) new habitat for colonization, which once occupied will enhance connectivity between sites.

2.1.3.1. Use existing habitat acquisition/conservation priorities. Use existing evaluations and priorities for acquiring, securing, and/or enhancing riparian habitat, whether for mitigation or pro-active conservation. The Bureau of Reclamation (USBR 1999c) has completed a range-wide assessment of flycatcher habitat for acquisition and conservation priorities.

2.1.4. Enhance connectivity to currently isolated occupied sites. Using the habitat restoration techniques described above, increase habitat near to and between currently isolated sites. This will create "stepping stones" of habitat to enhance connectivity as well as provide replacement habitat and colonization habitat.

2.1.5. Facilitate establishment of new, large populations in areas where none exist. Through habitat restoration, establish new populations of large size (≥25 territories) in areas where few or no flycatchers exist, but where there is a potential for habitat and establishing a population will increase metapopulation stability. This is particularly important in areas lacking such core populations, e.g., the lower Colorado River.

2.1.6. Increase population sizes at small occupied sites. Using the habitat restoration techniques described above, increase the number of breeding pairs at small sites (especially those with 10 or fewer territories) to improve stability and colonization potential.

3. Improve demographic parameters.

3.1. Increase reproductive success. A fundamental need for expanding flycatcher populations toward recovery are increases, locally and rangewide, in reproductive success. Increasing reproductive success will generate the increased numbers of new breeding birds needed to colonize restored habitats. Several stressors are at work that reduce reproductive success below adequate levels; these stressors must be relieved. Increasing the availability of suitable habitat, also fundamental to recovery, will remain unfulfilled without the new breeding birds to fill it.

3.1.1. Manage brown-headed cowbird parasitism after collection of baseline data show high rates of parasitism. Cowbird parasitism impacts flycatchers to varying degrees across the range of the bird. Local site situations, and management approaches, will differ because of many factors including habitat quality, flycatcher population size, and relative severity of other stressors on the flycatcher. For a complete discussion of cowbird effects and management, see Appendix F.

3.1.1.1. Increase the amount and quality of riparian habitat to increase habitat patch sizes and local flycatcher population sizes thereby minimizing levels and impacts of cowbird

parasitism. Enhancing habitat is likely to reduce the impact of cowbird parasitism, in several ways. Increased amounts of high quality habitat and increased patch sizes of such habitat will allow for larger flycatcher breeding populations. These larger populations are likely to experience reduced levels of cowbird parasitism by dispersing cowbird eggs over a larger number of nests. Larger populations are also less likely to suffer from stochastic demographic effects of parasitism such as total reproductive failure of all breeders. Also, due to their relatively larger amounts of interior habitat, large patches of riparian woodland are likely to further reduce cowbird parasitism and nest predation, both of which tend to be concentrated along habitat edges.

3.1.1.2. Develop cowbird management programs if warranted by baseline data on parasitism rates. Develop cowbird trapping programs that include the following elements: (1) a program of periodic reviews, every 3-5 years, by scientists who are not involved in the trapping program but who will assess its benefits to flycatcher breeding populations; (2) a statement of goals that define conditions that will end the trapping program (including local flycatcher population targets and delisting the bird); (3) a nest monitoring program for at least two years after trapping ceases to determine whether parasitism rates exceed acceptable levels; (4) assurance that funds will be available if cowbird trapping needs to be reinstated.

3.1.1.3. Implement cowbird management programs if warranted by baseline data on parasitism rates. Cowbird trapping should be instituted only after baseline data show that parasitism on a local population exceeds 20% - 30% for two or more successive years. See Appendix F for full discussion of important elements of trapping programs.

3.1.1.4. Pursue long-term landscape objectives for cowbird reduction. A long-term management objective should be to reduce cowbird numbers at landscape levels by reducing anthropogenic influences that provide foraging opportunities for them. These influences include bird feeders and other anthropogenic food sources such as livestock pastures. There should be no single distance over which livestock must be excluded from flycatcher populations, because the effectiveness of livestock exclusion depends on the availability of other food sources for cowbirds in the local landscape. In some landscapes there are so many potential food sources for cowbirds that the only limits on livestock should be exclusion from riparian habitat to protect the habitat itself.

3.1.2. Reduce direct impacts that topple or otherwise destroy nests. Reduce potential direct impacts on nests, by implementing grazing guidelines (see above and Appendix G) and measures to reduce recreation impacts (see above and Appendix M).

3.1.3. Reconsider assessments of habitat quality or other threats if cowbird control and/or other measures increase reproductive output but not the number of breeding flycatchers. Reconsider assessments of habitat quality or other threats if increases in flycatcher reproductive success due to cowbird control or other measures do not lead to increases in numbers of breeding birds in populations experiencing improved reproductive success or in populations that could receive emigrants from such populations.

4. Minimize threats to wintering and migration habitat. At this time, it is not possible to target management actions specifically for the endangered southwestern willow flycatcher subspecies, because the timing and areas of migration and wintering overlap for all subspecies. However, actions that benefit any one subspecies (or the species as a whole) are likely to benefit *E.t. extimus*.

4.1. Identify, for purposes of protection, riparian habitats in the U.S. that provide essential migration and stopover habitat. For a migrating flycatcher, almost any riparian vegetation is preferable to rip-rap banks, agricultural fields, or urban development. The presence of water can influence local insect abundance, a critical energy resource. Therefore, keeping water present in or adjacent to riparian habitats is desirable.

4.2. Restore, protect, and expand riparian migration and stopover habitats in the U.S. Expanding riparian habitats, and restoring those that are heavily damaged, will increase the distribution and amount of food (energy) resources available to migrating flycatchers. Pursue all opportunities for creating or restoring riparian vegetation, especially along portions of major river systems where riparian vegetation is rare or lacking. Prevent or minimize loss and degradation of existing riparian habitats. Protection should be afforded to a wide variety of habitats, not only those with the characteristics of flycatcher breeding sites. The presence of water can influence local insect abundance, and thus potential prey base and energy resources. Therefore, riparian restoration or creation projects should include the goal of maintaining water in or adjacent to these riparian habitats.

4.3. Pursue international partnerships to identify migration and winter habitats and threats. Almost nothing is known regarding migration patterns and stopover habitats, especially south of the U.S. border. Also, there is more information needed on winter status and distribution for much of the flycatcher's winter range, especially in northern South America. The USFWS, USGS, USFS, USBR, and State Game and Fish (SGF) agencies should pursue and support international partnerships that facilitate gathering this important information. Such partnerships may be governmental, private, or combinations of both. Much of the needed work could be conducted by local biologists in cooperation with experts from the U.S..

4.4. Encourage programs that preserve habitats used by wintering and migrating flycatchers. Once migration and winter habitats are identified, Federal agencies (including Agency for International Development) should work with other countries and existing private international conservation groups to develop programs to protect these habitats. Such programs could involve the functional equivalents of conservation easements and agreements, land purchases, government agency policy directives, and/or similar programs. Successful programs will involve close cooperation between partners, and should incorporate extensive public outreach and education.

4.5. Encourage programs that minimize threats to wintering and migrating flycatchers. Migrating and wintering flycatchers face potential threats such as exposure to pesticides and other agrochemicals. This is especially true in parts of Central and South America, where many potent and injurious chemicals banned in the U.S. are still in widespread use. Federal agencies should work with other countries and existing private international conservation groups to develop and implement programs to alleviate or minimize these threats. Such programs could involve the functional equivalents of conservation easements and agreements, government agency policy directives, and/or similar programs. Successful programs will involve effective partnerships, and should incorporate extensive public outreach and education.

5. Survey and Monitor.

5.1. Facilitate and institute effective survey and monitoring programs.

5.1.1. Adopt standardized protocols for surveying and monitoring. Adopt standardized, rangewide protocols for surveying and monitoring to achieve rangewide comparable measures of occupancy, reproductive performance, and cowbird parasitism. These standardized protocols should also standardize and institutionalize annual reporting of data to appropriate State or Federal agencies, or other central data repository. Identify monitoring approach for downlisting: How often? What scale? What intensity (sampling, total census, etc.).

5.1.2. Institute appropriate monitoring of all reaches within management units.

5.1.3. Integrate survey data at State and rangewide levels. All survey and monitoring data should be reported annually and integrated at State and regional levels. This will allow annual monitoring of flycatcher status, particularly with respect to numerical recovery goals.

5.2. Monitor effects of management and restoration practices.

5.2.1. Review data for adaptive management purposes to improve effectiveness of management and restoration practices. The implementation and effectiveness of management and restoration practices should be monitored. Monitoring reports should be submitted to the USFWS to allow future practices to be modified and improved as warranted.

5.3. Survey to determine dispersal movements and colonization events. Suitable but unoccupied habitat should be surveyed to document dispersal movements, colonization events, and progression of habitat suitability.

5.4. Expand survey efforts in wintering habitat. With the consent of appropriate international authorities, perform surveys for wintering flycatchers in Central and South America. Provide technical and, where possible, financial support for local investigators to perform surveys.

6. Conduct Research.

6.1. Determine habitat characteristics that influence occupancy and reproductive success. Determine at local and landscape scales those habitat characteristics that influence occupancy of habitat by flycatchers, and reproductive success.

6.1.1. Determine plant species/structure that determines occupancy and reproductive success. The floristic characteristics of breeding habitat that contribute beneficially to site occupancy and reproductive success should be better defined. Characteristics requiring further definition include plant species composition and associations, structure, age classes, and patch size/configuration. These investigations should be done at both the patch and landscape scales using remote sensing and GIS technology.

6.1.2. Determine habitat area needed for breeding birds. The amount of habitat area needed for long-term conservation along dynamic ecosystems, as well as on managed, regulated rivers, should take into account the rate of riparian habitat succession, loss, and regeneration in different parts of the flycatcher's range; plant species composition; frequency of catastrophic events such as flood, fire, and drought; and factors identified in 6.1.1. above. These investigations should be done at both the patch and landscape scales using remote sensing and GIS technology.

6.1.3. Determine effects of conspecifics on site occupancy and reproductive success. The flycatcher is sometimes described as quasi-colonial, in that breeding pairs tend to occur in clusters. This tendency may affect annual occupancy of a habitat patch, and also reproductive success, due to effects on defense against (or attraction of) cowbirds and/or predators, opportunities for polygyny and re-pairing, etc. The presence of other willow flycatcher subspecies in *E. t. extimus* breeding habitat early in the breeding season may affect these phenomenon. These phenomena should be better understood, because of their potential effect on the fundamental demographic factors of site colonization, site occupancy, and reproductive success.

6.1.4. Determine use vs. availability of exotics in occupied sites. The use of exotic plant associations by flycatchers should be compared with availability of exotic associations, to better define any preferences and/or avoidances.

6.1.5. Determine long-term ecological productivity of native habitats vs. exotic habitats. The relative effects on long-term flycatcher productivity of native habitats (e.g., willows, boxelder) versus exotics (e.g., tamarisk, Russian olive) and various mixed associations, should be determined.

6.1.6. Refine understanding of effects of physical microclimate on site occupancy and reproduction. Physical parameters of nest sites such as the temperature, humidity, and insolation of the habitat interior may significantly affect site occupancy and reproductive success. These parameters may substantially differ in habitats dominated by native vs. exotic plant associations. The significance of these parameters should be better defined.

6.1.7. Determine influence of environmental toxins on breeding, survival, and prey base. Environmental toxins are a potential impact on breeding flycatchers. The possible scope and influence of this factor should be determined, by blood/tissue sampling, soil and water analysis, and by conducting information surveys to determine what agents are being used in any given area.

6.2. Investigate dam and reservoir management for maximizing downstream and delta habitat. Research is needed to identify management opportunities for operating dams and reservoirs to maximize habitat downstream, and at river inflow delta areas. This research should not only identify ways to maximize habitat, but also ways to anticipate and manage the inevitable setbacks imposed by prolonged drought and large/extended precipitation events.

6.3. Investigate surface and groundwater management scenarios to determine thresholds for habitat suitability and to maximize habitat quality. Research is needed to identify management opportunities for managing surface and groundwater to maximize habitat. This research should not only identify ways to maximize habitat, but also ways to anticipate and manage the inevitable setbacks imposed by prolonged drought.

6.4. Investigate grazing systems, strategies, and intensities for riparian recovery and maintenance.

6.4.1. Investigate grazing systems, strategies, and intensities for riparian recovery and maintenance. Research on the effects and uses of livestock grazing on riparian ecosystem health and recovery should be increased and refined. It is imperative that such research include comparison of control versus treatment areas, better documentation of grazing intensities and systems, previous land uses, and other potentially complicating factors. Federal land management agencies should work with State universities, private colleges, and research institutions to fund and facilitate research that better defines the ecological and hydrological effects and sustainability of livestock grazing in southwestern riparian ecosystems.

6.4.2. Investigate direct effects of livestock grazing on the flycatcher. The direct effects of livestock grazing, such as physically damaging nests or nest trees, should be further investigated.

6.4.3 Investigate impacts of native ungulates on riparian recovery and maintenance.

6.5. Conduct research on cowbird parasitism and control.

6.5.1. Collect baseline data on cowbird parasitism. Before cowbird control is initiated at a site, collect at least two years of baseline data to determine whether cowbird control is warranted. See Appendix F for guidelines.

6.5.2. Experimentally test the efficacy of cowbird trapping programs. Trapping efforts should be designed in part as experiments that can determine whether cowbird trapping benefits flycatcher populations, by reducing declines or allowing increases in numbers. See Appendix F for guidelines for these experiments.

6.6. Determine the most successful techniques for creating or restoring suitable habitat to degraded or former riparian lands, such as abandoned agricultural fields in riparian corridors.

6.7. Refine methods for determining distribution and population status and trends.

6.7.1. Acquire demographic and dispersal information. Acquire data on demographics and dispersal, through color banding.

6.7.2. Conduct limiting factor analyses. Conduct analyses to identify factors that may be limiting population stability, including contaminants, predators, patch size, and habitat effects on reproductive success.

6.7.3. Explore new methods and data needs for population viability analyses. As data on the flycatcher accumulate and the science of population viability analysis evolves, managers should evaluate which methods are most appropriate for the flycatcher, and assure that the necessary data are being collected.

6.7.4. Develop methodologies, which can be site specific if necessary, for determining year-to-year trends in population sizes at breeding sites. As various management strategies are applied at sites over periods of several years or more, it will be essential to accurately determine whether targeted populations respond in a favorable manner with increased population sizes. Methodologies developed to achieve this goal will have to control for survey intensity and frequency, amount of area surveyed, development of additional habitat (if the management action of interest is not dealing with the generation of new habitat) and year-to-year within site movements of flycatchers. To achieve success in this regard, methodologies need not result in complete counts of local populations but should generate reliable yearly indicators of the population size at a particular site.

6.7.5. Establish and refine protocols for addressing flycatcher distribution. To accurately determine changes in distribution and status, methodologies should be developed to monitor sites with suitable habitat but lacking flycatchers, so as to establish data on absence and on years when the sites become occupied.

6.8. Determine present and historical distribution of the subspecies through genetic work. The taxonomic status and distribution of the willow flycatcher subspecies should continue to be refined, through genetic research.

6.9. Determine migration and wintering distribution, habitat, and threats.

6.9.1. Investigate migration ecology, habitat selection and use. Although recent work has shed some light on migration timing and habitat use within some major southwestern rivers, little is known about migration, especially south of the U.S. border. Migration routes and stopover habitats/areas should be determined. This will require continued banding on the breeding grounds, in combination with netting/banding during migration periods, in all potential migration regions and habitats. Because most of the distance flycatchers travel during migration is outside of the U.S., research should focus on the types, locations, and extent of habitats used in those areas. This could identify geographic areas of habitats of particular concern, and allow development of specific management actions. Additional research is also needed to document important migratory behaviors, pathways, and survival in the U.S., including the relative value of different riparian habitats.

6.9.2. Investigate wintering distribution, status, ecology, and habitat selection. Recent work has provided valuable information on flycatcher wintering distribution, status, and ecology. However, these data are limited to Mexico, Costa Rica, El Salvador, and Panama, and do not include a substantial part of the willow flycatcher's winter range. Knowledge of winter distribution, habitat use, survival, and threats is needed for other areas. Additional research on winter survival, site fidelity, habitat selection, and habitat quality are also needed to properly assess habitat characteristics, quality, and availability. Remote sensing and GIS technologies should be used to determine landscape-level habitat distribution and availability.

6.9.3. Determine influence of environmental toxins on wintering flycatchers and their prey base. As in the breeding range, environmental toxins are a potential impact on the wintering grounds. The possible scope and influence of this factor should be determined, by blood/tissue sampling and by conducting information surveys to determine what agents are being used in any given area.

6.10. Conduct research on means of increasing reproductive success by approaches other than, or in addition to, cowbird management. Evaluate feasibility and effectiveness of reproductive manipulations such as reducing losses of flycatcher eggs and nestlings to general nest predators.

6.11. Conduct research to determine why increases in reproductive success due to cowbird control, or other measures, may not lead to increases in numbers of breeding birds. Determine for populations experiencing reproductive success and for populations that could receive emigrants from such populations, why numbers of breeding birds do not increase.

6.12. Investigate feasibility of reducing or eliminating habitat fire hazards. Without impacting flycatcher habitat, investigate methods for reducing or eliminating flammability of riparian habitat, e.g., reducing ignition sources. There has been little, if any, experimentation with fuel reduction in riparian habitats, especially tamarisk, and there are no standard guidelines on how best to accomplish this. Experimental riparian fuel reduction and flammability modification should be tested, conducted only in unoccupied habitats until the success and ramifications are better understood. Efficacy of these actions as a fire management tool, and effects on flycatcher habitat, should be tested in a scientific, controlled fashion.

6.12.1. Evaluate fuel reduction techniques in riparian habitats, especially tamarisk types. There has been little, if any, experimentation with fuel reduction in riparian habitats, especially tamarisk, and there are no standard guidelines on how best to accomplish this.

6.12.2. Test modifying flammability for fuels to modify fire risks. Evaluate whether managing for high water content in tamarisk by providing shallow depth to ground water allows tamarisk stands to be more fire resistant than if water is deeper.

6.12.3. Test the ability of prescribed fires to achieve desired fire hazard reduction, habitat protection, and habitat improvement. To better manage the controlled burns in tamarisk stands, one may wish to limit efforts to the rainy season, inundate the stand before burning, or reduce the fuel loads mechanically before burning.

7. Provide public education and outreach.

7.1. Hold annual Implementation Subgroup meetings. Convene annual meetings to report progress, review data, evaluate ongoing actions, and to plan and coordinate future work.

7.2. Maintain updated website. Maintain updated flycatcher website to disseminate new information on the flycatcher, current and developing habitat restoration technologies, problem-solving forums relating to implementing recovery actions, and other information relevant to flycatcher recovery.

7.3. Prepare brochures and make available to public.

7.3.1. Educate public about landscaping with native plants. Educate agencies and public about the benefits of landscaping and revegetating with native plants, and discourage use of exotics.

7.3.2. Educate public about other recreational impacts, especially fire hazards. Develop brochures, signs, and other interpretive materials to educate river and riparian recreationists about the ecological roles of fires and floods, and the potential dangers of accidental fires. In the long-term, this should help to reduce accidental fires and garner public support for the implementation of ecological restoration approaches. Inform maintenance and utility workers about the importance of protecting habitat. Educate equestrians about the value of overhanging branches to nesting birds and encourage them to avoid trimming overhanging branches.

7.3.3. Educate public about cowbird control. Inform public about cowbird ecology, impacts on other bird species, and approaches to cowbird control (See Appendix F). Inform the public of factors that enhance cowbird abundance, and measures that can be taken to reduce their abundance.

7.4. Post and maintain signs at some protected flycatcher breeding locations. At flycatcher breeding locations that are exposed to substantial levels of public use, signs should be posted and maintained that inform the public about necessary protective measures, and the overall ecological and economic goals and benefits of riparian restoration.

7.5. Conduct information exchange programs with foreign governments and publics. Inform the foreign governments and public about the flycatcher, the importance of migration stopover and winter habitats, and the threats the flycatcher faces during these periods. Work with local biologists, government officials, and private landowners to identify specific actions that can be undertaken, at particular sites, that will benefit wintering and migrating flycatchers.

7.6. Conduct symposia and workshops. As information accumulates regarding flycatcher ecology, restoration ecology and techniques, and ancillary issues of riparian and aquatic recovery, it will be important to share information in the interactive forum of symposia and workshops. These should be organized and sponsored by State and Federal agencies, and target private stakeholders, academic, independent researchers, and government regulatory and resource biologists.

7.7. Continue survey training. Survey training provided by State wildlife agencies, the USFWS, and/or Partners In Flight programs should be continued. These training sessions are crucial for assuring consistency in survey methods and minimizing disturbance of flycatchers. Training sessions also serve as important information-sharing meetings. While written survey protocols largely achieve the goals of standardizing surveys, annual survey training allows valuable opportunities for clarifying questions, exploring issues, and sharing accumulated experiences in an interactive setting.

8. Assure implementation of laws, policies and agreements that benefit the flycatcher.

8.1. Fully implement §7(a)(1) of the ESA. Section 7(a)(1) of the ESA requires all Federal agencies to use their authorities to further the conservation of the flycatcher and all other listed species. Federal agencies should meet this obligation to promote recovery of the flycatcher proactively, not simply as an outcome of consultation under ESA §7(a)(2).

8.2. Fully implement all Biological Opinions resulting from ESA §7(a)(2) consultations. Federal agencies can accomplish significant recovery efforts by fully implementing all Reasonable and Prudent Measures, Alternatives, and Conservation Recommendations resulting from consultation with the USFWS under the authority of ESA §7(a)(2). For example, the Lower Colorado River Biological Opinion obligates significant habitat acquisition that will substantially promote flycatcher recovery.

8.3. Monitor, support, and evaluate compliance with laws, policies and agreements that provide conservation benefits to the flycatcher.

8.3.1. Support compliance with ESA §7(a)(1) of the ESA. Section 7(a)(1) requires Federal agencies to use their authorities to further the conservation of the southwestern willow flycatcher and all other listed species.

8.3.2. Provide resource managers with training in conservation benefits. Provide resource managers with training in the ecological and economic benefits of riparian protection and enhancement, for species and resources other than the flycatcher.

8.3.3. Monitor compliance with ESA §7(a)(2) of the ESA. Section 7(a)(2) requires Federal agencies to consult with the Service to ensure that they are not undertaking, funding, permitting, or authorizing actions likely to jeopardize the continued existence of listed species or destroy or adversely modify designated critical habitat.

8.3.4. Ensure consistency among ESA §7(a)(2) consultations. Consultations and resultant Biological Opinions should use consistent approaches, criteria, and data with regard to environmental baselines, effects of actions, take, jeopardy/non-jeopardy thresholds, incidental take allowed, reasonable and prudent measures, and conservation recommendations.

8.3.5. Monitor compliance with existing Biological Opinions. All Federal agencies should assure compliance with Biological Opinions, including reporting implementation of conservation recommendations and reasonable and prudent measures and alternatives. Determining the actual effects of Federal actions, to compare with the anticipated effects, will provide an important feedback loop to continually refine conservation and recovery measures.

8.4. Integrate recovery efforts with those for other species. Planning flycatcher recovery is directly related to planning for other endangered riparian birds, native fishes, reptiles, amphibians, invertebrates, and plants because they all are dependent on the same hydrologic, geomorphic, and vegetation systems. Decisions that affect one species will inevitably affect all of them, yet recovery planning and implementation efforts are not formally connected. Therefore, formally connect planning and decision making for flycatcher recovery with the recovery of other imperiled aquatic and riparian species, e.g., Rio Grande silvery minnow, woundfin, Virgin River chub, Moapa dace, Pahranagat roundtail chub, and others (see Table 6). Determine likely interaction effects of implementing a plan for one species on the others. Integrate management into State and regional Partners In Flight Bird Conservation Plans.

8.5. Monitor compliance and effectiveness of agreements and other mechanisms used as delisting criteria.

8.6. Continue implementation of Secretarial Order 3206.

8.6.1. Effectively communicate with Tribes. Appropriate agencies should meet annually with Tribes to report progress on conservation measures, review data, plan future efforts, and coordinate joint activities.

9. Track recovery progress.

9.1. Maintain collaborative structure of Recovery Team. Maintain a Recovery Team structure that retains the Technical and Implementation Subgroups, and the Tribal Working Group. Appoint a USFWS southwestern willow flycatcher recovery coordinator in each USFWS region, with lead coordination through USFWS Region 2.

9.2. Annual review of survey and monitoring data. The Technical Subgroup and recovery coordinators should have access to, acquire, and review all annual survey and monitoring data; these data should be shared with the Implementation Subgroups and Tribal Working Group. Data and interpretations provided by compiling entities (e.g., State wildlife agencies, Partners In Flight programs) should be reviewed and included in an annually updated comprehensive assessment of the population status of the flycatcher.

9.3. Review and synthesis of current flycatcher research and other pertinent research. The Technical Subgroup and recovery coordinators should keep aware of current research on the flycatcher and other pertinent research (e.g., restoration ecology), to maintain a comprehensive synthesis of the current body of knowledge relevant to flycatcher recovery. New research data should be shared with the Implementation Subgroups and Tribal Working Group.

9.4. Repeat Population Viability Analysis. After adequate new monitoring data have accumulated, repeat a Population Viability Analysis to re-examine the flycatcher's status and conservation priorities.

9.5. Develop recommendations for survey and monitoring strategies. The Technical Subgroup and recovery coordinators should, with the assistance of State wildlife agencies and Partners In Flight groups, periodically review survey and monitoring strategies and methods to evaluate their efficacy in maintaining an effective view of the flycatcher's status. Methodologies and strategies should be revised as appropriate, and this information communicated to the Implementation Subgroups and Tribal Working Group.

9.6. Update Recovery Plan every 5 years. Modify this recovery plan in response to management, monitoring, and research data, at 5-year intervals.

F. Minimization of Threats to the Southwestern Willow Flycatcher Through Implementation of Recovery Actions

A species may be determined to be an endangered or threatened species due to one or more of the five factors described in Section 4(a)(1) of the ESA. The final rule listing the southwestern willow flycatcher evaluated threats to the species in terms of three listing factors (USFWS 1995). The three listing factors included: the present or threatened destruction, modification, or curtailment of the flycatcher's habitat or range; the inadequacy of existing regulatory mechanisms; and other natural or manmade factors affecting the flycatcher's continued existence. At the time of listing, the USFWS was unaware of threats resulting from overutilization for commercial, recreational, scientific, or educational purposes. The USFWS was also unaware of any disease that constitutes a significant threat to the flycatcher, but did recognize that predation of southwestern willow flycatchers may constitute a significant threat that may be increasing with habitat fragmentation. Implementation of the recovery actions described in Section IV. D. and E. above would minimize these threats as follows:

<u>Listing Factor 1: The present or threatened destruction, modification, or curtailment of its habitat or range.</u> Loss and modification of southwestern riparian habitats have occurred from urban and agricultural development, water diversion and impoundment, channelization, livestock grazing, off-road vehicle and other recreational uses, and hydrological changes resulting from these and other land uses (USFWS 1995). The final rule also recognizes invasion by the exotic tamarisk as another likely factor in the loss and modification of southwestern willow flycatcher habitat. Recommended recovery actions that would minimize these threats are: 1. Increase and improve currently suitable and potentially suitable habitat; 1.1. Secure and enhance currently suitable and potentially suitable habitat on Federal lands, lands affected by Federal actions, and cooperating non-Federal and Tribal lands; 1.1.1. Develop management plans to reduce threats and promote processes that secure, restore, and enhance currently suitable and potentially suitable habitat; 1.1.2. Manage physical elements and processes to reduce threats and promote processes that secure, restore, and enhance currently suitable and potentially suitable habitat; 1.1.2.1. Restore the diversity of fluvial processes; 1.1.2.1.1. Identify dams where modification of dam operating rules will benefit recovery of the flycatcher; 1.1.2.1.2. Identify dams where modification of dam operations will benefit recovery of the flycatcher by taking advantage of system flexibility and water surpluses/flood flows; 1.1.2.1.3. Determine feasibility of simulating the natural hydrograph to restore/enhance riparian systems; 1.1.2.1.4. Determine feasibility of managing reservoir levels to establish and maintain lake fringe and inflow habitat; 1.1.2.1.5. Determine feasibility of using surplus and/or flood flows to increase or add water to marsh areas between levees and on flood plains; 1.1.2.1.6. Determine feasibility of keeping daily ramping rates and daily fluctuations for dam releases as gradual as possible to prevent bank erosion and loss of riparian vegetation, except when mimicking flood flows; 1.1.2.1.7. Determine feasibility of augmenting sediment in sediment-depleted systems; 1.1.2.1.8. Implement 1.1.2.1.3. – 1.1.2.1.7., where determined feasible; 1.1.2.1.9. Monitor 1.1.2.1.3. – 1.1.2.1.7., and provide feedback to the Technical Subgroup; 1.1.2.2.

Restore adequate hydrogeomorphic elements to expand habitat, favor native over exotic plants, and reduce fire potential; 1.1.2.2.1. Increase water available for recovery; 1.1.2.2.1.1. Increase efficiency of groundwater management to expand habitat, favor native over exotic plants, and reduce fire potential; 1.1.2.2.1.2. Use urban waste water outfall and rural irrigation delivery and tail waters for habitat restoration to expand habitat, favor native over exotic plants, and reduce fire potential; 1.1.2.2.1.3. Provide (reestablish) instream flows to expand habitat, favor native over exotic plants, and reduce fire potential; 1.1.2.2.2. Expand the active channel area that supports currently suitable and potentially suitable flycatcher habitat by increasing the width of levees and using available flows to mimic overbank flow; 1.1.2.2.3. Reactivate flood plains to expand native riparian forests; 1.1.2.2.4. Restore more natural channel geometry (width, depth, bank profiles) where the return of the natural hydrograph will be insufficient to improve habitat; 1.1.2.3. Manage fire to maintain and enhance habitat quality and quantity; 1.1.2.3.1. Develop fire risk and management plans; 1.1.2.3.2. Suppress fires; 1.1.2.3.3. Restore ground water, base flows, and flooding; 1.1.2.3.4. Reduce incidence of flammable exotics; 1.1.2.3.4.1. Manage/reduce exotic species that contribute to increased fire incidence; 1.1.2.3.4.2. Use water more efficiently and reduce fertilizer applications; 1.1.2.3.5. Reduce recreational fires; 1.1.3. Manage biotic elements and processes; 1.1.3.1. Restore biotic interactions, such as herbivory, within evolved tolerance ranges of the native riparian plant species; 1.1.3.1.1. Manage livestock grazing to restore desired processes and increase habitat quality and quantity; 1.1.3.1.1.1. If livestock grazing is a major stressor implement conservative livestock grazing guidelines. Implement general livestock grazing guidelines from Appendix G (see also Section IV. F.; Narrative Outline for Recovery Actions) in occupied, suitable, or restorable habitat (restorable habitats are riparian systems that have the appropriate hydrologic and ecologic setting to be suitable flycatcher habitat); 1.1.3.1.1.2. Determine appropriate use areas for grazing; 1.1. 3.1.1.3. Reconfigure grazing management units; 1.1.3.1.1.4. Improve documentation of grazing practices; 1.1.3.1.2. Manage wild ungulates; 1.1.3.1.3. Manage keystone species; 1.1.3.2. Manage exotic plant species; 1.1.3.2.1. Develop exotic species management plans; 1.1.3.2.2. Coordinate exotic species management efforts; 1.1.3.2.3. Restore ecosystem conditions that favor native plants; 1.1.3.2.3.1. Eliminate physical stresses, such as high salinity or reduced stream flows, that favor exotic plants; 1.1.3.2.3.2. Create or allow for a river hydrograph that restores the natural flood disturbance regime; 1.1.3.2.3.3. Restore ungulate herbivory to intensities and types under which native plant species are more competitive; 1.1.3.2.4. Retain native riparian vegetation in floodplains or channels; 1.1.3.2.5. Retain exotic species at sites dominated by native riparian vegetation.; 1.1.3.2.5.1. At native dominated sites, retain tamarisk in occupied flycatcher habitat and, where appropriate, in suitable but unoccupied habitat, unless there is a trend for steady increase of tamarisk; 1.1.3.2.5.2. If needed, increase habitat quality within stands of exotic plants by implementing restorative actions such as seasonal flooding; 1.1.3.2.6. Remove exotics in occupied, suitable but unoccupied, and potentially suitable habitats dominated by exotics only if: 1) underlying causes for dominance of exotics have been addressed, 2) there is evidence that the exotic species will be replaced by vegetation of higher functional value, and 3) the action is part of an overall restoration plan; 1.1.3.2.6.1. In suitable and potential habitats where exotic species are to be removed through chemical or mechanical means, use a temporally staged approach to clear areas so some mature habitat remains throughout the restoration period for potential use by flycatchers; 1.1.3.2.6.2. Release habitat-targeted biocontrol agents only outside the breeding range of the flycatcher; 1.1.3.3. Provide areas protected from recreation; 1.1.3.3.1. Reduce impacts from recreationists; 1.1.3.3.2. Confine camping areas; 1.1.3.3.3. Restore habitat impacted by recreation; 1.1.3.3.4. Place designated recreation shooting areas away from riparian areas; 1.1.3.3.5. Minimize attractants to scavengers, predators, and brown-headed cowbirds; 1.1.3.3.6. Provide on-site monitors where recreation conflicts exist; 1.2. Work with private landowners, State agencies, municipalities, and nongovernmental organizations to conserve and enhance habitat on non-Federal lands; 1.2.1. Evaluate and provide rangewide prioritization of non-Federal lands; 1.2.2. Achieve protection of occupied habitats; 1.2.3. Provide technical assistance to conserve and enhance occupied habitats on non-Federal lands; 1.2.4. Pursue joint ventures toward flycatcher conservation; 1.3. Work with Tribes to develop conservation plans and strategies to realize the considerable potential for conservation and recovery on Tribal lands; 1.3.1. Work with Tribes to establish a regular system of surveys and monitoring, and train Tribal staff in the flycatcher survey protocol; 1.3.2. Determine protocols for information sharing; 1.3.3. Maintain an incumbent in the position of Tribal Liaison to the Technical Subgroup; 1.3.4. Provide technical assistance to Tribes that have flycatchers on their lands; 1.3.5. Support Tribal efforts to improve currently suitable and potentially suitable habitat; 1.3.6. Work with Tribes to determine the extent to which Tribal water rights might or might not be available to aid in conservation and recovery of the flycatcher; 1.3.7. Provide aid in developing educational programs and opportunities that further flycatcher recovery; 2. Increase metapopulation stability; 2.1. Increase size, number, and distribution of populations and habitat within Recovery Units; 2.1.1. Conserve and manage all existing breeding sites; 2.1.2. Secure, maintain, and enhance largest populations; 2.1.3. Develop new habitat near extant populations; 2.1.3.1. Use existing habitat acquisition/conservation priorities; 2.1.4. Enhance connectivity to currently isolated occupied sites; 2.1.5. Facilitate establishment of new, large populations in areas where none exist, through habitat restoration; 2.1.6. Increase population sizes at small occupied sites; 4.1. Identify, for purposes of protection, riparian habitats in the U.S. that provide essential migration and stopover habitat; 4.2. Restore, protect, and expand riparian migration and stopover habitats in the U.S.; 4.3. Pursue international partnerships to identify migration and winter habitats and threats; 4.4. Encourage programs that preserve habitats used by wintering and migrating flycatchers; 4.5. Encourage programs that minimize threats to wintering and migrating flycatchers. 5.4. Expand survey efforts in wintering habitat; 6.1. Determine habitat characteristics that influence occupancy and reproductive success; 6.1.1. Determine plant species / structure that determines occupancy and reproductive success; 6.1.2. Determine habitat area needed for breeding birds; 6.1.3. Determine effects of conspecifics on site occupancy and reproductive success; 6.1.4. Determine use vs. availability of exotics in occupied sites; 6.1.5. Determine long-term ecological productivity of native habitats vs. exotic habitats; 6.1.6. Refine understanding of effects of physical microclimate on site occupancy and reproduction; 6.2. Investigate dam and reservoir management for maximizing downstream and delta habitat; 6.3. Investigate surface and groundwater management scenarios to determine thresholds for habitat suitability and to maximize habitat quality; 6.4. Investigate grazing systems, strategies, and intensities for riparian recovery and maintenance; 6.4.1. Investigate grazing systems, strategies, and intensities for riparian recovery and maintenance; 6.4.2. Investigate direct effects of livestock grazing on the flycatcher; 6.4.3 Investigate impacts of native ungulates on riparian recovery and maintenance; 6.6. Determine the most successful techniques for creating or restoring suitable habitat to degraded or former riparian lands, such as abandoned agricultural fields in riparian corridors; 6.9.

Determine migration and wintering distribution, habitat, and threats; 6.9.1. Investigate migration ecology, habitat selection and use; 6.9.2. Investigate wintering distribution, status, ecology , and habitat selection; 6.12. Investigate feasibility of reducing or eliminating habitat fire hazards; 6.12.1. Evaluate fuel reduction techniques in riparian habitats, especially tamarisk types; 6.12.2. Test modifying flammability for fuels to modify fire risks; 6.12.3. Test prescribed fire to achieve desired fire hazard reduction, habitat protection, and habitat improvement; 7.3.1. Educate the public about landscaping with native plants; 7.3.2. Educate the public about recreational impacts, especially about fire hazards; and 7.4. Post and maintain signs at some protected flycatcher breeding locations.

Listing Factor 2: Overutilization for commercial, recreational, scientific, or educational purposes. The USFWS is unaware of threats resulting from overutilization.

Listing Factor 3: Disease or predation. The USFWS is unaware of any disease that constitutes a significant threat to the southwestern willow flycatcher. However, predation may constitute a significant threat and may be increasing with habitat fragmentation. This threat is addressed by recovery actions 1.1.3.3.5. Minimize attractants to scavengers, predators, and brown-headed cowbirds; and 6.10. Conduct research on means of increasing reproductive success by approaches other than, or in addition to, cowbird management, such as reducing losses of flycatcher eggs and nestlings to general nest predators.

Listing Factor 4: The inadequacy of existing regulatory mechanisms. Prior to listing, the Migratory Bird Treaty Act (MBTA) (16 U.S.C. § 703-712) was the only Federal protection provided for the southwestern willow flycatcher. Unlike the ESA, there are no provisions in the MBTA preventing habitat destruction unless direct mortality or destruction of active nests occurs. State listings of the flycatcher in New Mexico and Arizona do not convey habitat protection or protection of individuals beyond existing regulations on capture, handling, transportation, and take of native wildlife. In California, the California Endangered Species Act (CESA) prohibits unpermitted possession, purchase, sale, or take of listed species, but the CESA definition of take does not include harm, which under the ESA can include destruction of habitat that actually kills or injures wildlife by significantly impairing essential behavioral patterns (although CESA requires consultation between the CDFG and other State agencies to ensure that activities of State agencies will not jeopardize the continued existence of State-listed species). As a consequence, the USFWS determined additional protections under the ESA to be necessary. Threats associated with the inadequacy of existing regulatory mechanisms are addressed by the following recommended recovery actions: 4. Minimize threats to wintering and migration habitat; 4.1. Identify, for purposes of protection, riparian habitats in the U.S. that provide essential migration and stopover habitat; 4.2. Restore, protect, and expand riparian migration and stopover habitats in the U.S; 4.3. Pursue international partnerships to identify migration and winter habitats and threats; 4.4. Encourage programs that preserve habitats used by wintering and migrating flycatchers; 4.5.

Encourage programs that minimize threats to wintering and migrating flycatchers; 7.5. Conduct information exchange programs with foreign governments and publics; 8. Assure implementation of laws, policies and agreements that benefit the flycatcher; 8.1. Fully implement §7(a)(1) of the ESA; 8.2. Fully implement all Biological Opinions resulting from ESA §7(a)(2) consultations; 8.3. Monitor, support, and evaluate compliance with laws, policies and agreements that provide conservation benefits; 8.3.1. Support compliance with ESA §7(a)(1) of the ESA; 8.3.3. Monitor compliance with ESA §7(a)(2) of the ESA; 8.3.4. Ensure consistency among ESA §7(a)(2) consultations; 8.3.5. Monitor compliance with existing Biological Opinions; 8.5. Monitor compliance and effectiveness of agreements and other mechanisms used as delisting criteria; 8.6. Continue implementation of Secretarial Order 3206; and 8.6.1. Effectively communicate with Tribes.

<u>Listing Factor 5: Other natural or manmade factors affecting its continued existence.</u> The final rule recognizes threats associated with the susceptibility of small, isolated populations, threats from brood parasitism by the brown-headed cowbird, and potential threats from pesticides as a result of the flycatcher's preference for floodplain areas that are now largely agricultural. Recommended recovery actions that address these threats include: 2. Increase metapopulation stability; 2.1. Increase size, number, and distribution of populations and habitat within Recovery Units; 2.1.1. Conserve and protect all existing breeding sites; 2.1.2. Secure, maintain, and enhance largest populations; 2.1.3. Develop new habitat near extant populations; 2.1.3.1. Use existing habitat acquisition/conservation priorities; 2.1.4. Enhance connectivity to currently isolated occupied sites; 2.1.5. Facilitate establishment of new, large populations in areas where none exist, through habitat restoration; 2.1.6. Increase population sizes at small occupied sites; 3.1.1.1. Increase the amount and quality of riparian habitat to increase habitat patch sizes and local flycatcher population sizes thereby minimizing levels and impacts of cowbird parasitism; 3. Improve demographic parameters; 3.1. Increase reproductive success; 3.1.1. Manage brown-headed cowbird parasitism after collection of baseline data shows high rates of parasitism; 3.1.1.1. Increase the amount and quality of riparian habitat to increase habitat patch sizes and local flycatcher population sizes thereby minimizing levels and impacts of cowbird parasitism; 3.1.1.2. Develop cowbird management programs if warranted by baseline data on parasitism rates; 3.1.1.3. Implement cowbird management programs if warranted by baseline data on parasitism rates; 3.1.1.4. Pursue long-term landscape objectives for cowbird reduction; 3.1.2. Reduce direct impacts that topple or otherwise destroy nests; 3.1.3. Reconsider assessments of habitat quality or other threats if cowbird control measures do not increase numbers of breeding flycatchers; 6.1.7. Determine influence of environmental toxins on breeding, survival, and prey base; 6.5. Conduct research on cowbird parasitism and control; 6.5.1. Collect baseline data on cowbird parasitism; 6.5.2. Experimentally test the efficacy of cowbird trapping programs; 6.9.3. Determine influence of environmental toxins on wintering flycatchers and their prey base; 6.11. Conduct research to determine why increases in reproductive success due to cowbird control or other measures may not lead to increases in numbers of breeding birds in populations experiencing improved reproductive success or in populations that could receive emigrants from such populations; and 7.3.3. Educate the public that cowbird parasitism is a natural process but may require management efforts in some instances due to high levels or other stressors that have endangered flycatchers.

V. Implementation Schedule

The following Implementation Schedule outlines actions and costs for the southwestern willow flycatcher recovery program. It is a guide for meeting the objectives elaborated throughout Section IVof this Recovery Plan. This schedule indicates action numbers, priorities, descriptions, duration, potential partners, and estimated costs. These actions, when accomplished, should bring about the recovery of the southwestern willow flycatcher. The costs estimated are intended to assist in planning. The time estimated to reclassification as threatened is 20 years, with removal from the Federal endangered species list possible in 30 years. Primary emphasis is placed on estimating costs for the first 5 years because the USFWS intends to re-evaluate this Recovery Plan, and amend as necessary, in 5 years. This Recovery Plan does not obligate any involved agency and/or partner to expend the estimated funds. Although cooperation and collaboration with private landowners is an important tenant of this Recovery Plan, private landowners are also not obligated to expend any funds. In some instances, it it not possible to estimate costs until related actions have been completed.

Action Priority

Priority actions for recovering the southwestern willow flycatcher are based on the following ranking system: actions with a value of 1 are necessary to prevent extinction or irreversible decline in the species in the foreseeable future; actions with a value of 2 are necessary to prevent a significant decline in species population/habitat quality, or some other significant negative impact, short of extinction; and actions with a value of 3 include all other actions necessary to meet recovery objectives.

Commonly used abbreviations in the Implementation Schedule are noted below. Refer to Appendix B for a complete list of acronyms and abbreviations.

FTE Full Time Equivalent. Estimated at GS-11 salary and benefits ($61,000) in Phoenix, Arizona.
FY Fiscal Year. FY01 refers to the first year, subsequent to approval of the Recovery Plan, in which implementation of recovery actions begin.
MU Management Unit, as designated in the Recovery Plan.
RU Recovery Unit, as designated in the Recovery Plan.
TBD To be determined.

Shaded boxes represent years when no action (or funds) is expected to be taken.

V. Implementation Schedule

Priority #	Action #	Action Description	Duration	Minimum List of Potential Partners	Total Estimated Costs	Costs ($1000s) FY 01	FY 02	FY 03	FY 04	FY 05	FY 06-20	FY 21-30	Comments
1	1.1.1	Develop management plans to reduce threats and promote processes that secure, restore, and enhance currently suitable and potentially suitable habitat.	5 yrs.	AFA	600	120	120	120	120	120			20% of MUs complete 1 plan each year until 100%. At $20,000 per management plan/year, $20,000 x 6 MUs = $120,000/year.
2	1.1.2.1.1	Identify dams where modification of dam operating rules will benefit recovery of the flycatcher.	2 yrs.	USBR, COE, FERC	1100	550	550						6 RUs x 1.5 FTEs/RU = 9 FTEs. 9 FTEs @ $61,000/year = $549,000/year.
2	1.1.2.1.2	Identify dams where modification of dam operations will benefit recovery of the flycatcher by taking advantage of system flexibility and water surpluses/flood flows.	2 yrs.	USBR, COE, FERC	0	0	0						Same funds as 1.1.2.1.1.
3	1.1.2.1.3	Determine feasibility of simulating the natural hydrograph to restore/enhance riparian systems.	3 yrs.	USBR, COE, DOE, GCAMWG	1650			550	550	550			6 RUs x 1.5 FTEs/RU = 9 FTEs. 9 FTEs @ $61,000/year = $549,000/year. Feasibility studies to be conducted for those areas identified in 1.1.2.1.1-1.1.2.1.2.

V. Implementation Schedule

Priority #	Action #	Action Description	Duration	Minimum List of Potential Partners	Total Estimated Costs	Costs ($1000s) FY 01	FY 02	FY 03	FY 04	FY 05	FY 06-20	FY 21-30	Comments
2	1.1.2.1.4	Determine feasibility of managing reservoir levels to establish and maintain lake fringe and inflow habitat.	3 yrs.	USBR, COE	0			0	0	0			Same funds as 1.1.2.1.3. Feasibility studies to be conducted for those areas identified in 1.1.2.1.1-1.1.2.1.2.
3	1.1.2.1.5	Determine feasibility of using surplus and/or flood flows to increase or add water to marsh areas between levees and on flood flows.	3 yrs.	USBR, COE, MRGCD, MSCP	0			0	0	0			Same funds as 1.1.2.1.3. Feasibility studies to be conducted for those areas identified in 1.1.2.1.1-1.1.2.1.2.
2	1.1.2.1.6	Determine feasibility of keeping daily ramping rates and daily fluctuations for dam releases as gradual as possible to prevent bank erosion and loss of riparian vegetation, except when mimicking flood flows.	3 yrs.	USBR, COE, GCAMWG	0			0	0	0			Same funds as 1.1.2.1.3. Feasibility studies to be conducted for those areas identified in 1.1.2.1.1-1.1.2.1.2.
3	1.1.2.1.7	Determine feasibility of augmenting sediment in sediment-depleted systems.	3 yrs.	USBR, COE, MRGCD, MSCP, GCAMWG	0			0	0	0			Same funds as 1.1.2.1.3. Feasibility studies to be conducted for those areas identified in 1.1.2.1.1-1.1.2.1.2.

V. Implementation Schedule

Priority #	Action #	Action Description	Duration	Minimum List of Potential Partners	Total Estimated Costs	Costs ($1000s)							Comments
						FY 01	FY 02	FY 03	FY 04	FY 05	FY 06-20	FY 21-30	
2	1.1.2.1.8	Implement 1.1.2.1.3-1.1.2.1.7, where feasible.	6-30 yrs.	USBR, COE	TBD						TBD	TBD	Costs dependent on feasibility findings.
2	1.1.2.1.9	Monitor 1.1.2.1.3-1.1.2.1.7, and provide feedback to the Technical Subgroup.	6-30 yrs.	USBR, COE	TBD						TBD	TBD	Costs dependent on feasibility findings.
1*	1.1.2.2.1.1	Increase efficiency of groundwater management to expand habitat, favor native over exotic plants, and reduce fire potential.	30 yrs.	IRR, MRGCD, ADWR, ABQ	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Critical areas need to be identified and strategies agreed upon.
2	1.1.2.2.1.2	Use urban waste water outfall and rural irrigation delivery and tail waters for habitat restoration to expand habitat, favor native over exotic plants, and reduce fire potential.	30 yrs.	MRGCD, IRR, MWD, ABQ, PHX, LSV, SND	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Water districts to identify opportunities for implementation and determine associated costs.
2	1.1.2.2.1.3	Provide (reestablish) instream flows to expand habitat, favor native over exotic plants, and reduce fire potential.	6-30 yrs.	USBR, COE, ADWR, MWD, MRGDC, ABQ, PHX, LSV, SND, IRR	TBD						TBD	TBD	Cost should be coordinated with 1.1.2.1.3-1.1.2.1.7.

V. Implementation Schedule

Priority #	Action #	Action Description	Duration	Minimum List of Potential Partners	Total Estimated Costs	Costs ($1000s)							Comments
						FY 01	FY 02	FY 03	FY 04	FY 05	FY 06-20	FY 21-30	
2	1.1.2.2.2	Expand the active channel area that supports currently suitable and potentially suitable flycatcher habitat by increasing the width of levees and using available flows to mimic overbank flow.	6-30 yrs.	USBR, COE	TBD						TBD	TBD	Costs should be coordinated with 1.1.2.1.3-1.1.2.1.7.
2	1.1.2.2.3	Reactivate flood plains to expand native riparian forests.	6-30 yrs.	USBR, COE, MSCP, MRGCD	TBD						TBD	TBD	Costs should be coordinated with 1.1.2.1.3-1.1.2.1.7.
3	1.1.2.2.4	Restore more natural channel geometry (width, depth, bank profiles) where the return of the natural hydrograph will be insufficient to improve habitat.	6-30 yrs.	USBR, COE	TBD						TBD	TBD	
2	1.1.2.3.1	Develop fire risk and management plans.	5 yrs.	BLM, FS, FWS, DOD, USBR	600	120	120	120	120	120			Same formula as 1.1.1.
2	1.1.2.3.2	Suppress fires.	30 yrs.	BLM, FS, FWS, DOD, USBR	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Sites to be prioritized in management plans in 1.1.2.3.1.

V. Implementation Schedule

Priority #	Action #	Action Description	Duration	Minimum List of Potential Partners	Total Estimated Costs	Costs ($1000s)							
						FY 01	FY 02	FY 03	FY 04	FY 05	FY 06-20	FY 21-30	Comments
1	1.1.2.3.3	Restore ground water, base flows, and flooding.	6-30 yrs.	USBR, COE MWD, MRGCD, ADWR, IRR	TBD						TBD	TBD	Identify opportunities from implementing 1.1.1.
3	1.1.2.3.4.1	Manage/reduce exotic species that contribute to increased fire incidence.	6-30 yrs.	BLM, FS, USBR, FWS, DOD, NRCS	TBD						TBD	TBD	Identify opportunities from implementing 1.1.1.
3	1.1.2.3.4.2	Use water more efficiently and reduce fertilizer applications.	30 yrs.	NRCS, FWS, BLM	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Opportunities based on local conditions.
3	1.1.2.3.5	Reduce recreational fires.	5 yrs.	USBR, BLM, FS, FWS	1200	240	240	240	240	240			4 agencies x 6 RU x $10,000/year = $240,000/year.

V. Implementation Schedule

Priority #	Action #	Action Description	Duration	Minimum List of Potential Partners	Total Estimated Costs	Costs ($1000s) FY 01	FY 02	FY 03	FY 04	FY 05	FY 06-20	FY 21-30	Comments
2	1.1.3.1.1.1	If livestock grazing is a major stressor implement conservative livestock grazing guidelines. Implement general livestock grazing guidelines from Appendix G (see also Section E. Narrative Outline for Recovery Actions) in occupied, suitable, or restorable habitat (restorable habitats are riparian systems that have the appropriate hydrologic and ecologic setting to be suitable flycatcher habitat.)	5 yrs.	BLM, FS	7320	1464	1464	1464	1464	1464			Reevaluate with 5 year revision of plan. 24 FTEs @ $61,000/year = $1,464,000/year. (Assuming 12 FTEs per agency.)
2	1.1.3.1.1.2	Determine appropriate use areas for grazing.	5 yrs.	BLM, FS, FWS, SGF	0	0	0	0	0	0			Same funds as 1.1.3.1.1.1.
2	1.1.3.1.1.3	Reconfigure grazing management units.	5 yrs.	BLM, FS	0	0	0	0	0	0			Same funds as 1.1.3.1.1.1.
3	1.1.3.1.1.4	Improve documentation of grazing practices.	5 yrs.	BLM, FS	0	0	0	0	0	0			Same funds as 1.1.3.1.1.1.

V. Implementation Schedule

Priority #	Action #	Action Description	Duration	Minimum List of Potential Partners	Total Estimated Costs	Costs ($1000s) FY 01	FY 02	FY 03	FY 04	FY 05	FY 06-20	FY 21-30	Comments
3	1.1.3.1.2	Manage wild ungulates.	30 yrs.	BLM, FS, FWS, SGF	0	0	0	0	0	0	0	0	Can be accomplished through existing and ongoing program activities; no new funds needed.
3	1.1.3.1.3	Manage keystone species.	30 yrs.	BLM, FS, FWS, SGF	0	0	0	0	0	0	0	0	Can be accomplished through existing and ongoing program activities; no new funds needed.
2	1.1.3.2.1	Develop exotic species management plans.	5 yrs.	USBR, COE, BLM, FS, FWS, DOD, NRCS, SGF, SAG, MRGCD	600	120	120	120	120	120			20% of MUs complete 1 plan each year until 100%. At $20,000 per management plan/year, $20,000 x 6 MUs/year = $120,000/year.
3	1.1.3.2.2	Coordinate exotic species management efforts.	5 yrs.	USBR, BLM, FS, FWS, DOD, NRCS, SGF, SAG, MSCP, MRGCD	1830	366	366	366	366	366			6 RUs x 1 FTE /RU @ $61,000/year x 5 yrs = $366,000/year.
2	1.1.3.2.3.1	Eliminate physical stresses, such as high salinity or reduced stream flows, that favor exotic plants.	30 yrs.	USBR, COE, FWS, SGF	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Opportunities identified in 1.1.3.2.1.

V. Implementation Schedule

Priority #	Action #	Action Description	Duration	Minimum List of Potential Partners	Total Estimated Costs	Costs ($1000s) FY 01	FY 02	FY 03	FY 04	FY 05	FY 06-20	FY 21-30	Comments
2	1.1.3.2.3.2	Create or allow for a river hydrograph that restores the natural flood disturbance regime.	30 yrs.	USBR, COE	732	366	366	TBD	TBD	TBD	TBD	TBD	To identify appropriate areas, 6 RU x 1 FTE/RU @ $61,000 = $366,000/year. FY03-30 funds dependent on feasibility findings in FY01-02.
2	1.1.3.2.3.3	Restore ungulate herbivory to intensities and types under which native plant species are more competitive.	30 yrs.	BLM, FS, FWS, SGF	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Coordinate with 1.1.3.1.2.
1	1.1.3.2.4	Retain native riparian vegetation in floodplains or channels.	20 yrs.	BLM, FS, FWS, USBR, SGF, SAG	1,800	600	600	600	TBD	TBD	TBD		$100,000 for each RU (6) for 3 years to retain native riparian vegetation where immediately threatened. Prioritize with plans in 1.1.1 for longer-term management.
2	1.1.3.2.5.1	At native dominated sites, retain tamarisk in occupied flycatcher habitat and, where appropriate, in suitable but unoccupied habitat, unless there is a trend for steady increase of tamarisk.	20 yrs.	BLM, FS, FWS, USBR, NRCS, SGF, SAG	TBD	TBD	TBD	TBD	TBD	TBD	TBD		Coordinate with 1.1.2.3.3.

V. Implementation Schedule

Priority #	Action #	Action Description	Duration	Minimum List of Potential Partners	Total Estimated Costs	Costs ($1000s)							Comments
						FY 01	FY 02	FY 03	FY 04	FY 05	FY 06-20	FY 21-30	
2	1.1.3.2.5.2	If needed, increase habitat quality within stands of exotic plants by implementing restorative actions such as seasonal flooding.	30 yrs.	USBR, COE	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Coordinate with 1.1.2.3.3.
3	1.1.3.2.6.1	In suitable and potential habitats where exotic species are to be removed through chemical or mechanical means, use a temporally staged approach to clear areas so some mature habitat remains throughout the restoration period for potential use by flycatchers.	30 yrs.	NRCS, BLM, FS, FWS, SAG	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Depends on planned site-specific management actions.
2	1.1.3.2.6.2	Release habitat-targeted biocontrol agents only outside the occupied breeding range for the flycatcher.	30 yrs.	USDA, USGS, FWS	0	0	0	0	0	0	0	0	Costs not accrued within range of flycatcher.

V. Implementation Schedule

Priority #	Action #	Action Description	Duration	Minimum List of Potential Partners	Total Estimated Costs	Costs ($1000s)							Comments
						FY 01	FY 02	FY 03	FY 04	FY 05	FY 06-20	FY 21-30	
3	1.1.3.3.1	Reduce impacts from recreationists.	5 yrs.	BLM, FS, NPS, SPK	7320	1464	1464	1464	1464	1464			4 agencies x 6 RU = 24 FTEs @ $61,000/year = $1,464,000/year. Reassess at 5 yr. revision.
3	1.1.3.3.2	Confine camping areas.	5 yrs.	BLM, FS, NPS, SPK	0	0	0	0	0	0			Same funds as 1.1.3.3.1.
3	1.1.3.3.3	Restore habitat impacted by recreation.	5 yrs.	BLM, FS, NPS, SPK	0	0	0	0	0	0			Same funds as 1.1.3.3.1.
3	1.1.3.3.4	Place designated recreation shooting areas away from riparian areas.	5 yrs.	BLM, FS, FWS, SGF	0	0	0	0	0	0			Same funds as 1.1.3.3.1.
3	1.1.3.3.5	Minimize attractants to scavengers, predators, and brown-headed cowbirds.	5 yrs.	BLM, FS, NRCS, SPK, SGF, SAG	0	0	0	0	0	0			Same funds as 1.1.3.3.1.
3	1.1.3.3.6	Provide on-site monitors where recreation conflicts exist.	5 yrs.	BLM, FS, FWS, NPS, SGF, SPK	0	0	0	0	0	0			Same funds as 1.1.3.3.1.
2	1.2.1	Evaluate and provide rangewide prioritization of non-Federal lands.	Complete	USBR, BLM, FS, FWS, NRCS, SGF	0								

V. Implementation Schedule

Priority #	Action #	Action Description	Duration	Minimum List of Potential Partners	Total Estimated Costs	Costs ($1000s)							
						FY 01	FY 02	FY 03	FY 04	FY 05	FY 06-20	FY 21-30	Comments
1	1.2.2	Achieve protection of occupied habitats.	30 yrs.	FWS, FS, BLM, NRCS	24315	1430	1430	1430	1430	1430	715 / year	644 / year	Approximately half of currently known territories occur on federal lands and are already protected. Assume that half (975)of total number of territories needed to delist the species (1950) need protection. Based on the Recovery Plan, each territory = 1.1 ha. Cost of protection of 1 territory is estimated at $2,600/ha. Years 1-5: 500 territories x 1.1ha x $2600/ha. Years 6-20: 250 territories x 1.1ha x $2600/ha. Years 21-30: 225 territories x 1.1ha x $2,600/ha.
2	1.2.3	Provide technical assistance to conserve and enhance occupied habitats on non-Federal lands.	30 yrs.	DOI, USDA	29280	976	976	976	976	976	976 / yr	976 / yr	32 MU x 0.5 FTE/year = $976,000/year.
2	1.2.4	Pursue joint ventures toward flycatcher conservation.	5 yrs.	FWS	250	50	50	50	50	50			For projects along U.S. - Mexico border.

V. Implementation Schedule

Priority #	Action #	Action Description	Duration	Minimum List of Potential Partners	Total Estimated Costs	Costs ($1000s) FY 01	FY 02	FY 03	FY 04	FY 05	FY 06-20	FY 21-30	Comments
2	1.3.1	Work with tribes to establish a regular system of surveys and monitoring, and train tribal staff in the flycatcher survey protocol.	10 yrs.	DOI	100	10	10	10	10	10	10 /yr thru FY10		4 (Phoenix, Albuquerque, Southern California, Utah) regional workshops through BIA area offices, at $2500 / workshop + travel costs per year.
3	1.3.2	Determine protocols for information sharing.	5 yrs.	DOI	305	61	61	61	61	61			4 BIA area offices (as above) x 0.25 FTEs/office @ $61,000/FTE.
2	1.3.3	Maintain an incumbent in the position of Tribal Liaison to the Technical Subgroup.	30 yrs.	FWS	30	1	1	1	1	1	1/yr	1/yr	Travel costs.
2	1.3.4	Provide technical assistance to tribes that have flycatchers on their lands.	5 yrs.	FWS, BIA, USBR	1220	244	244	244	244	244			1 FTE @ $61,000/year x 4 BIA area offices.
2	1.3.5	Support tribal efforts to improve currently suitable and potentially suitable habitat.	5 yrs.	FWS, BIA, USBR	0	0	0	0	0	0			Same funds as 1.3.4.

V. Implementation Schedule

Priority #	Action #	Action Description	Duration	Minimum List of Potential Partners	Total Estimated Costs	Costs ($1000s)							
						FY 01	FY 02	FY 03	FY 04	FY 05	FY 06-20	FY 21-30	Comments
3	1.3.6	Work with tribes to determine the extent to which tribal water rights might or might not be available to aid in conservation and recovery of the flycatcher.	5 yrs.	FWS, BIA, USBR	0	0	0	0	0	0			Same funds as 1.3.4.
3	1.3.7	Provide aid in developing educational programs and opportunities that further flycatcher recovery.	5 yrs.	FWS, BIA	0	0	0	0	0	0			Same funds as 1.3.4.
1	2.1.1	Conserve and manage all existing breeding sites.	30 yrs.	AFA, SGF, SPK, SAG	0	0	0	0	0	0	0	0	Same funds as 1.2.2.
1	2.1.2	Secure, maintain, and enhance largest populations.	5 yrs.	AFA, SGF, SPK, SAG	600	120	120	120	120	120			See narrative outline 2.1.2 for list of 12 largest populations. $10,000/year x 12 populations = $120,000/year
2	2.1.3.1	Use existing habitat acquisition / conservation priorities.	30 yrs.	USBR, BLM, FS, FWS, DOD, NRCS	0	0	0	0	0	0	0	0	No additional funds necessary.

V. Implementation Schedule

Priority #	Action #	Action Description	Duration	Minimum List of Potential Partners	Total Estimated Costs	Costs ($1000s)							Comments
						FY 01	FY 02	FY 03	FY 04	FY 05	FY 06-20	FY 21-30	
2	2.1.4	Enhance connectivity to currently isolated occupied sites.	5 yrs.	USBR, BLM, FS, FWS, DOD, NRCS, SGF	15750			3150	3150	3150	3150 FY06 - 07		6 RU x 7 agencies x $75,000/year = $2,100,000/year.
2	2.1.5	Facilitate establishment of new, large populations in areas where none exist, through habitat restoration.	3-5 yrs.	USBR, BLM, FS, FWS, DOD, NRCS, SGF, MSCP, MRGCD	515			172	172	172			Assume 1 new site of at least 10 territories in each RU. 1 territory = 1.1 ha. Costs of $2,600 per territory. 6 RU x 10 territories x 1.1 ha x $2,600 = $172,000/year.
2	2.1.6	Increase population sizes at small occupied sites.	5 yrs.	USBR, BLM, FS, FWS, DOD, NRCS, SGF, MSCP, MRGCD	7545	1509	1509	1509	1509	1509			Based on Recovery Plan, approximately 223 sites currently exist, minus 12 large populations; assume that 25% of small sites will be increased by 10 territories at 1.1 ha/territory @$2600/territory. (25%) (211) x 11 ha x $2600 = $1,509,000

V. Implementation Schedule

Priority #	Action #	Action Description	Duration	Minimum List of Potential Partners	Total Estimated Costs	Costs ($1000s)							Comments
						FY 01	FY 02	FY 03	FY 04	FY 05	FY 06-20	FY 21-30	
2	3.1.1.1	Increase the amount and quality of riparian habitat to increase habitat patch sizes and local flycatcher population sizes thereby minimizing levels and impacts of cowbird parasitism.	5 yrs.	USBR, BLM, FS, FWS, DOD, NRCS, SGF, MRGCD, MSCP	0	0	0	0	0	0			Coordinate with 2.1.4 - 2.1.6.
2	3.1.1.2	Develop cowbird management programs if warranted by baseline data on parasitism rates.	3-5 yrs.	USBR, BLM, FS, FWS, DOD, NRCS, SGF, MRGCD, MSCP	0			0	0	0			See FY 01-02 baseline data collection, action 6.5.1. Coordinate funds with 3.1.1.3.
2	3.1.1.3	Implement cowbird management programs if warranted by baseline data on parasitism rates.	3-10 yrs.	USBR, BLM, FS, FWS, DOD, NRCS, SGF, MRGCD, MSCP	3120			390	390	390	390 / year until FY10		$65,000/year per 5-trap site x 6 RU for 7 years.
3	3.1.1.4	Pursue long-term landscape objectives for cowbird reduction.	30 yrs.	BLM, FS, FWS, DOD, MRGCD, MSCP, NRCS, SGF	0	0	0	0	0	0	0	0	Coordinate with 2.1.4 - 2.1.6 and 3.1.1.2 - 3.1.1.3.
2	3.1.2	Reduce direct impacts that topple or otherwise destroy nests.	30 yrs.	BLM, FS, FWS	0	0	0	0	0	0	0	0	Coordinate with 1.1.3.1.1.1 and 1.1.3.3.1.

V. Implementation Schedule

Priority #	Action #	Action Description	Duration	Minimum List of Potential Partners	Total Estimated Costs	Costs ($1000s)							Comments
						FY 01	FY 02	FY 03	FY 04	FY 05	FY 06-20	FY 21-30	
3	3.1.3	Reconsider assessment of habitat quality or other threats if cowbird control measures do not increase numbers of breeding flycatchers.	10 yrs.	USGS, FWS, BLM, FS	TBD	TBD	TBD	TBD	TBD	TBD	TBD		Based on results from 3.1.1.3.
2	4.1	Identify, for purposes of protection, riparian habitats in the U.S. to provide migration and stopover habitat.	5 yrs.	USBR, COE, BLM, FS, FWS, DOD, SGF, SPK, IRR	750	150	150	150	150	150			Estimated funds for studies to complement ongoing research in each RU.
2	4.2	Restore, protect, and expand riparian migration and stopover habitats in the U.S.	4-30 yrs.	USBR, COE, BLM, FS, FWS, DOD, SGF, SPK	TBD				TBD	TBD	TBD	TBD	Based on 4.1. Prioritze areas to protect.
2	4.3	Pursue international partnerships to identify migration and winter habitats and threats.	1-5 yrs.	FWS, USGS, USBR, SGF	125	25	25	25	25	25			Re-evaluate with 5-year Recovery Plan revision.
2	4.4	Encourage programs that preserve habitats used by wintering and migrating flycatchers.	5 yrs.	FWS, USGS	125	25	25	25	25	25			Re-evaluate with 5-year Recovery Plan revision.

V. Implementation Schedule

Priority #	Action #	Action Description	Duration	Minimum List of Potential Partners	Total Estimated Costs	Costs ($1000s) FY 01	FY 02	FY 03	FY 04	FY 05	FY 06-20	FY 21-30	Comments
2	4.5	Encourage programs that minimize threats to wintering and migrating flycatchers.	5 yrs.	FWS, USGS	125	25	25	25	25	25			Re-evaluate with 5-year Recovery Plan revision.
2	5.1.1	Adopt standardized protocols for surveying and monitoring.	1 yr.	FWS, SGF	15					15			Re-evaluate with 5-year Recovery Plan revision.
2	5.1.2	Institute appropriate monitoring of all reaches within management units.	5 yrs.	FWS, USBR, BLM, FS, DOD, SGF, USGS	3500	700	700	700	700	700			Extrapolated from 2000-2001 statistics from BLM, FS.
2	5.1.3	Integrate survey data at state and rangewide levels.	5 yrs.	FWS, USGS, SGF	125	25	25	25	25	25			
2	5.2.1	Review data to improve effectiveness of management and restoration practices.	5 yrs.	FWS, USGS, SGF	50	10	10	10	10	10			Funds for several team meetings per year.
3	5.3	Survey to determine dispersal movements and colonization events.	5 yrs.	USGS, FWS, USBR, BLM, FS, SGF	0	0	0	0	0	0			Same funds as 5.1.2.
3	5.4	Expand survey efforts in wintering habitat.	5 yrs.	USGS, FWS	500	100	100	100	100	100			Extrapolated from current USGS survey efforts in wintering habitat.

V. Implementation Schedule

Priority #	Action #	Action Description	Duration	Minimum List of Potential Partners	Total Estimated Costs	Costs ($1000s)							Comments
						FY 01	FY 02	FY 03	FY 04	FY 05	FY 06-20	FY 21-30	
3	6.1.1	Determine plant species / structure that determines occupancy and reproductive success.	5 yrs.	USGS, SGF, FS, BLM	500	100	100	100	100	100			
3	6.1.2	Determine habitat area needed for breeding birds.	3 yrs.	USGS, FWS, SGF	1098			366	366	366			6 RU x 1 FTE/RU @ $61,000 = $366,000
3	6.1.3	Determine effects of conspecifics on site occupancy and reproductive success.	3 yrs.	USGS, FWS, SGF	225			75	75	75			Estimated costs for two studies within the range.
3	6.1.4	Determine use vs. availability of exotics in occupied sites.	3 yrs.	USGS, SGF, USBR, BLM, FS, FWS	150	50	50	50					Estimated costs for one study within the range.
3	6.1.5	Determine long-term ecological productivity of native habitats vs. exotic habitats.	5 yrs.	USGS, SGF, FWS	1000	200	200	200	200	200			Estimated costs for one study within the range.
3	6.1.6	Refine understanding of effects of physical microclimate on site occupancy and reproduction.	3 yrs.	USGS, SGF, FWS	180			60	60	60			Estimated costs for one study within the range.

V. Implementation Schedule

Priority #	Action #	Action Description	Duration	Minimum List of Potential Partners	Total Estimated Costs	Costs ($1000s)							Comments
						FY 01	FY 02	FY 03	FY 04	FY 05	FY 06-20	FY 21-30	
3	6.1.7	Determine influence of environmental toxins on breeding, survival, and prey base.	3 yrs.	FWS, USGS	225	75	75	75					Estimated costs for one study within the range.
2	6.2	Investigate dam and reservoir management scenarios to determine thresholds for habitat suitability and to maximize habitat quality.	30 yrs.	USGS, FWS, USBR, COE, GCAMWG, MSCP	0	0	0	0	0	0	0	0	Coordinate funds with feasibility studies in actions 1.1.2.1.3 - 1.1.2.1.7.
2	6.3	Investigate surface and groundwater management scenarios to determine thresholds for habitat suitability and to maximize habitat quality.	3 yrs.	FWS, USGS, USBR, SGF	0	0	0	0					Same funds as 1.1.2.2.1.1.
2	6.4.1	Investigate grazing systems, strategies, and intensities for riparian recovery and maintenance.	5 yrs.	BLM, FS, FWS	0	0	0	0	0	0			Same funds as 1.1.3.1.1.1.
3	6.4.2	Investigate direct effects of livestock grazing on the flycatcher.	5 yrs.	BLM, FS, FWS	0	0	0	0	0	0			Same funds as 1.1.3.1.1.1.

V. Implementation Schedule

Priority #	Action #	Action Description	Duration	Minimum List of Potential Partners	Total Estimated Costs	Costs ($1000s)							Comments
						FY 01	FY 02	FY 03	FY 04	FY 05	FY 06-20	FY 21-30	
3	6.4.3	Investigate impacts of native ungulates on riparian recovery and maintenance.	3 yrs.	SGF, BLM, FS, FWS,	150			50	50	50			Estimated funds for one study within the range.
2	6.5.1	Collect baseline data on cowbird parasitism.	2 yrs.	USGS, SGF, USBR, BLM, FS, FWS	300	150	150						See 3.1.1.2.
3	6.5.2	Experimentally test the efficacy of cowbird trapping programs.	7 yrs.	USGS	0			0	0	0	0 thru FY10		Coordinate funds with programs from 3.1.1.3.
2	6.6	Determine the most successful techniques for creating or restoring suitable habitat to degraded or former riparian lands, such as abandoned agricultural fields in riparian corridors.	10 yrs.	USGS, USDA, MSCP, MRGCD, IRR	1720	172	172	172	172	172	172 / yr. FY 06-10		Based on efforts to create 11ha of suitable habitat in each RU each year for 10 years. 11ha x 2,600$ x 6RUs = $172,000
2	6.7.1	Acquire demographic and dispersal information.	5 yrs.	USGS, SGF, USBR, BLM, FS, FWS	750	150	150	150	150	150			Complement ongoing surveys rangewide.
2	6.7.2	Conduct limiting factor analyses.	5 yrs.	USGS, SGF, FWS	250	50	50	50	50	50			Estimated costs for one study within the range.

V. Implementation Schedule

Priority #	Action #	Action Description	Duration	Minimum List of Potential Partners	Total Estimated Costs	Costs ($1000s) FY 01	FY 02	FY 03	FY 04	FY 05	FY 06-20	FY 21-30	Comments
3	6.7.3	Explore new methods and data needs for population viability analyses.	5 yrs.	USGS, FWS	0	0	0	0	0	0			Coordinate funds with 5.1.3 and 5.2.1.
3	6.7.4	Develop methodologies, which can be site specific if necessary, for determining year-to-year trends in population sizes at breeding sites.	3 yrs.	USGS, SGF, FWS	300	100	100	100					Complement ongoing surveys rangewide.
3	6.7.5	Establish and refine protocols for addressing flycatcher distribution.	3 yrs.	USGS, SGF, FWS	450	150	150	150					Complement ongoing studies rangewide.
3	6.8	Determine present and historical distribution of the subspecies through genetic work.	3 yrs.	USGS	150	50	50	50					Estimated costs for one study within the range.
3	6.9.1	Investigate migration ecology, habitat selection and use.	5 yrs.	USGS	375	75	75	75	75	75			Continue ongoing work.
3	6.9.2	Investigate wintering distribution, status, ecology, and habitat selection.	5 yrs.	USGS	375	75	75	75	75	75			Continue ongoing work.

V. Implementation Schedule

Priority #	Action #	Action Description	Duration	Minimum List of Potential Partners	Total Estimated Costs	Costs ($1000s) FY 01	FY 02	FY 03	FY 04	FY 05	FY 06-20	FY 21-30	Comments
3	6.9.3	Determine influence of environmental toxins on wintering flycatchers and their prey base.	3 yrs.	USGS, FWS	225			75	75	75			Estimated costs for one study.
3	6.10	Conduct research on means of increasing reproductive success by approaches other than, or in addition to, cowbird management, such as reducing losses of flycatcher eggs and nestlings to general nest predators.	5 yrs.	USGS, FWS	250	50	50	50	50	50			Estimated costs for one study within the range to complement an ongoing nest monitoring study.
3	6.11	Conduct research to determine why increases in reproductive success due to cowbird control or other measures may not lead to increases in numbers of breeding birds in populations experiencing improved reproductive success or in populations that could receive emigrants from such populations.	5 yrs.	USGS	250	50	50	50	50	50			Estimated costs for one study within the range to complement an ongoing nest monitoring study.

V. Implementation Schedule

Priority #	Action #	Action Description	Duration	Minimum List of Potential Partners	Total Estimated Costs	Costs ($1000s)							Comments
						FY 01	FY 02	FY 03	FY 04	FY 05	FY 06-20	FY 21-30	
3	6.12.1	Evaluate fuel reduction techniques in riparian habitat, especially tamarisk types.	3 yrs.	BLM, FS, FWS, DOD, SGF, USGS	450			150	150	150			Estimated costs for one assessment within the range to complement ongoing fuel reduction activities.
3	6.12.2	Test modifying flammability for fuels to modify fire risks.	5 yrs.	BLM, USGS, FWS, FS, DOD	250	50	50	50	50	50			
3	6.12.3	Test prescribed fire to achieve desired fire hazard reduction, habitat protection, and habitat improvement.	20 yrs.	BLM, FS, FWS, DOD, SGF, USGS	3,000	600	600	600	600	600	TBD		1 study ($100,000) in each RU (6). Reevaluate with Recovery Plan revision.
3	7.1	Hold annual Implementation Subgroup meetings.	5 yrs.	RTTS, ISGs	0	0	0	0	0	0			Same duration and funds as 9.1.
3	7.2	Maintain updated website.	Ongoing	FWS, USGS	25	5	5	5	5	5	TBD	TBD	Repeat 5 year time cycle as needed, based on plan revisions.
3	7.3.1	Educate the public about landscaping with native plants.	5 yrs.	USDA, DOI, SGF	0	0	0	0	0	0			Revise public education focal themes based on plan revision. Same funds as 1.1.3.2.
3	7.3.2	Educate the public about recreational impacts, especially about fire hazards.	5 yrs.	USDA, DOI, SGF	0	0	0	0	0	0			Revise public education focal themes based on plan revision. Same funds as 1.1.2.3.5.

V. Implementation Schedule

Priority #	Action #	Action Description	Duration	Minimum List of Potential Partners	Total Estimated Costs	Costs ($1000s)							Comments
						FY 01	FY 02	FY 03	FY 04	FY 05	FY 06-20	FY 21-30	
3	7.3.3	Educate the public that cowbird parasitism is a natural process but may require management efforts in some instances due to high levels or other stressors that have endangered flycatchers.	5 yrs.	USDA, DOI, SGF	TBD*	TBD	TBD	TBD	TBD	TBD			*Could include brochures/printed materials, information sessions, presentations for recreationists (e.g., campfire talks)
3	7.4	Post and maintain signs at some protected flycatcher breeding locations.	5 yrs.	BLM, FS, NPS, FWS, SGF, SPK	0	0	0	0	0	0			Coordinate funds with 1.1.3.3.1.
3	7.5	Conduct information exchange programs with foreign governments and publics.	Ongoing	USGS, FWS	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	
3	7.6	Conduct symposia and workshops.	1 workshop every 10 yrs.	USGS, FWS	75						25 in FY10	25 in FY20 and FY30	
2	7.7	Continue survey training.	5 yrs.	FWS, SGF, USGS	125	25	25	25	25	25			
1	8.1	Fully implement 7(a)(1) of the ESA.	Ongoing	AFA	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	

V. Implementation Schedule

Priority #	Action #	Action Description	Duration	Minimum List of Potential Partners	Total Estimated Costs	Costs ($1000s)							Comments
						FY 01	FY 02	FY 03	FY 04	FY 05	FY 06-20	FY 21-30	
1	8.2	Fully implement all Biological Opinions resulting from ESA 7(a)(2) consultations.	Ongoing	AFA	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	
2	8.3.1	Support compliance with ESA 7(a)(1)	Ongoing	AFA	915	183	183	183	183	183	TBD	TBD	1FTE @ $61,000 x 3 FWS Regions = $183,000. Estimated for five year periods, to be revised and continued as needed.
3	8.3.2	Provide resource managers with training in conservation benefits.	Ongoing	AFA, SGF, SPK	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	
2	8.3.3	Monitor compliance with ESA 7(a)(2).	Ongoing	AFA	0	0	0	0	0	0	0	0	Same funds as 8.3.1
2	8.3.4	Ensure consistency among ESA 7(a)(2) consultations.	Ongoing	FWS	0	0	0	0	0	0	0	0	Same funds as 8.3.1.
2	8.3.5	Monitor compliance with existing Biological Opinions.	Ongoing	AFA	0	0	0	0	0	0	0	0	Same funds as 8.3.1.
2	8.4	Integrate recovery efforts with those for other species.	Ongoing	RTTS, ISGs	0	0	0	0	0	0	0	0	Same funds as 9.1.

V. Implementation Schedule

Priority #	Action #	Action Description	Duration	Minimum List of Potential Partners	Total Estimated Costs	Costs ($1000s)							Comments
						FY 01	FY 02	FY 03	FY 04	FY 05	FY 06-20	FY 21-30	
2	8.5	Monitor compliance and effectiveness of agreements and other mechanisms used as delisting criteria.	20 yrs.	FWS	275						25 in FY20	25 per year	Action would begin at downlisting; downlisting is estimated to occur in 20 years.
2	8.6.1	Effectively communicate with Tribes.	5 yrs.	AFA	0	0	0	0	0	0			Can be accomplished through existing and ongoing program activities; no new $ needed.
3	9.1	Maintain collaborative structure of Recovery Team.	Ongoing	FWS, RTTS, ISGs	120	20	20	20	20	40			$20,000 each year; $40,000 in fifth year to revise plan. Repeat as necessary.
2	9.2	Annual review of survey and monitoring data.	1-5 yrs.	RTTS	0	0	0	0	0	0			Same funds as 9.1.
2	9.3	Review and synthesis of current flycatcher research and other pertinent research.	1-5 yrs.	USGS, FWS, SGF	50	10	10	10	10	10			
3	9.4	Repeat Population Viability Analysis.	4th, 5th years	FWS, USGS	120				20	100			
2	9.5	Develop recommendations for survey and monitoring strategies.	5 yrs.	USGS, FWS, SGF	0	0	0	0	0	0			Coodinate funds with 9.1 - 9.3.

V. Implementation Schedule

Priority #	Action #	Action Description	Duration	Minimum List of Potential Partners	Total Estimated Costs	Costs ($1000s)							Comments
						FY 01	FY 02	FY 03	FY 04	FY 05	FY 06-20	FY 21-30	
2	9.6	Update Recovery Plan every 5 years.		FWS, RTTS, ISGs	40					40			

VI. LITERATURE CITED

Abrams, M. D. 1986. Historical development of gallery forests in northeast Kansas. Vegetation 65:29-37.

Adams, D. E., R. C. Anderson, and S. L. Collins. 1982. Differential response of woody and herbaceous species to summer and winter burning in an Oklahoma grassland. The Southwestern Naturalist 27:55-61.

Agee, J. K. 1993. Fire ecology of Pacific Northwest forests. Washington, DC, Island Press.

Ahlers, D. and R. Tisdale. 1998a. Annotated Bibliography for Parasitic Birds of the Genus *Molothrus*. Technical Memorandum no. 8210-98-1. Bureau of Reclamation. Denver, CO.

Ahlers, D. and Tisdale, R. 1998b. Cowbird control program Middle Rio Grande, New Mexico 1997. U.S. Bureau of Reclamation, Albuquerque Area Office, U.S. Dept. Interior, and Technical Service Center, Ecological Planning and Assessment, Denver, CO.

Ahlers, D. and Tisdale, R. 1999a. Brown-headed Cowbird movements and distribution within the Middle Rio Grande, New Mexico. U.S. Bureau of Reclamation, U.S. Dept. Interior, Technical Service Center, Ecological Planning and Assessment, Denver, CO.

Ahlers, D. and Tisdale, R. 1999b. Cowbird control program Middle Rio Grande, New Mexico 1998. U.S. Bureau of Reclamation, Albuquerque Area Office, U.S. Dept. Interior, and Technical Service Center, Ecological Planning and Assessment, Denver, CO.

Airola, D.A. 1986. Brown-headed Cowbird parasitism and habitat disturbance in the Sierra Nevada. J. Wildl. Manage. 50:571-575.

Aitchison, S.W. 1977. Some effects of a campground on breeding birds in Arizona. Pages 175-182 *in* Importance, preservation, and management of riparian habitat: A symposium. 9 July 1977, Tucson, Arizona. USDA Forest Service Gen. Tech. Rep. RM-43.

Albert, S. 1999. The Beaver and the Flycatcher. Endangered Species Bulletin 24 (4):16-17. U.S. Department of Interior, Washington, D.C.

Akcakaya, H.R. 1998. RAMAS GIS: Linking landscape data with population viability analysis (Version 3.0) Applied Biomathematics, Setauket, NY.

Aldrich, J.W. 1951. A review of the races of the Traill's flycatcher. Wilson Bull. 63:192-197.

Aldrich, J.W. 1953. Habitats and habitat differences in two races of Traill's Flycatcher. Wilson Bull. 65:8-11.

Allen. A.W. 1982. Habitat Suitability Index Models: Beaver. U.S.D.I. Fish and Wildlife Service. FWS/OBS-8210.30.

Alpert, P., F. T. Griggs, and D. R. Peterson. 1999. Riparian forest restoration along large rivers: Initial results from the Sacramento River Project. Restoration Ecology 7:360-368.

Alzerreca-Angelo, H., E. W. Schupp, and S. G. Kitchen. 1998. Sheep grazing and plant cover dynamics of a shadscale community. J. Range Manage. 51:214-222.

American Ornithologists' Union. 1973. 32nd checklist supplement. Auk 90:415-416.

American Ornithologists' Union. 1983. Checklist of North American birds, 6th edition. Allen Press, Lawrence, Kansas. 877 pp.

Ames, C.R. 1977. Wildlife conflicts in riparian management: Grazing. Pages 39-51 *in* Importance, preservation, and management of riparian habitat : A symposium. USDA Forest Service Gen. Tech. Rep. RM-43.

Ammon, E.M., and P.B. Stacey. 1997. Avian nest success in relation to past grazing regimes in a montane riparian system. Condor 99(1):7-13.

Anable, M. E., M. P. McClaran and G. B. Ruyle. 1992. Spread of introduced Lehmann lovegrass *Eragrostis lehmanniana* Nees. in southern Arizona, USA. Biological Conservation 61:181-188.

Anderson, B. W., A. Higgins, and R. D. Ohmart. 1977. Avian use of saltcedar communities in the Lower Colorado River Valley. Pages 128-136 *in* R. R. Johnson and D. A. Jones, technical coordinators, Importance, Preservation, and Management of Riparian Habitat: A Symposium. USDA Forest Service General Technical Report RM-43. Fort Collins, Colorado.

Anderson, B. W., R. D. Ohmart, and H. A. Allen, Jr. 1984. Riparian birds in the riparian/agricultural interface. USDA Forest Service Gen. Tech. Rep. PSW-110: 419-423.

Anderson, B. 1995. Salt cedar, revegetation and riparian ecosystems in the Southwest. Pages 1-16 *in* J. Lovitch, J. Randall, and M. Kelly, eds. Proceedings of the California Exotic Pest Plant Control Council.

Anderson, B. 1998. The case for salt cedar. Restoration and Management Notes 16:130-134.

Andrews, R., and R. Righter. 1992. Colorado Birds: a reference to their distribution and habitat. Denver Museum of Natural History. Denver, Colorado. 442 pp.

Apple, L.L. 1985. Riparian habitat restoration and beavers. Pp. 489-490 *in* R.R. Johnson, C.D. Ziebell, D.R. Patten, P.F. Ffolliott, and P.F. Hamre (tech. Coords). 1985. Riparian ecosystems and their management: Reconciling conflicting uses. USDA Forest Service Gen. Tech. Rep. RM-120. 523 pp.

Arcese, P. and Smith, J.N.M. 1999. Impacts of nest depredation and brood parasitism on the productivity of North American passerines. *In*: Adams, N. & Slotow, R. (Eds.) Proc. 22 Int. Ornithol. Congr. Durban, University of Natal.

Arcese, P., Smith, J.N.M. and M.I. Hatch. 1996. Nest predation by cowbirds and its consequences for passerine demography. Proc. Natl. Acad. Sciences. 93:4608-4611

Arizona Department of Water Resources. 1994. Arizona riparian protection program legislature report. Phoenix, Arizona: Arizona Department of Water Resources.

Arizona Game and Fish Department. 1988. List of threatened native wildlife in Arizona. Arizona Game and Fish Commission, Phoenix Arizona. 32 pp.

Arizona Game and Fish Department. 1996. Wildlife of special concern in Arizona. Arizona Game and Fish Commission, Phoenix Arizona. XX pp.

Arizona Game and Fish Department. in prep. Conservation assessment and strategy for the Bald Eagle in Arizona. Draft Report. Nongame Branch, Wildlife Management Division. Phoenix, Arizona.

Armstong, D. P. and M. Westoby. 1993. Seedlings from large seeds tolerate defoliation better- a test using phylogenetically independent contrasts. Ecology 74: (4) 1092-1100.

Arthington, A. H. et al. 1992. Development of an holistic approach for assessing environmental flow requirements of riverine ecosystems. Pages 69-76 *in* Water Allocation for the Environment, Workshop Proceedings. Centre for Water Policy research, University of New England, Armidale, Australia.

Atkinson, C.T. and C. van Riper III. 1991. Pathogenicity and epizootiology of avian haematozoa: *Plasmodium*, *Leucocytozoon*, and *Haemoproteus in* Loye, J.E. and M. Zuk (eds). Bird-Parasite Interactions. Oxford University Press, Oxford. 406 pp.

Audubon, J.J. 1831. Ornithological biography. Vol. 1. Adam, Edinburgh, Scotland. 512 pp.

Averill-Murray, A., S. Lynn and M. L. Morrison. 1999. Cowbird parasitism of Arizona Bell's Vireo (*Vireo bellii arizonae*) in a desert riparian landscape: implications for cowbird management and riparian restoration. pp. 109-120. *In*: Research and Management of The Brown-headed Cowbird in Western Landscapes (M. L. Morrison, L. S. Hall, S. K. Robinson, S. I. Rothstein, D. C. Hahn and T. Rich eds.), Studies in Avian Biology No. 18.

Avise, J, C. and D. Walker. 1998. Pleistocene phylogeographic effects avian populations and the speciation process. Proc. Royal Soc. London B 265:457-463.

Bailey, A.M. and R.J. Niedrach. 1965. The Birds of Colorado. Denver Museum of Natural History, Denver.

Bailey, F.M. 1928. Birds of New Mexico. New Mexico Department of Game and Fish.

Baird, K. 1989. High quality restoration of riparian ecosystems. Restoration and Management Notes 7:60-64.

Baird, K. L. and J. P Rieger. 1989. A restoration design for least Bell's vireo habitat in San Diego County. Pages 462-467 *in* D. L. Abell, technical coordinator. Proceedings of the California Riparian Systems Conference: protection, management, and restoration for the 1990's; September 22-24, 1988; Davis, California. General Technical Report PSW-110.

Baker, R. G., D. P. Schwert, E. A. Bettis III, and C. A. Chumbley. 1993. Impact of Euro-American settlement on a riparian landscape in northeast Iowa, midwestern USA: an integrated approach based on historical evidence, floodplain sediments, fossil pollen, plant macrofossils and insects. The Holocene 3:314-323.

Barlow, J.C. and W.B. McGillivray. 1983. Foraging and habitat relationships of the sibling species Willow Flycatcher (*Empidonax traillii*) and Alder Flycatcher (*E. alnorum*) in southern Ontario. Can. J. Zool. 61:1510-1516.

Barro, S.C., P.M. Wohlgemuth, and A.G. Campbell. 1989. Post-fire interactions between riparian vegetation and channel morphology and the implications for stream channel rehabilitation choices. Pages 51-3 *in* D. L. Abell (Tech. Coord.); Proceedings of the California Riparian Systems Conference: Protection, Management, and Restoration for the 1990s. USDA Forest Service General Technical Report PSW-110.

Barrows, C. W. 1993. Tamarisk control. II. A success story. Restoration and Management Notes 11:35-38.

Barrows, C. 1998. The case for wholesale removal. Restoration and Management Notes 16:135-139.

Barstad, J. F. 1981. Factors controlling plant distribution in southeastern Arizona. M. S. Thesis, Arizona State University, Tempe, Arizona.

Bayley, P.B. 1991. The flood-pulse advantage and the restoration of river-floodplain systems. Regulated Rivers: Research and Management 6:75-86.

Beal, F.E.L. 1912. Food of our more important flycatchers. U.S. Bureau of Biological Survey, Bulletin 4. Washington, D.C. 67 pp.

Beane, J.C. and S.L. Alford. 1990. Destruction of a Pine Warbler brood by an adult cowbird. Chat 54:85-86.

Beaver, D.L. and P.H. Baldwin. 1975. Ecological overlap and the problem of competition and sympatry in the Western and Hammond's flycatchers. Condor 77:1-13.

Behle, W.H. Bushman, and C.M. Greenhalgh. 1958. Birds of the Kanab area and adjacent high plateaus of southern Utah. Univ. Utah Biol. Ser. 11:1-92.

Behle, W.H. and H.G. Higgins. 1959. The birds of Glen Canyon. Pp. 107-133 *in* Ecological Studies of Flora and Fauna in Glen Canyon (A.M. Woodbury, ed.) Univ. Utah Anthropol. Pap. 40 (Glen Canyon Series No. 7).

Bell, G.P. 1997. Ecology and management of *Arundo donax,* and approaches to riparian habitat restoration in southern California. Pages 103-113 *in* Plant Invasions: Studies from North America and Europe, J, H, Brock, M, Wade, P. Pysek, and D. Green (eds.), Backhuys Publishers, Leiden, The Netherlands.

Belles-Isles, J.C. and J. Picman. 1986. Destruction of heterospecific eggs by the Gray Catbirds. Wilson Bull. 98:603-605.

Belsky, A.J., and D.M. Blumenthal. 1997. Effects of livestock grazing on stand dynamics and soils in upland forest of the Interior West. Conservation Biology 11(2):315-328.

Belsky, A. J., A. Matzke, and S. Uselman. 1999. Survey of livestock influences on stream and riparian ecosystems in the western United States. Journal of Soil and Water Conservation 54:419-431.

Bennett, G., M. Whiteway and C. Woodworth. 1982. Host-parasite catalogue of the avian haematozoa. Memorial University of Newfoundland Occasional Papers in Biology 5:1-243.

Bent, A.C. 1960. Life histories of North American flycatchers, larks, swallows and their allies. Dover Press, New York, New York. 555 pp.

Bent, A.C. 1965. Life histories of North American blackbirds, orioles, tanagers, and allies. Dover Press, New York, New York. 549 pp.

Berger, A.J. 1967. Traill's Flycatcher in Wastenaw County, Michigan. Jack-Pine Warbler 45:117-123.

Berger, J., and P.B. Stacey. In prep. Trophic cascades and the conservation of biological diversity: How the loss of grizzly bears and wolves reduces riparian birds in the Greater Yellowstone Ecosystem. Submitted to Ecological Applications.

Billings, W. D. 1990. *Bromus tectorum*, a biotic cause of ecosystem impoverishment in the Great Basin. Pages 301-322 *in* The Earth in Transition: Patterns and Processes of Biotic Impoverishment, G. M. Woodell (ed.), Cambridge University Press, Cambridge.

Blake, E.R. 1953. Birds of Mexico. University of Chicago Press, Chicago, Illinois. 644 pp.

Blakesley, J.A. and K.P. Reese. 1988. Avian use of campground and noncampground sites in riparian zones. J. Wildl. Manage. 52 (3):399-402.

Block, W.M. and L.A. Brennan. 1993. The habitat concept in ornithology *in* D.M. Power (ed.), Current Ornithology 11:35-91.

Bock, C. E. and J. H. Bock. 1978. Response of birds, small mammals, and vegetation to burning sacaton grasslands in southeastern Arizona. Journal of Range Management 31(4):296-300.

Bock, C. E., J. H. Bock, K. L. Jepson, J. C. Ortega. 1986. Ecological effects of planting African lovegrasses in Arizona. Natural Geographic Research 2:456-463.

Bock, C.E., V.A. Saab, T.D. Rich, and D.S. Dobkin. 1993. Effects of livestock grazing on neotropical migratory landbirds in western North America. p 296-309 *in* Finch and Stangel GTR-RM-229.

Bock, C. E., J. H. Bock, and H. M. Smith. 1993. Proposal for a system of federal livestock exclosures on public rangelands in the Western United States. Conservation Biology 7:731-733.

Boelman, S.F., H.L. Mosley, and D.C. Baird. 1999. Endangered species design considerations of the Santa Ana Project along the Rio Grande, NM, pp. 137-140. *In*: R. Sakrison and P. Sturtevant (eds.), Proceedings of American Water Resource Association's 1999 Annual Water Resources Conference: Watershed Management to Protect Declining Species, 5-6 December 1999, Seattle, Washington. American Water Resources Technical Publication Series TPS-99-4. American Water Resources Association, Middleburg, Virginia.

Bohing-Gaese, K, M L Taper & J H Brown. 1993. Are declines in North American insectivorous songbirds due to causes on the breeding range? Conservation Biology 7:76-86.

Boland, S.P., J.A. Halstead, and B.E. Valentine. 1989. Willow Flycatcher nestling parasitized by larval fly, *Protocalliphora cuprina*. Wilson Bull. 101 (1):127.

Boren, J. 1997. Brown-headed cowbird parasitism on southwestern willow flycatchers: a literature review. Range Improvement Task Force, New Mexico State Univ.

Born, S.M., K.D. Genskow, T. L. Filbert, N. Hernandez-Mora, M. L. Keefer, and K. A. White. 1998. Socioeconomic and institutional dimensions of dam removals: The Wisconsin experience. Environmental Management 22:359-370.

Boukidis, J.G. 1993. A fire and fuels analysis for the South Fork Wildlife Area on the Cannell Meadow Ranger District, Sequoia National Forest. USDA Forest Service Pacific Southwest Region. 43 pages.

Bowers, J.E. and S.P. McLaughlin. 1996. Flora of the Huachuca Mountains, a botanically rich and historically significant sky island in Cochise County, Arizona. Journal of the Arizona-Nevada Academy of Science 29:66-107.

Bowler, P.A. 1989. Riparian woodland: an endangered habitat in southern California. Pages 80-97 *in* Endangered Plant Communities of Southern California - Proceedings of the 15th annual symposium. Special Publication No. 3, Southern California Botanists and California State University, Fullerton.

Bowles, A.E. 1995. Response of wildlife to noise. *In* Knight, R.L. and K.J. Gutzwiller, Eds. Wildlife and recreationists. Coexistence through management and research, 109-156. Island Press. Washington, D.C.

Bowser, C.W. 1957. Introduction and spread of the undesirable tamarisks in the Pacific Southwest section of the United States and comments concerning the plants' influence upon the indigenous vegetation. American Geophysical Union Transactions 38:415-416.

Boyle, S.A. and F.B. Samson. 1985. Effects of nonconsumptive recreation on wildlife: a review. Wildl. Soc. Bull. 13:110-116.

Braatne, J.H., S.B. Rood, and P.E. Heilman. 1997. Life history, ecology, and conservation of riparian cottonwoods in North America. Pages 57-85 in R. F. Stettler, H. D. Bradshaw Jr., P. E. Heilman and T. M. Hinckley (eds), Biology of *Populus* and its Implications for Management and Conservation. National Research Council, Ottawa, Canada.

Braden, G.T. and R.L. McKernan. 1998. Nest cycles, vocalizations, and survey protocols of the endangered southwestern willow flycatcher (*Empidonax traillii extimus*). Report to U.S. Bureau of Reclamation, Lower Colorado River Office, Boulder City, Nevada. 36 pp.

Bradshaw, A.D. 1997. What do we mean by restoration? Pages 8-14 *in* Urbansksa, K.M., N.R. Webb, and P.J. Edwards, eds. Restoration Ecology and Sustainable Development. Cambridge University Press.

Briggs, M. 1992. An evaluation of riparian revegetation efforts in Arizona. Master's thesis. University of Arizona.

Briggs, M.K. 1996. Riparian Ecosystem Recovery in Arid Lands - Strategies and References. The University of Arizona Press, Tucson. 159 pp.

Briggs, M.K. and S. Cornelius. 1998. Opportunities for ecological improvement along the lower Colorado River and delta. Wetlands 18:513-529.

Brinkman, K.A. 1974. *Salix* L.-willow. *In: Seeds of woody plants in the United States*, USDA Agriculture Handbook 450. pp. 746-750.

Brinson, M.M. and R. Rheinhardt. 1996. The role of reference wetlands in functional assessment and mitigation. Ecological Applications 6:69-76.

Briskie, J.V. and S.G. Sealy. 1990. Evolution of short incubation period in the parasitic cowbirds, *Molothrus* spp. Auk 107:789-794.

Briskie, J.V. 1994. Least Flycatcher. Pp. 1-22 *in* The Birds of North America, No. 99 (A. Poole and F. Gill, eds.). Philadelphia, Academy of Natural Sciences; Washington DC, American Ornithologists' Union.

Brittingham, M.C. and S.A. Temple. 1983. Have cowbirds caused forest songbirds to decline? BioScience 33:31-35.

Brock, J. H. 1994. *Tamarix* spp. (salt cedar), an invasive exotic woody plant in arid and semi-arid riparian habitats of Western USA. Pages 27-44 *in* Ecology and Management of Invasive Riverside Plants, L.C. de Waal, L.E. Child, P. M. Wade and J.H. Brock (eds.), John Wiley and Sons Ltd., West Sussex, England.

Brooks, M.L. 1995. Benefits of protective fencing to plant and rodent communities of the Western Mojave Desert, California. Environmental Management 19:65-74.

Brothers, T.S. 1984. Historical vegetation change in the Owens River riparian woodland. Pages 75-84 *in* R. E. Warner and K. M. Hendrix (eds.), California riparian systems: Ecology, conservation, and productive management. UC Press, Berkeley, CA.

Brothers, T.S. and A. Spingarn. 1992. Forest fragmentation and alien plant invasion of central Indiana old-growth forests. Conservation Biology 6:91-100.

Brown, B.T. 1988. Breeding Ecology of a Willow Flycatcher Population in Grand Canyon, Arizona. Western Birds 19:25-33.

Brown, B.T. and M.W. Trosset. 1989. Nesting-Habitat relationships of riparian birds along the Colorado River in Grand Canyon, Arizona. Southwestern Naturalist 34(2):260-270.

Brown, B.T. 1991. Status of Nesting Willow Flycatchers along the Colorado River from Glen Canyon Dam to Cardenas Creek, Arizona. Endangered Species Report No. 20 to the U.S. Fish and Wildlife Service, Phoenix, Arizona. 34 pp.

Brown, D.E., C.H. Lowe, and C.P. Pase. 1979. A digitized classification system for the biotic communities of North America, with community (series) and association examples for the Southwest. Journal of the Arizona-Nevada Academy of Science 14:1-16.

Brown, D.E. (Editor). 1982. Biotic communities of the American Southwest - United States and Mexico. Desert Plants 4(1-4). 342 pp.

Brown, D.E. and R.A. Minnich. 1986. Fire and changes in creosote bush scrub of the western Sonoran desert, California. American Midland Naturalist 116:411-422.

Brown, H.E., M.B. Baker, Jr., J.J. Rogers, W.P. Clary, J.L. Kovner, F.R. Larson, C.C. Avery, and R.E. Campbell. 1974. Opportunities for increasing water yields and other multiple use values on ponderosa pine forest lands. U.S. Forest Service Rocky Mountain Forest and Range Experiment Station, Research Paper RM-129, Ft. Collins, CO. 36 pp.

Brown, S.C. and B.L. Bedford. 1997. Restoration of wetland vegetation with transplanted wetland soil: an experimental study. Wetlands 17: 424-437.

Browning, M.R. 1993. Comments on the taxonomy of *Empidonax traillii* (willow flycatcher). Western Birds 24:241-257.

Brush, T. 1993. Declines in orioles of the Lower Rio Grande Valley, Texas--possible effects of cowbirds. (abstract) North American Research Workshop on the Ecology and Management of Cowbirds. Austin, Texas.

Bryan, K. 1928. Change in plant association by change in ground water level. Ecology 9(4):474-478.

Bryant, F.T., R.E. Blaser, and J.R. Peterson. 1972. Effect of trampling by cattle on bluegrass yield and soil compaction of a Meadowville Loam. *Agron. J.* 64:331-334.

Bureau of Land Management. 1995. Riparian Area Management: Process for Assessing Proper Functioning Condition. Technical Reference 1737-9, Revised, Denver, Bureau of Land Management.

Burhans, D.E., and P.C. Freeman. 1997. Partial rejection of immaculate foreign eggs by yellow-breasted chats. Auk 114:503-506.

Burhans, D.E. 2000. Sunrise nest attentiveness in cowbird hosts: their role in aggression, cowbird recognition and host response to parasitism. *In*: Ecology and Management of Cowbirds and Their Hosts (J.N.M. Smith, T.L. Cook, S.K. Robinson, S.I. Rothstein and S.G. Sealy eds.), Univ. of Texas Press, Austin, Texas.

Burke, D.J. 1997. Donor wetland soil promotes revegetation in wetland trials. Restoration & Management Notes 15:168-172.

Burkham, D.E. 1972. Channel Changes of the Gila River in Safford Valley, Arizona. U.S. Geological Survey Professional Paper 655-G, U.S. Geological Survey, Washington, D.C.

Burkhardt, J.W. 1996. Herbivory in the intermountain west. Univ. Idaho, Forest , Wildlife and Range Experiment Station. Bull. 58. 35 pp.

Burnham, K.P. and D.R. Anderson. 1998. Model selection and inference: a practical information-theoretic approach. Springer-Verlag, New York, NY.

Busch, D.E. and S.D. Smith. 1993. Effects of fire on water salinity relations of riparian woody taxa. Oecologia 94:186-194.

Busch, D.E. 1995. Effects of fire on southwestern riparian plant community structure. Southwestern Naturalist 40:259-267.

Busch, D.E. and S.D. Smith. 1995. Mechanisms associated with decline of woody species in riparian ecosystems of the Southwestern U.S. Ecological Monographs 65:347-370.

Busch, J.D., M.P. Miller, E.H. Paxton, and M.K. Sogge. 2000. Genetic variation in the endangered southwestern willow flycatcher. The Auk 117(3):586-595.

Cairns, J. 1995. Rehabilitating damaged ecosystems. Boca Raton: Lewis Publishers.

California Department of Fish and Game. 1992. State and Federal endangered and threatened animals of California. Revised July, 1992. State of California, The Resources Agency, Department of Fish and Game, Natural Heritage Division. Sacramento, California. 13 pp.

Callaway, R.M., T.H. DeLuca, and W.M. Belliveau. 1999. Biological-control herbivores may increase competitive ability of the noxious weed *Centaurea maculosa*. Ecology 80:1196-1201.

Cannon, R.W and F.L. Knopf. 1984. Species composition of a willow community relative to seasonal grazing histories in Colorado. Southwestern Naturalist. 29:234-237.

Carman, J.G. and J.D. Brotherson. 1982. Comparison of sites infested and not infested with saltcedar (*Tamarix pentandra*) and Russian olive (*Elaeagnus angustifolia*). Weed Science 30:360-364.

Carothers, S.W. 1977. Importance, preservation and management of riparian habitat: An overview. *In*: Importance, preservation and management of riparian habitat, USDA Forest Service Gen. Tech. Rep. RM-43.

Carothers, S.W., S.W. Aitchison, and R.R. Johnson. 1979. Natural resources, white water recreation, and river management alternatives on the Colorado River, Grand Canyon National Park, Arizona. Pp.253-259. *In*: R. M. Linn (ed.), First Conference on Scientific Research in the National Parks, Vol. I. Proceedings of the Conference. USDI Natl. Park Serv. Trans. and Proceed. Series No. 5, Natl. Park Serv., Washington, D.C. 681 pp.

Carothers, S.W., R.A. Johnson, and R. Dolan. 1984. Recreational impacts on Colorado River beaches in Glen Canyon, Arizona. Environmental Management. 8:353-358.

Carothers, S.W., G.S. Mills, and R.R. Johnson. 1990. The creation and restoration of riparian habitat in southwestern arid and semi-arid regions. *In*: Wetland creation and restoration: the status of science, vol. 1, Regional Reviews, edited by J.A. Kusler and M.E. Kentula, 359-376. Covelo, Calif.: Island Press.

Carothers, S., and Brown, B. 1991. The Colorado River Through Grand Canyon: Natural History and Human Change, Univ. of Arizona Press, Tucson.

Catchpole, C.K. and P.J.B. Slater. 1995. Bird song: biological themes and variations. Cambridge University Press, Cambridge, United Kingdom.

Chace, J.F. and A. Cruz. 1999. Past and present distribution of the Brown-headed Cowbird in the Rocky Mountain Region. pp. 89-93. *In:* Research and Management of The Brown-headed Cowbird in Western Landscapes (M. L. Morrison, L. S. Hall, S. K. Robinson, S. I. Rothstein, D. C. Hahn and T. Rich eds.), Studies in Avian Biology No. 18.

Chang, C. 1996. Ecosystem responses to fire and variations in fire regimes. Pages 1071-1099 *in* Sierra Nevada Ecosystem

Project, Volume II. Wildland Resources Center Report No. 37, University of California, Davis,

Christensen, K. 1998. Southwestern Willow Flycatcher Surveys in Lower Grand Canyon, 1998. Hualapai Tribe, Department of Natural Resources. Peach Springs, AZ

Cimprich, D.A. and Moore, F.R. 1995. Gray catbird (*Dumetella carolinensis*). *In:* The Birds of North America, No. 167 (Ed. by A. Poole & F. Gill). Philadelphia: Academy of Natural Sciences.

Clary, W.P., and B.F. Webster. 1989. Managing grazing of the riparian areas in the Intermountain Region. Gen. Tech. Rep. INT-263. Ogden, Utah. USDA Forest Service, Intermountain Research Station. 11 pp.

Clary, W.P., and D.E. Medin. 1992. Vegetation, breeding bird and small mammal biomass in two high-elevation sagebrush riparian habitats. pp. 100-110 in W.P. Clary et al. (Compilers) GTR INT-289.

Cleverly, J.R., S.D. Smith, A. Sala, and D.A. Devitt. 1997. Invasive capacity of *Tamarix ramosissima* in a Mojave Desert floodplain: the role of drought. Oecologia 111:12-18.

Coker, D.R., and D.E. Capen. 1995. Landscape-level habitat use by brown-headed cowbirds in Vermont. Journal of Wildlife Management 59:631-637.

Cole, D.N. 1986. Recreational impacts on backcountry campsites in Grand Canyon National Park, Arizona, USA. Environmental Management. 10(5): 651-659.

Cole, D.N. 1993. Trampling effects on mountain vegetation in Washington, Colorado, New Hampshire, and North Carolina. USDA Forest Service Research Paper INT-464. Ogden, Utah: Intermountain Research Station.

Cole, D.N. and P.B. Landres. 1995. Indirect effects of recreation on wildlife. *In*: Knight, R.L. and K.J. Gutzwiller, Eds. Wildlife and recreationists. Coexistence through management and research, 183-202. Island Press. Washington, D.C.

Cole, D.N. and D.R. Spildie. 1998. Hiker, horse and llama trampling effects on native vegetation in Montana, USA. Journal of Environmental Management. 53:61-67.

Collier, M., Webb, R., Schmidt, J. 1997. Dams and Rivers: Primer on the Downstream Effects of Dams, U.S. Geological Survey Circular 1126, U.S. Geological Survey, Denver.

Converse, Y.K., C.P. Hawkins, and R. A. Valdez. 1998. Habitat relationships of subadult humpback chub in the Colorado River through Grand Canyon: Spatial variability and implications of flow regulation. Regulated Rivers- Research and Management 14: 267-284.

Cook, C.W., L.E. Harris, M.L. Young. 1967. Botanical and nutritive content of diets in cattle and sheep under single and common use on mountain ranges. J. Animal Sci. 26:1169-1174.

Cook, C.W., and L.E. Harris. 1968. Nutritive value of seasonal ranges. Utah Agricultural Experiment Station, Bull. 472.

Cook, T. L., J. A. Koloszar, M. D.Goering and L. L. Sanchez. 1998. The spatial and temporal response of Brown-headed Cowbirds (*Molothrus ater)* to cattle removal. Pp. 76-96 *in* Summary of 1997 Research Activities (Compiled by L. L. Sanchez.). Texas Conservation Center, The Nature Conservancy, Fort Hood, Texas.

Cooke, R.U., and Reeves, R.W. 1976. Arroyos and Environmental Change in the American South-West, Clarendon Press, Oxford.

Cooper, C.A. 1996. Summary of 1995 Surveys for Willow Flycatchers in New Mexico. New Mexico Department of Game and Fish. Santa Fe, New Mexico. Contract #96-516.51.

Cooper, C.A. 1997. Statewide summary of 1996 surveys for willow flycatchers in New Mexico. New Mexico Department of Game and Fish Report. Contract # 96-516.81.

Costanza R, R. d'Arge , R. de Groot, S. Farber, M. Grasso, B. Hannon, K. Limburg, S. Naeem, R. V. O'Neill, J. Paruelo, R. G. Raskin, P. Sutton, and M van den Belt. 1998. Ecological Economics 25:3-15.

Cote, I.M., and W.J. Sutherland. 1997. The effectiveness of removing predators to protect bird populations. Conservation Biology 11:395-405.

Cottrell, T.R. 1995. Willow colonization of Rocky Mountain mires. Canadian Journal of Forest Research 25:215-222.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. La Roe, Eds. 1979. Classification of wetlands and deepwater habitats of the United States. Fish and Wildlife Service, U.S. Dept. of the Interior, Washington, D.C.

Covington, W.W. and M.M. Moore. 1994. Southwestern ponderosa forest structure: changes since Euro-American settlement. Journal of Forestry 92:39-47.

Covington, W.W., P.Z. Fule, M.M. Moore, S.C. Hart, T.E. Kolb, J.N. Mast, S.S. Sackett, and M.R. Wagner. 1997. Restoring ecosystem health in Ponderosa pine forests of the Southwest. Journal of Forestry 95: 23-29.

Craig, D., R.W. Schlorff, B.E. Valentine and C. Pelles. 1992. Survey protocol for Willow Flycatchers (*Empidonax traillii*) on National Forest Service lands in the Pacific Southwest region. U.S. Forest Service.

Craig, W.S. 1977. Reducing impacts from river recreation users. *In*: Proceedings from the symposium on river recreation management and research, 155-162. USDA Forest Service General Technical Report NC-28. St. Paul, Minn.: North Central Experiment Station.

Crawford, C.S., A.C. Cully, R. Leutheuser, M.S. Sifuentes, L.H. White, and J.P. Wilber. 1993. Middle Rio Grande Ecosystem: Bosque Biological Management Plan. Albuquerque, NM: Middle Rio Grande Biological Interagency Team.

Cruz, A., W. Post, J.W. Wiley, C.P. Ortega, T.K. Nakamura, and J.W. Prather. 1998. Potential impacts of cowbird range expansion in Florida. pp. 313-336 *In:* Parasitic Birds and Their Hosts, Studies in Coevolution. (S.I. Rothstein and S.K. Robinson, eds), Oxford Univ. Press, New York.

Curson, D.R., C.B. Goguen, and N.E. Mathews. 2000. Long-distance commuting by Brown-headed Cowbirds in New Mexico. Auk 117:795-799.

Dahl, T.E. 1990. Wetlands losses in the United States, 1780s to 1980s. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C. 13 pp.

D'Antonio, C.M., T.L. Dudley, and M. Mack. 1999. Disturbance and biological invasions: direct effects and feedbacks, pp. 413-452. *In*: L.R. Walker (ed.), Ecosystems of Disturbed Ground. Elsevier Press, Amsterdam.

Davies, N.B. and M. de L. Brooke. 1989. An experimental study of co-evolution between the cuckoo, *Cuculus canorus*, and its hosts. I. Host egg discrimination. J. Anim. Ecol. 58:207-224.

Davies, N.B., A.F.G. Bourke and M. de L. Brooke. 1989. Cuckoos and parasitic ants: interspecific parasitism as an evolutionary arms race. Trends Ecol. Evol. 4:274-278.

Davis, F.W., E.A. Keller, A. Parikh, and J. Florsheim. 1989. Recovery of the chaparral riparian zone following wildfire. USDA Forest Service General Technical Report PSW 110:194-203.

Davis, G.P., Jr. 1982. Man and wildlife in Arizona- the American Exploration Period 1824-1865. Phoenix, Arizona: the Arizona Game and Fish Department.

Dearborn, D.C. 1996. Video documentation of a brown-headed cowbird nestling ejecting an indigo bunting nestling from the nest. Condor 98:645-649.

DeBenedetti, S.H., and D.J. Parsons. 1979. Natural fire in subalpine meadows: a case description from the Sierra Nevada. Journal of Forestry 77:477-9.

DeCamps, H.A., M. Planty-Tabacchi, and E. Tabacchi. 1995. Changes in the hydrological regime and invasions by plant species along riparian systems of the Adour River, France. Regulated Rivers: Research and Management 11:23-33.

DeCapita, M.E. 2000. Brown-headed Cowbird control on Kirtland's Warbler nesting areas in Michigan. *In:* Ecology and

Management of Cowbirds and Their Hosts (J.N.M. Smith, T.L. Cook, S.K. Robinson, S.I. Rothstein and S.G. Sealy eds.), Univ. of Texas Press, Austin, Texas.

DeLay, L, D.M. Finch, S. Brantley, R. Fagerlund, M.D. Means and J.F. Kelley. 1999. Arthropods in native and exotic vegetation and their association with Willow Flycatchers and Wilson's Warblers. Pages 216-221 *in* Finch, D.M., J.C. Whitney, J.F. Kelley and S.R. Loftin (eds). Rio Grande ecosystems: linking land, water, and people. USDA Forest Service Rocky Mountain Research Station Proceedings RMRS-P-7.

DeLoach, C.J. 1991. Biological control of weeds in the United States. Natural Areas Journal 11:129-142.

DeLoach, C.J. 1997. Effects of biological control of saltcedar (*Tamarix ramosissima*) on endangered species. Biological Assessment. USDA, Agricultural Research Service, Grassland Soil & Water Research Laboratory, Grassland Protection Research Unit, Temple, Texas.

Deluca, T.H., W.A. Patterson IV, W.A. Freimund, and D.N. Cole. 1998. Influence of llamas, horses, and hikers on soil erosion from established recreation trails in western Montana, USA. Environmental Management 22(2) 255-262.

del Nevo, A.J., S.A. Laymon, J.R. McBride, R.M. Marshall, R.M. Ohmart and M.K. Sogge. 1998. California Subcommittee of the Southwestern Willow Flycatcher Recovery Team: An Assessment of the Status and Habitat Use of Southwestern Willow Flycatchers in Relation to the Operation of Isabella Reservoir Within the Kern River Valley. Final Report to the U.S. Fish and Wildlife Service and U.S. Army Corps of Engineers, Sacramento, CA.

DeLong, A.K., and J.T. Schmidt. In prep. Literature Review: Effects of human disturbance on wildlife with emphasis on wildlife-dependent recreation relevant to Stillwater National Wildlife Refuge. U.S. Fish and Wildlife Service. Stillwater National Wildlife Refuge. 52pp.

Densmore, R., and J. Zasada. 1983. Seed dispersal and dormancy patterns in northern willows: ecological and evolutionary significance. Canadian Journal of Botany. 61: 3207-3216.

Deshler, E.T., M.K. Sogge, and R.M. Marshall. 1997. An annotated bibliography for the Southwestern Willow Flycatcher. National Park Service Technical Report NPS/NAUCPRS/NRTR-97/13.

Devitt, D.A., A. Sala, S.D. Smith, J. Cleverly, L. K. Shaulis, and R. Hammett. 1998. Bowen ratio estimates of evapotranspiration for *Tamarix ramosissima* stands on the Virgin River in southern Nevada. Water Resources Research 34:2407-2414.

Devitt, D.A., J.M. Piorkowski, S.D. Smith, J.R. Cleverly, and A. Sala. 1997. Plant water relations of *Tamarix ramosissima* in response to the imposition and alleviation of soil moisture stress. Journal of Arid Environments 36:527-540.

Dixon, M.D., and W.C. Johnson. 1999. Riparian vegetation along the middle Snake River, Idaho: zonation, geographical trends, and historical changes. Great Basin Naturalist 59:18-34.

Dobkin, D.S., A.C. Rich, and W.H. Pyle. 1998. Habitat and avifuanal recovery from livestock grazing in a riparian meadow system of the northwestern Great Basin. Conserv. Biol. 12(1):209-221.

Dobkin, D.S., A.C. Rich, and W.H. Pyles. 1998. Habitat and avifaunal recovery from livestock grazing in a riparian meadow system of the Northwestern Great Basin. Conservation Biology 12:209-221.

Donovan, T.M., F.R. Thompson III, J. Faaborg,and J.R. Probst. 1995. Reproductive success of migratory birds in habitat sources and sinks. Conservation Biology 9:1380-1395.

Donovan, T.M., P.W. Jones, E.M. Annand, and F.R. Thompson III. 1997. Variation in local-scale edge effects: mechanisms and landscape context. Ecology 78:2064-2075.

Dotzenko, A.D., N.T. Papamichos, and D. S. Romine. 1967. Effect of recreational use on soil and moisture conditions in Rocky Mountain National. Park. Journal of Soil and Water Conservation 22:196-197.

Drost, C.A., M.K. Sogge and E. Paxton. 1997. Preliminary diet study of the endangered southwestern willow flycatcher.

USGS Colorado Plateau Field Station, Flagstaff, Arizona.

Dudley, T. and B. Collins. 1995. Biological Invasions in California Wetlands: The Impacts and Control of Non-indigenous Species. Pacific Institute for SIDES, Oakland, California.

Dudley, T. 2000. *Arundo donax* (L.) (Giant reed, Giant cane). In C. Bossard, J. Randall. and M. Hoshovsky (eds). Wildland Weeds of California. California Native Plant Society, Sacramento, California.

Dufty, A. M., Jr. 1982. Response of Brown-headed Cowbirds to simulated conspecific intruders. Animal Behav. 30:1043-1052.

EA Engineering, Science, and Technology. 1997. Southwestern Willow Flycatcher survey for the Santa Ana River 1 and 2 hydroelectric project Mill Creek 2/3 hydroelectric project Lytle Creek hydroelectric project. Southern California Edison Company. Rosemead, CA

Eckrich, G.H., T.E. Kolozar, and M.D. Goering. 1999. Effective landscape management of Brown-headed Cowbirds at Fort Hood Texas. pp. 267-274. *In:* Research and Management of The Brown-headed Cowbird in Western Landscapes (M. L. Morrison, L. S. Hall, S. K. Robinson, S. I. Rothstein, D. C. Hahn and T. Rich eds.), Studies in Avian Biology No. 18.

Ehrenfeld, J.G. 1983. The effects of changes in land-use on swamps of the New Jersey Pine Barrens. Biological Conservation 25:353-375.

Ehrhart, R.C. and P.H. Hansen. 1997. Effective cattle management in riparian zones: a field survey and literature review. Montana BLM Riparian Technical Bulletin 3. Missoula Montana: USDI Bureau of Land Management.

Elliott, P.F. 1980. Evolution of promiscuity in the brown-headed cowbird. Condor 82:138-141

Ellis, L.M. 1995. Bird use of saltcedar and cottonwood vegetation in the Middle Rio Grande Valley of New Mexico, USA. Journal of Arid Environments 30:339-349.

Ellis, L.M. 1997. Rodent communities in native and exotic riparian vegetation in the middle Rio Grande Valley of Central New Mexico. Southwestern Naturalist 42:13-19.

Ellis, L.M., C.S. Crawford, and M.C. Molles. 1998. Comparison of litter dynamics in native and exotic riparian vegetation along the Middle Rio Grande of central New Mexico, USA. Journal of Arid Environments 38:283-296.

Elmore, W. 1992. Riparian responses to livestock grazing. Chapter 17 *in* "Watershed Management: Balancing sustainability and environmental change." R.J. Naiman, Ed. Springer-Verlag, New York New York.

Elmore, W. and B. Kauffman. 1994. Riparian and watershed systems: degradation and restoration. Pages 212-231 in M. Vavra, W. A. Laycock, and R. D. Pieper, eds. Ecological Implications of Livestock Herbivory in the West. Society for Range Management, Denver, CO.

Else, J.A. 1996. Post-flood establishment of native woody species and an exotic, *Arundo donax*, in a southern Californian riparian system. Unpublished Master's thesis, San Diego State University.

Everitt, B.L. 1980. Ecology of saltcedar- a plea for research. Environmental Geology 3:77-84.

Everitt, B.L. 1998. Chronology of the spread of tamarisk in the central Rio Grande. Wetlands 18:658-668.

Evans, D.E., and R.R. Drebs. 1977. Avian use of livestock watering ponds in western South Dakota. USDA Forest Service Gen. Tech. Rep. RM-35.

Faber, P.M. and J.F. Watson. 1989. The ecology of riparian habitats of the Southern California Coastal Region: a community profile. U. S. Fish and Wildlife Biological Report 85(7.27). Washington, D. C.

Famolaro, Peter. 1998. Endangered/threatened species monitoring report. Prepared for the U.S. Fish and Wildlife Service, Carlsbad Field Office, Carlsbad, California.

Farley, G.H., L.M. Ellis, J.N. Stuart, and N.J. Scott, Jr. 1994. Avian species richness in different-aged stands of riparian forest along the middle Rio Grande, New Mexico. Conservation Biology 8:1098-1108.

Farmer, C. 1999a. The density and distribution of Brown-headed Cowbirds: the Central Coastal California enigma. Pp. 62-67, *In*: Research and Management of the Brown-headed Cowbird in western landscapes, M.L. Morrison, L.S. Hall, S.K. Robinson, S.I. Rothstein, D.C. Hahn and T.R. Rich, eds. Studies in Avian Biology No. 18.

Farmer, C. 1999b. Factors influencing the distribution and abundance of Brown-headed Cowbirds. Ph. D. thesis. University of California, Santa Barbara.

Finch, D.M. 1991. Population ecology, habitat requirements, and conservation of neotropical migratory birds. Gen. Tech. Rep. RM-205. Fort Collins, Colorado. USDA Forest Service, Rocky Mountain Forest and Range Experimental Station. 26 pp.

Finch, D., M. Means, L. Delay, and J. Kelly. 1998. Use of willow and adjacent habitats along the low flow conveyance channel by willow flycatchers and other migratory birds. Final report to the Bureau of Reclamation USDA Forest Service Rocky Mountain Research Station. Albuquerque, NM.

Finch, D.M. and S.H. Stoleson, Eds. 1999. Status, ecology, and conservation of the southwestern willow flycatcher. US Forest Service Rocky Mountain Research Station, Albuquerque, NM.

Finch, D.M. and J.F. Kelley. 1999. Status of management of the Southwestern Willow Flycatcher in New Mexico. Pages 197-203 *in* Finch, D.M., J.C. Whitney, J.F. Kelley and S.R. Loftin (eds). Rio Grande ecosystems: linking land, water, and people. USDA Forest Service Rocky Mountain Research Station Proceedings RMRS-P-7.

Finch, D.M., J.F. Kelly, and J-L.E. Cartron. 2000. Migration and winter ecology. Chapter 7 in Status, Ecology, and Conservation of the Southwestern Willow Flycatcher. (D.M. Finch and S.H. Stoleson, eds). USDA Forest Service Gen Tech. Rep. RMRS-GTR-60. 131 pp.

Fitzpatrick, J.W. 1980. Foraging behavior of neotropical Tyrant flycatchers. Condor 82:43-57.

Flather, C.H. and H.K. Cordell. 1995. Outdoor recreation: historical and anticipated trends. *In*: Knight, R.L. and K.J. Gutzwiller, Eds. Wildlife and recreationists. Coexistence through management and research, 3-16. Island Press. Washington, D.C.

Fleischer, R C. 1985. A new technique to identify and assess the dispersion of eggs of individual brood parasites. Behav. Ecol. Sociobiol. 17:91-99.

Fleischer, R.C., A.P. Smyth, and S.I. Rothstein. 1987. Temporal and age-related variation in the laying rate of the parasitic Brown-headed Cowbird in the eastern Sierra Nevada, California. Can. J. Zool. 65: 2724-2730.

Fleming, W., D. Galt, and J. Holechek. 2001. Ten Steps to Evaluating Rangeland Riparian Health. Rangelands. 23(6):22-27.

Fox, M.D. and B.J. Fox. 1986. The susceptibility of natural communities to invasion. Pages 57-66 in Ecology of Biological Invasions, R.H. Groves and J.J. Burdon (eds), Cambridge University Press, New York, New York.

Frakes, R.A. and R.E. Johnson. 1982. Niche convergence in Empidonax flycatchers. Condor 84:286-291.

Frank, D.A. 1998. Ungulate regulation of ecosystem process in Yellowstone National Park: direct and feedback effects. Wildl. Soc. Bull. 26(3):410-418.

Franklin, A.B., K.P. Burnham, G.C. White, R.G. Anthony, E.D. Forsman, C. Schwarz, J.D. Nichols, and J. Hines. 1999. Range-wide status and trends in northern spotted owl populations. Unpublished Report, Colorado Cooperative Fish and Wildlife Research Unit, Fort Collins CO.

Frederick, K., VandenBerg, T., and Hanson, J. 1997. Economic Values of Freshwater in the United States, Resources for the Future Discussion Paper 97-03, Resources for the Future, Washington.

Friedmann, H. and L.F. Kiff. 1985. The parasitic cowbirds and their hosts. Proc. West. Found. Vert. Zool. 2:225-304.

Friedmann, H., L.F. Kiff, and S.I. Rothstein. 1977. A further contribution to knowledge of the host relations of the parasitic cowbirds. Smith. Contr. Zool. 235.

Friedmann, H. 1929. The cowbirds: a study in the biology of social parasitism. C. Thomas, Springfield.

Friedmann, H. 1963. Host relations of the parasitic cowbirds. U. S. Nat. Mus. Bull. 233

Friedman, J.M., M.L. Scott, and W.M. Lewis. 1995. Restoration of riparian forest using irrigation, artificial disturbance, and natural seedfall. Environmental Management 19:547-557.

Friedman, J.M., W.R. Osterkamp, M.L. Scott, and G.T. Auble. 1998. Downstream effects of dams on channel geometry and bottomland vegetation: regional patterns in the Great Plains, USA. Wetlands 18:619-633.

Frissell, S.S., Jr., and D.P. Dunken. 1965. Campsite preference and deterioration in the Quetico Superior, Canoe County. Journal of Forestry 63: 256-260.

Fox, M.D. and B.J. Fox. 1986. The susceptibility of natural communities to invasion. Pages 57-66 in Ecology of Biological Invasions, R. H. Groves and J. J. Burdon (eds), Cambridge University Press, New York, New York.

Gates, J.E. and D.R. Evans. 1998. Cowbirds breeding in the Central Appalachians: Spatial and temporal patterns and habitat selection. Ecol. Appl. 8:27-40.

General Accounting Office. 1988. Public rangelands: Some riparian areas restored but widespread improvement will be slow. General Accounting Office, U.S. Government. Washington, D.C.

Gifford, G.F. and R.H. Hawkins. 1978. Hydrologic impact of grazing on infiltration: a critical review. Water Resources Research. 14:305-313.

Gillen, R.L., W.C. Krueger, and R.F. Miller. 1985. Cattle use of riparian meadows in the Blue Mountains of northeastern Oregon. J. Range Manage. 38:205-209.

Gladwin, D.N. and J.E. Roelle. 1998. Survival of plains cottonwood (*Populus deltoides* subsp. *monilifera*) and tamarisk (*Tamarix ramosissima*) seedlings in response to flooding. Wetlands 18:669-674.

Glenn, E., R. Tanner, S. Mendez, T. Kehret, D. Moore, J. Garcia, and C. Valdes. 1998. Growth rates, salt tolerances and water use characteristics of native and invasive plants from the delta of the Colorado River. Journal of Arid Environments 40:281-294.

Glinski, R.L. 1977. Regeneration and distribution of sycamore and cottonwood: their ecology and conservation. *In:* Importance, preservation and management of riparian habitat, USDA Forest Service Gen. Tech. Rept. RM-43.

Glinski, R.L., and R.D. Ohmart. 1984. Factors of reproduction and population densities in the Apache cicada (*Diceroprocta apache*). Southwestern Naturalist 29:73-79.

Goguen, C.B. and N.E. Mathews. 1999. Review of the causes and implications of the association between cowbirds and livestock. Pp.10-17, *In:* Research and Management of the Brown-headed Cowbird in Western Landscapes, M.L. Morrison, L.S. Hall, S.K. Robinson, S.I. Rothstein, D.C. Hahn and T.R. Rich, eds. Studies in Avian Biology No. 18.

Goodwin, C.N., C.P. Hawkins, and J.L. Kershner. 1997. Riparian restoration in the Western United States: Overview and perspective. Restoration Ecology 5(4S):4-14.

Gorski, L.J. 1969. Traill's Flycatchers of the "fitz-bew" songform wintering in Panama. Auk 86:745-747.

Gotmark, F. 1992. The effects of investigator disturbance on nesting birds. In Current Ornithology, vol. 9, ed., D.M. Power, 63-104. New York: Plenum Press.

Gourley, C.R. 1997. Restoration of the lower Truckee River ecosystem: challenges and opportunities. Paper presented at

Wallace Stegner Conference: “To Cherish and Renew”: Restoring Western Ecosystems and Communities

Graf, W.L. 1978. Fluvial Adjustments to the Spread of Tamarisk in the Colorado Plateau Region. Geological Society of America Bulletin, vol. 89, p. 1491-1501.

Graf, W.L. 1982. Tamarisk and river-channel management. Environmental Management 6(4):283-296.

Graf, W.L. 1988. Fluvial Processes in Dryland Rivers, New York, Springer-Verlag.

Graf, W.L. 1999. Dam Nation: A geographic census of American dams and their large-scale hydrologic impacts. Water Resources Research 35:1305-1311.

Graf, W.L., J. Stromberg, and B. Valentine. 1999. Implications of water and river management for the Southwestern Willow Flycatcher: the fluvial, hydrologic and geomorphic context for recovery. Issues paper from the USFWS Southwestern Willow Flycatcher Recovery Team.

Grafe, A.R. and J.S. Holland. 1997. An analysis of recreational use and associated impacts at Lake Mead National Recreation Area - A social and environmental perspective. Lake Mead National Recreation Area. Draft Unpublished Manuscript.

Graham, D.S. 1988. Responses of five host species to cowbird parasitism. Condor 90:588-591.

Gregory, K.J., and Park, C.C. 1974. Adjustments of river channel capacity downstream from a reservoir. Water Resources Research 10:870-873.

Green, D.M., and J.B. Kauffman. 1995. Succession and livestock grazing in a northeastern Oregon riparian ecosystem. Journal of Range Management 48:307-313.

Griffin, G.F., D.M. Stafford Smith, S.R. Morton, G.E. Allan, and K.A. Masters. 1989. Status and implications of the invasion of tamarisk (*Tamarix aphylla*) on the Finke River, Northern Territory, Australia. Journal of Environmental Management 29:297-315.

Griffin, J.S. 1943. A Doctor Comes to California: The Dairy of John S. Griffin, California Historical Society, San Francisco.

Griffith, J.T. and J.C. Griffith. 1994. Brown-headed Cowbird removal program on Marine Corps Base Camp Pendleton, California. U. S. Marine Corps, Camp Pendleton, Calif.

Griffith, J.T. and J.C. Griffith. 1995. The status of the Southwestern Willow Flycatcher at the Upper San Luis Rey River, San Diego County, California, in 1994. Final Report to the U.S. Forest Service, Palomar Ranger District, No. 43-91U4-4-0271.

Griffith, J.T. and J.C. Griffith. 2000. Cowbird control and the endangered Least Bell's Vireo: a management success story. *In:* Ecology and Management of Cowbirds and Their Hosts (J.N.M. Smith, T.L. Cook, S.K. Robinson, S.I. Rothstein and S.G. Sealy eds.), Univ. of Texas Press, Austin, Texas.

Grinnell, J. and A.H. Miller. 1944. The distribution of the birds of California. Pacific Coast Avifauna 27.

Groeneveld, D.P., and Griepentrog, T.E. 1985. Interdependence of groundwater, riparian vegetation, and streambank stability: a case study. U.S.D.A. Forest Service General Technical Report RM-120: 44-48.

Grzybowski, J.A. and C.M. Pease. 1999. A model of the dynamics of cowbirds and their host communities. Auk 116:209-222.

Grzybowski, J.A. and C.M. Pease. 2000. Relative influence of predation and brood parasitism on seasonal fecundity in passerine birds. *In:* Ecology and Management of Cowbirds and Their Hosts (J.N.M. Smith, T.L. Cook, S.K. Robinson, S.I. Rothstein, and S.G. Sealy eds.), Univ. of Texas Press, Austin, Texas.

Gurney, W.S.C. and R.M. Nesbitt. 1978. Single species population fluctuations in patchy environments. American Naturalist 112:1075-1090.

Gutzwiller, K. 1995. Recreational disturbance and wildlife communities. *In*: Knight, R.L. and K.J. Gutzwiller, Eds. Wildlife and recreationists. Coexistence through management and research, 169-182. Island Press. Washington, D.C.

Gutzwiller, L.A., R.M. McNatt, and R.D. Price. 1997. Watershed restoration and grazing practices in the Great Basin: Mary's River of Nevada. Pages 360-380 in J. E. Williams, C. A. Wood, and M. P. Dombeck, eds. Watershed Restoration: Principles and Practices. American Fisheries Society, Bethesda, MD.

Hahn, D.C., Sedgwick, J.A., Painter, I.S. and N.J. Casna. 1999. A spatial and genetic analysis of cowbird host selection. pp. 204-217 *In:* Research and Management of The Brown-headed Cowbird in Western Landscapes (M. L. Morrison, L. S. Hall, S. K. Robinson, S. I. Rothstein, D. C. Hahn and T. Rich eds.), Studies in Avian Biology No. 18.

Haig, S.M., J.R. Belthoff, and D.H. Allen. 1993. Population viability analysis for a small population of red-cockaded woodpeckers and an evaluation of enhancement strategies. Conservation Biology 7:289-301.

Hall, L. and S.I. Rothstein. 1999. Cowbird control: the efficacy of long term-control and proposed alternatives to standard control practices. pp. 254-259 *In:* Research and Management of The Brown-headed Cowbird in Western Landscapes (M.L. Morrison, L.S. Hall, S.K. Robinson, S.I. Rothstein, D.C. Hahn, and T. Rich, eds.), Studies in Avian Biology No. 18.

Hammitt, W.E. and D.N. Cole 1987. Wildland Recreation: Ecology and Management. New York: John Wiley and Sons.

Haney, C.J., D.S. Lee, and M. Walsh-McGehee. 1998. A quantitative analysis of winter distribution and habitats of Kirtland's Warblers in the Bahamas. Condor 100:201-217.

Hansen, A.J. and D.L. Urban. 1992. Avian response to landscape pattern: the role of species' life histories. Landscape Ecology 7:163-180.

Hanski, I. 1994. A practical model of metapopulation dynamics. Journal Animal Ecology 63:151-162.

Hanski, I., A. Moilanen, and M. Gyllenberg. 1996. Minimum viable metapopulation size. American Naturalist 147:527-541.

Hanski, I. 1997. Metapopulation dynamics: From concepts and observations to predictive models. Pp. 69-91 *In*: Metapopulation Biology: Ecology, Genetics, and Evolution (I.A. Hanski and M.E. Gilpin, eds.). Academic Press, Inc., New York.

Harper, J.L., J.T. Williams, and G.R. Sagar. 1965. The behaviour of seeds in soil. I. The heterogeneity of soil surface and its role in determining the establishment of plants from seed. Journal of Ecology 53:273-286.

Harris, D.R. 1966. Recent plant invasions in the arid and semi-arid Southwest of the United States. Annals of the Association of American Geographers 56:408-422.

Harris, G.A. 1967. Some competitive relationships between *Agropyron spicatum* and *Bromus tectorum*. Ecological Monographs 37:89-111.

Harris, J.H. 1974. The influence of nest building and egg laying behavior on clutch size in renests of the willow flycatcher. Bird Banding 45:320-325.

Harris, J.H., S.D. Sanders, and M.A. Flett. 1986. The status and distribution of the willow flycatcher in California, 1986. California Department of Fish and Game, Wildlife Management Division Administrative Report 88-1.

Harris, J.H., S.D. Sanders, and M.A. Flett. 1987. The status and distribution of the willow flycatcher (*Empidonax traillii*) in the Sierra Nevada. California Department of Fish and Game, Wildlife Management Branch Administrative Report 87-2.

Harris, J.H. 1991. Effects of brood parasitism by brown-headed cowbirds on willow flycatcher nesting success along the Kern River, California. Western Birds 22:13-26.

Hauer, F.R. and R.D. Smith. 1998. The hydrogeomorphic approach to functional assessment of riparian wetlands: evaluating impacts and mitigation on river floodplains in the USA. Freshwater Biology 40:517-530.

Hartshorn, G.S. 1983. Plants. Pp. 118-157 *In*: Costa Rican Natural History (D.H. Janzen, ed.). University of Chicago Press, Chicago.

Hendrickson, D.A. and W.L. Minckley. 1984. Ciénegas- vanishing climax communities of the American Southwest. Desert Plants 6:131-175.

Hennessey, R. 1999. Field release of a nonindigenous leaf beatle, Diorhabda elongata (ColeopteraChrysomelidae) for biological control of deciduous saltcedar, *Tamarix ramosissima* and *T. parviflora* (Tamaricaceae).

Environmental Assessment. USDA--APHIS. Riverdale, Maryland.

Higgins, A. 1981. Avian succession in burned riparian vegetation. M. S. Thesis. Arizona State University, Tempe, Arizona.

Hill, M.T. and W.S. Platts. 1998. Ecosystem restoration: A case study in the Owens River Gorge, California. Fisheries 23:18-27.

Hirschboeck, K.K. 1988. Flood hydroclimatology. *In*: Flood Geomorphology (V. Baker, R.C. Kochel, and P.C. Patton, eds.). John Wiley & Sons, New York, p. 27-50.

Hobbs, R.J. and L.F. Huenneke. 1992. Disturbance, diversity, and invasion: implications for conservation. Conservation Biology 6:324-337.

Hobbs, R.J. and D.A. Norton. 1996. Towards a conceptual framework for restoration ecology. Restoration Ecology 4: 93-110.

Hoddenbach, G. 1990. Tamarix control. Pp. 116-123. *In*: (M. R. Kunzmann, R. R. Johnson, and P. S. Bennett, eds.). Tamarisk control in Southwestern United States. Special Report No. 9, University of Arizona Cooperative National Resources Studies Unit, Tucson, AZ.

Hoffman, E.C. 1929. Note on cowbird. Bull. Northeastern Bird-Banding Assoc. 5:118-119.

Hofstra, T.S., J.C. Stromberg, and J.C. Stutz. 1999. Factors associated with wetwood intensity of Fremont cottonwood (*Populus fremontii*) in Arizona. Great Basin Naturalist 59(1):85-91.

Holechek, J.L. 1995. Range management: principles and practices. Englewood Cliffs, N.J.: Prentice Hall.

Holechek, J.L., and M. Vavra. 1983. Drought effects on diet and weight gains of yearling heifers in northeastern Oregon. J. Range Manage. 36:227-231.

Holechek, J.L. 1992. Financial aspects of cattle production in the Chihuahuan Desert rangelands. 14:145-149.

Holcomb, L.C. 1972. Traill's Flycatcher breeding biology. Nebraska Bird Review 40:50-68.

Holcomb, L.C. 1974. The influence of nest building and egg laying behavior on clutch size in renests of the willow flycatcher. Bird Banding 45:320-325.

Holdridge, L.R. 1967. Life Zone Ecology. Rev. ed. San Jóse: Tropical Science Center.

Holmes, B. 1993. An avian arch-villain gets off easy. Science 262:1514-1515.

Holmgren, M.A. and Collins. 1995. Interim report on the distribution, breeding status, and habitat associations of seven federal special-status bird species and Brown-headed Cowbirds at Vandenberg Air Force Base, Santa Barbara County, California. Museum of Systematics and Ecology, Department of Ecology, Evolution and Marine Biology, University of California. Santa Barbara, California. Environmental Report No. 3.

Hopkins, R.M. and W.H. Patrick, Jr. 1969. Combined effect of oxygen content and soil compaction on root penetration. Soil Science. 108:408-413.

Horton, J.S. 1977. The development and perpetuation of the permanent tamarisk type in the phreatophyte zone of the

Southwest. Pp. 124-127. *In*: R.R. Johnson and D.A. Jones, technical coordinators. Importance, Preservation, and Management of Riparian Habitat: A Symposium. USDA Forest Service General Technical Report RM-43. Fort Collins, Colorado.

Hosoi, S.A. and S.I. Rothstein. 2000. Nest desertion and cowbird parasitism: evidence for evolved responses and evolutionary lag. Anim. Behav. 59:823-840.

Houston, W.R., and R.R. Woodward. 1966. Effects of stocking rates on range vegetation and beef cattle production in the northern Great Plains. U.S. Dept. Agric. Tech. Bull. 1357.

Howe, F.P. 2000. Southwestern Willow Flycatcher and Yellow-billed Cuckoo Surveys along the Green River (Sand Wash - Swaseys Beach) Utah, 1997-1999. Utah Division of Wildlife Resources Publication Number 00-8. Salt Lake City, UT.32 pp.

Howe, W.H. and F.L. Knopf. 1991. On the imminent decline of Rio Grande cottonwoods in central New Mexico. Southwestern Naturalist 36(2):218-224.

Howell, Steve N.G. and S. Webb. 1995. A guide to the birds of Mexico and northern Central America. Oxford University Press. 851 pp.

Hubbard, J.P. 1982. The breeding season. New Mexico. Am. Birds 36:1006-1007.

Hubbard, J.P. 1987. The status of the willow flycatcher in New Mexico. Endangered Species Program, New Mexico Department of Game and Fish, Santa Fe, New Mexico. 29 pp.

Hughes, L.E. 1993. "The devil's own"- tamarisk. Rangelands 15:151-155.

Hundertmark, C.A. 1978. Breeding birds of Elephant Butte Marsh. New Mexico Ornith. Soc. Publ. 5:1-17.

Hunt, C., 1988. Down by the River: The Impact of Federal Water Projects and Policies on Biological Diversity. Washington, D.C.: Island Press.

Hunter, W.C., R.D. Ohmart, and B.W. Anderson. 1988. Use of exotic saltcedar (*Tamarix chinensis*) by birds in arid riparian systems. Condor 90:113-123.

Imhof, T.A. 1962. Alabama birds. University of Alabama Press, Tuscaloosa, Alabama. 591 pp.

Intergovernmental Panel on Climate Change, Climate Change. 1995. Impacts, Adaptations, and Mitigation. World Meteorological Organization/United Nations Environment Programme, New York.

International Bird Census Committee. 1970. An international standard for a mapping method in bird census work recommended by the International Bird Census Committee. Audubon Field Notes 24:722-726.

Jackson J., J.T. Ball, and M.R. Rose. 1990. Assessment of the salinity tolerance of eight Sonoran Desert riparian trees and shrubs. Desert Research Institute, Reno, NV, USA.

Jackson, L.L , N. Lopoukhine, and D. Hillyard. 1995. Ecological restoration: a definition and comments. Restoration Ecology 3:71-76.

Jefferson, R.G. and P.V. Grice. 1998. The conservation of lowland wet grassland in England. Pp. 31-48 *In*: European Wet Grasslands: Biodiversity, Management, and Restoration (C. B. Joyce and P. M. Cade eds.). John Wiley and Sons.

Johnsgard, P.A. 1997. The Avian Brood Parasites. Oxford Univ. Press, New York.

Johnson, K.L. 1992. Management for water quality on rangelands through best management practices; the Idaho approach. Pp. 415-441 In: Watershed management; balancing sustainability and environmental change (Naiman, R.J., ed.). Springer-Verlag, New York, NY.

Johnson, K., P. Mehlhop, C. Black, and K. Score. 1999. Reproductive failure of endangered southwestern willow flycatchers on the Rio Grande, New Mexico. The Southwestern Naturalist 44(2):226-231.

Johnson, M.J. and M.K. Sogge. 1995. Cowbird concentrations at livestock corrals in Grand Canyon National Park. Pages 275-284 *in* van Riper, C. III, editor. Proceedings of the Second Biennial Conference on Research in Colorado Plateau National Parks. 25-28 October 1993. National Park Service Transactions and Proceedings Series NPS/NRNAU/NRTP-95/11.

Johnson, M.J. and M.K. Sogge. 1997. Southwestern Willow Flycatcher surveys along portions of the San Juan River, Utah (Montezuma Creek - Mexican Hat and Clay Hills Crossing) 1997. USGS Colorado Plateau Field Station: Flagstaff, Arizona.

Johnson, M.J. and C. O'Brien. 1998. Southwestern willow flycatcher and yellow-billed cuckoo surveys along the San Juan River, Utah (Four Corners Bridge - Mexican Hat): 1998. Final Report to the Utah Division of Wildlife Resources (Contract # 976475). Colorado Plateau Field Station/Northern Arizona University report. 45 pp.

Johnson, M.J. 1998. Southwestern willow flycatcher surveys in the Manti-La Sal National Forest, (Moab and Monticello Districts) Utah: 1998. Final report to the Utah Division of Wildlife Resources. USGS Biological Resources Division, Forest and Rangeland Ecosystem Science Center, Colorado Plateau Field Station, Northern Arizona University report, Flagstaff, AZ. 19 pp.

Johnson, M.J., A. Brand, H.C. English, C. Michaud and B. Moore. 1999. Southwestern Willow Flycatcher and Western Yellow-billed Cuckoo Surveys along the Colorado River (Dewey Bridge - Canyonlands National Park Northern Boundary) and Green River (Green River, UT - Canyonlands National Park Northern Boundary) 1999. U.S. Geological Survey report to the U.S. Bureau of Reclamation and the Utah Department of Wildlife Resources. 34 pp.

Johnson, M.J., A. Brand, H.C. English, C. Michaud and B. Moore. 1999. Southwestern Willow Flycatcher Surveys in Canyonlands National Park along the Colorado and Green Rivers, 1999. U.S. Geological Survey report to the U.S. Bureau of Reclamation and the Utah Department of Wildlife Resources. 33 pp.

Johnson, R.R. and S.W. Carothers. 1982. Riparian habitat and recreation: interrelationships and impacts in the Southwest and Rocky Mountain region. Eisenhour Consortium for Western Environmental Forestry Research. Bulletin 12.

Johnson, W.M. 1953. Effect of grazing intensity on vegetation and cattle gains on ponderosa pine-bunchgrass range. U.S. Dept. Agric. Circ. 929.

Johnston, C.A. and R.J. Naiman. 1987. Boundary dynamics at the aquatic-terrestrial interface: the influence of beaver and geomorphology. Landscape Ecology 1:47-57.

Jorgensen, M.C. 1996. The use of prescribed fire and mechanical removal as means of control of tamarisk trees. Saltcedar Management Workshop, June 1996.

Judd, J.B., J.M. Laughlin, H.R. Guenther, and R. Handergrade. 1971. The lethal decline of mesquite on the Casa Grande National Monument. Great Basin Naturalist 31:153-159.

Kandtrud, H.A. 1981. Grazing intensity effects on the breeding avifauna of North Dakota native grasslands. Can. Field-Nat. 95(4):404-417.

Kandtrud, H.A., and R.L. Kologiski. 1982. Effects of soils and grazing on breeding birds of uncultivated upland grasslands of the northern Great Plains. USDI F&WS Wildl. Res. Rept. 15. 33 pp.

Karstad, L. 1971. Arboviruses. Pp. 17-21. *In*: Infections and parasitic disease of wild birds (J.W. Davis, R.C. Anderson, L. Karstad, and D.O. Trainer, eds.). Iowa State University Press, Ames.

Kauffman, J.B., W.C. Krueger, and M. Vavra. 1983. Effects of late season cattle grazing on riparian plant communities. J. Range. Manage. 36:685-691.

Kauffman, J.B. and C.W. Krueger. 1984. Livestock impacts on riparian ecosystems and streamside management implications...A review. Journal of Range Management 37(5):430-438.

Kay, C.E., and S. Chadde. 1992. Reduction of willow seed production by ungulate browsing in Yellowstone Park. *In*: W.P. Clary, E.D. McArthur, D. Bedunah, and C.L. Wambolt, Compilers, Symposium on Ecology and Management of Riparian Shrub Communities. USDA For. Serv. Gen. Tech. Rep. INT-289. 232 pp.

Kay, D.E. 1998. Are ecosystems structured from the top-down or the bottom-up: A new look at an old debate. Wildl. Soc. Bull. 26(3):484-98.

Kentula, M.E., R.P. Brooks, S.E. Gwin, C.C. Holland, A. D. Sherman, and J.C. Sifneos. 1993. An approach to improving decision making in wetland restoration and creation. C. K. Smoley, Inc., CRC Press, Boca Raton, FL.

Kerpez, T.A. and N.S. Smith. 1987. Saltcedar control for wildlife habitat improvement in the southwestern United States. U.S. Dept. of Interior, Fish and Wildlife Service Resource Publication 169. 16 pp.

Kershner, J.L. 1997. Setting riparian/aquatic restoration objectives within a watershed context. Restoration Ecology 5:15-24, Suppl.

Kino, E.F. 1919. Kino's Historical Memoir of Pimeria Alta, Volume 1, edited by H. E. Bolton, Arthur H. Clark Publishers, Cleveland.

Klebenow, D.A. and R.J. Oakleaf. 1984. Historical avifaunal changes in the riparian zone of the Truckee River, Nevada. Pp. 203-209. *In*: California Riparian Systems (R.E. Warner and K.M. Hendrix, eds.). University of California Press, Berkeley. 1034 pp.

Klein, M.L., S.R. Humphrey, and F. Percival. 1995. Effects of ecotourism on distribution of waterbirds in a wildlife refuge. Conservation Biology 9:1454-1465.

Klipple, G.E. and D.F. Costello. 1960. Vegetation and cattle responses to different intensities of grazing on shortgrass ranges of the central Great Plains. U.S. Dept. Agric. Tech. Bull. 1216.

Knopf, F.L. and R.W. Cannon. 1982. Structural resilience of a willow riparian community to changes in grazing practices *In* Wildlife-livestock Relationships Symposium: Proc. 10, University of Idaho Forest, Wildlife and range Experimental Sta., Moscow ID.

Knopf, F.L. and T.E. Olson. 1984. Naturalization of Russian olive- implications to Rocky Mountain wildlife. Wildlife Society Bulletin 12: (3) 289-298.

Knopf, F.L., J.A. Sedgwick, and R.W. Cannon. 1988. Guild structure of a riparian avifuana relative to seasonal cattle grazing. J. Wildl. Manage. 52:280-90.

Koloszar, J. A., and J. S. Horne. 2000. The spatial and temporal response of Brown-headed Cowbirds (*Molothus ater*) to a reduction in cattle stocking rates - final analysis. Pp. 147-177 *in* Endangered species monitoring and management at Fort Hood, Texas: 1999 annual report (Anonymous ed.). Fort Hood Project, The Nature Conservancy of Texas, Fort Hood, Texas.

Komar, O. 1998. Avian Diversity in El Salvador. Wilson Bulletin 110: 511-533.

Kondolf, G.M. 1993. Lag in stream channel adjustment to livestock exclosure, White Mountains, California. Restoration Ecology 1: 226-230.

Kondolf, G.M. 1995. Five elements for effective evaluation of stream restoration. Restoration Ecology 3:133-136.

Koronkiewicz, T., M.K. Sogge, and C.A. Drost. 1998. A preliminary survey for wintering willow flycatchers in Costa Rica. USGS Forest and Rangelend Ecosystem Science Center, Colorado Plateau Field Station, Northern Arizona University, Flagstaff. 47 pp.

Koronkiewicz, T.J. and M.J. Whitfield. 1999. Surveys for Wintering WillowFlycatchers (Empidonax traillii) in Costa Rica and Panama. Final report submitted to the Bureau of Reclamation Phoenix Area Office (Federal Grant No. 98-FG-32-0200), Phoenix, AZ. 91 pp.

Koronkiewicz, T.J. and M.K. Sogge. 2000. Winter ecology of the willow flycatcher (*Empidonax traillii*) in Costa Rica: 1999/2000. USGS Report to the U.S. Bureau of Reclamation.

Koronkiewicz, T.J. and M.K. Sogge. 2001. Southwestern Willow Flycatchers Recaptured at Wintering Sites in Costa Rica. North American Bird Bander 26:161-162.

Koronkiewicz, T.J. 2002. Intraspecific territoriality and site fidelity of wintering Willow Flycatchers (*Empidonax traillii*) in Costa Rica, and intraspecific winter territory defense behavior in the Willow Flycatcher (*Empidonax traillii*). M.S. Thesis. Northern Arizona University, Flagstaff, AZ.

Kovalchik, B.L. and W. Elmore. 1992. Effects of cattle grazing systems on willow-dominated plant associations in central Oregon. *In:* Proceedings: Symposium on ecology and management of riparian shrub communities, (W.P. Clary, E.D. McArthur, D. Bedunah, and C.L. Wambolt, eds.). USDA Forest Service Gen. Tech. Rept INT-289. Intermountain Research Station, Ogden, UT.

Krebs, C.J. 1972. Ecology: The experimental analysis of distribution and abundance. Harper & Row, Publishers. New York, N.Y. 694 pp.

Kroodsma, D. E. 1984. Songs of the Alder Flycatcher (*Empidonax alnorum*) and Willow Flycatcher (*Empidonax traillii*) are innate. Auk 101:13-24.

Krueger, H.O., and S.H. Anderson. 1985. The use of cattle as a management tool for wildlife in shrub-willow riparian systems. p 300-304 in R.R. Johnson et al. GTR RM-120.

Krueper, D.J. 1993. Effects of land use practices on western riparian ecosystems. Pp. 321-330. *In*: D. Finch and P. Stangel, eds., Status and Management of Neotropical Migratory Birds. Gen Tech. Rep. RM-229. USDA Forest Service, Rocky Mountain Range and Experiment Station, Fort Collins, Colorado. 422 pp.

Kus, B.E. 1996. Status of the least Bell's vireo and southwestern willow flycatcher at Marine Corps Base Camp Pendleton, 1995. Prepared for the Environmental and Natural Resources Office, Marine Corps Base Camp Pendleton.

Kus, B.E. and P.P. Beck. 1998. Distribution and abundance of the least Bell's vireo *(Vireo bellii pusillus*) and the southwestern willow flycatcher (*Empidonax traillii extimus*) at selected southern California sites in 1997. Prepared for the California Department of Fish and Game (draft).

Kus, B.E. 1998. Use of restored riparian habitat by the endangered least Bell's vireo. Restoration Ecology 6(1):75-82.

Kus, B. E. 1999. Impacts of Brown-headed Cowbird parasitism on productivity of the endangered Least Bell's Vireo. pp. 160-166 *In:* Research and Management of The Brown-headed Cowbird in Western Landscapes (M. L. Morrison, L. S. Hall, S. K. Robinson, S. I. Rothstein, D. C. Hahn, and T. Rich, eds.), Studies in Avian Biology No. 18.

Kus, B.E, P.P. Beck, and J.M.Wells. 1999. Status and breeding activities of the Southwestern Willow Flycatcher at the Cleveland national Forest in 1999. Report to Cleveland National Forest. U.S. Geologic Survey. Western Ecological Research Center, San Diego, California.

Lack, D. 1954. The natural regulation of animal numbers. Clarendon Press, Oxford. 343 pp.

Lambeck, R.J. 1997. Focal species: A multi-species umbrella for nature conservation. Conservation Biology 11: 849-856.

Lamberson, R.H., B.R. Noon, and M.L. Farnsworth. 2000. An incidence function analysis of the viability of the southwestern willow flycatcher. Colorado State University. Report to the U.S. Bureau of Reclamation, Phoenix, Arizona. 35 pp. plus appendices.

Lammon, J.S. 1994. Effects of season and intensity of defoliation on two important montane riparian species. M.S. Thesis, Colorado State University, Fort collins, CO.

Lande, R. 1995. Mutation and conservation. Conservation Biology 9:782-791.

Langridge, S.M. and M.K. Sogge. 1997. Banding of the Southwestern Willow Flycatcher in the White Mountains - 1997 summary report. U.S.G.S. Colorado Plateau Field Station/Northern Arizona University report.

Langridge, S.M. and M.K. Sogge. 1998. Banding and genetic sampling of willow flycatcher in Utah: 1997 and 1998. U.S.G.S. Colorado Plateau Field Station/Northern Arizona University report. 60 pp.

Larison, B., S.A. Laymon, P.L. Williams, and T. B. Smith. 1998. Song Sparrows vs. cowbird brood parasites: impacts of forest structure and nest-site selection. Condor 100:93-101.

Larsen, R.E., W.C. Krueger, M.R. George, M. Barrington, J.C. Buckhouse, D.E. Johnson. 1998. Viewpoint: Livestock influences on riparian zones and fish habitat: Literature classification. Journal of Range Management 51(6):661-664.

Lebreton, J-D., K.P. Burnham, J. Clobert, and D.R. Anderson. 1992. Modeling survival and testing biological hypotheses using marked animals: a unified approach with case studies. Ecological Monographs 62: 67-118.

Leege, T.A. 1979. Effects of repeated prescribed burns on northern Idaho elk browse. Northwest Science 53:107-113.

Ligon, J.S. 1961. New Mexico Birds and where to find them. The University of New Mexico Press, Albuquerque, New Mexico.

Linsdale, J.M. 1936. The Birds of Nevada. Pacific Coast Avifauna 23. Cooper Ornithological Society, Berkeley, CA.

Linton, C.B. 1908. Notes from Buena Vista Lake, May 20 to June 16, 1907. Condor 10: 196-198.

Loft, E.R., J.W. Menke, J.G. Kie, and R.C. Bertram. 1987. Influence of cattle stocking rate on the structural profile of deer hiding cover. J. Wildl. Manage. 51: 655-664.

Lovich, J.E. and R.C. DeGouvenain. 1997. Saltcedar invasion in the desert wetlands of the Southwestern United States: ecological and political implications. Pages 447-467 in Ecology of Wetlands and Associated Systems, S. K. Majundar, E. W. Miller, and F. J. Brenner (eds), The Pennsylvania Academy of Sciences.

Lowther, P.E. 1993. Brown-headed Cowbird (*Molothrus ater*). *In*: The Birds of North America, No. 47 (A. Poole and F. Gill, eds.). Philadelphia: The Academy of Natural Sciences.

Lowther, P.E. 1995. Bronzed Cowbird (*Molothrus aeneus*). *In*: The Birds of North America, No. 144 (A. Poole and F. Gill, eds.). Philadelphia: The Academy of Natural Sciences.

Loye, J.E. and M. Zuk (eds). 1991. Bird-Parasite Interactions: Ecology, evolution, and behavior. Oxford University Press, Oxford. 406 pp.

Luff, J.A., E.H. Paxton, K.E. Kenwood, and M.K. Sogge. 2000. Survivorship and movements of southwestern willow flycatchers in Arizona - 2000. U.S. Geological Survey report to the U.S. Bureau of Reclamation, Phoenix. USGS Forest and Rangelend Ecosystem Science Center, Colorado Plateau Field Station at Northern Arizona University, Flagstaff. 46 pp.

Lutz, H. 1945. Soil conditions on picnic grounds in public forest parks. Journal of Forestry. 43:121-127.

Lynn, J.C. and M.J. Whitfield. 2000. Winter distribution of the Willow Flycatcher (Empidonax traillii) in Panama and El Salvador. Kern River Research Center report to U.S. Geological Survey and U.S. Bureau of Reclamation. 69 pp.

Lynn, J.C. and M.J. Whitfield. 2002. Winter distribution of the Willow Flycatcher in Mexico. Southern Sierra Research Station report, Weldon, CA.

Mack, R.N. 1986. Plant invasion into the Intermountain West. Pages 191-213 in, Ecology of Biological Invasions of North America and Hawaii, H. A Mooney and J. A. Drake (eds), Springer-Verlag, New York, New York.

Mahoney, J.M. and S.B. Rood. 1998. Streamflow requirements for cottonwood seedling recruitment- an integrative model. Wetlands 18:634-645.

Manley, W.A., R.H. Hart, M.A. Smith, J.W. Waggoner, Jr., and J.T. Manley. 1997. Vegetation, cattle, and economic responses to grazing strategies and pressure. J. Range Manage. 50:638-646.

Manning, R.E. 1979. Impacts of recreation on riparian soil and vegetation. Water Resources Bulletin. 15:30-43.

Marcuson, P.E. 1977. The effect of cattle grazing on brown trout in Rock Creek, Montana. Montana Dept. of Fish and Game, Fisheries Division, (v. Special Report). Project No. F-20-R-21, II-a.

Marshall, R.M. 2000. Population status on breeding grounds. Chapter 3 *In*: D. Finch and S. Stoleson, eds. Status, ecology, and conservation of the southwestern willow flycatcher. USDA Forest Service, Rocky Mountain Research Station, Albuquerque, NM.

Marshall, R.M. and S.H. Stoleson. 2000. "Threats". Chapter 4 *In*: D. Finch and S. Stoleson, eds. Status, ecology, and conservation of the southwestern willow flycatcher. USDA Forest Service, Rocky Mountain Research Station, Albuquerque, New Mexico.

Martin, S.C. and D.R. Cable. 1974. Managing semi-desert grass-shrub ranges: Vegetation responses to precipitation, grazing, soil texture, and mesquite control. U.S. Dep. Agric. Tech. Bull. 1480.

Martin, S.C. 1975. Stocking strategies and net cattle sales on semi-desert range. U.S. Dept. Agric. For. Serv. Res. Pap. RM-146.

Martin, P.S., and C.R. Szuter. 1999. War zones and game sinks in Lewis and Clark's west. Conserv. Biol. 13(1):36-45.

Martin, T.E. 1992. Breeding productivity considerations: what are thee appropriate habitat features for management. Pp. 455-473. *In*: Ecology and Conservation of Neotropical Migrant Landbirds (J.M. Hagan, III and D. Johnston, eds.). Smithsonian Institution Press, Washington, D. C.

Martin, T.E. 1993. Nest predation among vegetation layers and habitat types: revising the dogmas. Amer. Nat. 141:897-913.

Mayfield, H.F. 1977. Brown-headed Cowbird: agent of extermination? Amer. Birds 31:107-113.

Maynard, W.R. 1995. Summary of 1994 survey efforts in New Mexico for the Southwestern Willow Flycatcher (*Empidonax traillii extimus*). New Mexico Department of Game and Fish Report. Contract # 94-516-69.

McCabe, R.A. 1991. The little green bird: ecology of the willow flycatcher. Palmer publications, Inc., Amherst, Wisconsin. 171 pp.

McCarthey, T.D., C.E. Paradzick, J.W. Rourke, M.W. Sumner, and R.F. Davidson. 1998. Arizona Partners In Flight southwestern willow flycatcher 1997 survey and nest monitoring report. Nongame and Endangered Wildlife Program Technical Report 130. Arizona Game and Fish Department, Phoenix, Arizona. 81 pp.

McClatchie, A.J. 1901. Wild barley. University of Arizona Agricultural Experiment Station Bulletin 38:287-290.

McDonald, K.P., J. Snider, C.L. Peterson, M. St. Germain and S. Staats. 1995. Results of 1995 Southwestern Willow Flycatcher surveys in the Virgin River drainage and southern Utah. Utah Division of Wildlife Resources, Publication No. 95-17.

McEvoy, P.B. and E.M. Coombs. 1999. Biological control of plant invaders: regional patterns, field experiments, and structured population models. Ecological Applications 9:387-401.

McIntyre, S., P. Ladiges and G. Adams. 1988. Plant species-richness and invasion by exotics in relation to disturbance of wetland communities on the Riverine Plain, NSW. Australian Journal of Ecology 13:361-373.

McKernan, R.L. 1997. Status, distribution, and habitat affinities of the southwestern willow flycatcher along the lower Colorado River: Year 1 - 1996. U.S. Bureau of Reclamation Report. 55 pp.

McKernan, R.L. and G. Braden. 1998. Status, distribution, and habitat affinities of the southwestern willow flycatcher along the lower Colorado River: Year 2 - 1997. U.S. Bureau of Reclamation Report. 64 pp.

McKernan, R.L. and G. Braden. 1999. Status, distribution, and habitat affinities of the southwestern willow flycatcher along the lower Colorado River: Year 3 - 1998. Report to U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, and U.S. Bureau of Land Management. San Bernardino County Museum. 71 pp.

McMaster, D.G. and S.G. Sealy. 1998. Short incubation periods of brown-headed cowbirds: how do cowbird eggs hatch before yellow warbler eggs? Condor 100:102-111.

McPherson, G.R. 1995. The role of fire in the desert grasslands. *In*: M. P. McClaran and T. R. VanDevender (eds), The Desert Grassland. University of Arizona Press, Tucson, Arizona.

McPherson, G.R. 1997. Ecology and management of North American savannas. University of Arizona Press, Tucson.

Mensing, S. and R. Byrne. 1999. Invasion of Mediterranean weeds into California before 1769. Fremontia 27(3):6-9.

Merriam, L.C. Jr. and C.K. Smith. 1974. Visitor impact on newly developed campsites in the Boundary Waters Canoe Area. Journal of Forestry. 72:627-630.

Meyer de Schauensee, R.M. and W.H. Phelps Jr. 1978. A guide to The Birds of Venezuela. Princeton Univ. Press, Princeton, NJ. 424 pp.

Michener, W.K. 1997. Quantitatively evaluating restoration experiments: research design, statistical analysis, and data management considerations. Restoration Ecology 5:324-337.

Micone, K. and C.R. Tomlinson. 2000. Breeding status of the Southwestern Willow Flycatcher and initial surveys for the Yuma Clapper Rail at various sites in southern Nevada. Nevada Division of Wildlife, Southern Region, Nongame Program. Las Vegas, NV.

Middleton, B. 1999. Wetland restoration: flood pulsing and disturbance dynamics. New York: John Wiley and Sons.

Miner, K. L. 1989. Foraging ecology of the least Bell's vireo, *Vireo bellii pusillus*. Unpublished Master's thesis, San Diego State University.

Moksnes, A., E. Røskaft, and A.T. Braa. 1991. Rejection behavior by common cuckoo hosts towards artificial brood parasite eggs. Auk 108:348-354.

Molles, M.C., C.S. Crawford, L.M. Ellis, H.M. Valett, and C.N. Dahm. 1998. Managed flooding for riparian ecosystem restoration - Managed flooding reorganizes riparian forest ecosystems along the middle Rio Grande in New Mexico. BioScience 48: 749-756.

Moore, F.R., S.A. Gauthreaux Jr., and T.R. Simons. 1993. Stopover habitat: management implications and guidelines. Pp. 58-63. *In*: Finch, D.M. and P.W. Stengel (eds). Status and management of neotropical migratory birds. USDA Forest Service General Technical Report RM-299.

Moore, S. 1989. Visitor management in a riparian wilderness habitat. Paper Presented at the Fourth Annual Conference of the Riparian Council, September 22-23, Sun Rise ski Resort, McNary, Arizona.

Monson, G. and A.R. Phillips. 1981. Annotated checklist of the birds of Arizona. The University of Arizona Press, Tucson, Arizona. 240 pp.

Montgomery, J.M., G.S. Mills, S. Sutherland, and R.B. Spicer. 1985. Wildlife and fisheries studies, upper Gila water supply project. Part 1: terrestrial wildlife. U.S. Bureau of Reclamation, Boulder City, Nevada.

Monz, C.A. 1998. Monitoring recreation resource impacts in two coastal areas of western North America: An initial assessment. *In*: Watson, Alan E.; Alphet, Greg. Eds. Personal, Societal and Ecological Values of Wilderness: Sixth World Wilderness Congress Proceedings on Research, Department of Agriculture, Forest Service, Rocky Mountain Research Station. In press.

Morin, E., A. Bouchard, and P. Jutras. 1989. Ecological analysis of disturbed riverbanks in the Montreal area of Quebec. Environmental Management 13:215-225.

Morin, N. 1995. Vascular plants of the United States. Pages 200-205 in Our Living Resources: a Report to the Nation on the Distribution, Abundance, and Health of U.S. Plants, Animals and Ecosystems, LaRoe ET, Farris GS, Puckett CE, Doran PD, Mac MJ (eds), Washington, DC: U.S. Department of the Interior, National Biological Service.

Morris, D.L. and F.R. Thompson, III. 1998. Effects of habitat and invertebrate density on abundance and foraging behavior of Brown-headed Cowbirds. Auk 115:376-385.

Morrison, M.L., B.G. Marcot and R.W. Mannan. 1992. Wildlife-Habitat Relationships; Concepts and applications. University of Wisconsin Press, Madison, WI. 343 pp.

Morrison, M.L., T. Tennant, and T.A. Scott. 1994. Laying the foundation for a comprehensive program of restoration for wildlife habitat in a riparian floodplain. Environmental Management 18:939-955.

Morrison, J.I., S.L. Postel, and P.H. Gleick. 1996. The sustainable use of water in the Lower Colorado River basin. Pacific Institute, Oakland, California.

Morrison, M.L., L.S. Hall, S.K. Robinson, S.I. Rothstein, D. C. Hahn, and T. Rich (eds.). 1999. Research and Management of The Brown-headed Cowbird in Western Landscapes. Studies in Avian Biology No. 18. 312 pp.

Morse, L.E., J.T. Kartesz, and L.S. Kutner. 1995. Native vascular plants. Pp. 205-209 *In*: Our Living Resources: a Report to the Nation on the Distribution, Abundance, and Health of U.S. Plants, Animals and Ecosystems, LaRoe ET, Farris GS, Puckett CE, Doran PD, Mac MJ (eds), Washington, DC: U.S. Department of the Interior, National Biological Service.

Mosley, J.C., P.S. Cook, A.J. Griffis, and J. O'Laughlin. 1997. Guidelines for managing cattle grazing in riparian areas to protect water quality: Review of research and best management practices policy. Idaho Forest, Wildlife and Range Policy Analysis Group, Report No. 15. University of Idaho, Moscow, ID.

Muiznieks, B.D., S.J. Sferra, T.E. Corman, M.K. Sogge, and T.J. Tibbitts. 1994. Arizona Partners In Flight southwestern willow flycatcher survey, 1993. Draft report: Nongame and Endangered Wildlife Program, Arizona Game and Fish Department, Phoenix, Arizona. Draft of April 1994. 28 pp.

Naiman, R.J., C.A. Johnston and J.C. Kelly. 1988. Alterations of North American streams by beaver. Bioscience 38:753-762.

Naiman, R.J., H. DeCamps and M. Pollock. 1993. The role of riparian corridors in maintaining regional biodiversity. Ecological Applications 3:209-212.

Naiman R.J. and K.H. Rogers. 1997. Large animals and system level characteristics in river corridors. BioScience 47: 521-529.

Nakamura, H., Kubota, S. and Suzuki, R., 1998. Coevolution between the common cuckoo and its major hosts in japan: stable versus dynamic specialization on hosts. *In:* Parasitic Birds and Their Hosts, Studies in Coevolution (S. I. Rothstein and S. K. Robinson, eds.), pp. 94-112. New York: Oxford University Press.

National Research Council. 1991. Colorado River Ecology and Dam Management. Washington, D.C.: National Academy Press.

National Research Council. 1992. Planning and evaluating aquatic ecosystem restoration. Pages 55-70 in Restoration of Aquatic Ecosystems: Science, Technology, and Public Policy. National Academy Press, Washington DC.

Netter, M.R., E.H. Paxton, and M.K. Sogge. 1998. Banding and movements of the southwestern willow flycatcher at Roosevelt Lake and San Pedro River/Gila River confluence, Arizona - 1998. USGS Forest and Rangeland Ecosystem Science Center, Colorado Plateau Field Station, Flagstaff, Arizona. Funded by the U.S. Bureau of Reclamation, Phoenix, Interagency Agreement #98-AA-32-0010. 48 pp.

Newkirk, T. 1996. Southwestern Willow Flycatcher Survey Results for 1996. California Department of Transportation: Santa Ana, California.

Newsome, A.E. and I. R. Noble. 1986. Ecological and physiological characters of invading species. Pages 1-20 in Ecology of Biological Invasions, R. H. Groves and J. J. Burdon (eds), Cambridge University Press, New York, New York.

New Mexico Department of Game and Fish. 1988. Handbook of species endangered in New Mexico. Santa Fe, New Mexico.

Noon, B.R., and J.R. Sauer. 1992. Population models for passerine birds: structure, parameterization, and analysis. Pp. 441-464 *In*: Wildlife 2001 Populations (D.R. McCullough and R.H. Barrett, eds.). Elsevier Scientific Publishers, Ltd. London, England.

Noon, B.R. and M. Farnsworth. 2000. Demographic analysis of the southwestern willow flycatcher: Kern River population. Colorado State University. Report to Bureau of Reclamation. Phoenix Arizona. 26 pp.

Oberholser, H.C. 1918. New light on the status of *Empidonax traillii* (Audubon). Ohio J. Sci. 18:85-98.

Oberholser, H.C. 1974. The bird life of Texas. University of Texas Press. Austin, Texas. 1069 pp.

Ohmart, R.D., W.O. Deason, and S.J. Freeland. 1975. Dynamics of marsh land formation and succession along the lower Colorado River and their importance and management problems as related to wildlife in the arid Southwest. Transactions of the Fortieth North American Wildlife Natural Resources Conference 1975: 240-251.

Ohmart, R.D. and B.W. Anderson. 1986. Riparian habitat. Pp. 169-199. *In*: A.Y. Cooperrider, R. J. Boyd, and H. R. Stuart (eds). Inventory and monitoring of wildlife habitat. Bureau of Land Management, Washington, D.C.

Ohmart, R.D. 1996. Historical and present impacts of livestock grazing on fish and wildlife resources in western riparian habitats. Chapter 16 *In*: (P.R. Krausman, ed.) Rangeland Wildlife. Soc. Range Manage. Denver, CO.

Olson, T.E. and F.L. Knopf. 1986. Naturalization of Russian-olive in the western United States. Western Journal of Applied Forestry 1:65-69.

Ortega, C.P. 1998. Cowbirds and other brood parasites. Tucson: University of Arizona Press.

Otahal, C.D. 1998. Fall stopover behavior of willow flycatchers using a riparian corridor in central California. North American Bird Bander 23(4):115-123.

Owen, J.C. and M.K. Sogge. 1997. Banding and genetic sampling of Willow Flycatchers in Colorado - 1996 & 1997 summary report. U.S.G.S. Colorado Plateau Field Station/Northern Arizona University report.

Owensby, C. E., F. Smith, and K. L. Anderson. 1973. Deferred rotation grazing with steers in the Kansas Flint Hills. J. Range Manage. 26:393-395.

Page, J.L., N. Dodd, T. Osborne, and J.A. Carson. 1978. The influence of livestock grazing on non-game wildlife. Cal-Neva Wildl. 1978:159-73.

Paine, R.T., M.J. Tegner, and E.A. Johnson. 1998. Compound perturbations yield ecological surprises. Ecosystems 1:535-545.

Paradzick, C.E., R.F. Davidson, J.W. Rourke, M.W. Sumner, and T.D. McCarthey. 1999. Southwestern Willow Flycatcher 1998 Survey and Nest Monitoring Report. Technical Report 141. Arizona Game and Fish Department Phoenix, AZ.

Paradzick, C.E., R.F. Davidson, J.W. Rourke, M.W. Sumner, A.M. Wartell, and T.D. McCarthey. 2000. Southwestern Willow Flycatcher 1999 Survey and Nest Monitoring Report. Technical Report 151. Arizona Game and Fish Department, Phoenix, AZ. 93 pp.

Parker, D. 1997. The Gila Valley revisited: 1997 survey results of willow flycatchers found along the Gila River near Gila and Cliff, Grant County, New Mexico. Applied Ecosystem Management, Inc., Patagonia, Arizona.

Parker, I.M. and S.H. Reichard. 1998. Critical issues on invasion biology for conservation science. Pp. 283-305. *In*: Conservation Biology for the Coming Decade, (P. L. Fiedler and P. M. Kareiva eds.), Chapman Hall, New York, NY, USA.

Parker, M., F.J. Wood Jr., B.H. Smith and R.G. Elder. 1985. Erosional downcutting in lower order riparian ecosystems: have historical changes been caused by removal of beaver? United States Forest Service General Technical Report RM-120:35-38.

Paulsen, J.A., Jr. and F.N. Ares. 1962. Grazing values and management of black grama and tobosa grasslands and associated shrub ranges of the southwest. U.S. Dept. Agric. Tech. Bull .1270.

Paxton, E., J. Owen and M.K. Sogge. 1996. Southwestern willow flycatcher response to catastrophic habitat loss. U.S.G.S. Colorado Plateau Research Station/Northern Arizona University report. 12 pp.

Paxton, E., S. Langridge, and M.K. Sogge. 1997. Banding and population genetics of Southwestern Willow Flycatchers in Arizona - 1997 summary report. U.S.G.S. Colorado Plateau Field Station/Northern Arizona University report.

Paxton, E.H. 2000. Molecular genetic structuring and demographic history of the willow flycatcher (*Empidonax traillii*). Master's Thesis. Northern Arizona University, Flagstaff. May 2000. 42 pp.

Pease, C.M. and J.A. Grzybowski. 1995. Assessing the consequences of brood parasitism and nest predation on seasonal fecundity in passerines birds. Auk 112:343-363.

Peer, B.D. and S.G. Sealy. 1999. Parasitism and egg puncture behavior by Bronzed and Borwn-headed Cowbirds. Pp. 235-240 *In:* Research and Management of The Brown-headed Cowbird in Western Landscapes (M. L. Morrison, L. S. Hall, S. K. Robinson, S. I. Rothstein, D. C. Hahn and T. Rich eds.), Studies in Avian Biology No. 18.

Pence, D.B. 1975. Keys, species and host lists, and bibliography for nasal mites of North American birds (Acarina: Rhinonyssinae, Turbinoptinae, Speleognathinae, and Cytoditidae). Texas Tech Press: Lubbock, Texas.

Peterson, L.C., K.P. McDonold, and K. Day. 1998. Summary of southwestern willow flycatcher investigations in southern Utah: 1997. Publication No. 98-17. Utah Division of Wildlife Resources, Cedar City, UT. 52 pp.

Peterson, R.T., and E. Chalif. 1973. A field guide to Mexican birds. Houghton Mifflin Company, Boston, Massachusetts. 432 pp.

Petit, S. and M.B. Usher. 1998. Biodiversity in agricultural landscapes: the ground beetle communities of woody uncultivated habitats. Biodiversity and Conservation 7:1549-1561

Petterson, J.R. and M.K. Sogge. 1996. Distribution and status of the southwestern willow flycatcher along the Colorado River in the Grand Canyon - 1996. Grand Canyon National Park and Colorado Plateau Research Station: Grand Canyon, Arizona and Flagstaff, Arizona.

Petts, G. 1984. Impounded Rivers: Perspectives for Ecological Management. Chichester: John Wiley & Sons.

Phillips, A.R. 1948. Geographic variation in *Empidonax traillii*. Auk 65:507-514.

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

Pielou, E.C. 1991. After the Ice Age: The Return of Life to Glaciated North America. Chicago: University of Chicago Press.

Pickett, S.T.A. and P.S. White. 1985. The ecology of natural disturbance and patch dynamics. New York: Academic Press.

Pike, J., M. Wheeler, V. Smith, and L.R. Hays. 1996. The status and management of the Least Bell's Vireo and Southwestern Willow Flycatcher within the Prado Basin, California, 1986-1996.

Pike, J., D. Pellegrini, V. Smith and L.R. Hays. 1997. The status and management of the Least Bell's Vireo and the Southwestern Willow Flycatcher in the Prado Basin, California 1986-1997. Prepared for The Nature Conservancy, Orange County Water District, U.S. Army Cops of Engineers, U.S. Fish and Wildlife Service, and California Department of Fish and Game.

Planty-Tabacchi, A.E. Tabacchi, R.J. Naiman, C. Deferrari, and H. DeCamps. 1996. Invisibility of species-rich communities in riparian zones. Conservation Biology 10:598-607.

Platts, W.S. 1982. Influence of forest and rangeland mangement on anadromous fish habitat in western North America: Effects of livestock grazing. USDA Forest Service Gen. Tech. Rep. PNW-124.

Platts, W.S., and R.L. Nelson. 1989. Characteristics of riparian plant communities with respect to livestock grazing. *In*: Practical approaches to riparian resource management (R.E. Gresswell ed.). USDI Bureau of Land Management, Billings, MT.

Platts, W.S. 1991. Livestock grazing. Pp. 389-424 *In*: W.R. Meehan (Ed.), AFS Publ. 19.

Poff, N.L., J.D. Allan, M.B. Bain, J.R. Karr, K.L. Prestegaard, B.D. Richter, and J.C. Stromberg. 1997. The natural flow regime: A paradigm for river conservation and restoration. BioScience 47:769-784.

Pradel, R. 1996. Utilization of capture-mark-recapture for the study of recruitment and population growth rate. Biometrics 52:703-709.

Prescott, D.R.C. and A.L.A. Middleton. 1988. Feeding-time minimization and the territorial behavior of the willow flycatcher (*Empidonax traillii*). Auk 105:17-28.

Prichard, D., H. Barrett, J. Cagney, R. Clark, J. Fogg, K. Gebhardt, P.L. Hansen, B. Mitchell, and D. Tippy. 1998. Riparian area management: process for assessing proper functioning condition. U. S. Bureau of Land Management Service Center, Denver, CO.

Pulliam, H.R. 1988. Sources, sinks, and population regulation. American Naturalist 132:652-661.

Pulliam, H.R. and J.B. Dunning. 1994. Demographic processes: Population dynamics on heterogeneous landscapes. Pp. 179-208. *In*: (G.K. Meffe and C.R. Carroll eds.), Principles of Conservation Biology. Sinauer Associates, Inc., Sunderland, Massachusetts.

Pyle, L.L. 1995. Effects of disturbance on herbaceous exotic species on the floodplain of the Potomac River. American Midland Naturalist 134:244-253.

Pyle, P. 1997. Identification guide to North American Birds. Part 1. Slate Creek Press, Bolinas, California. 730 pp.

Rappole, J.H. 1995. The Ecology of Migrant Birds: a neotropical perspective. Smithsonian Institution Press, Washington, D.C.

Richards, K. 1982. Rivers: Forms and Processes. Methuen, London.

Richter, H. 1992. Development of a conceptual model for floodplain restoration. Arid Lands Newsletter. 32:13-17.

Richter, B.D., J.V. Baumgartner, J. Powell, and D.P. Braun. 1996. A method for assessing hydrologic alteration within ecosystems. Conservation Biology 10:1163-1174

Rickard, W.H. and C.E. Cushing. 1982. Recovery of streamside woody vegetation after exclusion of livestock grazing. J. Range Manage. 35:360-361.

Ridgely, R.S. and J. Gwynne. 1989. A guide to the birds of Panama with Costa Rica, Nicaragua, and Honduras. Princeton Press, Princeton, New Jersey.

Ridgely, R.S.. and G. Tudor. 1994. The Birds of South America. Volume II: The Suboscine Passerines. University of Texas Press, Austin. 814 pp.

Rinne, J.N. 1999. Fish and grazing relationships: The facts and some pleas. Fisheries. 24(8):12-21.

Roberts, T.S. 1932. The birds of Minnesota. University of Minnesota Press, Minneapolis, Minnesota. 821 pp.

Robertson, L. 1997. 1966 cowbird control program. U.S. Bureau of Reclamation, Albuquerque Area Office.

Robinson, S.K., S.I. Rothstein, M.C. Brittingham, L.J. Petit and J.A. Grzybowski. 1995. Ecology and behavior of cowbirds and their impact on host populations. pp. 428-460 *in* Ecology and Management of Neotropical Migratory Birds, ed. by T.E. Martin and D.M. Finch. Oxford Univ. Press., New York.

Robinson, S.K., F.R. Thompson, T.M. Donovan, D. Whitehead, and J. Faaborg. 1995b. Regional forest fragmentation and the nesting success of migratory birds. Science 267:1987-1990.

Robinson, T.W. 1965. Introduction, spread, and areal extent of saltcedar (*Tamarix*) in the western states. U.S. Geological Survey Professional Paper 491-A:1-13.

Rood S.B, A.R. Kalischuk, and J.M. Mahoney. 1998. Initial cottonwood seedling recruitment following the flood of the century of the Oldman River, Alberta, Canada. Wetlands 18: 557-570.

Rood, S.B., J.M. Mahoney, D.E. Reid, and L. Zilm. 1995. Instream flows and the decline of riparian cottonwoods along the St. Mary River, Alberta. Canadian Journal of Botany 73:1250-1260.

Rosenberg, K.V., R.D. Ohmart, W.C. Hunter, and B.W. Anderson. 1991. Birds of the lower Colorado River valley. University of Arizona Press. Tucson, Arizona.

Rothstein, S.I. 1975a. An experimental and teleonomic investigation of avian brood parasitism. Condor 77:250-271.

Rothstein, S.I. 1975b. Evolutionary rates and host defenses against avian brood parasitism. Amer. Nat. 109:161-176.

Rothstein, S.I. 1977. Cowbird parasitism and egg recognition of the Northern Oriole. Wilson Bull. 89: 21-32.

Rothstein, S.I. 1982. Successes and failures in avian egg and nestling recognition with comments on the utility of optimality reasoning. Amer. Zool. 22: 547-560.

Rothstein, S.I. 1986. A test of optimality: Egg recognition in the Eastern Phoebe. Animal Behav. 34: 1109-1119.

Rothstein, S.I., D.A. Yokel and R.C. Fleischer. 1986. Social dominance, mating and spacing systems, female fecundity, and vocal dialects in captive and free-ranging Brown-headed Cowbirds. Current Ornith. 3: 127-185.

Rothstein, S.I., J. Verner, E. Stevens, and L.V. Ritter. 1987. Behavioral differences among sex and age classes of the Brown-headed Cowbird and their relation to the efficacy of a control program. Wilson Bull. 99: 322-337.

Rothstein, S.I. and S.K. Robinson. 1994. Conservation and coevolutionary implications of brood parasitism by cowbirds. Trends Ecol. Evol. 9: 162-164.

Rothstein, S.I. 1994a. Brood parasitism, the importance of experiments and host defenses of avifaunas on different continents. Proc. Seventh Pan-African Ornithol. Cong.: 521-535.

Rothstein, S.I. 1994b. The Brown-headed Cowbird's invasion of the Far West: history, causes and consequences experienced by host species. Pp. 301-315 *In*: A Century of Avifaunal Change in Western North America. (Studies in Avian Biol., No. 15) Jehl, J.R. Jr. and N.K. Johnson, eds., Cooper Ornithol. Soc.

Rothstein, S.I. and S.K. Robinson. 1998. Major unanswered questions in the study of avian brood parasitism. Pp.. 419-425 *In:* Parasitic Birds and Their Hosts, Studies in Coevolution. (S.I. Rothstein and S.K. Robinson, eds), Oxford Univ. Press, New York.

Rothstein, S.I. and S.K. Robinson. 1998. The evolution and ecology of avian brood parasitism: an overview. Pp. 3-56 *In:* Parasitic Birds and Their Hosts, Studies in Coevolution. (S.I. Rothstein and S.K. Robinson, eds), Oxford Univ. Press., New York.

Rothstein, S.I. and S.K. Robinson. 2000. Population Trends of Cowbirds and Hosts and Relevant Methodology. *In:* Ecology and Management of Cowbirds and Their Hosts (J.N.M. Smith, T.L. Cook, S.K. Robinson, S.I. Rothstein and S.G. Sealy eds.), Univ. of Texas Press, Austin, Texas.

Rothstein, S.I. and T.L. Cook. 2000. Cowbird management, host population regulation and efforts to save endangered species. *In:* Ecology and Management of Cowbirds and Their Hosts (J.N.M. Smith, T.L. Cook, S.K. Robinson, S.I. Rothstein and S.G. Sealy eds.), Univ. of Texas Press, Austin, Texas.

Rothstein, S.I., J. Verner and C. Farmer. 2000. Cowbird vocalizations: an overview and the use of playbacks to enhance cowbird detectability. *In:* Ecology and Management of Cowbirds and Their Hosts (J.N.M. Smith, T.L. Cook, S.K. Robinson, S.I. Rothstein and S.G. Sealy eds.), Univ. of Texas Press, Austin, Texas.

Rothstein, S.I., M.A. Patten, and R.C. Fleischer. 2002. Phylogeny, specialization, and brood parasite-host coevolution: some possible pitfalls of parsimony. Behav. Ecol.: 13: 1-10.

Sabrosky, C.W., G.F. Bennett, and T.L. Whitworth. 1989. Bird blow flies (*Protocalliphora*) in North America (Diptera: Calliphoridae), with notes on the Palearctic species. Smithsonian Institution Press, Washington, D.C. 312 pp.

Sala, A., S.D. Smith, and D.D. Devitt. 1996. Water use by *Tamarix ramosissima* and associated phreatophytes in a Mojave Desert floodplain. Ecological Applications 6:888-898.

Sanders, S.D., and M.A. Flett. 1989. Montane riparian habitat and Willow Flycatchers: Threats to a sensitive environment and species. Pp. 262-266 *In*: D.L. Abell. (Tech. Coord.); Proceedings of the California Riparian Systems Conference: Protection, Management, and Restoration for the 1990s. USDA For. Serv. Gen. Tech. Rep. PSW-110. 544 pp.

Sauer, J.R., J.E. Hines, G. Gough, I. Thomas, and B.G. Peterjohn. 1997. The North American Breeding Bird Survey Results and Analysis. Version 96.4. Patuxent Wildlife Research Center, Laurel, MD.

Schlorff, R.W. 1990. Status Review of the willow flycatcher (*Empidonax traillii*) in California. Report to the California Department of Fish and Game, Department Candidate Species Status Report 90-1. 23 pp.

Schmidt, J.C., R.H. Webb, R.A. Valdez, G.R. Marzolf, and L.E. Stevens. 1998. Science and values in river restoration in the Grand Canyon. BioScience 48:735-747.

Schmidt, K.A. and C.J. Whelan. 1999. The relative impacts of nest predation and brood parasitism on seasonal fecundity in songbirds. Cons. Biol. 13:46-57.

Schoener, T.W. 1982. The controversy over interspecific competition. American Scientist 70:586-595.

Schreier, W. 1996. Bryce Canyon National Park 1996 Federal Endangered Avian Species Survey Report: Southwestern Willow Flycatcher. Colorado Plateau System Support Office, Intermountain Field Area, National Park Service: Bryce Canyon, Utah.

Schropp, M.H. and C. Bakker. 1998. Secondary channels as a basis for the ecological rehabilitation of Dutch rivers. Aquatic Conservation- Marine and Freshwater Ecosystems 8:53-59.

Schultz, T.T., and W.C. Leininger. 1990. Differences in riparian vegetation structure between grazed areas and exclosures. J. Range. Manage. 43:295-299.

Schweitzer, S.H., D.M. Finch, and D.M. Leslie, Jr. 1998. The Brown-headed Cowbird and its hosts in New Mexico. General Technical Report RMRS-GTR-1. U. S. Dept. Agric., Forest Service, Rocky Mountain Research Station, Fort Collins, CO.

Scott, M. L., P.B. Shafroth, and G.T. Auble. 1999. Responses of riparian cottonwoods to alluvial water table declines. Environmental Management 23: 347-358.

Scott, P.E. and B.R. McKinney. 1994. Brown-headed cowbird removes Blue-gray Gnatcatcher nestlings. Journal of Field Ornithology 65:363-364.

Seaber, P., F. Kapinos, and G. Knapp. 1987. Hydrologic Unit Maps, U.S. Geological Survey Professional Paper 2294, U.S. Geological Survey, Washington, D.C.

Seaber, P.R., F.P. Kapinos, and G.L. Knapp. 1994. Hydrologic Unit Maps. United States Geological Survey Water-Supply Paper 2294. U.S. Geological Survey. Denver, Colorado.

Sealy, S.G. 1992. Removal of Yellow Warbler eggs in association with cowbird parasitism. Condor 94:40-54

Sealy, S.G. 1994. Observed acts of egg destruction, egg removal, and predation on nests of passerine birds at Delta, Manitoba. Can. Field-Natur. 108:41-51.

Sealy, S.G., Neudorf, D.L., Hobson, K.A. and S.G. Gill. 1998. Nest defense by potential hosts of the Brown-headed Cowbird: methodological approaches, benefits of defense, and coevolution. Pp. 194-211 *In*: Parasitic Birds and Their Hosts, Studies in Coevolution. (S.I. Rothstein and S.K. Robinson, eds), Oxford Univ. Press, New York.

Sedgwick, J.A. and F.L. Knopf. 1988. A high incidence of Brown-Headed Cowbird parasitism of Willow Flycatchers. Condor 90:253-256.

Sedgwick, J.A. and F.L. Knopf. 1992. Describing willow flycatcher habitats: scale perspectives and gender differences. Condor 94:720-733.

Sedgwick, J.A. 1998. Regional variability in the song of the willow flycatcher. Draft report to the Arizona Game and Fish Department. USGS Biological Resources Division, Midcontinent Research Station, Fort Collins, CO. 15 pp. plus appendices.

Sedgwick, J.A. and W.M. Iko. 1999. Costs of Brown-headed Cowbird parasitism to Willow Flycatchers. Pp. 167-181 *In:* Research and Management of The Brown-headed Cowbird in Western Landscapes (M. L. Morrison, L. S. Hall, S. K. Robinson, S. I. Rothstein, D. C. Hahn and T. Rich eds.), Studies in Avian Biology No. 18.

Sedgwick, J.A. 2000. Willow Flycatcher (*Empidonax traillii*). *In* The Birds of North America, No. 533 (A. Poole and F. Gill, eds.). The Birds of North America, Inc. Philadelphia, PA. 31 pp.

Sedgwick, J.A. In Press. Geographic variation in the song of the Willow Flycatcher. Differentiation between *Empidonax traillii adastus* and *E.t. extimus*. Auk.

Sell, R.S, D.A. Bangsund, F.L. Leistritz. 1999. *Euphorbia esula*: perceptions by ranchers and land managers. Weed Science 47:740-749.

Settergren, C.D., and D.M. Cole. 1970. Recreation effects on soil and vegetation in the Missouri Ozarks. Journal of Forestry. 68:231-234.

Settergren, C.D. 1997. Impacts of river recreation use on streambank soils and vegetation: state of the knowledge. In River recreation management and research symposium, 55-59. USDA Forest Service General Technical Report NC-28. St Paul, Minn.:North Central Forest Experiment Station.

Seutin, G. 1987. Female song in Willow Flycatchers (*Empidonax traillii*). Auk 104: 329-330.

Seutin, G. and J-P Simon. 1988. Genetic variation in sympatric Willow Flycatchers (*Empidonax traillii*) and Alder flycatchers (*E. alnorum*). Auk 105 (2):235-243.

Sferra, S.J., T.E. Corman, C.E. Paradzick, J.W. Rourke, J.A. Spencer, and M.W. Sumner. 1997. Arizona Partners In Flight southwestern willow flycatcher survey: 1993-1996 summary report. Nongame and Endangered Wildlife Program Technical Report 113. Arizona Game and Fish Department, Phoenix, Arizona.

Sferra, S.J., B.E. Kus, T.D McCarthey, M.K. Sogge, and S.O. Williams, III. Rangewide distribution of the southwestern willow flycatcher in tamarisk. Presentation at "The Ecology and Conservation of the Willow Flycatcher." Conference organized by U.S. Geological Survey October 24-26, 2000. Arizona State University, Tempe, Arizona.

Shaw, N.L. and W.P. Clary. 1995. Willow establishment in relation to cattle grazing on an eastern Oregon stream. USDA Forest Service Rept. - GTR-272.

Shafroth, P.B., J.M. Friedman, and L.S. Ischinger. 1995. Effects of salinity on establishment of *Populus fremontii* (cottonwood) and *Tamarix ramosissima* (saltcedar) in Southwestern United States. Great Basin Naturalist 55:58-65.

Shafroth, P.B., G.T. Auble, and M.L. Scott. 1995. Germination and establishment of the native Plains cottonwood (*Populus deltoides* Marshall subsp. *monilifera*) and the exotic Russian olive (*Elaeagnus angustifolia*). Conservation Biology 9: (5) 1169-1175.

Shafroth, P.B., G.T. Auble, J.C. Stromberg, and D.T. Patten. 1998. Establishment of woody riparian vegetation in relation to annual patterns of stream flow, Bill Williams River, Arizona. Wetlands 18:577-590. .

Shafroth, P.B. 1999. Downstream effects of dams on riparian vegetation: Bill Williams River, Arizona. PhD Dissertation, Arizona State University, Tempe, AZ.

Shafroth, P.B., Stromberg, J.C., Patten, D.T. 2000. Woody riparian vegetation response to different alluvial water-table regimes. Great Basin Naturalist. In Press.

Sheppard, J.M. 1996. Nestling Kentucky warblers and cowbird attacked by brown-headed cowbird. Journal of Field Ornithology 67:384-386.

Sherry, T.W. and R.T. Holmes. 1993. Are populations of neotropical migrant birds limited in summer or winter? Implications for management. Pp. 47-57 *In*: (D. Finch and P. Stangel, eds.), Status and Management of Neotropical Migratory Birds. Gen Tech. Rep. RM-229. USDA Forest Service, Rocky Mountain Range and Experiment Station, Fort Collins, Colorado. 422 pp.

Sherry, T.W. and R.T. Holmes. 1995. Summer versus winter limitation of populations: What are the issues and what is the evidence? Pp. 85-120 *In*: Ecology and Management of Neotropical Migratory Birds, ed. by T.E. Martin and D.M. Finch. Oxford Univ. Press., New York.

Sherry, T.W. and R.T. Holmes. 1996. Winter habitat quality, population limitation, and conservation of neotropical –nearctic migrant birds. Ecology 77: 36-48

Shuman, J.R. 1995. Environmental considerations for assessing dam removal alternatives for river restoration. Regulated Rivers- Research and Management 11: 249-261.

Siegel, R.S. and J.H. Brock. 1990. Germination requirements of key southwestern woody riparian species. Desert Plants 10:3-8, 34.

Simberloff, D. 1981. Community effects of introduced species. Pages 53-81 in Biotic Crises in Ecological and Evolutionary Time, M. H. Nitecki (ed), New York: Academic Press.

Simberloff, D. and P. Stiling. 1996. How risky is biocontrol? Ecology 77:1965-1974.

Simberloff, D. 1998. Flagships, umbrellas, and keystones: Is single-species management passe in the landscape era? Biol. Cons. 83:247-257.

Singer, F.J., L.C. Mark, and R.C. Cates. 1994. Ungulate herbivory of willows on Yellowstone's northern winter range. J. Range Manage. 47(6): 435-465.

Skaggs, R.W. 1996. Population size, breeding biology, and habitat of Willow Flycatchers in the Cliff-Gila Valley, New Mexico - 1995. New Mexico Department of Game and Fish report. Contract #95-516-91.

Skinner, C.N. and C. Change. 1996. Fire regimes, past and present. Pages 1041-1069 *in* Sierra Nevada Ecosystem Project, Volume II. Wildland Resources Center Report No. 37, University of California, Davis, California.

Skovlin, J.M. 1984. Impacts of grazing on wetlands and riparian habitat: A review of our knowledge. Pp. 1001-1103 *In*: Developing strategies for range management. Westview Press, Boulder CO.

Smith, B.H. 1982. Livestock-riparian-fisheries interrelationships; or functional applications of adaptation for personal survival. *In:* Proceedings 17th annual meeting American Fisheries Society, Fort Collins, CO.

Smith, J.N.M., P. Arcese, and I.G. McLean. 1984. Age, experience, and enemy recognition by wild Song Sparrows. Behav. Ecol .Sociobio. 14:101-106.

Smith, J.N.M., T.L. Cook, S.K. Robinson, S.I. Rothstein, and S.G. Sealy, eds. 2000. Ecology and Management of Cowbirds and Their Hosts, Univ. of Texas Press, Austin, Texas. 388 pp.

Smith, S.D., D.A. Devitt, A. Sala, J.R. Cleverly, and D.E. Busch. 1998. Water relations of riparian plants from warm desert regions. Wetlands 18:687-695.

Smith, S.D., A.B. Wellington, J.L. Nachlinger, and C.A. Fox. 1991. Functional responses of riparian vegetation to streamflow diversion in the eastern Sierra Nevada. Ecological Applications 1:89-97

Snyder, C.T., D.G. Frickel, R.F. Hadley, and R.G. Miller. 1976. Effects of off-road vehicle use on the hydrology and landscape of arid environments in Central and Southern California. U.S. Geological Survey Water Resources Investigations no. 4. Denver.

Sogge, M.K. and T.J. Tibbitts. 1992. Southwestern willow flycatcher (*Empidonax traillii extimus*) Surveys along the Colorado River in Grand Canyon National Park and Glen Canyon National Recreation Area - 1992 Summary Report. National Park Service Cooperative Park Studies Unit/Northern Arizona University and U.S. Fish and Wildlife Service report. 43 pp.

Sogge, M.K., T.J. Tibbitts, and S.J. Sferra. 1993. Status of the southwestern willow flycatcher along the Colorado River between Glen Canyon Dam and Lake Mead - 1993. Summary report. National Park Service Cooperative Park Studies Unit/Northern Arizona University, U.S. Fish and Wildlife Service, and Arizona Game and Fish Department report. 69 pp.

Sogge, M.K. and T.J. Tibbitts. 1994. Distribution and status of the southwestern willow flycatcher along the Colorado River in the Grand Canyon - 1994. Summary Report. National Biological Service Colorado Plateau Research Station/Northern Arizona University and U.S. Fish and Wildlife Service. 37 pp.

Sogge, M.K. 1995. Southwestern willow flycatcher (*Empidonax traillii extimus*) monitoring at Tuzigoot National Monument. 1995 progress report to the National Park Service. National Biological Service Colorado Plateau Research Station/Northern Arizona University report. 20 pp.

Sogge, M.K., T.J. Tibbitts, C. Van Riper III, and T. May. 1995. Status of the southwestern willow flycatcher along the Colorado River in Grand Canyon National Park - 1995. Summary Report. National Biological Service Colorado Plateau Research Station/Northern Arizona University. 26 pp.

Sogge, M.K. 1997. Primary song by a juvenile willow flycatcher. Journal of Field Ornithology 68:630-631.

Sogge, M.K., T.J. Tibbitts, and J. Petterson. 1997a. Status and ecology of the southwestern willow flycatcher in the Grand Canyon. Western Birds 28:142-157.

Sogge, M.K., R.M. Marshall, S.J. Sferra, and T.J. Tibbitts. 1997b. A southwestern willow flycatcher natural history summary and survey protocol. National Park Service Technical Report NPS/NAUCPRS/NRTR-97/12. 37 pp.

Sogge, M.K. 1998. Status and distribution of the southwestern willow flycatcher along the Colorado River in the Grand Canyon - 1997. USGS Colorado Plateau Field Station final report. 24 pp.

Sogge, M.K., J. Busch, E. Paxton, M. Miller, and P. Keim. 1998. Population genetic analysis of the southwestern willow flycatcher: 1996 - 1997. A report prepared for the Arizona Game and Fish Department. Heritage Grant I96049.USGS Colorado Plateau Field Station, Northern Arizona University, Flagstaff. 34 pp.

Sogge, M.K., and R.M. Marshall. 2000. A survey of current breeding habitats. Chapter 9 *In* D. Finch and S. Stoleson, eds. Status, ecology, and conservation of the southwestern willow flycatcher. USDA Forest Service, Rocky Mountain Research Station, Albuquerque, NM.

Sogge, M.K. and E.H. Paxton. 2000. A summary of observed physical deformities in the willow flycatcher: 1996-2000. USGS Forest and Rangeland Ecosystem Science Center, Colorado Plateau Field Station, Flagstaff, AZ.

Sogge, M.K., S.J. Sferra, T.D. McCarthey, S.O. Williams, III, and B.E. Kus. Summary of southwestern willow flycatcher breeding site and territory characteristics - 1999. Prepared for the Southwestern Willow Flycatcher Recovery Team, U.S. Fish and Wildlife Service, Region 2, Albuquerque, NM. November 2000.

Sogge, M.K., S.J. Sferra, T. McCarthey, S.O. Williams and B.E. Kus. 2002. Southwestern Willow Flycatcher breeding site and territory summary – 2001. USGS Forest and Rangeland Ecosystem Science Center, Colorado Plateau Field Station report to the U.S. Fish and Wildlife Service Southwestern Willow Flycatcher Recovery Team.

Solley, W.B., Pierce, R.R., and Perlman, H.A. 1998. Estimated Use of Water in the United States in 1995, U.S. Geological Survey Circular 1200, U.S. Geological Survey, Washington, D.C.

Spautz, H. 1999. Common Yellowthroat brood parasitism and nest success vary with host density and site characteristics. Pp. 218-228. *In:* Research and Management of The Brown-headed Cowbird in Western Landscapes (M. L. Morrison, L.S. Hall, S.K. Robinson, S.I. Rothstein, D.C. Hahn, and T. Rich eds.), Studies in Avian Biology No. 18.

Spencer, J.A., S.J. Sferra, T.E. Corman, J.W. Rourke and M.W. Sumner. 1996. Arizona Partners in Flight 1995 Southwestern Willow Flycatcher survey. Arizona Game and Fish Department, Phoenix. Nongame Technical Report 97.

Springer, A.E., J.M. Wright, P.B. Shafroth, J.C. Stromberg, and D.T. Patten. 1999. Coupling ground-water and riparian vegetation models to simulate riparian vegetation changes due to a reservoir release. Water Resources Research 35:3621-3630.

Staab, C.A. and M.L. Morrison. 1999. Managing riparian vegetation to control cowbirds. Pp. 18-22. *In*: Research and Management of The Brown-headed Cowbird in Western Landscapes (M.L. Morrison, L.S. Hall, S.K. Robinson, S.I. Rothstein, D.C. Hahn, and T. Rich, eds.), Studies in Avian Biology No. 18.

Stacey, P.B. and M. Taper. 1992. Environmental variation and the persistence of small populations. Ecological Applications 2:18-29.

Stafford, M.D. and B.E. Valentine. 1985. A preliminary report on the biology of the willow flycatcher in the central Sierra Nevada. California-Nevada Wildlife Trans. pp. 66-67.

Stanford, J.A., J.V. Ward, W.J. Liss, C.A. Frissell, R.N. Williams, J.A. Lichatowich, and C.C. Coutant. 1996. A general protocol for restoration of regulated rivers. Regulated Rivers: Research and Management 12:391-413.

Stein, R.C. 1958. The behavioral, ecological, and morphological characteristics of two populations of the alder flycatcher, *Empidonax traillii* (Audubon). New York State Museum and Science Service Bulletin 371. 63 pp.

Stein, R.C. 1963. Isolating mechanisms between populations of Traill's Flycatchers. Proceedings of the American Philosophical Society 107 (1):21-50.

Stein, S.J., P.W. Price, W.G. Abrahamson, and C.F. Sacchi. 1992. The effect of fire on stimulating willow regrowth and subsequent attack by grasshoppers and elk. Oikos 65:190-196.

Stephens, H.G., and Shoemaker, E.M. 1987. In the Footsteps of John Wesley Powell: An Album of Comparative Photographs of the Green and Colorado Rivers, 1871-1872 and 1968, Johnson Books and the Powell Society, Boulder and Denver, Colorado.

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

Stock, C. 1992. Rancho La Brea, a Record of Pleistocene Life in California. Natural History Museum of Los Angeles, Science Series No. 37.

Stoleson, S.H., D.M. Finch, and H.A. Walker. 1998. Surveys for southwestern willow flycatchers along the Gila and Mimbres Rivers, New Mexico: Final Report. USDA Forest Service, Rocky Mountain Research Station, Albuquerque, NM, and University of New Mexico, Albuquerque. 21 pp.

Stoleson, S.H. and D.M. Finch. 1999. Reproductive success of southwestern willow flycatchers in the Cliff-Gila Valley, New Mexico. Report to Phelps-Dodge Corporation. USDA Forest Service, Rocky Mountain Research Station, Albuquerque, New Mexico. 25 pp.

Stoleson, S.H. M.J. Whitfield, and M.K. Sogge. 1999. Demographic characteristics and population modeling. Chapter 7 *In*: D. Finch and S. Stoleson, eds. Status, ecology, and conservation of the southwestern willow flycatcher. USDA Forest Service, Rocky Mountain Research Station, Albuquerque, NM.

Stotz, D.F.,T.A. Parker III, J.W. Fitzpatrick, and D.K. Moskovits. 1996. Neotropical Birds: Ecology and Conservation. University of Chicago Press: Chicago. 478pp.

Stransky, K. 1995. 1995 Field survey by the Colorado Division of Wildlife: Southwestern Willow Flycatcher (*Empidonax traillii extimus*). Report by the Colorado Division of Wildlife.

Stromberg, J.C., D.T. Patten, and B. D. Richter. 1991. Flood flows and dynamics of Sonoran riparian forests. Rivers 2(3):221-235.

Stromberg, J.C. 1993. Instream flow models for mixed deciduous riparian vegetation within a semiarid region. Regulated Rivers- Research and Management 8:225-235.

Stromberg, J.C., M.R. Sommerfeld, D.T. Patten, J. Fry, C. Kramer, F. Amalfi, and C. Christian. 1993. Release of effluent into the Upper Santa Cruz River, Southern Arizona: Ecological considerations. Pages 81-92 in M. G. Wallace, Editor. Proceedings of the Symposium on Effluent Use Management. American Water Resources Association, Tucson, Arizona.

Stromberg, J.C., R. Tiller, and B. Richter. 1996. Effects of groundwater decline on riparian vegetation of semiarid regions: the San Pedro River, Arizona, USA. Ecological Applications 6:113-131.

Stromberg, J.C. and M. K. Chew. 1997. Herbaceous exotics in Arizona's riparian ecosystems. Desert Plants 13:11-17.

Stromberg, J.C. 1997. Growth and survivorship of Fremont cottonwood, Goodding willow, and salt cedar seedlings after large floods in central Arizona. Great Basin Naturalist 57:198-208.

Stromberg, J.C. 1998a. Dynamics of Fremont cottonwood (*Populus fremontii*) and saltcedar (*Tamarix chinensis*) populations along the San Pedro River, Arizona. Journal of Arid Environments 40: 133-155.

Stromberg, J.C. 1998b. Functional equivalency of saltcedar (*Tamarix chinensis*) and Fremont cottonwood (*Populus fremontii*) along a free-flowing river. Wetlands 18(4):675-686.

Stromberg, J.C. 2000. Influence of stream flow regime and temperature on growth rate of the riparian tree, *Platanus wrightii*, in Arizona. Freshwater Biology, in press.

Stuever, M.C. 1997. Fire-induced mortality of Rio Grande cottonwood. M. S. Thesis, University of New Mexico, Albuquerque, New Mexico.

Stutchbury, B.J.M. 1997. Effects of female cowbird removal on reproductive success of hooded warblers. Wilson Bull. 109:74-81.

Suckling, K., D. Hogan, R. Silver, D.C. Carlton, P. Galvin, and S. Hitt. 1992. Petition to list the southwestern willow flycatcher (*Empidonax traillii extimus*) as a federally endangered species. Letter to the Secretary of the Interior. January 25, 1992, Luna, New Mexico. 61 pp.

Swarth, H.S. 1914. A distributional list of the birds of Arizona. Museum of Vertebrate Zoology, University of California. Cooper Ornithological Club, Pacific Coast Avifauna No. 10. Hollywood, California. 133 pp.

SWCA, Inc., Environmental Consultants. 2000. Final report on behavior, ecology, and nest monitoring of southwestern willow flycatchers from 1996 to 1998 along the Verde River, Arizona. Final Report by SWCA, Inc., Environmental Consultants, Salt Lake City, submitted to Phelps Dodge Development Corporation, Phoenix.

Swetnam, T.W. and J.L. Betancourt. 1998. Mesoscale disturbance and ecological response to decadal climatic variability in the American Southwest. Journal of Climate 11:3128-3147.

Sykes, P.W. and M.H. Clench. 1998. Winter habitat of Kirtland's Warbler: an endangered Nearctic/Neotropical migrant. Wilson Bull. 110:244-261.

Szaro, R.C. 1989. Riparian forest and scrubland community types of Arizona and New Mexico. Desert Plants 9:70-138.

Tate, J., Jr. 1967. Cowbird removes warbler nestlings from nest. Auk 84:422.

Taylor, D.M., and Littlefield. 1984. Willow flycatcher and yellow warbler responses to reduced cattle use of willow habitat. Abstract from Cooper Ornith. Soc. Annual Meeting, Arcata, CA.

Taylor, D.M. 1986. Effects of cattle grazing on passerine birds nesting in riparian habitat. J. Range Mgmt. 39:254-258.

Taylor, D.M. and C.D. Littlefield. 1986. Willow flycatcher and yellow warbler response to cattle grazing. Am. Birds 40:1169-1173.

Taylor J.P. and K.C. McDaniel. 1998. Restoration of saltcedar (*Tamarix* sp.)-infested floodplains on the Bosque del Apache National Wildlife Refuge. Weed Technology 12: 345-352.

Taylor, J.P., D.B. Wester, and L.M. Smith. 1999. Soil disturbance, flood management, and riparian woody plant establishment in the Rio Grande floodplain. Wetlands 19:372-382.

Tellman, B. 1997. Exotic pest plant introduction in the American Southwest. Desert Plants 13:3-8.

Tellman, B., R. Yarde, and M.G. Wallace. 1997. Arizona's changing rivers: how people have affected the rivers. University of Arizona: Water Resources Research Center.

Terborgh, J. 1989. Where Have All the Birds Gone? Princeton University Press, Princeton, NJ.

Tewksbury, J.J., Hejl, S.J., Martin, T.E. 1998. Breeding productivity does not decline with increasing fragmentation in a western landscape. Ecology 79:2890-2903.

Tewksbury, J.J., T.E. Martin, S.J. Hejl, T.S. Redman, and F.J. Wheeler. 1999. Cowbirds in a western valley: effects of landscape structure, vegetation, and host density. Pp. 23-33. *In*: Research and Management of The Brown-headed Cowbird in Western Landscapes (M. L. Morrison, L. S. Hall, S. K. Robinson, S. I. Rothstein, D. C. Hahn and T. Rich eds.), Studies in Avian Biology No. 18.

Thomas, H.E. 1963. Causes of depletion of the Pecos River in New Mexico. U. S. Geological Survey Water-Supply Paper 1619-G.

Thomas, M.B. and A.J. Willis. 1998. Biocontrol- risky but necessary? Trends in Ecology and Evolution 13:325-329.

Thompson, F.R., III. 1994. Temporal and spatial patterns of breeding Brown-headed Cowbirds in the midwestern United States. Auk 111:979-990.

Tibbitts, T.J., M.K. Sogge, and S.J. Sferra. 1994. A survey protocol for the southwestern willow flycatcher (*Empidonax traillii extimus*). Technical Report NPS/NAUCPRS/NRTR-94-04. National Park Service, Colorado Plateau Research Station at Northern Arizona University, Flagstaff. 24 pp.

Tibbitts, T.J. and M.J. Johnson. 1999. Southwestern willow flycatcher inventory and monitoring along the Colorado River in Grand Canyon National Park. 1998 Summary Report. USGS Biological Resources Division, Colorado Plateau Field Station, Northern Arizona University, Flagstaff. 17 pp.

Tibbitts, T.J. and M.J. Johnson. 2000. Southwestern willow flycatcher inventory and monitoring along the Colorado River in Grand Canyon National Park. 1999 Summary Report. USGS Biological Resources Division, Colorado Plateau Field Station, Northern Arizona University, Flagstaff. 19 pp.

Trautman, M.B. 1940. The birds of Buckeye Lake, Ohio. Misc. Pub. Mus. Zool., University of Michigan Press, Ann

Arbor, Michigan. 466 pp.

Travis, James R. 1996. Song types of willow flycatchers in New Mexico. Contract No. 95-516-67. Endangered Species Program, New Mexico Department of Game and Fish, Santa Fe, NM. 31 pp.

Treadaway, M., V.W. Howard, Jr., C. Allison, M.K. Wood, and J.C. Boren. 1999. Forage utilization by elk and livestock in selected riparian areas in the Gila National Forest. New Mexico State University Cooperative Extension Service, Range Improvement Task Force Report.

Treberg, M.A. and B.C. Husband. 1999. Relationship between the abundance of *Lythrum salicaria* (purple loosestrife) and plant species richness along the Bar River, Canada. Wetlands 19:118-125.

Turner, B. 1983. Recreational impacts on riparian vegetation along the lower Salt River. M.S. Thesis, Arizona State University, Tempe Arizona.

Turner, R.M. 1974. Quantitative and historical evidence of vegetation changes along the Upper Gila River, Arizona. U.S. Geological Survey Professional Paper 655-H. U.S. Govt. Printing Office.

Turner, R.M. and M.M. Karpiscak. 1980. Recent vegetation changes along the Colorado River between Glen Canyon Dam and Lake Mead, Arizona. U.S. Department of Interior, U.S.G.S. Professional Paper #1132.

Uchytil, R.J. 1989. *Salix exigua*. *In*: W.C. Fischer (compiler), The fire effects information system [database]. Missoula, MT: U.S.D.A, For Serv. Intermountain Res. Sta., Interm. Fire Sci. Lab. http://www.fs.fed.us/database/feis.

Unitt, P. 1984. The birds of San Diego County. San Diego Soc. Nat. Hist. Memoir 13.

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

Unitt, P. 1997. Winter range of *Empidonax traillii extimus* as documented by existing museum collections. Report to U.S. Bureau of Reclamation, Phoenix, Arizona.

Unitt, P. 1999. Winter Range and discriminant function analysis of theWillow Flycatcher. Final report submitted to the Bureau of Reclamation Phoenix Area Office (Federal Grant No. 98-FG-32-0200), Phoenix, AZ

U.S. Air Force. 1999. Final minutes for 1 December 1998 monitoring kick-off meeting. Langley Air Force Base, Virginia.

U.S. Army Corps of Engineers. 1996. Water Control Infrastructure: National Inventory of Dams, CD-ROM. Federal Emergency Management Agency, Washington.

U.S. Bureau of Reclamation, 1995. Operation of Glen Canyon Dam: Final Environmental Impact Statement. Washington, D.C.:U.S. Dept. of Interior.

U.S. Bureau of Reclamation. 1997. Fire occurrence along the Lower Colorado River in potential or occupied southwestern willow flycatcher habitat from October 1996 through July 1997. Lower Colorado Regional Office, Boulder City, Nevada.

U.S. Bureau of Reclamation. 1998. Fire occurrence along the Lower Colorado River in potential or occupied southwestern willow flycatcher habitat from August 1997 through August 1998. Lower Colorado Regional Office, Boulder City, Nevada.

U.S. Bureau of Reclamation. 1999a. Long term restoration program for historical Southwestern Willow Flycatcher habitat along the Lower Colorado River. Lower Colorado Region. Boulder City, NV.

U.S. Bureau of Reclamation. 1999b. Fire occurrence along the Lower Colorado River in potential or occupied southwestern willow flycatcher habitat from August 1998 through August 1999. Lower Colorado Regional Office, Boulder City, Nevada.

U.S. Bureau of Reclamation. 1999c. Rangewide Assessment of Habitat Acquisition Priorities for the Southwestern Willow Flycatcher. Lower Colorado Regional Office, Boulder City, Nevada.

U.S. Bureau of Reclamation Lower Colorado Region (LCRBR). 2000. Long term restoration program for the historical Southwestern Willow Flycatcher (Empidonax traillii extimus) habitat along the Lower Colorado River. http://www.lc.usbr.gov/~g2000

U.S. Census Bureau. 1999. State population projections. Population Division. Washington, DC.

USDA Forest Service. 1979. Action program for resolution of livestock-riparian conflicts on the Salt River and Verde River. Region Three: Tonto, Prescott, and Coconino National Forests. 129 pp.

U.S. Fish and Wildlife Service. 1989. Notice of review: animal candidate review for listing as endangered or threatened species. January 6, 1989. Federal Register 54:554

U.S. Fish and Wildlife Service. 1991. Notice of review: animal candidate review for listing as endangered or threatened species. November 21, 1991. Federal Register 56:58804-58836

U. S. Fish and Wildlife Service. 1991b. Black-capped Vireo (*Vireo atricapillus*) Recovery Plan. U. S. Fish and Wildlife Service, Austin, TX.

U.S. Fish and Wildlife Service. 1992. Notice of 90-day finding on a petition to list *Empidonax traillii extimus* as an endangered species. Federal Register 57:39664-39668.

U. S. Fish and Wildlife Service. 1992b. Golden-cheeked Warbler (*Dendroica chrysoparia*) Recovery Plan. U. S. Fish and Wildlife Service, Albuquerque, NM.

U.S. Fish and Wildlife Service. 1993. Notice of 12-month petition finding/proposal, and to designate critical habitat. July 23, 1993. Federal Register 58:39495-39522.

U.S. Fish and Wildlife Service. 1995. Final rule determining endangered status for the southwestern willow flycatcher (*Empidonax traillii extimus*). Federal Register 60:10694 (February 27, 1995).

U.S. Fish and Wildlife Service. 1996. Biological opinion on the operation of the modified Roosevelt Dam. Arizona Ecological Services Field Office, Phoenix, Arizona. 57 pp.

U.S. Fish and Wildlife Service. 1997a. Final determination of critical habitat for the southwestern willow flycatcher (*Empidonax traillii extimus*). Federal Register 62(140):39129-39147.

U.S. Fish and Wildlife Service. 1997b. Final determination of critical habitat for the southwestern willow flycatcher: Correction . Federal Register 62(161):44228.

U.S. Fish and Wildlife Service. 1997c. Biological and conference opinion on the lower Colorado River operations and maintenance. Arizona Ecological Services Field Office, Phoenix, Arizona. 196 pp.

U. S. Fish and Wildlife Service. 1998. Draft recovery plan for the least Bell's vireo. U. S. Fish and Wildlife Service, Portland, OR. 139 pp.

U.S. Fish & Wildlife Service. 1998. South Dike Fire Rehabilitation Plan. Havasu NWR, 14 pp

U.S. Water Resources Council. 1978. The Nation's Water Resources, Parts 1-5, The Second National Assessment by the U.S. Water Resources Council, Government Printing Office, Washington, D.C.

Utah Division of Wildlife Resources. 1998. Utah sensitive species list. State of Utah, Department of Natural Resources. Salt Lake City, Utah. 34 pp.

Uyehara, J.C. and P.M. Narins. 1995. Nest defense by Willow Flycatchers to brood-parasitic intruders. Condor 97:361-368.

Uyehara, J.C., M.J. Whitfield and L. Goldwasser. 2000. The ecology of Brown-headed Cowbirds and their effects on Southwestern Willow Flycatchers. Pp. 95-106 *In*: D. Finch and S. Stoleson, eds. Southwestern Willow Flycatcher conservation assessment. Gen. Tech. Rep. RMRS-GTR-60. Ogeden, UT: USDA Forest Service Rocky Mountain Research Station.

Valentine, B.A., T.A. Roberts, S.P. Boland, and A.P. Woodman. 1988. Livestock management and productivity of willow flycatchers in the central Sierra Nevada. Trans. W. Sec., Wild. Soc. 24:105-114.

van der Zande, A.N., J.C. Berkhuizen, H.C. van Latesteijn, W.J. ter Keurs, and A.J. Poppelaars. 1984. Impact of outdoor recreation on the density of a number of breeding bird species in woods adjacent to urban residential areas. Biological Conservation 30:1-39.

van der Zande, A.N. and P. Vos. 1984. Impact of a semi-experimental increase in recreation intensity on the densities of birds in groves and hedges on a lake shore in The Netherlands. Biological Conservation 30:237-259.

van Riper, C. III. 1991. The impact of introduced vectors and avian malaria on insular passeriform bird populations in Hawaii. Bulletin of the Society of Vector Ecology 16:59-83.

Vavra, M., W.C. Krueger, and W.P. Wheeler. 1980. Cattle grazing potential on clearcuts. Oregon State University, Agricultural Experiment Station Res. Rep. 586, Corvallis, OR.

Verner, J. and S.I. Rothstein. 1988. Implications of range expansion into the Sierra Nevada by the parasitic Brown-headed Cowbird. pp. 92-98 *In*: Proc. State of the Sierra Symp. ed. by D. Bradley, Pacific Publ. Co., San Francisco.

Vitousek, P.M., C. D'Antonio, L.L. Loope, and R Westbrooks. 1996. Biological invasions as global environmental change. American Scientist 84:468-478.

Vora, R.S. 1992. Restoration of native vegetation in the Lower Rio Grande Valley, 1984-87. Restoration and Management Notes 10:150-157.

Wagner, F.H., R.B. Keigley, and C.L. Wambolt. 1995. Comment: Ungulate herbivory of willows on Yellowstone's northern winter range: Response to Singer et al. (1994). J. Range Manage. 48(5): 475-477.

Walkinshaw, L.H. 1966. Summer biology of Traill's Flycatcher. Wilson Bulletin 78:31-46.

Wauer, R.H., and D.L. Carter. 1965. Birds of Zion National Park and vicinity. Zion Natural History Association, Springdale, Utah. 92 pp.

Wauer, R.H. 1985. A field guide to the birds of the Big Bend. Texas Monthly Press, Austin, Texas.

Wauer, R.H. 1973. Birds of Big Bend National Park and vicinity. Univ. Tex. Press, Austin Texas.

Webb, R.H. 1983. Compaction of desert soils by off-road vehicles. Pp. 51-79 *In*: Environmental effects of off-road vehicles, (R.H. Webb and H.G. Wilshire, eds.). New York: Springer-Verlag.

Webb, R.H. and J.L. Betancourt. 1992. Climatic variability and flood frequency of the Santa Cruz River, Pima County, Arizona. U. S. Geological Survey Water Supply Paper 2379:1-40.

Weins, J.A. 1996. Wildlife in patchy environments: metapopulations, mosaics, and management. Pp. 53-84 *In*: (D.R. McCullough, ed.) Metapopulations and wildlife conservation. Island Press. 429 pp.

West, B.R. 1996. Prescribed burning and wildfire (Fire as a tool in saltcedar management).Saltcedar Management and Riparian Restoration Workshop. Las Vegas, Nevada, September 17 and http://refuges.fws.gov/NWRSFiles/HabitatMgmt/PestMgmt/SaltcedarWorkshopSep96/west.html

Western Water Policy Review Advisory Commission. 1998. Water in the West: Challenge for the Next Century, Government Printing Office, Washington, D.C.

Westman, W.E. 1990. Park management of exotic plant species: problems and issues. Conservation Biology 4:251-260.

Weydemeyer, W. 1973. Singing habits of Traill's Flycatcher in Northwestern Montana. Wilson Bulletin 85:276-283.

Wheelock, I.G. 1912. Birds of California: an introduction to more than three hundred common birds of the state and adjacent islands. A.C. McClurg and Company, Chicago, Illinois.

White, G.C. and K.P. Burnham. 1999. Program MARK: survival estimation from populations of marked animals. Bird

Study 46 Supplement: 120-138.

White, L. and E. Best. 1999. Brown-headed Cowbird control program. Bill Williams National Wildlife Refuge and Alamo Lake State Wildlife Area, Arizona, results of 1999 program. U.S. Bureau of Reclamation, Lower Colorado Regional Office, U.S. Dept. Interior, and Technical Service Center, Ecological Planning and Assessment, Denver, CO.

White, L.D., and A. McGinty. 1997. Stocking rate decisions key to successful ranch management. Texas Agric. Exten. Service B-5036.

White, P.S. and J.L. Walker. 1997. Approximating nature's variation: selecting and using reference information in restoration ecology. Restoration Ecology 5(4):338-349.

Whitfield, M.J. 1990. Willow flycatcher reproductive response to brown-headed cowbird parasitism. Masters Thesis, California State University, Chico, California. 25 pp.

Whitfield, M.J. 2002. Southwestern Willow Flycatcher monitoring and removal of Brown-headed Cowbirds on the South Fork Kern River, California in 2001. U.S. Army Corps of Engineers, Sacramento District, Environmental Resources Branch.

Whitfield, M.J. and C.M. Strong. 1995. A Brown-headed Cowbird control program and monitoring for the Southwestern Willow Flycatcher, South Fork Kern River, California, 1995. California Department of Fish and Game, Sacramento. Bird and mammal conservation program report 95-4.

Whitfield, M.J. and K.M. Enos. 1996. A Brown-headed Cowbird control program and monitoring for the Southwestern Willow Flycatcher, South Fork Kern River, California, 1996. California Department of Fish and Game, Sacramento. Final report for contract #FG4100WM-1.

Whitfield, M.J., K.M. Enos, and S.P. Rowe. 1998. Reproductive response of the southwestern willow flycatcher (*Empidonax traillii extimus*) to the removal of brown-headed cowbirds in 1997. Final report to the U.S. Army Corps of Engineers (P.O. # DACWO5-97-P-0670) and State of California - The Resources Agency (Contract #FG6151-1WM). Kern River Research Center, Weldon, CA. 20 pp.

Whitfield, M.J. and K.M. Enos. 1998. Reproductive response of the southwestern willow flycatcher (*Empidonax traillii extimus*) to the removal of brown-headed cowbirds in 1998. Final report to the U.S. Army Corps of Engineers (P.O. # DACWO5-98-P-0459) and State of California - The Resources Agency (Contract #FG6151-1WM). Kern River Research Center, Weldon, CA. 22 pp.

Whitfield, M. J. and M. A. Sogge. 1999. Range-wide impact of Brown-headed Cowbird parasitism on the Southwestern Willow Flycatcher (*Empidonax traillii extimus*). pp. 182-190 In: Research and Management of The Brown-headed Cowbird in Western Landscapes (M. L. Morrison, L. S. Hall, S. K. Robinson, S. I. Rothstein, D. C. Hahn and T. Rich eds.), Studies in Avian Biology No. 18.

Whitfield, M.J., K.M. Enos, and S.P. Rowe. 1999a. Is Brown-headed Cowbird trapping effective for managing populations of the endangered Southwestern Willow Flycatcher? Pp. 260-266 *In*: Research and Management of The Brown-headed Cowbird in Western Landscapes (M.L. Morrison, L.S. Hall, S.K. Robinson, S.I. Rothstein, D.C. Hahn, and T. Rich, eds.), Studies in Avian Biology No. 18.

Whitfield, M.J., E.B. Cohen and C.D. Otahal. 1999b. Southwestern Willow Flycatcher (*Empidonax traillii extimus*) surveys, nest monitoring and removal of Brown-headed Cowbirds on the South Fork Kern River, CA in 1999. Final report prepared for the U.S. Army Corps of Engineers, Sacramento District, Purchase order DACW05-99-P-0374, Sacramento, CA and California Department of Fish and Game, Bird and Mammal Conservation Program (contract #FG6151-1WM), Sacramento, CA.

Whitfield, M. J. 2000. Results of a Brown-headed Cowbird control program for the Southwestern Willow Flycatcher. *In:* Ecology and Management of Cowbirds and Their Hosts (J.N.M. Smith, T.L. Cook, S.K. Robinson, S.I. Rothstein and S.G. Sealy eds.), Univ. of Texas Press, Austin, Texas.

Whitfield, M.J. and J.C. Lynn. 2001. Southwestern Willow Flycatcher (*Empidonax traillii extimus*) surveys, nest monitoring and removal of Brown-headed Cowbirds on the South Fork Kern River, CA in 2000. Final report prepared for the U.S. Army Corps of Engineers, Sacramento District, Purchase order DACW05-00-220, Sacramento, CA and California Dept. of Fish and Game, Bird and Management Conservation Program (contract #P9985311).

Wiens, J.A. 1985. Habitat selection in variable environments: shrubbe-steppe birds. Pp. 227-251 *In*: Habitat Selection in Birds. M.L. Cody (ed). Academic Press. Orlando, Florida.

Wiens, J.A. 1989a. The ecology of bird communities: Volume 1- foundations and patterns. Cambridge University Press, Cambridge. 539 pp.

Wiens, J.A. 1989b. The ecology of bird communities: Volume 2- processes and variations. Cambridge University Press, Cambridge. 316 pp.

Wiens, J.A., D.T. Patten, and D.B. Botkin. 1993. Assessing ecological impact assessment lessons from Mono Lake, California. Ecological Applications 3: 595-609.

Wiesenborn, W.D. 1996. Saltcedar impacts on salinity, water, fire frequency and flooding. Saltcedar Management Workshop, June 12, 1996, Bureau of Reclamation, Boulder City NV. http://refuges.fws.gov/NWRSFiles/ HabitatMgmt/PestMgmt/SaltcedarWorkshopJun96/WorkshopPaper3.html

Wilbur, S.R. 1987. Birds of Baja California. University of California Press, Berkeley, California. 253 pp.

Willard, B.E., and J.W. Marr. 1970. Effects of human activities on Alpine tundra ecosystems in Rocky Mountain National Park, Colorado. Biological Conservation. 2:257-265.

Willett, G. 1912. Birds of the Pacific Slope of Southern California. Pacific Coast Avifauna No. 7. Cooper Ornithological Club.

Williams, C.D. and J.E. Deacon. 1998. Recommendations for a comprehensive Virgin River watershed and native fishes conservation program. Briefing Book. Pacific Rivers Council. http://www.pacrivers.org/Publications/virginbb.html

Williams, G.P., and M.G. Wolman. 1984. Downstream effects of dams on alluvial rivers. U. S. Geological Survey Professional Paper 1286:1-83.

Williams, K.S. 1993. Use of terrestrial arthropods to evaluate restored riparian woodlands. Restoration Ecology 1:107-116.

Williams, S.O. and D.A. Leal. 1998. Summary of Willow Flycatcher surveys in New Mexico during 1993-1998. Summary report by New Mexico Department of Game and Fish, Santa Fe, NM.

Williamson, M. and K. Brown. 1986. The analysis and modeling of British invasions. Philosophical Transactions of the Royal Society of London B 314:505-522.

Winder, J.A., C.C. Bailey, M.G. Thomas, and J.L. Holechek. 2000. Breed and stocking rate effects on Chihuahuan Desert cattle production. J. Range Manage. 53(1). In press.

Winker, K. 1994. Divergence in mitochondrial DNA of *Empidonax traillii* and *E. alnorum*, with notes on hybridization. Auk 111:710-713.

Winter, K.J. and S.D. McKelvey. 1999. Cowbird trapping in remote areas: alternative control measures may be more effective. Pp. 282-289 *In*: Research and Management of The Brown-headed Cowbird in Western Landscapes (M. L. Morrison, L.S. Hall, S.K. Robinson, S.I. Rothstein, D.C. Hahn, eds.), Studies in Avian Biology No. 18.

Wolden, L.G. and J.C. Stromberg. 1997. Experimental treatments (and unplanned natural events) for restoration of the herbaceous understory in an arid-region riparian ecosystem. Restoration and Management Notes 15:161-167.

Wolden, L., J.C. Stromberg, and D.T. Patten. 1994. Flora and vegetation of the Hassayampa River Preserve. Journal of the Arizona Nevada Academy of Science 28:76-111.

Woodley, S. 1993. Monitoring and measuring ecosystem integrity in Canadian National Parks. Pages 155-176 in S. Woodley, J. Kay, and G. Francis. Ecological integrity and the management of ecosystems. St. Lucie Press.

Woodworth, B. L. 1999. Modeling population dynamics of a songbird exposed to parasitism and predation and evaluating management options. Cons. Biol. 13:67-76.

Wunderlich R.C., B.D. Winter, and J.H. Meyer. 1994. Restoration of the Elwha River ecosystem. Fisheries 19:11-19.

Yoder, C.A., L.A. Miller, W.F. Andelt, and K.A. Crane. 1998. Potential oral contraceptives for birds. Pp. 14-15 *In*: A Workshop on the Status and Future of Wildlife Fertility Control. The Wildlife Society, Buffalo, NY.

Yong, W. and D.M. Finch. 1997. Migration of the Willow Flycatcher along the Middle Rio Grande. Wilson Bulletin 109:253-268.

Young, R.A. and A.R. Gilmore. 1976. Effects of various camping intensities on soil properties in Illinois campgrounds. Soil Science Society of America Journal 40:908-911.

Zasada, J.C. and L.A. Viereck. 1975. The effect of temperature and stratification on germination on selected members of Salicaceae in interior Alaska. Canadian Journal of Forest Research 5: 333-337.

Zedler, P.H. and G.A. Scheid. 1988. Invasion of *Carpobrotus edulis* and *Salix lasiolepis* after fire in a coastal chaparral site in Santa Barbara, California. Madrono 35:196-201.