ECOLOGY AND CONSERVATION OF THE WILLOW FLYCATCHER

MARK K. SOGGE, BARBARA E. KUS, SUSAN J. SFERRA, AND MARY J. WHITFIELD, EDITORS

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Mark K. Sogge, Barbara E. Kus, Susan J. Sferra, and
Mary J. Whitfield, editors

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Willow Flycatcher illustration above by John Schmitt.

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Studies in Avian Biology No. 26:viii, 2003.

PREFACE

During the course of development of the U.S. Fish and Wildlife Service's Southwestern Willow Flycatcher (*Empidonax traillii extimus*) recovery plan, team members recognized the urgent need for a synthesis of recent research projects and results. Team members also saw the need for increased communication and collaboration among the people conducting flycatcher research and management activities. This synthesis and collaboration was crucial to help assure that on-going research, funded at several million dollars per year, was addressing priority research needs. It was also valuable in determining whether management activities, often intensive and costly, were truly effective and beneficial to the flycatcher.

Several recovery team members organized a two-day conference, "The Ecology and Conservation of the Willow Flycatcher," held October 24–25, 2000, at Arizona State University in Tempe, Arizona. The goals of this conference, the first ever dedicated solely to this species, were to provide a forum for presenting new information on the ecology of the flycatcher, to share lessons learned on conservation and management activities, and to stimulate future research and conservation actions. In addition, the conference was intended to serve as the basis for a monograph in the Studies in Avian Biology series. Originally envisioned as a conference on the federally endangered southwestern subspecies, it soon became clear that the extent of flycatcher research and conservation concerns were more geographically widespread. Thus, although most presentations focused on the western U.S., participants came from throughout North America. The conference offered sixty-four presentations (48 talks, 16 posters), and attracted over 180 attendees. Thirty-two draft manuscripts were submitted for publication in this volume, of which 23 are included herein. Nearly all of the manuscripts contained in this volume are based on symposium presentations, although not all topics covered in the symposium are represented here. Each chapter has been peer-reviewed and reviewed by the editors, as well.

We are grateful to Arizona State University for providing an excellent venue for the conference, and to a wide variety of agencies for logistic and financial support. In particular, we are grateful to the U.S. Geological Survey, U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, U.S. Forest Service, Arizona Game and Fish Department, and the Arizona State University Plant Biology Department. Additional funds in support of the publication of this volume were provided by the U.S. Bureau of Reclamation (Upper Colorado River Regional Office, and the Phoenix Area Office), and the U.S. Geological Survey. Production of this volume was made possible by editorial and administrative assistance from S. Durst, T. Koronkiewicz, E. Paxton, and L. Sogge. The editors also thank John Rotenberry for his guidance, patience, and persistence throughout the publication process.

The quality of the contributions in this volume is due in part to the efforts of numerous referees who graciously devoted their time and expertise to manuscript reviews. We specifically thank D. Ahlers, J. Alexander, G. Beatty, P. Beck, H. Bombay, G. Braden, B. Brown, D. Callahan, P. Collins, T. Corman, D. Curson, T. Custer, D. DeSante, C. Drost, C. Farmer, D. Finch, K. Garrett, C. Goguen, W. Graf, C. Grotto-Trever, J. Grzybowski, J. Gustafson, W. Haas, J. Hatten, C. Henny, B. Howe, F. Howe, D. Hussell, M. J. Johnson, O. Komar, D. Krueper, B. Kulba, S. Leon, P. Lowther, P. Marra, R. Marshall, B. McGillivray, K. Miner, M. Morrison, C. Ortega, E. Paxton, D. Pereksta, H. Pinel, K. Purcell, J. Ratti, B. Raulston, J. Rorabaugh, C. Schultz, J. Sedgwick, G. Seutin, P. Shaffroth, R. Skaggs, P. Stacey, C. Stermer, I. Stewart, K.W. Sockman, S. Stoleson, J. Stromberg, T. Tibbitts, J. Turnbull, B. Valentine, J. Verner, J. Wells, K. Williams, R. R. Wilson, H. Yard, and W. Yong. The editors also thank Bob Steele for providing the excellent Willow Flycatcher photograph shown on the cover, and John Schmitt for the artwork gracing the title page.

Mark K. Sogge
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Studies in Avian Biology No. 26:1–2, 2003.

INTRODUCTION

MARK K. SOGGE, BARBARA E. KUS, SUSAN J. SFERRA, AND MARY J. WHITFIELD

The Willow Flycatcher (*Empidonax traillii*) is small and nondescript species, possessing neither colorful plumage nor a particularly melodious song. It generally inhabits dense, shrubby, wet, and buggy habitats where most people (other than, perhaps, professional biologists) spend very little time. Thus, it is not terribly surprising that this flycatcher, distributed across much of the lower 48 United States and in parts of southern Canada, is poorly known by the general public. Indeed, one recent editorial in a regional southwestern newspaper labeled the flycatcher as an insect. This bird is often overlooked even by birders and field biologists because its behavior and drab appearance can make it difficult to locate and identify. As a result, until recently the Willow Flycatcher received less study than might be expected given its widespread distribution.

Despite the limited attention, the Willow Flycatcher is certainly an ecologically interesting and variable species. In different parts of its range, it nests in a variety of dynamic habitats such as riparian forests, wet montane meadow shrublands, regenerating clearcuts, and recovering old-fields. It is comprised of four geographically-distinct subspecies that breed over a wide geographic and elevation range, and vary in morphology (Unitt 1987), genetics (Paxton 2000), and song (Sedgwick 2001). Although there are many ecological differences between subspecies, there is also substantial variation within each subspecies. This provides for interesting research opportunities, but also makes it difficult to generalize research findings from one breeding area or flycatcher population to another.

The Willow Flycatcher became the focus of widespread management and conservation attention in the 1980s, primarily due to concern for Sierra Nevada and southwestern populations (Serena 1982, Unitt 1987). In the early 1990s, Arizona Partners in Flight, a partnership of government and private organizations and individuals concerned about declining bird species and habitats, selected the Southwestern Willow Flycatcher as a focal species. At that time, the flycatcher was a bird species believed to be in great peril, and dependent upon one of the most threatened habitats in the southwest. Arizona Partners in Flight began a collaborative effort to conduct statewide presence/absence surveys and to describe flycatcher habitat. Data collected by this statewide effort were used by the U.S. Fish and Wildlife Service in its decision to list *E. t. extimus* as a federally endangered species.

Beginning in the mid-1990s, following the proposed and final listing of *E. t. extimus* as endangered (USFWS 1991, 1995), substantial amounts of funding became available to conduct research and management activities on this subspecies. This resulted in an explosion of field work designed to gather basic information on the status, distribution, and ecology of the Southwestern Willow Flycatcher throughout its range. Since then, literally thousands of flycatcher surveys have been conducted, and millions of dollars in research and conservation efforts undertaken. These efforts include, but are not limited to, basic presence/absence surveys, detailed demographic studies, genetics analyses, habitat characterization, breeding ecology studies, winter and migration ecology studies, habitat restoration, and conservation planning.

One of the major purposes of this volume was to provide a forum for publication of results from these recent activities. The 23 papers included herein cover a wide range of topics. Some describe the results of large-scale, multi-year research programs, and provide definitive answers to specific research and management questions. Others present intriguing preliminary results from small, short-term studies, where more detailed research is needed. All of the authors raise important questions that should be considered in future research and management efforts. Because the Southwestern Willow Flycatcher captured the initial federal regulatory attention, it became the subspecies of primary focus for research, conservation, and management activities in the western U.S. However, other populations and/or subspecies may be deserving of similar attention. Thus, although this volume deals primarily with *E. t. extimus*, it also includes chapters on other subspecies, some of which have not been as widely studied. This is important because much of the information gained from studies of one subspecies is useful for understanding the ecology and conservation challenges of other subspecies as well. Additionally, the knowledge gained through studies on Southwestern Willow Flycatchers can be applied to improve management of southwestern riparian systems and other riparian obligate species.

The papers in this volume are divided among

three basic sections, each of which begins with a summary chapter by one or more of the volume editors. Section 1 includes six chapters focusing on the status and distribution of local and regional Willow Flycatcher populations, on both the wintering and breeding grounds. The nine diverse papers in Section 2 deal primarily with flycatcher breeding ecology and behavior. Section 3 contains eight chapters with direct implications for Willow Flycatcher management, conservation, and research methods. The volume ends with a consolidated Literature Cited section. Because many of the papers published in this volume refer to data from agency reports and other unpublished sources, they cite nonpeer reviewed materials (i.e., "gray literature") that are often hard to obtain. To improve access to these unpublished materials, copies of all such gray literature cited in this volume have been deposited with the Wilson Ornithological Society Josselyn Van Tyne Memorial Library at the University of Michigan (URL: http://www.ummz.lsa.umich.edu/birds/sab26.html).

Thanks to the efforts of many individuals, and funding from many agencies, we have learned much about the Willow Flycatcher in the last 10 years. The answers and experiences gained—many of which are presented herein—have made important contributions to the field of avian ecology, helped in species- and site-specific management activities, and aided broad-scale conservation planning (e.g., the Southwestern Willow Flycatcher recovery plan). However, our data needs are still great, and we still lack basic distribution and ecological information from many parts of the flycatcher's range. This is especially true with regard to Willow Flycatcher habitat selection and use, dispersal and settlement patterns, migration and winter ecology, and the impacts of predators, parasites, disease, and human activities such as development, altered river systems, agriculture, grazing, and environmental contaminants. Furthermore, we are still in the early stages of developing effective conservation actions such as riparian habitat restoration and creation, as well as implementing monitoring programs to evaluate the efficacy of these actions. Meeting these information needs is a major challenge that will require scientific and management creativity, and substantial financial resources. Such efforts will be enhanced by continuation of the successful and collegial collaboration that has, so far, been widespread within the Willow Flycatcher research and conservation community. It is our sincere hope that this volume inspires additional efforts in that regard.

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A volume of this nature is made possible only by the efforts and assistance of many people. The conference on which this manuscript is based would not have been successful without financial support from numerous agencies (see PREFACE) and outstanding assistance from those who volunteered for registration desk duties, audio-visual tasks, session chair responsibilities, and numerous other activities: G. Beatty, S. Chambers, T. Cordery, R. Davidson, C. Karas, J. Kjesbo, N. Kaufman, J. Koloszar, D. Laush, S. Leon, T. McCarthey, J. McGlothlen, C. Paradzick, E. Paxton, H. Messing, M. Rasmussen, B. Raulston, J. Rourke, A. Smith, J. Stromberg, M. Stuart, and W. Murphy. We also thank the staff of the Arizona State University Memorial Union conference planning department.

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STATUS AND DISTRIBUTION—INTRODUCTION

BARBARA E. KUS AND MARK K. SOGGE

The Willow Flycatcher breeds throughout most of the United States and parts of southern Canada, occurring in a broad range of habitats across a wide elevational range. Interestingly, recent trends in distribution and abundance are variable across the species' range, likely the result of geographic differences in the nature and extent of human-associated alteration of the landscape, and possibly ecological differences among subspecies. In the eastern and southeastern U.S., the Willow Flycatcher has expanded its range over the last few decades (Sedgwick 2000a), and breeds in riparian shrubs and forests, and in human-altered landscapes such as shrubby old-fields and young pine plantations (Sogge 2000). In the Pacific Northwest, the species has disappeared from many lowland riparian areas, but has become a common breeder in regenerating clearcut habitat (Morrison and Meslow 1983, Altman et al. *this volume*; M. Sogge and E. Paxton, unpubl. data). There, intensive timber harvesting may have provided new breeding habitats, and given the extent of clearcuts in Oregon and Washington, it is possible that Willow Flycatchers are now more abundant and widespread than in the past (but see Altman et al. *this volume*). In contrast, Willow Flycatchers in the southwestern U.S. have declined to the point of near extinction as urbanization and a burgeoning human population have resulted in widespread loss and degradation of riparian habitat. Willow Flycatchers are now absent as a breeding species from the Central Valley of California, where they were once common (Harris et al. 1987), and have been dramatically reduced in number along the lower Colorado River, which in historic times probably supported one of the largest Willow Flycatcher populations in the southwest (Unitt 1987).

Despite years of concern about declining Willow Flycatcher populations, surprisingly few data have been available to effectively gauge trends in distribution and abundance, or to establish links between declines and potential causative factors. The following series of papers provides current information at regional and local scales critical to the management and conservation of endangered, rare, and declining species. The section begins with a rangewide synthesis by Mark Sogge and his colleagues describing the distribution of breeding sites of the Southwestern Willow Flycatcher, summarizing nine years of surveys and including analyses of site characteristics such as habitat type and land ownership. This overview is followed by statewide assessments of flycatcher status in California (Barbara Kus and co-authors) and Arizona (Charles Paradzick and April Woodward), which together support half of the Southwestern Willow Flycatchers in the United States. Chris Farmer and co-workers focus their attention at an even more local scale, considering Willow Flycatcher occurrence and habitat use at one of the largest coastal sites in California—the Santa Ynez River. Brian Kulba and Bruce McGillivray round out the presentations on breeding populations with their summary of the distribution and habitat characteristics of Willow Flycatchers in Alberta.

Several themes run through each of these papers, drawing attention to areas requiring further investigation. All of the authors assessing the status of Southwestern Willow Flycatchers point out that while many years of survey data are now available, their usefulness in determining population trends is severely limited because of inconsistent survey scope and effort across years. Standardized surveys at selected sites will be essential for detecting future population trends and assessing response to management (U.S. Fish and Wildlife Service 2002). Baseline data are needed for populations in less-studied parts of the flycatcher's range, such as Texas, and syntheses of historic and current status published for New Mexico, Utah, and Colorado. Second, regional compilations of survey data indicate that Southwestern Willow Flycatchers primarily occur in extremely small populations, the majority numbering fewer than five territories, heightening the risk of local extirpation through stochastic events. Each of the authors touches on the need for an improved understanding of the spatial connections between flycatcher populations and the extent to which they are structured in one or more metapopulations. Third, all of the authors present data describing general habitat features of sites used by flycatchers, comment that many evidently suitable sites are unoccupied, and note that flycatchers are sometimes found breeding in atypical habitats. Further research is needed to describe the range of habitat types used by Willow Flycatchers, and to identify the local and landscape-level hydrological and geomorphic conditions that support such habitats. Habitat selection by breeding flycatchers also needs to be investigated, as well as the

roles that site fidelity and social attraction play in determining local flycatcher distributions.

The volume of literature devoted to breeding Willow Flycatchers defies the reality that this species spends over half the year on wintering grounds outside of the United States. Until recently, much our knowledge of this part of the flycatcher's annual cycle was based on little more than distributional maps in popular field guides, hardly adequate for an understanding of the factors influencing population trends of breeding birds. Section 1 thus concludes with the first published information on the distribution and habitat use of Willow Flycatchers on their wintering grounds in Central America. Janet Lynn and coauthors provide detailed information on the types of habitats used by Willow Flycatchers, as well as threats to those habitats, and in so doing not only contribute new information on Willow Flycatcher ecology, but provide a strong foundation for future research and monitoring at these and other wintering sites.

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DISTRIBUTION AND CHARACTERISTICS OF SOUTHWESTERN WILLOW FLYCATCHER BREEDING SITES AND TERRITORIES: 1993–2001

MARK K. SOGGE, SUSAN J. SFERRA, TRACY D. MCCARTHEY, SARTOR O. WILLIAMS, AND BARBARA E. KUS

Abstract. Effective conservation and management of an endangered species requires knowledge of its abundance, distribution, and breeding site characteristics. Using published literature, unpublished reports, and personal communications, we synthesized information on all known Southwestern Willow Flycatcher (*Empidonax traillii extimus*) breeding sites from 1993 through 2001. Due to extensive survey efforts throughout the Southwest, the number of known flycatcher territories has increased from 111 (in 1993) to 986 (in 2001); the number of known breeding sites similarly increased from 30 to 221. Most territories are found within small breeding sites (those sites with five or fewer territories); only two sites have 50 or more territories. Sixty-five sites have been extirpated since 1993; 61 of these had five or fewer territories. The states of California, Arizona, and New Mexico account for 89% of known territories; Nevada, Colorado, and Utah collectively have 11%. Approximately half of territories are in habitats comprised of >90% native plants; the other half have a >10% exotic tree and/or shrub component. Approximately 90% of territories are in habitats where willow (*Salix* spp.), saltcedar (*Tamarix ramosissima*), or boxelder (*Acer negundo*) are the dominant tree species; boxelder use occurs only in the Cliff-Gila Valley, New Mexico. Slightly less than half of all sites are on federally-controlled lands; 26% are on private lands. Privately owned sites account for 37% of known territories, and one-third (35%) of these are found in the Cliff-Gila Valley. No data are available on the current status of the Southwestern Willow Flycatcher in Texas or northern Mexico.

Key Words: breeding sites, distribution, *Empidonax traillii extimus*, extirpation, habitat, saltcedar, Southwestern Willow Flycatcher, status.

A basic need in the conservation and management of rare and endangered species is an understanding of the species' abundance and geographic distribution; also important is knowing the ecological and administrative characteristics of the sites in which it occurs. Such data are important for determining the species' current status, evaluating different conservation options, and for comparing past and future data. Rangewide data are often difficult to obtain, especially for organisms with a large geographic range that crosses numerous political and administrative boundaries.

The Southwestern Willow Flycatcher (*Empidonax traillii extimus*) is an endangered bird known to breed only in dense riparian habitats in six southwestern states (southern California, extreme southern Nevada, southern Utah and Colorado, Arizona, and New Mexico). Unitt (1987) produced the first synthesis of the status and distribution of *E. t. extimus*, and noted that flycatchers had been lost from many historic breeding sites, current flycatcher sites were mostly small and widely scattered, and the total number of flycatchers was perilously low. Unitt found evidence of less than 200 pairs overall, and estimated that the total rangewide population of *extimus* was probably only 500–1000 pairs. Unitt's work focused attention on the decline of the flycatcher, emphasized the need for additional surveys, and formed an important basis for the federal government's decision to list the species as endangered.

Marshall (2000) provided the next summary of the rangewide abundance and distribution of the flycatcher. Compiling a substantial amount of new information from a wide variety of sources, Marshall presented a 1993–1996 summary of Southwestern Willow Flycatcher population abundance and distribution. His summary included some Utah and Colorado sites located north of the *E. t. extimus* boundary as defined by Unitt (1987) and Browning (1993), but administered as *extimus* by the U.S. Fish and Wildlife Service (USFWS) and other federal and state agencies. Marshall reported a total known population of approximately 550 territories distributed among 109 breeding sites; 77% of sites had only three or fewer territories. He noted examples of recent impacts to breeding sites, and the many conservation challenges posed by small and widely scattered breeding populations. Marshall reiterated Unitt's (1987) call for expanded survey efforts, especially in southwestern Texas, northern Sonora, and Baja California del Norte.

Since 1996, additional Willow Flycatcher surveys were conducted, many new flycatcher breeding sites were located, and many known sites were monitored over multiple years. Given

the large amount of new information and the need to include it in on-going Southwestern Willow Flycatcher conservation and recovery planning efforts, we set out to identify all known Southwestern Willow Flycatcher breeding sites (1993–2001). For each site, we assembled all available data on population size, location, habitat, and other information for as many years as possible. We report the latest information on the geographic distribution and abundance of *E. t. extimus*, and the administrative and ecological characteristics of its breeding sites.

METHODS

We consulted published and unpublished reports, including state-wide syntheses and site-specific agency and consulting firm reports (detailed in Sogge et al. 2002), and spoke directly with surveyors, researchers, and managers working on flycatcher projects and/or conservation issues (see ACKNOWLEDGMENTS). Most data came from surveys conducted according to Tibbitts et al. (1994) and Sogge et al. (1997) Southwestern Willow Flycatcher survey protocols, which use tape-broadcast flycatcher vocalizations to elicit vocal responses from territorial flycatchers. For each site where known or suspected territorial flycatchers were found, we extracted information on its location (state, drainage, elevation), gross estimates of whether the overall tree/shrub component was comprised of native and/or exotic plants, dominant tree species, flycatcher population size (number of territories), and management entity/agency responsible for administering the site. Site-specific information came from copies of field data sheets, summary reports, and/or conversations with biologists familiar with each site.

We included information on all flycatcher breeding sites reported between 1993 and 2001; this composite approach was necessary because not all sites were surveyed annually. The statistics included herein are based on survey data from the most recent year during which surveys were conducted, whether flycatchers were detected or not. Therefore, some sites with no flycatchers during the most recent survey year (as judged by the agencies consolidating statewide survey data) are included in the site tallies if they had resident flycatchers during one or more years since 1993. This report does not include data from sites where only migrant Willow Flycatchers were detected. Every effort was made to locate and include all survey information for every known Southwestern Willow Flycatcher breeding site; however, it is likely that some occupied sites have not yet been publicly reported and are therefore not included.

RESULTS AND DISCUSSION

Gathering and synthesizing information on breeding sites was challenging due to inconsistencies in practices of collecting and reporting flycatcher information across states. Rangewide, annual survey reporting requirements are not standardized and the nature and degree of readily available information varied widely. Some states and U.S. Fish and Wildlife Service regions require standard data sheets be submitted each year, and produce detailed statewide summary reports. For other areas, synthesis of annual flycatcher survey data was minimal or lacking. This lack of standardized, annual, state-based synthesis and reporting is the most immediate obstacle to rangewide synthesis of data.

Definitions of Units

We summarize data in terms of the number of flycatcher *sites* and the number of *territories*.

A site is defined as a location where one or more Willow Flycatchers establish a territory in which to breed. Sites with unpaired territorial males are considered breeding sites even if no nesting attempts were documented. A site is often a discrete patch of habitat; however, there is no standardized definition for site and its use varies among states. For example, five occupied habitat patches along a 10-km stretch of river might be considered as five different sites in one state, but as only a single site in another state. We deferred to the statewide summary documents, or to local managers and researchers, when delineating a site for inclusion in the database. Due to differences in site definitions, one should not evaluate the relative importance of a geographic region (drainage, watershed, state, etc.) based simply on the number of flycatcher sites.

A territory is an exclusive defended area within a breeding site. Although detailed monitoring studies have identified unpaired territorial males and/or polygynous males at some flycatcher breeding sites, a territory may be thought of as roughly equivalent to a pair of flycatchers. The concept of territory was more similar between states and among different investigators than was site, so the number of territories is a more appropriate unit to use for summaries and comparisons. Estimates of the number of territories were taken directly from the original data source.

Considerations in Using and Interpreting the Data

We used data from a wide variety of sources, and the amount of information and level of detail varied greatly among sites. Because survey methodology and effort varied among sites and/or between years, these summary data must be interpreted and used in context. Following are cautions to consider when using these data.

Subspecies status of each site

Determination of a precise "boundary line" between Willow Flycatcher subspecies is difficult. Based on analysis of song patterns, Sedgwick (2001) suggested that *E. t. extimus* may not

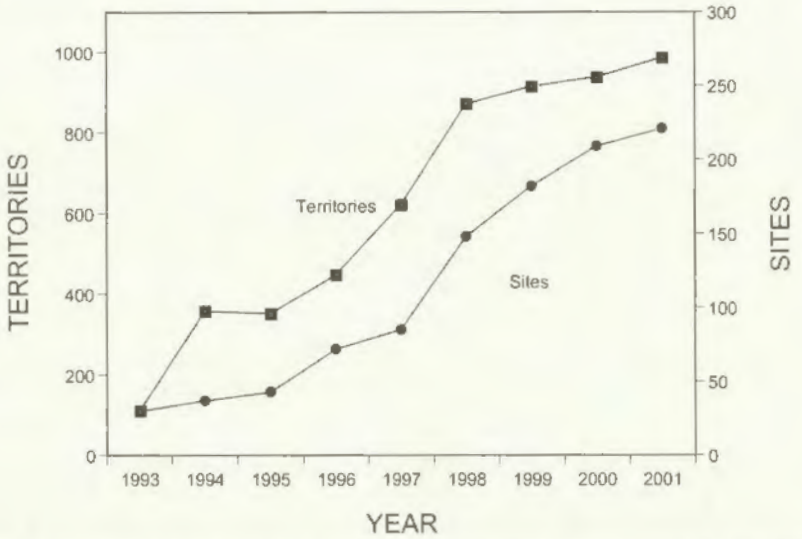

FIGURE 1. The increase in the number of known Southwestern Willow Flycatcher breeding sites (filled squares) and territories (filled circles), from 1993 to 2001. Note that this increase is due primarily to increased survey effort.

occur in Colorado, and that northern New Mexico may be a zone of intergradation between subspecies. However, Paxton (2000) found evidence of *E. t. extimus* genetic characteristic as far north as northwestern New Mexico and southwestern Colorado. For our analysis, we included Willow Flycatcher breeding sites within the geographic range of *E. t. extimus* as defined by Unitt (1987), Browning (1993), and the U.S. Fish and Wildlife Service Southwestern Willow Flycatcher recovery plan (USFWS 2002). Future studies or administrative decisions could ultimately reinforce or change the accepted boundary designations for *E. t. extimus*. Thus, some of the sites reported herein may eventually be removed from management as *extimus*, and/or new geographic areas and sites could be added. This should be considered when producing updates in future years, and when making range-wide comparisons among years.

Population estimates

Population estimates for a site vary with survey effort, surveyor experience, habitat density, and even background noise levels. Population estimates often represent the minimum number of flycatchers present; i.e., if surveyors suspected 12 to 14 flycatchers, we used the lower (more conservative) number. Therefore, although estimates may be very accurate for some intensively surveyed sites, the overall statistics presented herein should be recognized as approximations.

Recency of Survey Data

The information we report is based on the most recent available survey data for each site. Although there were a few sites (N = 5) for which the most recent survey data came from 1995 or earlier, 2000 and/or 2001 data were available for 185 sites (accounting for 84% of sites and 93% of territories).

Changes in the Number of Known Territories Over Time

Since 1993, extensive survey efforts in Arizona, California, Colorado, New Mexico and Utah have greatly increased the number of known breeding sites and breeding territories. From a 1993 estimate of 30 sites and 111 territories, we now know of 986 territories, located among 221 sites (Fig. 1). This increase should not be interpreted as a Southwestern Willow Flycatcher population increase. Rather, it is mostly a function of increased survey effort over time. Although population increases and decreases undoubtedly occur at some sites, movements of birds among sites and lack of standardized survey effort/reporting make it difficult to separate population trends from variances in survey effort. Original data sources (e.g., reports, survey data sheets, etc.) should be consulted when trying to elucidate population trends.

Population Sizes of Breeding Sites

Most (82%) Southwestern Willow Flycatcher breeding sites are small, both in terms of pop-

TABLE 1. NUMBER OF SOUTHWESTERN WILLOW FLYCATCHER BREEDING SITES AND TERRITORIES (TERR) FOR SIX WESTERN STATES, BY BREEDING SITE POPULATION SIZE

Site Size (number of territories)	AZ		CA		CO		NM		NV		UT		Overall	
	Sites	Terr	Sites	Terr	Sites	Terr	Sites	Terr	Sites	Terr	Sites	Terr	Sites	Terr
0	42	0	12	0	0	0	8	0	2	0	1	0	65	0
1–5	36	70	59	107	4	8	16	45	2	5	1	3	118	238
6–10	6	50	1	7	0	0	4	32	3	22	0	0	14	111
11–20	8	125	0	0	0	0	2	30	3	46	0	0	13	201
21–50	2	49	5	142	1	29	1	25	0	0	0	0	9	245
51–100	1	65	0	0	0	0	0	0	0	0	0	0	1	65
100+	0	0	0	0	0	0	1	126	0	0	0	0	1	126
Total	95	359	77	256	5	37	32	258	10	73	2	3	221	986

Notes: Data are for all known 1993–2001 breeding sites; the number of territories is based on last available survey data for each site. A breeding site was counted as having 0 territories if it was occupied during any year from 1993 to 2000, but had no flycatchers during subsequent surveys.

ulation size (five or fewer territories; Table 1) and habitat patch size. Smaller sites are more susceptible to extirpation; 61 of the 65 sites from which flycatchers were extirpated since 1993 were composed of five or fewer territories. Losses of the larger breeding sites at the Colorado River inflow to Lake Mead and the San Pedro River at PZ Ranch involved destruction of habitat by flooding and fire, respectively. However, flycatchers were also lost from sites at the Virgin River near St. George and on the San Pedro River near Indian Hills (both of which had >10 territories during their highest count), despite no large-scale habitat loss. Not all birds at extirpated sites necessarily died—some may have moved elsewhere. We know this is the case for banded flycatchers that moved from the Verde River (Tuzigoot Bridge) and San Pedro River (PZ Ranch) to other sites (Paxton and Sogge 1996, Paxton et al. 1997, Netter et al. 1998). Even excluding extirpated sites, 76% of extant breeding sites have five or fewer territories. Because most extirpated sites had very small populations (usually only one or two territories), their loss does not greatly affect the overall rangewide population estimates, nor the territory summary statistics that we report.

DISTRIBUTION OF TERRITORIES BY STATE

Arizona, New Mexico, and California have the greatest number of known Southwestern Willow Flycatcher sites and territories (Table 1). Nevada, Colorado, and Utah account for less than 15% of territories. There were no recent survey data or other records on current status and distribution in Texas and Mexico.

DISTRIBUTION OF TERRITORIES BY DRAINAGE

Between 1993 and 2001, Southwestern Willow Flycatchers bred within 40 river drainages. The Gila River, Rio Grande, Salt River, and San Pedro River drainages support the greatest number of flycatchers (Table 2). The primary flycatcher drainages in California are the Kern, San Luis Rey, Santa Ana, Santa Margarita, and Santa Ynez rivers.

ELEVATIONAL RANGE OF BREEDING TERRITORIES

As might be expected of a species that ranges over such a wide geographic area, the Southwestern Willow Flycatcher is distributed over a wide elevational range. Approximately 60% of sites occur between 0 and 800 m elevation, with another 28% between 801 and 1600 m (Table 3). Only 9% of territories are known to occur above 2000 m elevation.

USE OF NATIVE AND EXOTIC HABITATS

Many flycatcher breeding sites are comprised of spatially complex habitat mosaics, often including both exotic and native vegetation. Within a site, flycatchers often use only a part of the patch, with territories frequently clumped and/or distributed near the patch edge (Sogge and Marshall 2000). Therefore, the vegetative composition of individual territories may differ from the overall composition of the patch. Although detailed territory-based habitat measurements are lacking for the majority of Southwestern Willow Flycatcher breeding sites, it is useful to characterize the relative use of native and exotic habitats. To do so, we classified the habitat at each site based on the reported overall species composition of the tree/shrub layer(s). Because habitat descriptions varied widely, ranging from cursory examinations to detailed quantitative measurements, we grouped sites into several broad categories: Native (>90% native vegetation), Mixed—Mostly Native (>50–90% native vegetation), Mixed—Mostly Exotic (>50–90% exotic vegetation), and Exotic (>90% exotic vegetation).

Habitat patches comprised of native vegetation account for approximately half (48%) of the

TABLE 2. NUMBER OF SOUTHWESTERN WILLOW FLYCATCHER BREEDING SITES AND TERRITORIES LOCATED IN EACH RIVER DRAINAGE

Drainage	Number of Sites	Number of Territories	Drainage	Number of Sites	Number of Territories
Agua Hedionda, CA	1	0	San Dieguito River, CA	3	4
Amargosa River, NV	2	3	San Felipe Creek, CA	1	2
Big Sandy River, AZ	2	13	San Francisco River		
Bill Williams River, AZ	5	18	AZ	1	1
Canadian River, NM	3	12	NM	1	2
Chama River, NM	2	4	San Gabriel River, CA	1	1
Colorado River			San Juan Creek, CA	1	1
AZ	29	30	San Juan River		
CA	8	4	CO	3	3
Gila River			NM	1	0
AZ	28	69	San Luis Rey River, CA	9	61
NM	7	158	San Mateo Creek, CA	1	2
Hassayampa River, AZ	1	0	San Pedro River, AZ	14	80
Kern River, CA	2	23	Santa Ana River, CA	21	38
Las Flores Creek, CA	1	2	Santa Clara River, CA	6	12
Little Colorado River			Santa Cruz River, AZ	1	1
AZ	2	2	Santa Margarita River, CA	2	23
NM	2	4	Santa Maria River, AZ	1	1
Meadow Valley Wash, NV	1	0	Santa Ynez River, CA	3	33
Mojave River, CA	5	13	Sweet River, CA	2	2
Owens River, CA	5	28	Temecula Creek, CA	2	4
Pahranagat River, NV	3	32	Tonto Creek, AZ	1	27
Rio Grande			Verde River, AZ	4	3
CO	2	34	Virgin River		
NM	16	78	AZ	1	1
Salt River, AZ	5	113	NV	4	38
San Diego Creek, CA	1	0	UT	2	3
San Diego River, CA	2	3			

Notes: Data are for all known 1993–2001 breeding sites (N = 221); the number of territories is based on last available survey data for each site (N = 986 territories).

known flycatcher territories (Table 4). While this underscores the importance of native habitats, 25% of flycatcher territories are found in habitat patches with ≥50% exotic vegetation. In many of these cases, exotics are contributing significantly to the habitat structure by providing the dense lower-strata vegetation that flycatchers prefer (Sogge and Marshall 2000). Dominance of native vegetation at the single largest flycatcher site (126 territories in the Gila—Cliff Valley, NM) substantially affects this habitat summary. Removing the Gila-Cliff site from the analysis, the proportion of rangewide territories occurring in Native sites decreases to 40%, Mixed—Mostly Native sites account for 27%,

TABLE 3. ELEVATIONAL RANGE OF SOUTHWESTERN WILLOW FLYCATCHER BREEDING SITES AND TERRITORIES

Elevation range (m)	# Sites	# Territories
0–400	74	154
401–800	54	340
801–1200	37	160
1201–1600	25	237
1601–2000	12	28
2001–2400	14	62
>2401	5	5

Notes: Data are for all known 1993–2001 breeding sites (N = 221); the number of territories is based on last available survey data for each site (N = 986 territories).

TABLE 4. NUMBER OF SOUTHWESTERN WILLOW FLYCATCHER BREEDING SITES AND TERRITORIES OCCURRING IN BREEDING SITES OF NATIVE, EXOTIC, AND MIXED HABITATS

General breeding habitat category	Sites	Territories
Native (>90% Native)	69 (31%)	468 (48%)
Mixed Mostly Native (>50–90% Native)	70 (32%)	231 (23%)
Mixed Mostly Exotic (>50–90% Exotic)	45 (20%)	161 (16%)
Exotic (>90% Exotic)	12 (5%)	90 (9%)
Unknown	25 (12%)	36 (4%)

Notes: Habitat classification is based on rough field estimates of the relative amount of native and exotic tree and shrub species present at the site (not in each specific territory). Data are for all known 1993–2001 breeding sites (N = 221); the number of territories is based on last available survey data for each site (N = 938 territories). Numbers in parentheses are the percentage of total for that category.

TABLE 5. NUMBER OF SOUTHWESTERN WILLOW FLYCATCHER BREEDING SITES AND TERRITORIES OCCURRING IN BREEDING SITES DOMINATED BY DIFFERENT TREE SPECIES, BASED ON THE PREDOMINANT TREE OR SHRUB SPECIES PRESENT AT THE SITE (NOT IN EACH SPECIFIC TERRITORY)

Dominant tree species	Sites	Territories
Willow (*Salix*)	123 (56%)	541 (55%)
Saltcedar (*Tamarix*)	55 (25%)	243 (25%)
Boxelder (*Acer*)	1 (0.5%)	126 (13%)
Cottonwood (*Populus*)	8 (4%)	12 (1%)
All others	34 (15%)	64 (6%)

Notes: Data are for all known 1993–2001 breeding sites (N = 221); the number of territories is based on last available survey data for each site (N = 986 territories). Numbers in parentheses are the percentage of total for that category.

TABLE 6. NUMBER OF SOUTHWESTERN WILLOW FLYCATCHER BREEDING SITES AND TERRITORIES OCCURRING AT BREEDING SITES UNDER DIFFERENT OWNERSHIP/ADMINISTRATIVE CATEGORIES

Administration category	Sites	Territories
Federal government	99 (45%)	483 (48%)
Privately owned	57 (26%)	362 (37%)
State/local/municipal government	24 (11%)	57 (6%)
Tribal government	14 (6%)	44 (5%)
Unknown	27 (12%)	40 (4%)

Notes: Data are for all known 1993–2001 breeding sites (N = 221); the number of territories is based on last available survey data for each site (N = 986 territories). Numbers in parentheses are the percentage of total for that category.

19% occur in Mixed—Mostly Exotic sites, and Exotic sites support 11%.

DOMINANT TREE SPECIES AT BREEDING SITES

Because flycatcher breeding sites are often spatially complex mosaics of different tree species, and flycatchers often use only a part of the patch, the dominant tree species may differ between a patch and an individual territory within that patch. Generally, detailed territory-based habitat measurements are lacking for most Southwestern Willow Flycatcher breeding sites. Despite this limitation, it is useful to characterize the dominant tree species within known flycatcher breeding sites. To determine the degree to which flycatchers breed in habitats dominated by particular tree species, we tallied the number of territories occurring in breeding sites dominated by particular tree species. More territories were found at sites dominated by willow (*Salix* spp.) than by any other species (Table 5). Saltcedar (*Tamarix ramosissima*)-dominated sites support 25% of territories, and boxelder (*Acer* spp.)-dominated sites accounted for 13%. Taken together, sites dominated by all other tree species account for only 6% of territories. The large percentage of territories located in boxelder-dominated habitats might suggest that boxelder sites are widely used across the Southwestern Willow Flycatcher's range. However, boxelder-dominated breeding habitats occur only in the Cliff-Gila Valley, New Mexico. Removing that site from the analysis, no territories are found in boxelder dominated habitats, and the proportions of rangewide territories at willow and saltcedar sites increase to 63% and 28%, respectively.

ADMINISTRATION/MANAGEMENT OF SITES AND TERRITORIES

Another factor important in conservation and recovery planning is the nature of ownership or administration of a site. Slightly less than half of known breeding sites are under federal government administration and 26% are on privately owned lands (Table 6). State/local/municipal governments account for another 11% of sites, and 6% are administered by Native American tribes. Private lands account for 37% of territories, underscoring the importance of developing partnerships between the federal government and other landowners to encourage flycatcher conservation and recovery efforts. About one-third (35%) of the flycatcher territories on privately-owned lands are in the Cliff-Gila Valley, New Mexico.

CONCLUSIONS

Extensive flycatcher surveys conducted between 1993 and 2001 located many flycatcher breeding sites and territories that were not known when Unitt (1987) formulated the first rangewide population estimate for *E. t. extimus*. However, the reported population still falls within the upper end of Unitt's estimate of 500–1000 pairs, and is low enough that the status of the flycatcher remains a concern. Of particular concern is the fact that so many flycatcher breeding sites are small in terms of the number of breeding territories, and in the actual size of the habitat patch. Small populations and habitat patches are highly susceptible to loss due to natural events and human activities, and 61 small breeding sites have been lost since 1993. Even comparatively large populations have been impacted by human-related causes such as fire and flooding (Marshall 2000), and similar losses may occur in the future.

Although recent flycatcher surveys have covered large portions of potential Southwestern Willow Flycatcher breeding habitat (especially in the core of its range: Arizona, California, New Mexico), much riparian habitat remains to be surveyed, particularly on private and tribal

lands. Even basic presence/absence data are missing for southwestern Texas and the northern portions of Baja California and Sonora, Mexico. A better accounting of the distribution and abundance of the flycatcher, and continued surveys and synthesis of rangewide data, are clearly needed for effective Southwestern Willow Flycatcher management and conservation.

Rangewide population trends are obscured by variations in annual survey effort and locations, so we do not know if the overall population increased, decreased, or remained stable from 1993 to 2001. Even at a more local scale (e.g., drainages or individual breeding sites), trends are generally impossible to discern because not all sites are surveyed each year, survey effort is not equal among years, new sites are still being discovered in newly surveyed areas, and individual birds move among sites. These limitations occur primarily because the flycatcher was only recently listed as endangered; thus, there has been limited time to develop baseline data. Furthermore, surveys are often initiated by regulatory requirements associated with various development projects, and thus occur in a piecemeal fashion. Hopefully, management and regulatory agencies will develop and implement a more coordinated and programmatic survey program such that temporal trends can be determined (USFWS 2002).

Some breeding site characteristics highlight Southwestern Willow Flycatcher conservation and recovery opportunities. The wide geographic distribution of breeding sites, and their location on numerous different river drainages offers protection against wholesale loss from large-scale or local catastrophic events. Its widespread distribution also benefits recovery efforts by providing more geographic locations at which habitat can be created or restored in close proximity to currently occupied sites (thus increasing the potential for colonization of the new site). The fact that flycatchers will occupy small habitat patches (e.g., <10 ha) means that the flycatcher may benefit from small-scale riparian protection and/or restoration programs, as well as larger (and typically more expensive) projects. Because flycatchers breed in a variety of riparian habitat types (including native and some exotic vegetation), there are more habitat restoration options available than would be the case if flycatcher habitat use was restricted to the historical willow-cottonwood associations. The presence of so many flycatchers on non-government lands provides many opportunities for government-private partnerships to protect and enhance flycatcher populations and habitats.

The data we present raise some important questions for which additional research is warranted. Are flycatchers breeding in groups or clusters of small breeding sites collectively as productive as one larger site? How does habitat type influence flycatcher productivity and survival? With saltcedar being such a prevalent habitat component at many flycatcher breeding sites, what are the ramifications of saltcedar control and/or conversion to native habitats? The answers to these and the other questions highlighted above are important for effectively planning and implementing Southwestern Willow Flycatcher conservation and recovery.

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A synthesis of data from so many sites over such a broad geographic range was only made possible by the efforts of a great many cooperators. Originally, these data were gathered by hundreds of agency and non-governmental biologists surveying for thousands of hours, often in very difficult field conditions. Their dedication and efforts are greatly appreciated. Further, the ability to report specific information for each site was aided by agencies and people that provided detailed summary information; our sincere thanks go to the individuals listed below: D. Ahlers, S. Albert, P. Bloom, G. Braden, M. Cassell, K. Christensen, R. Davidson, K. Day, P. Famolaro, J. Greaves, D. Guthrie, W. Haas, L. Hays, E. Howe, M. Holmgren, E. Hopson, T. Ireland, T. Koronkiewicz, J. Krueger, S. Langridge, S. Laymon, D. Leal, S. Leon, J. Lucero, R. Marshall, M. McKernan, R. McKernan, R. Mesta, R. Netter, C. Paradzick, E. Paxton, D. Pereksta, C. Peterson, J. Rourke, A. Smith, D. St. George, S. Stoleson, K. Stone, P. Summer, M. Sumner, T. Tibbitts, C. Tomlinson, R. Wallen, L. White, M. Whitfield, and P. Zenone. C. Drost, E. Deshler, P. Deshler and E. Paxton provided other essential assistance. Data gathering and analysis was funded by the U.S. Geological Survey and the U.S. Bureau of Reclamation (Phoenix Area Office).

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SOUTHWESTERN WILLOW FLYCATCHER POPULATIONS IN CALIFORNIA: DISTRIBUTION, ABUNDANCE, AND POTENTIAL FOR CONSERVATION

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Abstract. Southwestern Willow Flycatchers (*Empidonax traillii extimus*) in California occupy a range extending from the United States-Mexico border north to the southern Sierra Nevada and adjacent valleys. Surveys conducted by numerous investigators in 1999–2001 indicate a statewide population of at least 194 territories distributed across 58 sites in ten counties, representing 20% of the US population. Flycatcher numbers at 26 sites surveyed in all three years increased slightly from 131 to 138 territories (5%) between 1999 and 2001. Populations ranged from 1–50 territories in size, with nearly half the flycatchers concentrated in three "large" (>15 territories) sites, including the South Fork of the Kern, upper San Luis Rey, and lower Santa Margarita rivers. Ninety percent of sites supported five or fewer territories, suggesting a potentially high degree of vulnerability to extinction by stochastic events. Rangewide surveys conducted in 1997 of over 500 km of riparian habitat in southern California revealed that over half was highly disturbed, and an additional third moderately disturbed, by sand mining, agriculture, grazing, urbanization, altered hydrology, and invasion by exotic plants. This suggests that availability of suitable habitat may be severely limited and conservation measures are needed to restore habitat. High spatial and temporal variability in patterns of nesting success, productivity, and population growth complicate efforts to identify factors limiting flycatcher populations and to provide conditions conducive to recovery.

Key Words: California, *Empidonax traillii extimus*, endangered species, habitat conservation, riparian, Southwestern Willow Flycatcher.

Southwestern Willow Flycatchers (*Empidonax traillii extimus*) in California occupy a range extending from the United States-Mexico border north to the southern Sierra Nevada range, and from the Pacific Ocean east to the Colorado River (Unitt 1987). Within this range, most flycatcher habitat—usually dense stands of willow-dominated vegetation (Sogge and Marshall 2000)—occurs along streams and rivers in lowland valleys draining the west-facing slopes of the Coast Range, although habitat also occurs inland at higher elevations, for example, along the upper San Luis Rey River near Lake Henshaw in San Diego County (elevation 800 m), at several sites in the San Bernardino Mountains (elevation 900–2150 m), and along the South Fork of the Kern River in the southern Sierra (elevation 800 m). Habitat also occurs in the arid regions east of the mountains, primarily in discontinuous patches along the Colorado River in Imperial County.

Formerly a widespread and common breeder in southern California lowlands, Southwestern Willow Flycatchers have declined in the last half-century as habitat loss and, to a lesser extent, parasitism by Brown-headed Cowbirds (*Molothrus ater*), reduced the subspecies to the point of "virtual extirpation" by the early 1980s (Remsen 1978, Garrett and Dunn 1981; Harris et al. 1987, 1988; Unitt 1987, Schlorff 1990). Fortunately, predictions of the flycatcher's imminent extirpation from California have not been borne out, probably attributable in some measure to cowbird control and other management since the mid-1980s targeting the endangered Least Bell's Vireo (*Vireo bellii pusillus*), a species with which the flycatcher is sympatric. Nevertheless, Southwestern Willow Flycatcher numbers remain low in this as well as the other six states comprising its United States range. The purpose of this paper is to summarize the flycatcher's current distribution and abundance in California, describe recent trends in population size, discuss factors limiting flycatchers, and present information on the condition of riparian habitat in southern California and the potential for species conservation.

METHODS

POPULATION DATA

Information on flycatcher locations and numbers were compiled from technical reports and personal communications with investigators (including ourselves) conducting surveys in 1999–2001, as reported to the U.S. Fish and Wildlife Service Southwestern Willow Flycatcher California working group. Population trend analyses were limited to three large sites for which long-term data from standardized surveys were available: the South Fork of the Kern River upstream of Lake Isabella, Kern County (Whitfield and Strong 1995; Whitfield and Enos 1996, 1998; Whitfield et al. 1998, 1999a; Whitfield and Lynn 2001, Whitfield 2002); the lower Santa Margarita River at Marine Corps Base Camp Pendleton, San Diego County (Griffith Wildlife Biology 2000, Kus 2001, Kus and Ferree 2002); and a 2.5 km segment of the upper San Luis Rey River within the Cleveland National Forest, San

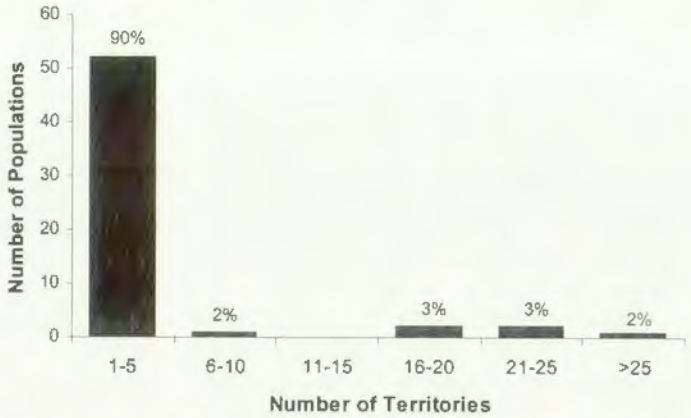

FIGURE 1. Population sizes (number of territories per population) of Southwestern Willow Flycatchers in California, 1999–2001. Values above bars represent % of total sites (N = 58).

Diego County, part of a larger population that occurs along 10 km of habitat below Lake Henshaw (Kus et al. 1999; Varanus Biological Services 2000d, 2001; W. Haas, unpubl. data). Data on reproductive success and productivity were drawn from these same sources.

Riparian Habitat Conditions

We assessed the condition of riparian habitat in southern California as part of a regional survey for Southwestern Willow Flycatchers and Least Bell's Vireos in 1997 (Kus and Beck 1998). In selecting sites to survey, we attempted to evaluate entire drainages populated by vireos or flycatchers, concentrating effort on areas outside of those regularly monitored for these species. Beginning with the major rivers in San Diego County, we systematically expanded our study area to the north and east, and evaluated a total of 566 km of habitat within 17 drainages. Of this habitat, 275 km were surveyed on foot between 2 April and 31 July; the remaining habitat was either surveyed by other investigators (53 km), was physically or otherwise inaccessible (e.g., private property; 64 km), or supported either no habitat or degraded habitat lacking the structure required by these species (175 km). The latter two types of areas were evaluated by driving along the river or by spot checks of the habitat from access or vantage points. Drainages were surveyed in sections, the lengths of which were determined by either by the amount of habitat that could be thoroughly surveyed on foot in one field day (dawn to approximately midday), or by the spatial configuration of habitat patches within a drainage. For each segment we characterized level (low, moderate, high) and nature of disturbance, and degree of invasion by exotic vegetation (low, moderate, high), where "low" corresponded roughly with an estimated areal cover of 25% or less, "moderate" 25–75%, and "high" greater than 75%. The types of land use adjacent to each segment were also recorded. Drainage segments were weighted by length for analysis.

RESULTS

Flycatcher Distribution and Abundance

Surveys between 1999 and 2001 documented breeding flycatchers at a total of 58 sites across ten southern California counties (Appendix). Between 163 and 194 flycatcher territories were confirmed each year, although not all sites were surveyed every year. Fifty-five to 46% of the flycatchers in 1999–2001, respectively, were concentrated in three "large" populations: the lower Santa Margarita River (17–18 territories annually), the Kern River (21–25 territories), and the upper San Luis Rey River (46–50 territories), currently the largest population in California. The remaining flycatchers were distributed in small populations numbering 1–12 territories (Appendix). The distribution of population size is highly skewed, with 90% of the sites occupied between 1999 and 2001 supporting just five or fewer territories (based on population size in the most recent year surveyed or occupied; Fig. 1). Only 5% of sites supported populations of more than 20 territories, including Owen's Valley, a previously little known site with a population of 24 territories in 2001 (B. Kus and M. Whitfield, unpubl. data).

Recent Population Trends

Rangewide, flycatcher numbers at 26 sites surveyed annually between 1999 and 2001 increased slightly from 131 to 138 territories (5%) over the 2-year period (Appendix). Most of this increase resulted from expansion of flycatchers into sites at which they had previously been confirmed absent (Piru Creek, Santa Barbara County; lower San Luis Rey River, San Diego County), rather than increases of existing populations. Of the three consistently monitored large populations, the lower Santa Margarita and upper San Luis Rey river populations have remained virtually constant in size since 1995, which might be predicted given that all three sites are managed to control cowbirds through annual trapping and removal (Fig. 2). In contrast, flycatcher

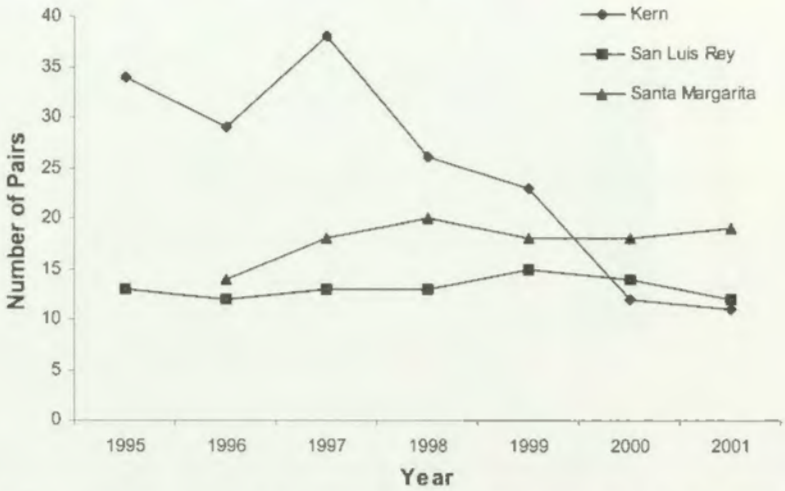

FIGURE 2. Recent population trends of Southwestern Willow Flycatchers at three California sites. Data for Santa Margarita River reflect number of territories, since pairing not determined in all years. Sources: Whitfield and Strong 1995; Whitfield and Enos 1996, 1998; Whitfield et al. 1998, 1999a; Whitfield and Lynn 2001, Whitfield 2002, Kus et al. 1999, Kus 2001, Kus and Ferree 2000, Griffith Wildlife Biology 2000; Varanus Biological Services 2000d, 2001; W. Haas, unpubl. data. See text for description of site locations.

numbers at the Kern River, which fluctuated between roughly 25–40 pairs between 1995 and 1998, now appear to be in steady decline, with only 11 pairs documented in 2001.

Nest Success and Productivity

Systematic nest monitoring at the three large sites revealed a high degree of temporal as well as spatial variability in nest success and productivity (Figs. 3, 4). For example, between 1995 and 2001, the percent of nests fledging flycatcher young at the Kern River ranged from 29–69%. In contrast, nest success at the Santa Margarita River in 1999 (the first year of monitoring) was approximately twice that at the Kern River during the same year, was even higher in 2000, and then dropped to a level comparable to that at the Kern River in 2001. Nest success at the San Luis Rey River varied over a range similar to that observed at the Kern River, but in a

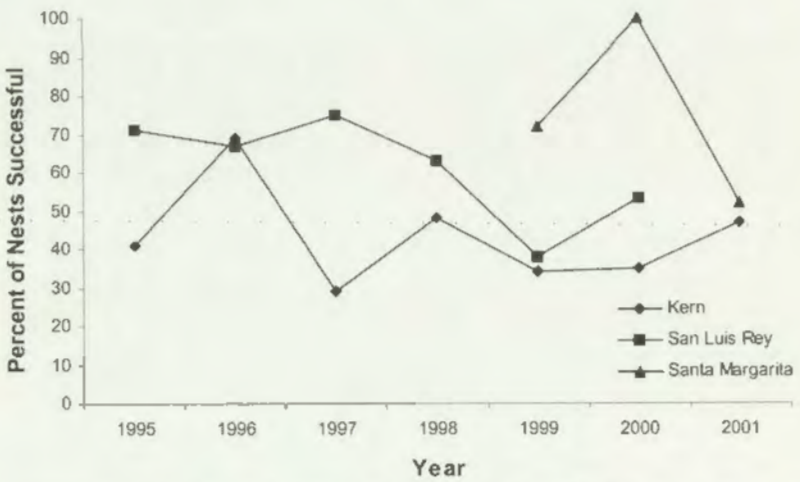

FIGURE 3. Nest success of Southwestern Willow Flycatchers at three California sites. Sources: Whitfield and Strong 1995; Whitfield and Enos 1996, 1998; Whitfield et al. 1998, 1999a; Whitfield and Lynn 2001, Whitfield 2002, Kus et al. 1999, Kus 2001, Kus and Ferree 2002, Griffith Wildlife Biology 2000; Varanus Biological Services 2000d, 2001. See text for description of site locations.

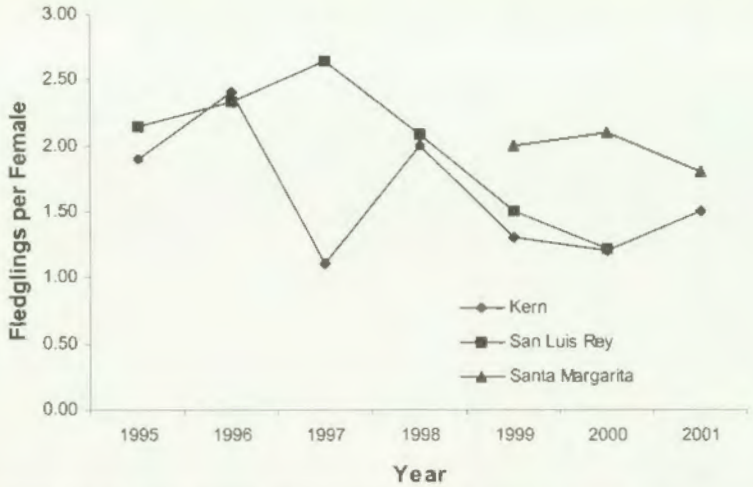

FIGURE 4. Productivity of Southwestern Willow Flycatchers at three California sites. Sources: Whitfield and Strong 1995; Whitfield and Enos 1996, 1998; Whitfield et al. 1998, 1999a; Whitfield and Lynn 2001; Whitfield 2002, Kus et al. 1999, Kus 2001, Kus and Feree 2002, Griffith Wildlife Biology 2000; Varanus Biological Services 2000d, 2001. See text for description of site locations.

pattern different from those at the other two sites. Similarly, productivity (fledglings per female) varied within and among sites between 1995 and 2001, showing no indication of spatial correspondence among sites. Since 1998, the Kern and San Luis Rey populations have shown similar productivity rates and trends; however, the Santa Margarita population appears distinct, with consistently higher productivity than the other two populations.

Riparian Habitat Condition

Habitat conditions were recorded for 514 km of habitat in 105 reaches along 17 drainages (Fig. 5). With the exception of an 88-km section of the Mojave River, study reaches ranged from 0.2–38.4 km (mean = 4.1 ± 5.3). Degree of disturbance was rated as high in 63% of the surveyed habitat, moderate in 28%, and low in 9%. Disturbance was particularly intense and widespread at the Mojave River, where 82% of the 171 km evaluated was highly disturbed, and 17% moderately disturbed. To avoid potentially biasing results for the remaining drainages by inclusion of this very large and highly disturbed river, we excluded the Mojave River from further analyses. Even with this exclusion, disturbance was rated as high in 54% of the habitat surveyed (N = 343 km total), moderate in 31%, and low in 13%.

Sources of disturbance were numerous and included a wide range of activities and habitat conversion associated with flood control and channelization, grazing, agriculture, sand and gravel extraction, recreation, and urban development (Table 1). Natural disturbance, such as scouring by floods, was evident in 10% of the reaches. Typically, more than one type of disturbance was present in a given reach, intensifying the effects on native habitat.

By far the most common type of disturbance along rivers was the presence of invasive exotic plants, particularly trees and shrubs, which occurred in 94% of reaches for which disturbance and presence of exotics were determined (N = 80 reaches, 263 km of habitat). The only sites from which exotics were absent were those virtually devoid of woody vegetation, such as sand mining sites and golf courses. Degree of invasion by exotics was rated as high in 43% of the reaches with exotics and moderate in 35%; only 22% of the reaches were characterized by a low presence of exotic plants. Not surprisingly, the degree of invasion by exotics was significantly correlated with disturbance level ($r = 0.54$, $P < 0.01$, $N = 75$), although it accounted for only 29% of the variation in disturbance, indicating that other sources were important contributors to habitat condition as well.

Of the exotics encountered in the study area, the most common were *Arundo donax* (giant reed) and *Tamarix ramosissima* (tamarisk or saltcedar), occurring either alone or in combination. *A. donax* was present in 87% of surveyed reaches, and was absent only from the Coachella Valley and grazed areas in the vicinity of Lake Henshaw on the upper San Luis Rey River, both relatively dry sites where tamarisk thrives. Tamarisk was equally widespread, occurring in 85% of reaches. *Arundo donax* and tamarisk occurred

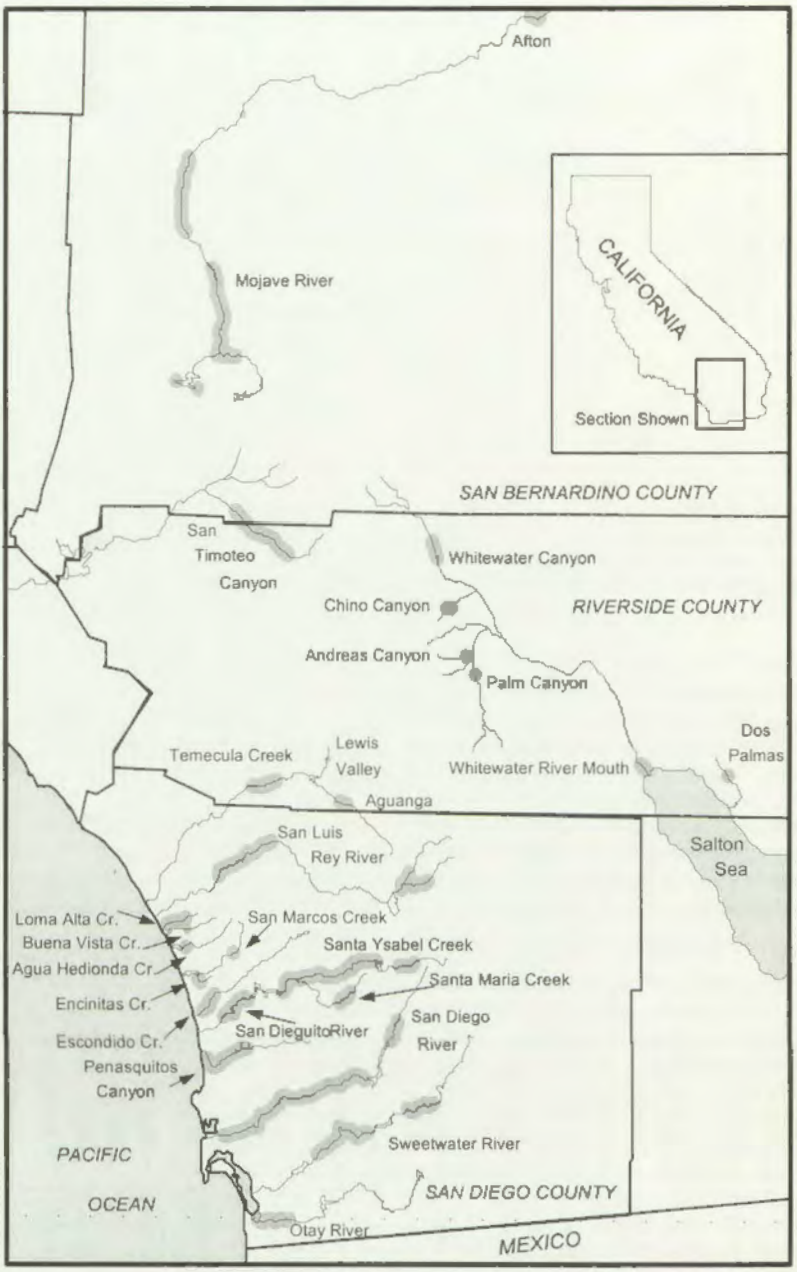

FIGURE 5. Southern California drainages assessed for riparian habitat condition in 1997. Surveyed sections highlighted in gray.

together in nearly half of the study reaches. Other common exotics included eucalyptus (*Eucalyptus* spp.), non-native palms, and castor bean (*Ricinus communis*).

DISCUSSION

The California population of Southwestern Willow Flycatchers, at 194 territories, represents 20% of the entire flycatcher population within the species' United States range (Sogge et al. *this volume*). Although effort was not devoted in all surveys to determining the pairing status of each male located, survey data for 1999–2001 indicate that the majority of males were paired and probably nesting. The persistence of the flycatcher two decades after its anticipated extir-

TABLE 1. TYPES OF DISTURBANCE IN SOUTHERN CALIFORNIA RIPARIAN HABITAT

Type of Disturbance	% of Reaches (N = 89)
Exotic vegetation	94[a]
Channelization	45
Grazing	38
Urbanization[b]	32
Agriculture	30
Recreational activities[c]	21
Sand and gravel extraction	17
Natural	10
Other[d]	2

[a] N = 80; occurrence of exotics not ascertained in nine reaches.
[b] Includes residential and commercial development, golf courses.
[c] E.g., equestrian use, picnic grounds.
[d] Itinerant campsites.

pation from California provides optimism that the species' decline has been arrested, although the potential for future population growth remains uncertain.

As elsewhere in their range (Marshall 2000, Sogge et al. *this volume*), the majority of flycatchers in California are distributed in small populations numbering fewer than five territories, making them potentially very vulnerable to extinction through stochastic events. Although at least some small populations have persisted for several years, data are not available with which to predict their capacity for long-term persistence. Small populations may persist through mechanisms not currently known, allowing overall population stability despite apparent vulnerability to local extinction. One possibility is that populations are connected by dispersal in a metapopulation, where individual populations are "rescued" from extinction by the immigration of colonizers from other populations. A population viability analysis of Southwestern Willow Flycatcher metapopulations in seven different geographic recovery units, including two in California, concluded that flycatchers in coastal California exhibit greater population stability than any other region analyzed, largely the result of high proximity of numerous small sites to one another as well as to a few large source populations (Lamberson et al. 2000). While encouraging for the future of flycatchers in southern California, the model's predictions for populations in the southern Sierra and Great Basin to the east were less optimistic, suggesting low persistence capability as a result of high isolation of the few sites known to exist. While useful in predicting the effects on flycatchers of various changes in riparian habitat distribution and suitability, and consequently carrying capacity for flycatchers, the conclusions of the population viability analysis and their applicability to actual flycatcher population dynamics should be viewed with caution until several aspects of flycatcher life history are better understood. Primary among these are the extent to which flycatchers actually function as metapopulations and the degree to which the model used to study flycatchers accurately captured dispersal behavior, endeavors that will require systematic tracking of color-banded individuals to quantify rates and patterns of movement between populations. Also needed are data on long-term persistence of small populations, as well as information on the composition and turnover of breeding populations, age-specific survival and dispersal probabilities, within- and between-season movement of breeding birds, and the dependence upon large populations as a source of colonizers.

While the persistence capabilities of small flycatcher populations are currently unknown, the persistence of California's three largest populations has been high, at least to the extent ascertainable from historical records. The Kern, upper San Luis Rey, and Santa Margarita river sites were among the few willow flycatcher populations known in the early 1980s when concerns over the flycatcher's future in California peaked (Serena 1982, Unitt 1987, Harris et al. 1988). The overall growth of the state's flycatcher population between the early 1980s and the mid-1990s was largely attributable to growth of each of these three core populations, coinciding with changes in land management at each site including the removal of grazing and the introduction of cowbird control programs. However, most of this growth occurred within a few years of the change in management, and none of the three populations show evidence of substantial continued growth since the mid-1990s. In fact, the Kern River population, formerly the largest in California, declined to an all-time low of 11 pairs in 2001, possibility the result of declining egg hatchability (Whitfield 2002). Particularly perplexing is the failure of the Santa Margarita population at Marine Corps Base Camp Pendleton to grow beyond the average of 15 territories reported by L. Salata (in Unitt 1987) in the mid-1980s, despite an abundance of apparently suitable habitat and annual trapping of cowbirds, which allowed the local Least Bell's Vireo population to increase from 15 to over 1000 territories during the same period (Salata 1980, Griffith Wildlife Biology 2001).

The apparent stability of the California population, particularly when viewed from the perspective of species recovery, raises the question of what currently limits flycatcher abundance and distribution. The answer to this will define what can realistically be expected in the future and help shape strategies for achieving flycatch-

er recovery. Most investigations of factors limiting populations, particularly populations of endangered species, focus on demographic factors and habitat availability. Studies of willow flycatcher nest success and productivity at the three large populations in California reveal a high degree of temporal and spatial variability in both parameters, and a general lack of correspondence among populations in trends of these variables. This suggests that flycatchers are influenced less by large-scale events and processes occurring rangewide than by localized site-specific factors. Such site-specificity in the factors influencing flycatcher populations will require corresponding specificity in tailoring management plans appropriate to particular populations.

The high degree of variability in productivity at the California sites is of interest with regard to the role of cowbird parasitism in limiting flycatcher populations. Although all three sites are subject to cowbird control, tremendous variability in productivity still exists, both within and among sites. Although reducing parasitism rates through cowbird control has been shown to increase flycatcher productivity at the Kern River (Whitfield et al. 1999b), none of the three populations has exhibited sustained growth over the one to two decades that they have been managed for cowbirds. This suggests that while cowbird parasitism may at one time have reduced the growth of these populations, other factors are currently limiting them. While cowbird control may have prevented local extinctions and allowed populations to stabilize, perhaps even grow, it no longer is sufficient as recovery-oriented management, and should be augmented or replaced by other strategies to facilitate population growth as they become identified.

Because extensive habitat loss and degradation throughout the flycatcher's range was responsible for the species' initial decline (Unitt 1987, Schlorff 1990), it is reasonable to hypothesize that habitat availability continues to limit populations, particularly where populations have increased and then stabilized. Management to enhance productivity will remain effective only as long as sufficient suitable habitat is available for occupation. Our evaluation of riparian condition in southern California indicates that the landscape available to willow flycatchers, indeed to all riparian species, is highly disturbed, calling into question just how much suitable habitat exists. A variety of land use practices and human activities, as well as the spread of invasive plants, have altered the condition of the majority of riparian woodlands to an extent that their current suitability for flycatchers is unknown. Some types of disturbance are clearly detrimental, such as those that result in removal or fragmentation of native habitat, interfere with seedling recruitment, alter stream geomorphology and hydrology, and elevate levels of predation, parasitism, or other threats such as fire. Other forms of disturbance are less clear in their effects on flycatchers. For example, the presence of tamarisk, an invasive exotic species, does not necessarily deter flycatchers from breeding (S. Sferra, unpubl. data). Agricultural and urban runoff systems often create hydrologic conditions favorable to flycatchers that would not otherwise exist. In fact, nearly half of the California sites occupied by flycatchers in 1999–2001 are dependent upon supplemental flows produced by agricultural and urban runoff, effluent outflow, or river regulation (e.g., canals, dams, reservoirs) for maintenance of existing habitat conditions (U.S. Fish and Wildlife Service 2001). Thus, while our findings indicate a level of habitat disturbance worthy of concern, the nature and magnitude of the effect of this disturbance on flycatcher habitat suitability is complex and remains to be quantified.

What are the future prospects for Southwestern Willow Flycatchers in California? We suggest that the future will depend on our ability to understand and manage the processes maintaining existing populations, as well as the conditions necessary for growth and expansion. This will require that we move beyond studies of nesting success and productivity to address other aspects of flycatcher demography, in particular, dispersal and survival. We must also expand our current focus to include small populations, in which nearly half of the state's flycatcher population resides. Moving research in these directions will allow us to improve our understanding of population structure and the processes responsible for population persistence, as well as to seek other factors influencing and currently limiting population growth. An improved understanding of the dynamics of small populations and their contribution to overall flycatcher persistence will aid in evaluating management options and allocating recovery effort. In addition, it is essential that we refine our knowledge of flycatcher habitat requirements through more detailed and experimental investigations of the conditions that render sites suitable for flycatchers. Quantitative modeling such as that undertaken for Willow Flycatcher habitat in northern California (C. Stermer, unpubl. data) holds promise for improving our ability to identify and protect existing suitable habitat as well as to create additional habitat through restoration and alleviation of stressors. Settlement patterns of dispersing flycatchers provide an opportunity to test predictions of such models, and to refine hypotheses regarding the critical components of

habitat suitability. We suggest that these research needs provide a high priority context for flycatcher studies during the next decade, for it is only through such efforts that we can expect to develop effective management to secure the flycatcher's existence into the future.

ACKNOWLEDGMENTS

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APPENDIX. Numbers and Locations of Southwestern Willow Flycatchers in California, 1999–2001

Location	Number of Territories			Source
	1999	2000	2001	
Kern County:				
Kern River	24	25	21	Whitfield et al. 1999a, Whitfield and Lynn 2001, Whitfield 2002
Inyo County:				
Owen's Valley	>12	—[a]	24	M. Whitfield, unpubl. data; B. Kus and M. Whitfield, unpubl. data
3 km W of Lone Pine	2	—		R. McKernan, unpubl. data
7 km S of Big Pine	2	—		R. McKernan, unpubl. data
Santa Barbara County:				
Santa Ynez River:				
Gardner Ranch	—	4	4	J. Greaves, unpubl. data; M. Holmgren, unpubl. data
Buellton–Yvonne	10[b]	>18[b]	—	Greaves et al. 1999; Farmer et al. 2001, *this volume*
Santa Rosa Park	—	4	—	Farmer et al. 2001
Vandenberg	3	1	1	Farmer et al. 2001, *this volume*
Upper Piru Creek	0	0	4	J. Uyehara, unpubl. data
Ventura County:				
Santa Clara River	3	3	3	Z. Labinger and J. Greaves, unpubl. data
Los Angeles County:				
San Francisquito Creek	—	—	3	J. Berkeley, unpubl. data
Soledad Canyon	—	—	2	J. Berkeley, unpubl. data
San Gabriel River	—	—	1	BonTerra 2001
Santa Clara River	—	—	2	BonTerra 2001
San Bernardino County:				
Day Canyon	1	1	1	R. McKernan, unpubl. data
Mojave Forks	1	2	2	R. McKernan, unpubl. data
Waterman Creek	1	1	0	R. McKernan, unpubl. data
San Timoteo Creek	3	2	2	Crook 1999, SAWA 2000; R. McKernan, unpubl. data
Oak Glenn	—	—	3	R. McKernan, unpubl. data
Mountain Home Village	3	4	4	R. McKernan, unpubl. data
Greenspot Thicket	—	1	1	R. McKernan, unpubl. data
Forest Falls	—	3	2	R. McKernan, unpubl. data
Jenks Meadow	1	2	3	R. McKernan, unpubl. data
Sand Creek	1	1	1	R. McKernan, unpubl. data
Rattlesnake Creek	1	1	1	R. McKernan, unpubl. data
Metcalf Creek	—	—	1	S. Myers, unpubl. data
Bear Creek	—	2	3	R. McKernan, unpubl. data
Cienega Seca	1	1	—	R. McKernan, unpubl. data
Little Bear Springs	1	1	4	R. McKernan, unpubl. data
Headgate Rock	1	—	—	R. McKernan, unpubl. data
Strawberry Creek	—	—	—	D. Guthrie, unpubl. data
Deer Creek	—	—	2	R. McKernan, unpubl. data
Van Dusen Canyon	—	—	2	R. McKernan, unpubl. data
Banning Canyon	—	—	1	R. McKernan, unpubl. data
S.R. 38 bridge (Mill Creek)	—	1	—	J. Konecny, unpubl. data
Mojave River	6	6	5	M. Crook, unpubl. data; S. Lawrey, unpubl. data
Santa Ana River (lowlands)	2	0	0	R. McKernan, unpubl. data; S. Lawrey, unpubl. data
San Bernardino/Riverside County				
Prado Basin (Santa Ana River)	5	5	7	Pike et al. 1999, 2000, 2002
Riverside County:				
Big Hole Slough	1	1	—	R. McKernan and G. Braden, unpubl. data

APPENDIX. CONTINUED

Location	Number of Territories 1999	2000	2001	Source
Orange County:				
Laguna Lakes	1	0[c]	—	R. Erickson, unpubl. data
Canada Gobernadora	1	1	1	P. Bloom, unpubl. data
San Diego County:				
Santa Margarita River (Camp Pendleton)	18	17	18	Griffith Wildlife Biology 2000, Kus 2001, Kus and Ferree 2002
Fallbrook Creek (Camp Pendleton)	0	1	1	Griffith Wildlife Biology 2000, Kus 2001, Kus and Ferree 2002
Pilgrin Creek	1	0	0	Kus et al. 2000, 2001; Kus and Peterson 2002
San Luis Rey River:				
Upper	46	47	50	Kus et al. 1999; Varanus Biological Services 2000d, 2001; W. Haas, unpubl. data
Pala	—	2	1	Varanus Biological Services 2000b; W. Haas, unpubl. data
Couser Canyon	2	2	2	J. Wells, unpubl. data; J. Konecny, unpubl. data; B. Kus, unpubl. data
I15-College Avenue	0	1	2	B. Kus, unpubl. data
College Avenue–I5	0	3	2	Wells and Turnbull 2000; B. Kus, unpubl. data
Macario Canyon	1	0	0	Varanus Biological Services 2000c; W. Haas, unpubl. data
Aqua Caliente Creek	—	2	0	W. Haas, unpubl. data
San Dieguito River	2	3	2	B. Kus and P. Beck, unpubl. data; W. Haas, unpubl. data
San Diego River (El Capitan)	—	—	2	B. Kus, unpubl. data
Sweetwater River	1	0	0	Sweetwater Authority 2000, 2001, 2002
Agua Tibia Creek	—	—	1	K. Weaver, unpubl. data
San Felipe Creek	4	3	2	Varanus Biological Services 2000a; W. Haas, unpubl. data
William Heise Park (Cedar Creek)	—	—	1	J. Barth, unpubl. data
Imperial County:				
Gila Confluence North	1	1	—	R. McKernan and G. Braden, unpubl. data
TOTALS	163	174[d]	194[d]	

[a] No data.
[b] Survey effort varied between years.
[c] Partial survey or not a focused Willow Flycatcher survey.
[d] Not all sites surveyed in each year.

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DISTRIBUTION, ABUNDANCE, AND HABITAT CHARACTERISTICS OF SOUTHWESTERN WILLOW FLYCATCHERS (*EMPIDONAX TRAILLII EXTIMUS*) IN ARIZONA, 1993–2000

CHARLES E. PARADZICK AND APRIL A. WOODWARD

Abstract. To determine the distribution and abundance of Southwestern Willow Flycatchers (*Empidonax traillii extimus*) in Arizona, personnel from many federal, state, tribal, and private entities conducted presence/absence surveys yearly, from 1993–2000. To aid recovery efforts for this endangered species, we synthesized the results of these surveys to provide a comprehensive estimate of Southwestern Willow Flycatcher distribution and abundance in Arizona. Surveys were conducted along 1279 km of riparian habitat in 17 drainages. Surveyors documented flycatchers within 16 geographical locations below 1500 m and one location above 2200 m in elevation. Below 1500 m, flycatchers occupied riparian forests dominated by mixtures of willow (*Salix* sp.) and tamarisk (*Tamarix* sp.) with median height 8.5 m (range 3–24 m). Above 2200 m, breeding sites consisted of Geyer willow (*Salix geyeriana*) patches with median height 4 m (range 3.5–4 m). Estimated number of territories increased from 32 in 1993 to 328 in 2000; this increase was largely the result of increased survey effort. Two locations (Roosevelt Lake and Gila/San Pedro River confluence) contained 71% of the known population. Historically, Southwestern Willow Flycatchers occurred along most major river drainages in Arizona. We compared current (1993–2000) distribution with historical records and found that flycatchers recently occurred in nine historic locations and were absent at four. Southwestern Willow Flycatchers in Arizona constitute one third of the range-wide population and this synthesis identifies extant populations where protection is needed, as well as future research needs.

Key Words: abundance, Arizona, distribution, *Empidonax traillii extimus*, endangered species, Southwestern Willow Flycatcher.

The central portion of the Southwestern Willow Flycatcher's (*Empidonax traillii extimus*) breeding range occurs in Arizona. Historical records indicate that flycatchers once bred along the Colorado, Gila, Little Colorado, San Francisco, Santa Cruz, San Pedro, and Verde rivers (Phillips et al. 1964, Unitt 1987). Phillips (1948) was one of the first to express concern over diminishing numbers of flycatchers in the state, and by the mid-1980s Unitt (1987) described its distribution as a few isolated groups. In 1995, the Southwestern Willow Flycatcher was listed as federally endangered (U.S. Fish and Wildlife Service 1995) and the U.S. Fish and Wildlife Service (USFWS) listed probable factors contributing to population declines as loss, alteration, and fragmentation of native riparian breeding habitat; loss of wintering habitat; nest predation; and brood parasitism by Brown-headed Cowbirds (*Molothrus ater*).

In 1993, prompted by concern for the declining population, the Arizona Game and Fish Department (AGFD) and Arizona Partners in Flight initiated statewide flycatcher surveys. These surveys intensified when the flycatcher was listed as endangered and are conducted yearly. Survey results are synthesized and reported annually as an AGFD technical report (see Paradzick et al. 2001) that is distributed regionally to agencies, private organizations, and the public as a basis for management recommendations.

Synthesizing and reporting survey results on an annual basis provides a snapshot of flycatcher distribution that, when combined across several years, allows us to build a more comprehensive picture of Southwestern Willow Flycatcher distribution and abundance in Arizona. Thus, we synthesized survey work conducted by multiple agencies and hundreds of individuals between 1993–2000. Our goal was to provide an estimate of flycatcher distribution and abundance in Arizona, as well as describe habitat characteristics, to aide recovery efforts for this endangered species. This synthesis not only gives a current picture of flycatcher distribution but also allows for an assessment of changes in distribution.

METHODS

SURVEY EFFORT AND TECHNIQUES

Numerous federal, state, and tribal agencies, as well as private organizations and volunteers, conducted surveys for Southwestern Willow Flycatchers in Arizona from 1993–2000. Surveys were performed within riparian habitat along major rivers and tributaries. Survey sites were selected in two ways: (1) personnel from natural resource agencies and private organizations voluntarily selected sites on public, tribal, or private lands (with landowner permission) that contained potentially suitable flycatcher breeding habitat; and, (2) public or private entities were required to survey specific sites through Section 7 consultation with USFWS. Definitions for what constituted a site were not standardized and consequently varied; however, in

most cases it referred to a discrete patch or multiple patches of habitat considered a manageable survey unit by the surveyor.

Survey objectives were to: (1) determine presence/absence of Southwestern Willow Flycatchers at a site; (2) estimate number of flycatcher territories; and, (3) provide a general habitat description. All surveyors were required to obtain federal endangered species permits, attend a training workshop conducted by AGFD, U.S. Geological Service, U.S. Bureau of Reclamation, and USFWS, and submit survey results to AGFD. This workshop included a natural history review of the Southwestern Willow Flycatcher, explanation of the survey protocol developed by Tibbitts et al. (1994) and later revised by Sogge et al. (1997a), instructions for completing forms and reporting data, and a field experience to familiarize participants with flycatcher identification, vocalizations, and breeding habitat.

The survey protocol (Tibbitts et al. 1994, Sogge et al. 1997a) requires a minimum of three surveys using tape-playback of the Southwestern Willow Flycatcher primary song to elicit vocalizations. At least one survey is required within each of three periods: 15 May–31 May, 1 June–21 June, and 22 June–10 July; consecutive surveys must be at least six days apart. Survey results were reported to AGFD on standardized forms that included location data, effort (survey hours), estimated number of adult flycatchers, territories, and pairs, breeding evidence, presence or recent sign of cattle, and presence/absence of cowbirds. Surveyors were also required to submit a 7.5-minute topographical map identifying the area surveyed.

Distribution and Abundance Data Synthesis

We considered Southwestern Willow Flycatchers to be breeding season residents when detected at a site between 22 June–25 July, or if breeding behavior was documented; birds detected solely outside those dates, and for which no breeding behavior was observed, were considered migrants. We report distribution as the number of sites occupied with breeding season residents. Luff et al. (2000) found that Southwestern Willow Flycatchers move more frequently between sites ≤30 km apart than those separated by greater distances; thus, we grouped occupied sites within 30 km into geographical locations.

Abundance estimates are given in terms of the number of territorial flycatchers detected; we defined a territorial flycatcher as a breeding season resident male defending an area within a site. However, the Southwestern Willow Flycatcher is a facultative polygynous species (Ford 1983) and at a few sites polygyny was as high as 50% (see Davidson and Allison *this volume*). Counting only male territories would under represent abundance; therefore, we considered a polygynous male with two females as two separate territories. Survey effort varied among surveyors and years; thus, abundance estimates should be considered the minimum number of territories present.

To compare recent (1993–2000) and historical breeding areas, we mapped pre-1990 distribution (per Phillips 1948, Phillips et al. 1964, Unitt 1987, Brown 1988) and overlaid recent survey results. We designated 16 historic locations, of which three were not recently surveyed: Fort Mohave, Fort Apache, and the Santa Cruz River near Tucson. Historical and recently occupied sites within approximately 30 km were considered the same location. We could not compare abundance estimates because most historical accounts did not include number of territories.

TABLE 1. Number of Sites, Hours, and Kilometers Surveyed for Southwestern Willow Flycatchers in Arizona, Listed by Drainage, 1993–2000

Drainage	Sites	Hours	Kilometers
Agua Fria River	17	77	34
Black River	6	71	9
Big Sandy River	9	447	25
Blue River	4	43	11
Bill Williams River	9	1,673	38
Colorado River	141	6,238	254
Gila River	112	4,814	268
Hassayampa River	9	293	46
Little Colorado River	48	989	124
Salt River	28	1,231	83
Santa Cruz River	18	238	46
San Francisco River	7	167	21
Santa Maria River	9	333	29
San Pedro River	47	3,592	175
Tonto Creek	12	873	33
Verde River	62	816	78
Virgin River	9	278	5
Total	547	22,172	1,279

Habitat

Surveyors classified site vegetation into five general types (per Sogge et al. 1997a): (1) monotypic high-elevation Geyer willow; (2) monotypic exotic tamarisk; (3) native broadleaf; (4) mixed native/exotic broadleaf (mostly native); and, (5) mixed native/exotic broadleaf (mostly exotic tamarisk). Surveyors also listed the three most common riparian plant species, visually estimated mean height of vegetation and distance to surface water or saturated soil, and recorded landownership information. We used data from the last year flycatchers were present at the site to summarize habitat and landownership information.

RESULTS

Survey Effort

Surveyors conducted 22,172 hrs of Southwestern Willow Flycatcher surveys at 547 sites from 1993–2000 (Table 1; Fig. 1), covering 1279 km of riparian habitat in 17 drainages. Survey site elevation ranged from 30 m near Yuma along the Colorado River to 2800 m in the White Mountains. The majority of sites (446) surveyed were below 1200 m, 69 were between 1200–2200 m, and 32 were above 2200 m. Mean site length was 1.6 km (range = 0.1–24 km). Two hundred thirty-nine sites were surveyed in only one year, while 16 were surveyed all eight years. Survey effort increased

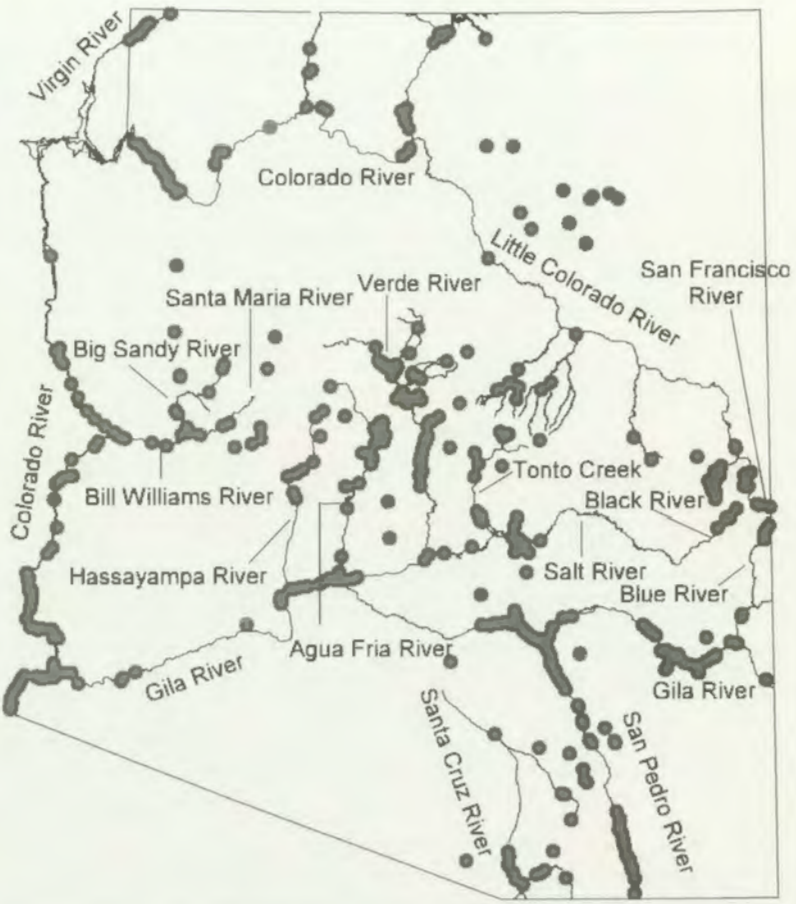

FIGURE 1. Southwestern Willow Flycatcher survey sites in Arizona, 1993–2000.

annually from 1993–1999, then decreased in 2000 (Fig. 2). Much of the increase in survey effort was focused along the lower Colorado River, Gila/San Pedro River confluence, and Roosevelt Lake, as a result of the Lake Mead (USFWS 1997) and Roosevelt Lake (USFWS 1996) Biological Opinions. These three areas accounted for over 65% of the statewide survey effort in 2000. Most sites surveyed were on federal (58%), private (20%), or tribal (8%) lands; the remainder (14%) were divided among county, municipal, and state lands.

Distribution and Abundance

Surveyors detected resident Southwestern Willow Flycatchers at 92 sites (Fig. 3) along 12 drainages. We grouped the 92 occupied sites into 17 geographical locations within the state (Table 2). Despite numerous surveys, no resident flycatchers were detected on the Agua Fria, Black, Blue, Santa Cruz, and Virgin rivers. Eighty-nine occupied sites were located below 1200 m elevation, zero between 1600–2200 m, and three above 2200 m.

The number of occupied sites increased from 1995–1997, corresponding to increased survey effort (Fig. 2); however, number of occupied sites remained relatively constant after 1997. The steepest increase occurred at the Gila/San Pedro River confluence, from two sites in 1993 to 21 in 1999. This increase was primarily due to expanded local survey effort.

Not all occupied sites had resident flycatchers throughout the study period. For example, only 47 of the 92 occupied sites were occupied in 2000 (five of the sites not surveyed in 2000 had resident birds when last surveyed). From 1993–2000, Southwestern Willow Flycatchers colonized 38 sites, abandoned 39, and were sporadically detected at eight. Colonization of sites was greatest at Lake Mead Delta, Gila/San Pedro River confluence, Roosevelt Lake, and Ehrenburg—Yuma locations, which had 10, six, six, and five colonizations, respectively. These lo-

FIGURE 2. Number of Southwestern Willow Flycatcher survey hours and number of sites occupied by Southwestern Willow Flycatchers in Arizona, 1993–2000.

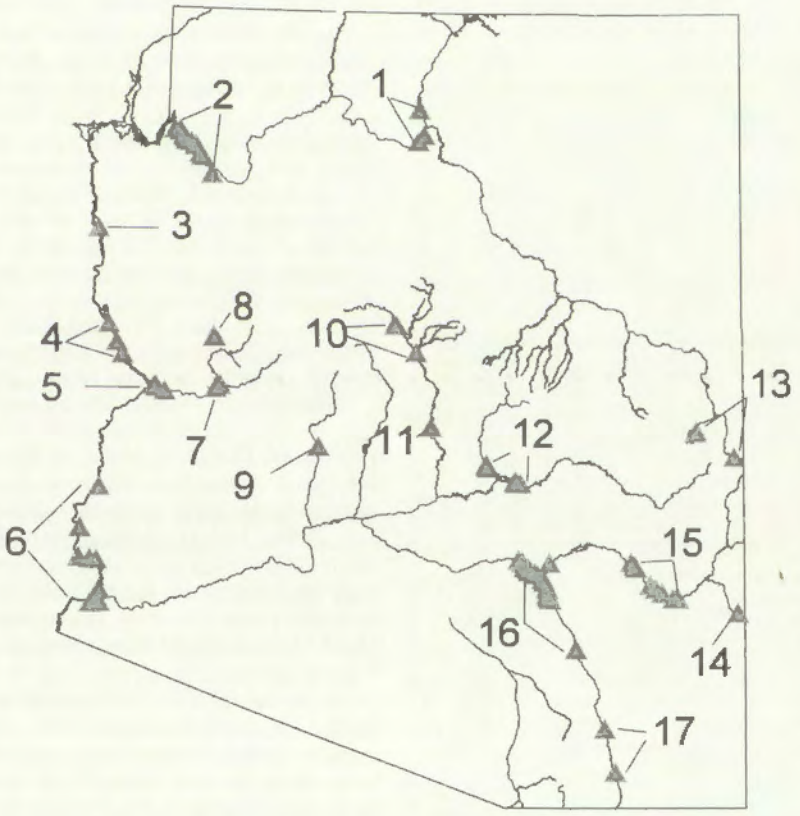

FIGURE 3. Survey sites/locations where resident Southwestern Willow Flycatchers were documented between 1993–2000 in Arizona. Location numbers correspond to locations listed in Table 2.

TABLE 2. SOUTHWESTERN WILLOW FLYCATCHER DISTRIBUTION AND TERRITORY ESTIMATES IN ARIZONA, 1993–2000

Map No.	Location	Occupied sites, estimated number of territories per year							
		1993	1994	1995	1996	1997	1998	1999	2000
1	Grand Canyon	2, 2	2, 5	2, 4	1, 3	1, 2	1, 1	1, 1	1, 1
2	Lake Mead Delta	1, 1		1, 1	1, 10	2, 8	8, 15	5, 11	5, 8
3	Lake Mohave				0, 0		0, 0	0, 0	1, 3
4	Topock Marsh	0, 0	0, 0	1, 2	2, 4	2, 13	1, 14	1, 15	1, 15
5	Bill Williams River Delta	0, 0	1, 1	1, 1	1, 1	0, 0	2, 2	1, 1	1, 1
6	Ehrenburg–Yuma	0, 0	0, 0	0, 0	7, 9	1, 1	0, 0	1, 2	0, 0
7	Alamo Lake	0, 0	2, 5	1, 4	2, 9	3, 10	3, 12	3, 23	3, 24
8	Rt. 93 Bridge		1, 1			1, 1			2, 16
9	Hassayampa River Preserve	0, 0	0, 0		0, 0	1, 1	1, 3	1, 2	0, 0
10	Camp Verde	1, 1	1, 7	1, 2	2, 8	1, 10	1, 7	1, 6	1, 5
11	Horseshoe Lake	1, 1	0, 0			1, 2	0, 0	0, 0	0, 0
12	Roosevelt Lake	2, 5	2, 33	2, 21	2, 38	2, 39	2, 48	5, 76	8, 115
13	White Mountains	2, 10	2, 10	2, 13	3, 14	3, 9	3, 10	3, 8	3, 5
14	Duncan						1, 2	1, 4	1, 1
15	Ft. Thomas—San Jose	1, 1	0, 0	1, 2	3, 8	4, 17	5, 12	2, 6	1, 15
16	Gila/San Pedro River	2, 11	4, 45	3, 32	6, 37	18, 76	18, 94	21, 134	19, 119
17	Upper San Pedro River				1, 2	1, 1	0, 0	0, 0	0, 0
Total		12, 32	15, 107	15, 82	31, 143	41, 190	46, 220	46, 289	47, 328

Notes: Map numbers correspond to Fig. 3. Blank fields indicate no surveys conducted.

cations, with the exception of Roosevelt Lake, also had the highest rate of abandonment: eight within both Ehrenburg—Yuma and Lake Mead Delta, and seven within Gila/San Pedro River confluence. No sites were abandoned at Roosevelt Lake. Resident Southwestern Willow Flycatchers were not detected in Ehrenburg—Yuma until 1996, when surveyors documented seven sites with resident birds; however, surveyors reported only one occupied site in 1997 and 1999, and no resident flycatchers were documented in 2000. Flycatchers were also absent from three other locations: Hassayampa River Preserve, Horseshoe Lake, and Upper San Pedro River during the most recent surveys. The reasons why flycatchers abandoned sites were not always obvious, but human-caused extirpation occurred, or was suspected, within three locations: Lake Mead was allowed to inundate 445 ha of delta habitat, causing tree fall and flycatcher nest loss (Marshall 2000, McKernan and Braden 2001); bridge construction destroyed habitat at Ft. Thomas—San Jose (Marshall 2000); and a 1996 fire within Gila/San Pedro River confluence destroyed occupied habitat (Paxton et al. 1996).

TABLE 3. SOUTHWESTERN WILLOW FLYCATCHER SURVEY RESULTS (1993–2000) AT HISTORIC LOCATIONS IN ARIZONA

Historic Location	Resident flycatchers detected
Grand Canyon	Yes
Pasture Canyon	No
Fort Mohave Indian Reservation	NA[a]
Bill Williams River Delta	Yes
Ehrenburg–Yuma	Yes
Big Sandy River Rt. 93 Bridge	Yes
Camp Verde	Yes
Middle Verde River	No
Fort Apache Indian Reservation	NA[a]
Black River	No
White Mountains	Yes
Blue River	No
Fort Thomas–San Jose	Yes
San Pedro/Gila River Confluence	Yes
Upper San Pedro River	Yes
Santa Cruz River: Tucson	NA[a]

Notes: Historic sites from Phillips (1948), Phillips et al. (1964), Unitt (1987), and Brown (1988).

[a] NA indicates that recent surveys were not conducted.

Southwestern Willow Flycatchers occurred at nine of 13 historic locations surveyed from 1993–2000 (Table 3); however, flycatchers were not found during the most recent survey at two of these locations (Ehrenburg—Yuma and Upper San Pedro River). Southwestern Willow Flycatchers occurred in eight locations where no prior record existed: Alamo Lake, Duncan, Hassayampa River Preserve, Horseshoe Lake, Lake Mead Delta, Lake Mohave, Roosevelt Lake, and Topock Marsh.

Territories documented statewide increased from 32 in 1993 to 328 in 2000 (Table 2). The most dramatic increase occurred at Roosevelt Lake and Gila/San Pedro River confluence; territory estimates at these two locations increased from 16 in 1993 to 234 in 2000, and accounted for 71% of the population in Arizona (35% and

TABLE 4. AVERAGE CANOPY HEIGHT AND DISTANCE TO WATER FOR SOUTHWESTERN WILLOW FLYCATCHER OCCUPIED SITES IN ARIZONA, 1993–2000

Habitat type	Canopy height (m)			Distance to water (m)		
	N	Median	Range	N	Median	Range
High-elevation						
Monotypic Geyer willow	3	4	3.5–4	3	1	0–50
Low-elevation						
Native broadleaf	8	7.5	4–24	10	0	0
Mixed native/exotic broadleaf (mostly native)	28	10	3.7–17	30	0	0–200
Mixed native/exotic broadleaf (mostly exotic tamarisk)	33	8	3–16	41	0	0–500
Monotypic exotic tamarisk	8	6.5	4–9	8	1	0–15
Total low-elevation	77	8.5	3–24	89	0	0–500

Notes: Average height and distance measurements were visually estimated for each occupied site. Data reported are from the most recent year that the site was occupied. N values may differ from text because not all surveyors reported habitat data for occupied sites.

36%, respectively). Territory estimates from all other Arizona sites increased from 16 to 94 during the same period. In 2000, six locations had 10–25 territories, seven locations had <10, and four locations had no territories. Increased survey effort accounted for most of the territory increases, except at Roosevelt Lake. Survey effort and area were consistent at Roosevelt Lake from 1998–2000; thus, the increase of 67 territories reflects a population increase.

Because confirming breeding activity was not a primary objective during most surveys, surveyors devoted variable amounts of effort to locating nests; therefore, some sites received more thorough nest search coverage than others. Surveyors documented nesting evidence at 13 of the 17 locations; nesting was not documented at Ehrenburg—Yuma, Horseshoe Lake, Lake Mohave, and Rt. 93 Bridge. Low survey effort at Horseshoe Lake and Rt. 93 Bridge may account for the lack of nest documentation, but breeding activity was not suspected at Lake Mohave. Although intensive surveys were conducted in Ehrenburg—Yuma, no active nests were documented.

HABITAT

Southwestern Willow Flycatchers occupied habitat within two major biotic community divisions (*sensu* Minckley and Brown 1994): high-elevation occupied sites (>2200 m elevation) within arctic-boreal wetland communities, and lower elevation sites (<1600 m) within Sonoran riparian deciduous forest communities. The three occupied high-elevation sites were predominantly monotypic Geyer willow patches, with mountain alder (*Alnus tenuifolia*) reported as a sub-dominant species at one site. Within Sonoran deciduous forests, habitat was more heterogeneous. Surveyors classified vegetation at 41 occupied sites as mixed broadleaf/exotic (mostly tamarisk), 30 as mixed broadleaf/exotic (mostly native), ten as native broadleaf, and eight as monotypic tamarisk. Willow was reported at 84 of the 89 low-elevation sites and tamarisk at 78. Fremont cottonwood (*Populus fremontii*) was reported less frequently at occupied sites (46); mesquite (*Prosopis* sp.), seepwillow (*Baccharis salicifolia*), buttonbush (*Cephalanthus occidentalis*), and boxelder (*Acer negundo*) were minor components of occupied habitat reported at 11, seven, two, and one site, respectively.

Canopy height was taller at low-elevation occupied sites, while the median distance to water was similar for all habitats types (Table 4). Surveyors reported seven occupied sites >50 m from water. However, six of these were located within reservoir deltas where fluctuating stream flows and lake levels may have lead to intermittent surface water closer than 50 m during the breeding season.

Surveyors reported Brown-headed Cowbirds at 88 occupied sites. Evidence of cattle was reported at 47 of 79 occupied sites where data were available. Southwestern Willow Flycatchers occurred predominantly on federal (50% of occupied sites and 57% of territories) and private lands (32% of occupied sites and 33% of territories). The remaining sites and territories were divided among county, municipal, state, and tribal lands.

DISCUSSION

Arizona has the most comprehensive statewide Southwestern Willow Flycatcher survey synthesis within the subspecies range. Cooperation among surveyors, data sharing, and adequate levels of funding made this synthesis possible. This level of effort allowed us to not only delineate occupied flycatcher habitat for conservation purposes, but also identify unoccupied areas and riparian habitat that require surveys. Arizona is located centrally in the subspecies

range, has the greatest number of occupied sites, and contains approximately one third of all territories (Sogge et al. *this volume*). Furthermore, the Gila/San Pedro River confluence and Roosevelt Lake comprise the second and third largest populations, respectively. However, with an entire population of about 1000 territories (Sogge et al. *this volume*), the Southwestern Willow Flycatcher remains endangered and in critical need of protection. This emphasizes the importance of conserving Arizona's population for recovery of the subspecies.

The status of Arizona's Southwestern Willow Flycatcher populations is linked to the extent to which we can protect and conserve relatively dense stands of riparian vegetation. Throughout the Southwest, such riparian habitat has been affected by over a century of poor land management practices, and up to 90% of riparian habitat in Arizona has been degraded (Governor's Riparian Habitat Task Force 1990). Prior to the 1880s, riparian habitats along low-elevation rivers and streams were wetter than at present (Minckley and Brown 1994). Subsequent river channelization, impoundment and diversion, groundwater withdrawal (Stromberg 1993), and excessive livestock grazing (Belsky et al. 1999a) have limited regeneration of native riparian plant species. The resulting riparian habitat loss has restricted flycatchers to isolated patches of habitat within a few locations in the state.

The extent to which Southwestern Willow Flycatcher populations in the state have declined is unknown. Historical distribution data are scarce (see Phillips 1948, Phillips et al. 1964, Unitt 1987, Brown 1988, Periman and Kelly 2000) and territory abundance records are nonexistent. However, anecdotal reports indicate that the species was locally common along drainages and in locations where they have been extirpated. Southwestern Willow Flycatchers are absent or severely reduced within four areas of the state. The most precipitous decline in distribution occurred along the lower Colorado River (near Yuma) and on the Santa Cruz River, where breeding has not been recorded since the early 1900s (Hunter et al. 1987; T. Huels, unpubl. data). Similarly, distribution of flycatchers at high-elevation locations (White Mountains, and Black and Blue rivers) has been reduced and is cause for concern, especially since recent surveys indicate declining populations at occupied sites.

Within the last seven years occupied habitat within three locations has been destroyed (Marshall 2000). Additionally, inundation of all currently occupied habitat at Roosevelt Lake is expected to occur (USFWS 1996). Few data are available to discern how this loss will affect the Arizona and range-wide population. Under natural conditions, riparian habitat in the Southwest is both spatially and temporally dynamic. Movement data (Luff et al. 2000) and surveys (i.e., site colonization and abandonment rates) suggest that flycatchers are adapted to dynamic conditions and move frequently between local sites, especially in response to development of new habitat. In 1993, floodwaters on the San Pedro River scoured much of the main channel vegetation suitable for flycatcher breeding (T. McCarthey, pers. comm.). However, habitat persisted in small areas on the edges of the floodplain near seeps and irrigation outflow zones. In recent years, flycatchers moved from these edge areas to riparian vegetation that reestablished in the main channel. A similar pattern occurred at Roosevelt Lake, where flycatchers dispersed from one large, older patch to younger vegetation that established following receding water levels. Areas outside frequent flood scouring and inundation zones may act as refuge habitat. These areas, which may or may not be currently occupied, could be critical for localized persistence and dispersal following a disturbance event, like the inundation of Roosevelt Lake. Demographic research is needed to elucidate population growth rates (sink/source relationships) and the linkages between local sites and locations.

Human-caused modification of riparian ecosystems has also contributed to the dynamic nature of flycatcher habitat. In Arizona, exotic tamarisk has become widespread in many drainages including the Colorado (Hunter et al. 1988), Gila, Salt (Graf 1982), and San Pedro rivers (Stromberg 1998). Although flycatchers historically nested in willow and other native vegetation (Phillips et al. 1964, Unitt 1987, Rosenberg et al. 1991), tamarisk now occurs at almost all occupied sites within Arizona and is frequently used as a nesting substrate (90% of 1220 flycatcher nests found 1993–2000 were placed in tamarisk; AGFD, unpubl. data). This is in contrast to other states where native-dominated sites and nesting substrates predominate (Sogge and Marshall 2000).

Whether native- or tamarisk-dominated, flycatchers occupy patches close to water with relatively dense canopy cover and understory. This precludes the flycatcher from shrub-dominated patches with low canopy cover, as well as gallery forests with little understory. Furthermore, recent landscape-level analysis of Southwestern Willow Flycatcher habitat at Alamo Lake, Roosevelt Lake, and Gila/San Pedro River confluence found that floodplain width and the amount and variation of dense vegetation were correlated with flycatcher presence (AGFD, unpubl.

data). The lack of occupied sites between 1600 and 2200 m elevation reflects topographical limitations for development of suitable riparian vegetation, because the cooler climate, steep canyons, and frequency of scouring floods in Arizona's mid-elevations often restrict habitat into narrow linear bands of vegetation often dominated by sycamore (*Platanus wrightii*) with little understory. The creation and persistence of suitable riparian vegetation is linked to local and landscape-scale environmental conditions (e.g., topography, hydrology, flow regimes, and soil conditions) and more research is needed to understand these connections.

Populations of Southwestern Willow Flycatchers in Arizona are in critical need of protection. Distribution surveys indicate two large flycatcher concentrations (one under threat of being lost) and 11 smaller populations scattered throughout the state. With over half of territories occurring on public lands, much could be done to protect and enhance breeding habitat. However, significant areas of riparian habitat have not been surveyed in Arizona and may contain unidentified populations of Southwestern Willow Flycatchers; this is especially true for private and tribal lands, both of which are in need of more survey effort. This emphasizes the need to develop partnerships to enhance riparian areas and allow access and data sharing. Finally, long-term persistence of Southwestern Willow Flycatchers in Arizona is tenuous without addressing the ultimate causes for riparian ecosystem degradation (e.g., modified flow regimes, groundwater withdrawal, and urbanization). Recovery will require cooperative planning that includes federal, state, local, and tribal governments, as well as private landowners and organizations to protect and restore flycatcher breeding habitat.

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THE DISTRIBUTION AND ABUNDANCE OF SOUTHWESTERN WILLOW FLYCATCHERS ON THE LOWER SANTA YNEZ RIVER, CALIFORNIA

CHRIS FARMER, STEPHEN I. ROTHSTEIN, AND MARK A. HOLMGREN

Abstract. We examined the distribution and abundance of Southwestern Willow Flycatchers (*Empidonax traillii extimus*) on the lower Santa Ynez River, California, from 1995–2000. The lower Santa Ynez River population is one of the largest remaining populations in California, and the northernmost coastal one. We detected from 8–39 territorial flycatchers each year, using a wide range of riparian habitats. There was a slight increase in the population from 1998 to 2000. We detected 17 nests and 39 total reproductive events. Six nests produced fledglings or independent juveniles (35%), four were depredated (24%), and seven were abandoned (41%); two abandoned nests were parasitized by Brown-headed Cowbirds (*Molothrus ater*).

Key Words: Brown-headed Cowbirds; *Empidonax traillii extimus;* habitat impacts; *Molothrus ater;* reproductive success; Santa Ynez River; Southwestern Willow Flycatcher; Vandenberg Air Force Base.

The Southwestern Willow Flycatcher (*Empidonax traillii extimus*) is a small, federally endangered, neotropical migrant (U.S. Fish and Wildlife Service [USFWS] 1995). It breeds in southern California, Arizona, New Mexico, southwestern Colorado, the extreme southern portions of Nevada and Utah, and possibly western Texas (Unitt 1987, USFWS 2001). There were approximately 900 confirmed territories, and an overall estimate of 1100–1200 territories across the entire subspecies' range in 1999 (USFWS 2001). Although the current range of the flycatcher is not much different than its historical range, habitat loss and other factors have dramatically reduced its abundance, and led to its listing as an endangered species (USFWS 1995, Marshall 2000).

The largest Southwestern Willow Flycatcher populations in California occur along the Kern, San Luis Rey, Santa Margarita, and the Santa Ynez rivers (Marshall 2000, USFWS 2001, Kus et al. *this volume*). The Kern River, Kern County, population has decreased from 44 territories in 1989 to 23 in 1999 (Whitfield et al. 1999a), and only 12–13 pairs remained in 2000 (M. Whitfield, unpubl. data). The population along the San Luis Rey River, San Diego County, has increased from 12 territories in the late 1980s to over 40 in 1999. This coincided with expanded survey efforts and improvements in the riparian habitat, primarily due to reduced grazing (Kus et al. 1999; W. Haas, unpubl. data). The flycatchers along the Santa Margarita River, San Diego County, have had a relatively constant population of 24 territories (or less) for the last twenty years (USFWS 2001).

Our study focused on the lower Santa Ynez River, the remaining large California population, from 1995–2000. The first modern surveys of the Santa Ynez River targeting flycatchers found a small population in the Buellton region in 1986 (Lehman 1994; Fig. 1). Lehman and Holmgren continued to survey the lower Santa Ynez opportunistically until our more extensive studies began in 1995. This earlier work (Table 1) indicated the occurrence of a stable, moderate sized population near Buellton, a small population on Vandenberg Air Force Base, and sporadic occurrences in the Lompoc and Santa Rosa areas (Table 1; Fig. 1). However the majority of the river from Buellton to the Pacific Ocean was not surveyed from 1986–1994.

Vandenberg Air Force Base (VAFB) initiated this study to determine the distribution, abundance, and reproductive success of the Southwestern Willow Flycatcher on-base. The flycatcher's high mobility and metapopulation structure, combined with the ephemeral nature of suitable on-base habitats, meant that the only way to fully understand the status of their population on VAFB was to determine the regional distribution and abundance of flycatchers in parts of the Santa Ynez River upstream from the base. We also sought to determine flycatcher reproductive success.

METHODS

Study Region

VAFB supports large, contiguous areas of native habitats and vegetation that were once much more common in the region (Schmalzer et al. 1988, Ferren and Collins 1999), including riparian forests and palustrine marshes that are preferred Willow Flycatcher habitats (Sogge and Marshall 2000). We surveyed the five perennial watersheds and all wetlands with emergent vegetation on VAFB. The dominant riparian vegetation on-base consists of arroyo willow (*Salix lasiolepis*), red willow (*Salix laevigata*), and black cottonwood (*Populus trichocarpa*), with an understory of blackberry (*Rubus ursinus*), poison oak (*Toxicoden-*

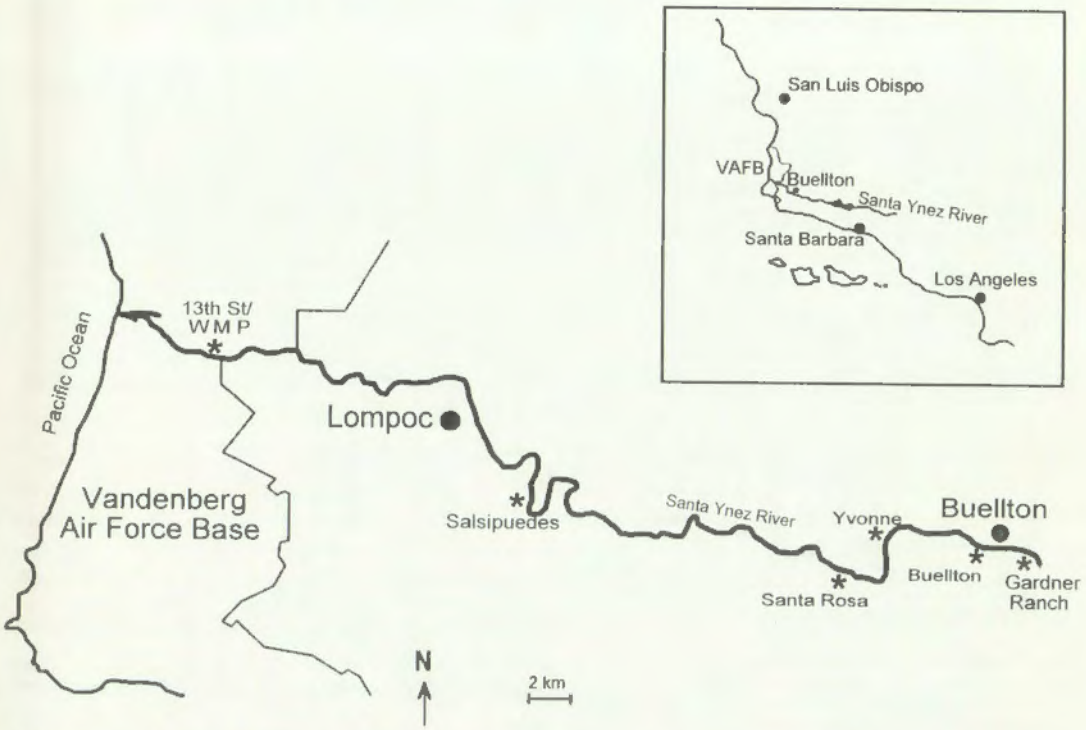

FIGURE 1. General locations of Southwestern Willow Flycatcher sub-populations along the lower Santa Ynez River, 1995–2000. The six sub-populations are indicated by an asterisk (*).

TABLE 1. THE NUMBER OF SOUTHWESTERN WILLOW FLYCATCHERS DETECTED AT SIX SITES ALONG THE LOWER SANTA YNEZ RIVER, 1986–2000[a]

Year	Lower Santa Ynez River[b]	13th St/ WMP	Santa Rosa	Buellton	Yvonne	Salsipuedes	Gardner Ranch	TOTAL
1986	5–6							5–6
1987	4							4
1988	4							4
1989	—							—
1990	1							1
1991	15							15
1992	12	4						16
1993	13							13
1994	9	2	16					27
1995		2 (1)[c]	0	6–7		0		8–9
1996		5–6 (2)	9–11 (3–4)	7 (3)	11–15 (5)	1		33–39
1997		3 (1)	6 (1)	5 (3[d])	12–14 (4)	0		26–28
1998		5 (2)	2 (1)	13–15 (6)	2 (1)	0		21–23
1999		3		12–14 (4)	1	0		17–19
2000		1	6 (2)	16–17	2	0	3–4	28–30

Notes: Survey effort and area varied among years. Site locations are shown in Fig. 1.

[a] Additional data from Lehman (1994, pers. obs.) and Holmgren (1995, pers. obs.).

[b] The precise location along the river was not specified in these years.

[c] The number of confirmed pairs at each site is shown in parentheses.

[d] There was definitive evidence of successful reproduction in three distinct territories; so although only five birds were observed, it was assumed that there were three pairs.

dron diversilobum), stinging nettles (*Urtica dioica*), and mulefat (*Baccharis salicifolia*; Farmer 1998).

Only the Santa Ynez River contains significant off-base riparian habitat. We surveyed the river from the Pacific Ocean to 62 km upstream (3 km east of Buellton, Santa Barbara County; Fig. 1). We focused our off-base field effort on sites known to have flycatchers from the previous years' work, but other parts of the river were also surveyed. Most of this region is private land, which made obtaining access for surveys difficult, particularly in 2000. Because of the access difficulty, field personnel conducted surveys from the river channel, so population estimates for these sites in 2000 should be viewed as minimum estimates.

The off-base riparian forest tends to be more heterogeneous and drier than on VAFB, with the amount of water highly variable among years and locations. Arroyo willow and red willow are the primary forest components, but boxelder (*Acer negundo*), black walnut (*Juglans californica*), black cottonwood, western sycamore (*Platanus racemosa*), and eucalyptus (*Eucalyptus* spp.) are also present. The understory is composed of blackberry, poison oak, stinging nettles, coyote bush (*Baccharis pilularis*), black mustard (*Brassica nigra*), western water hemlock (*Cicuta douglasii*), and fennel (*Foeniculum vulgare*).

Field Surveys

Due to annual differences in project funding and objectives, our field effort varied greatly from 1995–2000. We conducted a pilot study in 1995 that focused on eight different species on VAFB, with only limited surveys off-base (Holmgren and Collins 1995, Farmer et al. 2001). In 1996, we inventoried all riparian and palustrine systems on the lower Santa Ynez River and other VAFB drainages in order to locate all flycatchers and determine the suitability of the riparian habitat along the entire river course. During 1997, we monitored the productivity of breeding flycatchers through repeated field surveys at sites where flycatchers where found in 1995 and 1996. In 1998, we concentrated on determining reproductive productivity and habitat associations, and so focused on areas known to have had flycatchers in the past. During 1999, we monitored for flycatcher occurrence and breeding only on VAFB. In 2000, we intensively surveyed all regions along the river where flycatchers had been previously detected, monitored breeding status when possible, and surveyed the majority of the remaining river once. Overall, a complete survey of the entire 62 km lower river was only performed in 1996, thereby precluding quantitative comparisons and analyses among years.

We conducted field surveys by walking through riparian habitat, usually along the bank or in the waterway. We broadcast Southwestern Willow Flycatcher vocalizations approximately every 50 m to detect individuals, and discontinued the playback once flycatchers were detected, except in special circumstances (e.g., trying to detect paired individuals or nesting locations). In 1995–1997, we visited some sites of known or suspected occupation only once. After 1997 we surveyed all targeted sites once during each of three protocol periods: 15–31 May, 1–21 June, and 22 June–10 July (per Sogge et al. 1997a). All surveys were separated by at least five days, and were conducted between dawn to 09:00 PST. In 2000, we surveyed until 17 July per USFWS (2000). We employed standard nest finding techniques and precautions to locate the nest once we detected a pair of flycatchers (Martin and Geupel 1993, Ralph et al. 1993).

Other Data Sources

In addition to our surveys, we obtained data from several additional projects including: (1) a 1995–1996 study of the Santa Ynez River estuary and palustrine habitats on VAFB (Holmgren and Collins 1999); (2) a 1995–1998 study of Brown-headed Cowbirds (*Molothrus ater*; Farmer 1998, 1999a); (3) a 1997 study of VAFB riparian breeding bird communities (Gallo et al. 2000); and (4) a 2000 avian census of the lower Santa Ynez River for the United States Bureau of Reclamation (D. Compton, unpubl. data).

RESULTS

We detected from 8–39 flycatchers along the lower Santa Ynez River (Table 1), distributed among six sites along the lower river (Fig. 1): Gardner Ranch, Buellton, Yvonne, Santa Rosa, Salsipuedes, and 13th St./Waterfowl Management Ponds (WMP). Because of our wide variation in survey effort, it is impossible to statistically analyze changes in the overall regional flycatcher population.

We detected 17 nests in the egg-laying stage and 49 total reproductive events from 1995–2000 (Table 2). Of the 17 nests discovered at, or before, egg-laying and followed to completion, 35% were successful, 24% were depredated, and 41% were abandoned. The rate of cowbird parasitism was 12%.

Breeding sites were primarily a red willow-cottonwood canopy, with scattered sycamores. The understory was usually a mixture of stinging nettle, poison oak, coyote bush, blackberry, black mustard, western water hemlock, and young red and arroyo willows. The understory ranged from nearly impenetrable vegetation to bare dirt. It is difficult to reach specific conclusions about the flycatcher's preferred habitat along the lower river because of variation among and within the six sites, as well as changing conditions across the six years of the study. Breeding habitat ranged from highly degraded areas with only scattered willows and cottonwoods (e.g., Santa Rosa site) to sites with more dense and complex canopy and understory (e.g., Salsipuedes site). Some nests were located directly over the flowing river (e.g., Yvonne), while other nests were up to 700 m removed from the river's flow, (although they were within 50 m of standing water, e.g., 13th St/WMP). Despite intensive survey effort, breeding flycatchers were not found at numerous apparently suitable sites in extensive tracts of riparian forest with what visually appeared to be a denser can-

TABLE 2. SUMMARY OF SOUTHWESTERN WILLOW FLYCATCHER REPRODUCTIVE EVENTS ON THE LOWER SANTA YNEZ RVER, 1995–2000

Outcome	All events[a]	(%)	Egg-laying[b]	(%)
Successful events				
Independent juveniles	12	(30.8)	5	(29.4)
Fledgings	8	(20.5)	1	(5.9)
Depredated/destroyed	8	(20.5)	4	(23.5)
Cowbird fledglings (no flycatcher chicks)	2	(5.1)	—	(—)
Abandoned				
Without cowbird eggs	7	(17.5)	5	(29.4)
With cowbird eggs	2	(5.1)	2	(11.8)
Total[c]	39		17	

[a] All events detected 1995–2000.
[b] Only those reproductive events detected at, or before, the egg-laying stage.
[c] 10 events with unknown outcome are not included in the total, including one parasitized nest.

opy, subcanopy, and shrub layers and more mesic conditions than occupied sites.

DISCUSSION

The Southwestern Willow Flycatcher appears to be distributed as a series of metapopulations with high dispersal among the regional populations, which are in turn composed of smaller sub-populations (Busch et al. 2000, Marshall 2000, Stoleson et al. 2000b). Because metapopulations rely upon multiple smaller populations for long-term existence, each population and its component sub-populations contribute to the stability of the entire subspecies. As part of one of the largest regional populations in California, the lower Santa Ynez River flycatchers may play an important role in regional metapopulation dynamics and stability of the taxon. However, given the apparent low nest success rate, this region could also be a sink for flycatchers. Further study is needed to determine how the lower Santa Ynez River population contributes to the overall subspecies' persistence.

Another aspect of metapopulation ecology is that each population can serve as a "stepping stone", allowing movement among the remaining populations. The loss of any population may further isolate the remaining ones and could disrupt regional and subspecies-wide stability (Marshall 2000). Even if a sink population, the Santa Ynez River flycatchers could still function as a crucial "stepping-stone" in the possible colonization of the widespread coastal riparian habitat to the north.

REPRODUCTIVE EFFORT

We detected flycatchers dispersed over a large area of the lower Santa Ynez River, making monitoring of the regional reproductive success difficult, and off-base data collection more opportunistic. The Santa Ynez flycatcher nest success rate of 35% is slightly low for a small, cup-nesting passerine, which generally ranges from 38–70%, with a median of 52% (Martin 1993). It is also in the lower half of values (16–66%) reported for Willow Flycatchers elsewhere in the Southwest (Harris 1991, Griffith and Griffith 1995, Skaggs 1996, Sferra et al. 1997). The nest predation rate for this population (24%) was in the lower range of those reported in other flycatcher populations (14–60%; Stoleson et al. 2000b), and also lower than other open-cup nesting passerines (30–60%; Marshall and Stoleson 2000). The relatively low rate of cowbird parasitism (12%) is below that of many other flycatcher populations studied in Arizona (3–48%), California (29–66%), and New Mexico (18–40%; Whitfield and Sogge 1999), including the Kern River where there was an active cowbird trapping program (Whitfield et al. 1999b). The low parasitism rate may be related to the paucity of cowbirds in this region (Farmer 1999a,b).

The greatest source of nest failure was desertion of unparasitized nests (29%; Table 2). McCabe (1991), working on a different subspecies, found a substantially lower rate of nest failures due to desertion of unparasitized nests (8%; 16/193 nests). The desertion rate of parasitized nests (12%) along the lower Santa Ynez River is much lower than the 35–57% desertion rate of parasitized nests in other flycatcher populations (Sedgwick and Knopf 1988, Harris 1991, Paradzick et al. 1999, Stoleson and Finch 1999a). Although Sedgwick and Iko (1999) found no clear survivorship cost to adults or eventual young from desertion of parasitized nests, the high overall desertion rate for nests along the Santa Ynez River could explain the low overall nest success rate for this flycatcher population.

Habitat Preferences

Historically, flycatchers likely nested in heterogeneous riparian forests, using willows, buttonbush (*Ceanothus occidentalis*), and mulefat (Grinnell and Miller 1944, Unitt 1987). Flycatchers still nest in native vegetation where available, but they also commonly breed in saltcedar (*Tamarix* spp.) and Russian olive (*Elaeagnus angustifolia*)—two highly successful exotic species (Sogge and Marshall 2000). We detected flycatchers primarily using willow-cottonwood habitats, and at some sites sycamore, boxelder, black walnut, and elderberry.

We are unclear as to the reasons for the flycatcher's current pattern of local habitat usage. As an endangered subspecies, the Southwestern Willow Flycatcher is unlikely to have a large enough population to fill all potential suitable habitat. However, flycatchers do not appear to be selecting only the "best" breeding habitat. There are numerous unoccupied sites in the region that appear more suitable for flycatcher breeding, and that more closely resemble the mesic habitat typical in other regions of the bird's range (Sogge and Marshall 2000). If the definition of suitable habitat were expanded to include such dry and open sites as the occupied 13th/WMP and Santa Rosa sites, then the majority of habitat along all drainages in this region could be considered suitable. There may be some subtle vegetative or landscape factors that make the occupied sites favored over the rest of the unoccupied riparian habitat. Additionally, flycatchers may display strong site fidelity, which would result in the continued occupation of sites that have been degraded over time. A more quantitative comparison of occupied versus unoccupied sites is necessary to elucidate the factors influencing the current use of sites, which would enable proactive management to encourage an increase in the flycatcher population in this region. Understanding the factors underlying flycatcher distribution in the Central Coast of California may also prove important in maximizing the chances of a region-wide increase in the Southwestern Willow Flycatcher.

Large-scale Population Impacts

The flycatchers have likely been negatively impacted by habitat loss and degradation through factors such as flood control activities, overdrafting of ground water, conversion of riparian habitat to human use, and cattle grazing. Three dams along the Santa Ynez River have significantly altered the natural flow of water in the river, reducing the flooding and scouring necessary for riparian regeneration (Middleton 1999, Periman and Kelly 2000, USFWS 2001). Overdrafting of groundwater along the river further exacerbates the lack of regeneration (Briggs 1996, USFWS 2001). Though hard to quantify, overdrafting affects large amounts of riparian habitat in the area (Holmgren 1995, Farmer et al. 2001). Currently, California landowners have "the correlative right to extract as much groundwater as they can put to beneficial use" (California Department of Water Resources 1996: 1). This right has been further defined and restricted in some areas of the state, but this has not occurred on the Santa Ynez River (California Department of Water Resources 1996).

Potentially suitable habitat for flycatchers along the river has been destroyed and degraded by the conversion of riparian forest to agriculture and suburbs, and subsequent increased water use. These uses also fragment the habitat, disrupting potential movement corridors and increasing the proportion of edge and concomitant nest predation risk (Freemark et al. 1995, Robinson et al. 1995b, Donovan et al. 1997). We observed such fragmentation occurring in the region, including bulldozing previously occupied flycatcher habitat adjacent to the Buellton site in 1996, 1999, and 2000. These actions removed some of the native willows, altered the runoff through construction of berms, increased the sediment load and changed the hydrology of the river, eliminating water flow in channels previously used by flycatchers (M. Holmgren, pers. obs.).

Grazing has a similar suite of effects as agriculture, but with additional negative impacts such as compaction of soil, reducing infiltration, and increasing runoff (Kauffman and Krueger 1984, Belsky et al. 1999b). Cattle also cause direct habitat degradation through breaking the vegetation and churning up the soil. On VAFB some sites with apparently suitable overstories of willows and cottonwoods have understories that have been heavily damaged by cattle (Farmer et al. 2001).

The impact of exotic vegetation in the region is minor so far, but both giant reed (*Arundo donax*) and saltcedar are present on the lower Santa Ynez River (Holmgren 1995, Rothstein et al. 1999). Both are well represented on the upper stretches of the river, above 107 km east of the Pacific Ocean, so the lower river is constantly being subjected to propagules. These species have explosive growth potential (Bell 1997, Everitt 1998, USFWS 2001), and so could be a larger problem in the future.

Regional planning for housing or other hardscaped developments seldom incorporates an assessment of actions that directly or indirectly affect flycatchers. This problem is exacerbated by the Buellton General Plan's incorrect statement

that, "There are no rare or endangered wildlife species identified in the Buellton area" (Buellton Planning Department 1993: 110). Continued conversion of a large portion of upland to asphalt and concrete will likely cause significant impacts to the hydrology of the river (and subsequently to flycatchers).

By degrading or destroying the habitat, the above factors may limit potential flycatcher population growth and range expansion. They are large-scale, landscape factors that occurred prior to the initiation of this study, so it is difficult to determine the extent of their influence upon the riparian habitat and flycatchers. They are also indirect, occurring over a temporal and spatial scale that prevents short term population surveys from elucidating their influence. Further research on the lower Santa Ynez River is necessary to determine the regional impact of these factors.

Statewide Monitoring

California is the only state without a coordinated Southwestern Willow Flycatcher monitoring program (Marshall 2000, USFWS 2001). The lower Santa Ynez River flycatcher population is probably the third largest in the state, but the lack of local and state-wide surveys makes it difficult to compare among California populations. It is also difficult to determine any overall trends because of variation in field effort and study emphasis among localities, including the Santa Ynez River. A comprehensive state plan would aid all parties by encouraging monitoring and management of the subspecies throughout Southern California, not just local populations. Additional, more rigorous and standardized study of the lower Santa Ynez River flycatcher population will help in more completely understanding the factors limiting this bird's range and numbers. Our work, focused on VAFB, could direct only limited field effort to the other, larger sub-populations off-base where more research is clearly needed. Further neglect of one of the larger California populations can only hinder recovery efforts for this subspecies.

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DISTRIBUTION AND HABITAT CHARACTERISTICS OF THE WILLOW FLYCATCHER (*EMPIDONAX TRAILLII*) IN ALBERTA

BRYAN KULBA AND W. BRUCE MCGILLIVRAY

Abstract. The status of the Willow Flycatcher (*Empidonax traillii*) has been poorly known in Alberta due to a scarcity of documented records. We surveyed for Willow Flycatchers between May 25 and July 15 of 1999 in southwestern Alberta. The census area was determined from published historical records, specimen evidence from the Provincial Museum of Alberta, and recent datasets, particularly from Atlas of Breeding Birds of Alberta. When territorial males were found, we took a series of 26 measurements to quantify habitat and determine the risk that habitat loss may pose for the species. We found 32 habitat patches containing territorial males with an average of two singing birds per patch. Willow Flycatchers were restricted to the Foothills and Rocky Mountains regions ranging from Waterton Lakes National Park north to Jasper National Park. In Alberta, Willow Flycatchers showed a preference for wet riparian areas, many of which also supported Alder Flycatchers (*Empidonax alnorum*). We could determine no obvious reason why the range of Willow Flycatchers should be so restricted in Alberta, nor any evidence of significant range change compared to historical records.

Key Words: Alberta; distribution; *Empidonax traillii;* habitat characteristics; Willow Flycatcher.

The Willow Flycatcher (*Empidonax traillii*) and the Alder Flycatcher (*E. alnorum*) breed in sympatry and allopatry within Alberta (Semenchuk 1992). The Alder Flycatcher is common in central Alberta and the southern boreal forest (McGillivray and Semenchuk 1998) and is classed as a "green" species (Alberta Wildlife Management Division 1996), indicating that populations are stable and its habitat is not at risk. The Willow Flycatcher, however, is listed "Status Undetermined" (Alberta Wildlife Management Division 1996) due to the lack of information on its distribution and abundance. The specimen-based evidence for the presence of this species in Alberta is limited to a few individuals in the Provincial Museum of Alberta (PMA) collection. Holroyd and Van Tighem (1983) recorded the Willow Flycatcher as a fairly common summer resident in mountain parks. Throughout the five census years of the Breeding Bird Atlas Project (1987–1991), only two confirmed Willow Flycatcher breeding records were reported (Semenchuk 1992). Atlas observations (no confirmation of breeding) were concentrated in the Bow River Valley from west of Calgary to Banff.

In the southwestern United States, *E. traillii extimus* is endangered due to a loss of riparian habitat, cattle grazing, and Brown-headed Cowbird (*Molothrus ater*) parasitism (USFWS 1995). In other areas such as Ontario, the Willow Flycatcher is thought to be expanding into habitat previously used by Alder Flycatchers (Prescott 1987), while in British Columbia (Campbell et al. 1997) and historically in Wisconsin (Robbins 1974) the opposite is true. Campbell et al. (1997) noted that both species are expanding their range south and east in British Columbia.

Habitat characteristics for the Willow Flycatcher and Alder Flycatcher vary throughout their ranges. In Ontario, the Willow Flycatcher is associated with drier, upland habitat and the Alder Flycatcher with wetter, low-lying areas (Barlow and McGillivray 1983), while elsewhere, such as British Columbia, Willow Flycatchers can be found in wet areas (Campbell et al. 1997).

To update the range and assess habitat characteristics of Willow Flycatchers in Alberta, we censused areas of suitable habitat and quantified the vegetative and physical aspects of occupied habitats.

MATERIALS AND METHODS

STUDY AREA

Based on previous records of Willow Flycatchers from the PMA collection, the Federation of Alberta Naturalists' Birdlist database (which includes the records from the Breeding Bird Atlas), and Pinel et al. (1993), we established a census route north from Waterton Lakes National Park to Jasper National Park then east from the British Columbia border to Cadomin, and south to Sundre. This area covered all the documented sightings of the Willow Flycatcher in Alberta along the Eastern Slopes. Given the large geographic area, census routes were restricted to roads, major trails, and surrounding areas a short hike from road access. We assume that some suitable areas for this species exist away from roads in the foothills and mountains and were not surveyed.

CENSUS

Censuses were conducted from 04:00 to 13:00 between 25 May and 4 July 1999. We censused all sites which had a previous Willow Flycatcher record, or appeared to have suitable habitat. We broadcast taped vocalizations recorded from the Peterson's Western Bird Songs CD from the edges of the habitat patches, to elicit vocal responses from territorial Willow Fly-

flycatchers unless males were already singing. If a habitat patch was large enough (> 200 m in length or width), we performed playback in several spots in the habitat to estimate the number of males on territories. We used intervals of 30 sec playing the tape and then 30 sec of silence. Depending on habitat size, playback would last 2–5 min. As Willow Flycatchers and Alder Flycatchers were sympatric throughout the census area, identification was confirmed only if a bird produced species-specific song. Once a bird responded to the playback, we obtained the latitude, longitude, and elevation using a Garmin GPS 12XL, and noted the number of Willow Flycatchers and a brief habitat description.

Habitat Measurement

At each site we detected Willow Flycatchers, we diagramed the site and then measured its dimensions using a Bushnell Yardage Pro 800 range finder. We recorded the following variables for each habitat patch: (1) the type of vegetation surrounding its edges; (2) presence of water (standing or moving); (3) size of the largest area of standing water (estimated by sight if small, or with the Bushnell range finder); (4) patchiness (the percentages of the habitat covered by willows or other shrubs, open grass and water); (5) relative frequency of willow heights (the percentages of willows <1 m tall, 1–2 m, and >2 m in height); (6) height of the tallest perch (to the closest m); and (7) the type (species and live vs. dead) and relative frequency of other perches on site.

We defined a perch site as a tree that was regularly observed to be used by the male for singing and foraging. To provide detailed measurements of habitats near each perch site, we quantified the vegetation along four transects running 5 m in each of the four cardinal directions. At 1-m intervals, we recorded the type of ground cover, shrub species present (or absent), and vegetation height. Vegetation categories were willow (*Salix* spp.), other deciduous bush, coniferous (*Picea* spp.), or bare ground (no reading). The height of the vegetation was measured to the nearest 10 cm using a 3-m long pole marked in 10-cm increments. Data were analyzed using Microsoft Excel 97 and SPSS 7.5.

RESULTS

The Willow Flycatcher was not uniformly distributed across its range in Alberta; rather, it was found in concentrated populations in riparian areas dominated by willows (Fig. 1). We located Willow Flycatcher territories in 32 habitat patches, with an average of two males singing per patch (range = 1–4). The elevational range of our detections, 1232 m to 1618 m (average 1391 m), suggested a foothills or montane distribution from Waterton Lakes National Park north to Jasper National Park, and eastward throughout the foothills to beyond the Ram River area in the north, and Sibbald Flats in the south. The Willow Flycatcher was most common in the Bow River Valley.

Habitat patches ranged from 2–50 ha in size (median 27.4 ha). The majority of patches were in undisturbed areas, but eight sites were in areas clearly modified by human activity such as railroad rights-of-way and campgrounds. Forty-four percent of the sites found were within parks and protected areas. All sites were in low-lying areas where water collects, such as valleys, on flats along lakes, or in ditches along roads. At least seven sites were in areas that were flooded due to beaver dams. All patches were bordered by forest on at least one side; 40% of patch edges were coniferous forest, 6% were deciduous and 23% were mixed. Where Willow Flycatchers were found in valleys and along lakes, the edges of the patch were not often clearly defined because suitable habitat continued along the valley bottom or along the lake edge.

Habitat patches consisted of dense stands of willows, other shrubs, scattered open grassy spots, a few to many trees, dead snags, and open water (Table 1). Over 80% of the willows in the patches were greater than 1 m in height (Table 1). We did not find breeding Willow Flycatchers in riparian areas dominated by short (<1 m) willows, nor in extensive tall willow stands on relatively dry upland sites (such as Chain Lakes Provincial Park south to Crowsnest Pass).

The majority (80%) of the habitat patches contained standing (56%) or moving (24%) water; the remainder were either bordered by, or within 100 m of, water. The median size of the largest open water within the patch was 0.15 ha (range = 0–1.5 ha).

All of the sites contained many exposed perches, some of which Willow Flycatchers used for song posts and foraging. The majority of sites had both dead and live perches. These perches were normally 2–5 m taller than the willow canopy (Fig. 2). The mean height of used perches was 7.5 ± 0.4 SE m. Although the vast majority of perches were spruce, other species such as willow, pine (*Pinus* spp.), aspen (*Populus tremuloides*) and balsam poplar (*Populus balsamifera*) were present (Table 1).

Vegetation, usually grass or sphagnum, was the predominant ground cover type recorded along the transects centered at the perches (Table 1). Thirty-two percent of the transect points recorded water as ground cover, despite the low percentage (17%) of the patches having areas of standing water (Table 1). In a wetter year, a larger percentage of the total area would be classed as standing water.

Willow bushes predominated along the transects (Table 1). Other bushes, primarily alder (*Alnus* spp.), birch (*Betula* spp.) and rose (*Rosa* spp.), were encountered at low frequencies. The average height of woody vegetation measured at the transect points was 207 ± 24 SE cm. All patches had open areas, even in the relatively

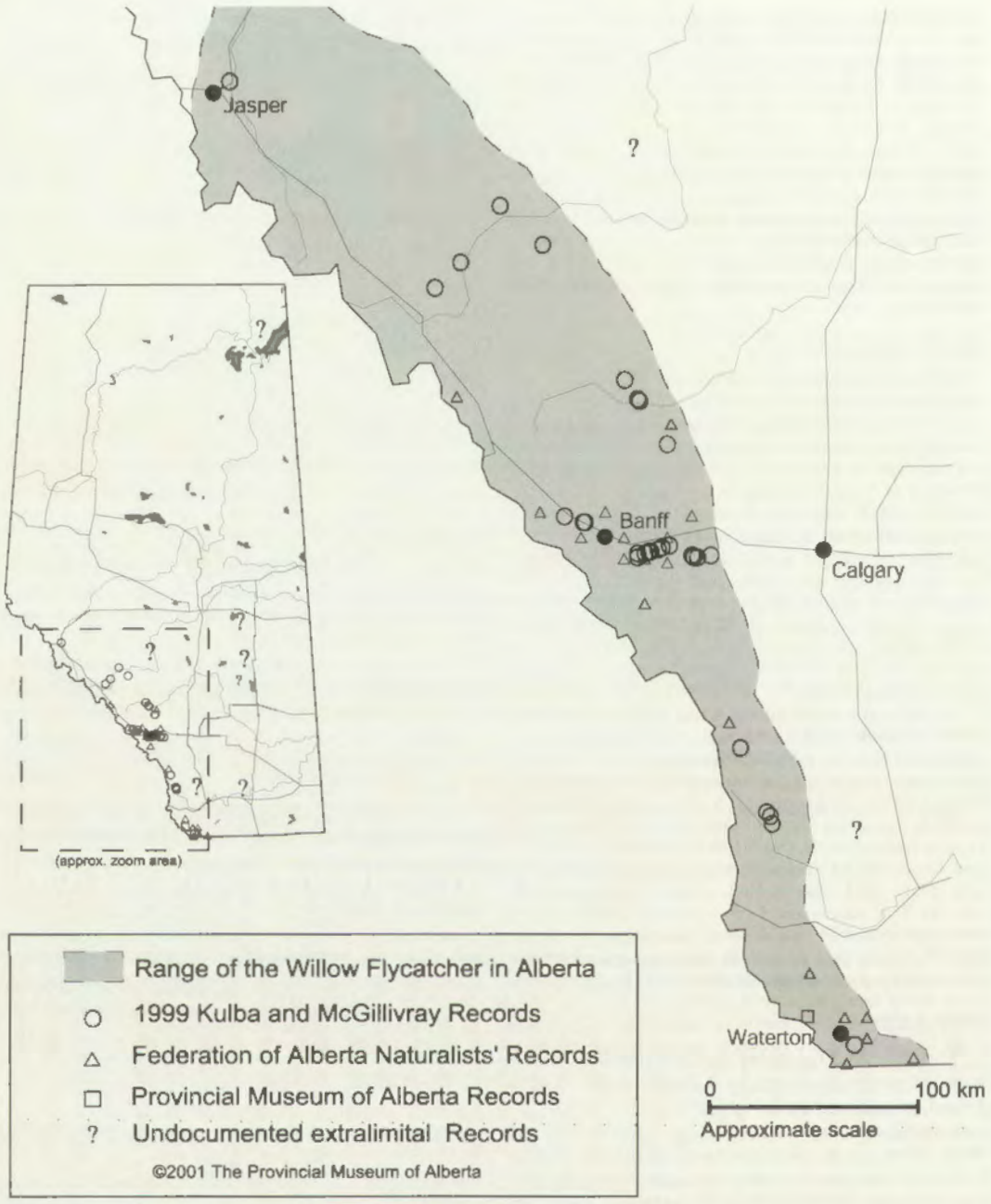

FIGURE 1. Willow Flycatcher distribution in Alberta.

dense vegetation near the perches; we recorded no woody vegetation at 20% of the transect points.

DISCUSSION

Earlier anecdotal observations described a range of Willow Flycatchers in Alberta (Salt and Salt 1976, Pinel et al. 1993) that is similar to what we documented. We located more Willow Flycatcher sites at the extremes (north and east) of the expected distribution, but that is not surprising when a survey is focused on a single species. In British Columbia, Campbell et al. (1997) noted that Willow Flycatchers have in-

TABLE 1. HABITAT PARAMETERS AT WILLOW FLYCATCHER BREEDING SITES IN ALBERTA

Parameter		Mean ± SE
Relative percent cover comprising occupied habitat	Willow	56 ± 5
	Forbs, open ground	25 ± 5
	Water	17 ± 3
Percent willow shrubs of different height classes in occupied habitat	<1 m high	17 ± 3
	1–2 m high	40 ± 3
	>2 m high	42 ± 5
Percent song and foraging perch types in occupied habitat (all sites combined)	Spruce	62 ± 8
	Willow	22 ± 0
	Pine	8 ± 5
	Aspen	4 ± 2
	Balsam popular	3 ± 2
Percentage of ground cover types along 5-m transects radiating from song and foraging perches	Vegetation	64 ± 8
	Water	32 ± 8
	Bare ground	5 ± 3
Habitat composition: percent hits along transects near song and foraging perches	Willow	62 ± 7
	Other deciduous bush	13 ± 0
	Conifers	7 ± 3
	Bare ground	18 ± 4

creased their range eastward, but points out that Alder Flycatchers have also expanded into former Willow Flycatcher range. *E. t. adastus*, the subspecies of Willow Flycatcher in Alberta, may have reached its northeastern limit in the Foothills and Rockies of Alberta.

In Alberta, Willow Flycatchers have been reported in both wet and dry shrub-dominated habitats (Semenchuk 1992, Pinel et al. 1993, McGillivray and Semenchuk 1998). We found Willow Flycatchers in the wet habitats normally typical of Alder Flycatchers (Semenchuk 1992,

FIGURE 2. Willow Flycatcher breeding habitat south of Highwood Pass, Kananaskis Country, Alberta (Elevation 1600 m).

McGillivray and Semenchuk 1998) and in some cases, the two species were found breeding sympatrically. Although Willow Flycatchers have been recorded in dry upland habitats, we found no evidence that those habitats supported any pairs.

The habitat characteristics we noted confirm open, wet, willow and spruce-dominated lowland as the breeding habitat for Willow Flycatchers in Alberta. It is noteworthy that sites with relatively short willow bushes did not support Willow Flycatchers. In Alberta, the range of the Willow Flycatcher is limited to the foothills and montane regions. We observed that Willow Flycatchers occur east of the main range of the Rockies but not out of the Foothills ecoregion (Fig. 1).

In addition to the relative wetness of the habitat sites, the abundance of coniferous perches scattered throughout most sites was striking (Fig. 2). These trees are evidence of sites recently or ephemerally flooded. The willow swales that support Alder Flycatchers in the Boreal Forest are more often on the edges of aspen stands, with the coniferous forest restricted to upland sites.

Because males arrive on site and begin singing before the females arrive (Sedgwick and Knopf 1992; B. Kulba, pers. obs.), males are responsible for breeding site selection. Sites with elevated perches, which are used for male display and territorial behavior, would likely be preferred. The majority of the sites we found had perching sites well above the canopy and within the habitat. At sites that did not have perches directly within the habitat, Willow Flycatchers used spruce, pine, or aspen on the periphery of the habitat.

In British Columbia, Willow Flycatchers are found largely in wet habitats (Van Tighem and Gyug 1983, Campbell et al. 1997), mirroring the habitat in which it is found in Alberta. The lack of wet willow habitat in the prairies of southern Alberta may present a barrier to eastward expansion.

We found Alder Flycatchers breeding sympatrically with Willow Flycatchers in many of the sites. In a number of foothills areas that looked similar to Willow Flycatcher sites, only Alder Flycatchers were recorded. Given this overlap in habitat characteristics of the two species, we would expect regular sightings of Willow Flycatchers in central and northern Alberta, where Alder Flycatchers are common. The lack of Willow Flycatcher records in these northern areas indicates that the environment is not suitable. Whether this is due to subtle habitat differences, the abundance of Alder Flycatchers, climate, or historical factors is unknown.

Although the Willow Flycatcher's range is limited to a narrow band in southwestern Alberta, it appears to have remained stable for 30 years. Loss of currently occupied habitat through cattle grazing and other human modification may not be of much concern in Alberta. Most of the sites were too moist and the willows too dense to be accessible for grazing, though some sites along the eastern edge of the range may be vulnerable. Other forms of human activity such as roads and rail-lines did not seem to hinder Willow Flycatchers from using nearby habitat. The wet willow lowlands favored by Willow Flycatchers are not suited to industrial or recreational development.

Fundamental research on the Willow Flycatcher in Alberta is lacking. Study of reproductive success and cowbird parasitism rates of Willow Flycatchers are needed to assess the population's stability in the province. Further censusing in northeastern BC and northwestern Alberta (north of the 53rd parallel) in the transition between the Rockies and the Boreal Forest would help clarify the northern limit of the species. Finally, the sympatric populations of Willow and Alder Flycatchers in Alberta present opportunities to quantify habitat preferences and their effect on productivity for these sibling species.

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WILLOW FLYCATCHER WINTER HABITAT IN EL SALVADOR, COSTA RICA, AND PANAMA: CHARACTERISTICS AND THREATS

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Abstract. The Willow Flycatcher (*Empidonax traillii*) spends more than half the year on wintering grounds from central Mexico to northern South America, yet there is little detailed information about Willow Flycatcher winter distribution and habitat use. We surveyed for wintering Willow Flycatchers in El Salvador, Costa Rica, and Panama during January and February of 1998–2000. Our objectives were to locate and describe occupied Willow Flycatcher winter habitat and identify possible threats to wintering flycatchers and their habitats. We detected 542 wintering Willow Flycatchers distributed among 28 survey locations. The majority of occupied winter Willow Flycatcher habitat was found along the Pacific lowlands below 250 m, and contained four main habitat components: standing or slow moving freshwater and/or saturated soil; patches and/or stringers of trees; woody shrubs; and open areas. Large and small-scale agricultural activities and/or cattle ranching were present near most occupied sites, resulting in a matrix of relatively small and fragmented patches of suitable wintering habitat within a larger agriculture-dominated landscape.

Key Words: Central America; distribution; *Empidonax traillii;* surveys; threats; Willow Flycatcher; winter habitat.

Sinopsis. El Mosquerito de Traill (*Empidonax traillii*) pasa la mitad del año en tierras invernales desde centro de México al norte de Sur América, sin embargo, hay pocas información detallada acerca de la distribución invernal del mosquerito de traill y del uso del habitat. Estuvimos estudiando Mosqueritos de Traill invernales en El Salvador, Costa Rica y Panamá durante enero y febrero de 1998–2000. Nuestros objetivos eran localizar y describir habitats invernales ocupados por mosqueritos de traill e identificar posibles amenazas a mosqueritos de traill y sus habitats. Detectamos 542 mosqueritos de traill invernales distribuidos entre 28 lugares de rastreo. La mayoría de habitats ocupados por Mosqueritos de Traill invernales se hallaron a lo largo de las tierras bajas a menos de 250 metros, y contenían cuatro componentes principales de habitat: agua fresca detenida o de lento correr y/o terreno saturado; manchas y/o filas de árboles; arbustos leñosos; y regiones abiertas. Cerca de la mayoría de lugares ocupados se encontraron actividades agrícolas en escalas grandes o pequeñas, dando así como resultado una matriz de manchas relativamente pequeñas y fragmentadas de habitat invernal adecuado dentro de un terreno dominado por una mayor actividad agrícola.

A nearctic-neotropical migrant, the Willow Flycatcher (*Empidonax traillii*) spends the majority of the year migrating and wintering in subtropical and tropical areas of the Pacific slope of central Mexico, Central America, and northern South America, where they have been reported in moist thickets, dry shrubby areas, and woodland borders in humid to semi-arid partially open areas (Meyer de Schauensee and Phelps 1978, Ridgely and Gwynne 1989, Stiles and Skutch 1989, Ridgely and Tudor 1994, Howell and Webb 1995, Unitt 1997, Edwards 1998). Stotz et al. (1996) associated Willow Flycatchers with tropical lowland evergreen and secondary forests and second-growth scrub along the Pacific Arid Slope and the Gulf-Caribbean Slope of Central America. Gorski (1969) found wintering Willow Flycatchers in Panama along transitional zones containing shrubs and open grassy areas, usually in close proximity to water. Rand and Traylor (1954) reported that flycatchers wintering in El Salvador used low perches in bushes and short trees within forested and thicketed areas. Most of the above descriptions do not differentiate between migration and wintering habitat, and some do not distinguish between Willow Flycatchers and Alder Flycatchers (*E. alnorum*), lumping the two as "Traill's Flycatcher." As a result, we know much less about Willow Flycatcher habitat use in winter than in the breeding season, where most studies to date have been focused.

Growing human populations and demands on natural resources throughout the tropics pose threats to the winter habitats of many neotropical migrants (Terborgh 1989), including the Willow Flycatcher. Although a topic of concern (Morse 1980, Holmes and Sherry 1992), the availability of wintering habitat, and the nature and extent of impacts and threats to that habitat, have received little research attention. Central America has experienced a long history of disturbance from various land use practices, and high rates of deforestation and growing human populations have caused dramatic changes to the Pacific lowlands, which comprise the majority of the winter range of the Willow Flycatcher. Although deforestation and slash-and-burn agriculture were practiced in some areas during pre-conquest periods (Katz 1972, Coates 1997), the arrival of the Spanish in the 1500s initiated larger-

scale changes through the introduction of intensive agricultural techniques and livestock. Even greater landscape changes, including some of the highest rates of deforestation worldwide, have occurred in the past 40–60 years in association with rapid human population growth (Jones 1990, Houghton et al. 1991, Hartshorn 1992).

Because habitat loss on winter ranges can influence some neotropical migrant populations (Terborgh 1989, Morton 1992, Rappole et al. 1992, Robbins et al. 1992), it is important to identify changes in land use patterns and their effects on winter habitat. This, coupled with a better understanding of Willow Flycatcher winter habitat characteristics and the landscape and human-use context in which that habitat occurs, can supply insight into possible limiting factors affecting flycatcher populations. To gather more detailed information on the distribution and status of winter Willow Flycatcher habitat and to identify potential threats to that habitat, we surveyed for wintering flycatchers in portions of Central America for three consecutive wintering periods. Our objectives were to locate and describe occupied flycatcher habitat, identify common habitat elements, and characterize potential threats to wintering flycatchers and their habitats.

METHODS

Study Area

We conducted surveys in El Salvador, Costa Rica, and Panama, primarily along Central America's Pacific lowlands, with some locations along the Caribbean coast and Canal Zone in Panama. Latitudes ranged from 13° 48′ N along the Rio Paz at the Guatemala and El Salvador border to 7°26′N at Tonosí along the Azuero Peninsula of Panama. Longitudes extended from 90°7′W in El Salvador to 77°43′W at El Real in the Darien region in Panama. Elevations ranged from sea level to 2000 m, with the majority of sites below 250 m. Annually, the Pacific lowlands experience two distinct seasons of roughly equal duration. *Invierno* (the rainy season) occurs from May/June until November/December, and *verano* (the dry season) extends from December/January until April/May. The Caribbean coast of Panama experiences a later and shorter dry season than does the Pacific slope, ranging from January to April.

Selection of Survey Locations

We selected locations at which to survey for wintering Willow Flycatchers based on museum specimen collection locations and dates (per Unitt 1997), reports in the literature, banding records, and recent observations by local bird enthusiasts and ornithologists. Due to the paucity of records along the Caribbean coast and central highlands, survey locations were concentrated along the Pacific lowlands. Within each location or general geographic area, we selected several specific sites (e.g., patches of habitat) and conducted one or more surveys at each site. Site selection was influenced by accessibility, and limited to sites readily accessible by roads, rivers, or other transportation corridors.

Habitat Surveyed

We surveyed a variety of habitat types including dry uplands with patches or stringers (narrow strips, typically only a few individuals wide) of trees and/or woody shrubs bordered by savannas, pasture land, and agricultural areas; *quebradas* (streams), rivers, and *esteros* (meandering oxbow waterways) bordered by gallery forests and woodlands comprised of patches or stringers of trees and woody shrubs; *lagunas* (intermittent freshwater wetlands) and seeps bordered by patches or stringers of trees and woody shrubs; seasonally inundated savannas and pasture land containing patches and/or stringers of trees and woody shrubs; *Parkinsonia* spp. dominated freshwater wetlands; reservoirs and sections of the Panama Canal; brackish tidal wetlands and mangroves; and lowland tropical deciduous and evergreen forest interior and edges.

Survey Technique

We conducted surveys during January and February of 1998–2000. Surveys were primarily performed between 0600–1000 hrs (N = 142) and 1600–1800 hrs (N = 12) when Willow Flycatcher activity and response to tape playback are greatest (Gorski 1969). At each site, we initially listened quietly (1–3 min) for spontaneous singing, then broadcast Willow Flycatcher vocalizations, using a hand-held tape player, at a volume similar to that of a naturally singing bird. The tape was played for 15–30 sec, followed by a 1–4 min listening period (in 2000, this was repeated twice at every broadcast point). Surveyors walked transects through or along the vegetation whenever possible and repeated the procedure every 20–40 m.

If a Willow Flycatcher was observed but did not respond with song to the tape playback, we stood quietly for up to 5 min before broadcasting a second tape. This tape included a variety of Willow Flycatcher *whits* and *creets/breets*, *wee-oos*, *churr/kitters*, and a set of interaction calls given by a mated pair of Willow Flycatchers. These calls were frequently effective in eliciting a *fitz-bew* song, thereby enabling surveyors to positively identify Willow Flycatchers. Sites were only considered Willow Flycatcher habitat if a *fitz-bew* vocalization was heard.

At each survey site, we recorded distance and direction to the nearest landmark, geographical coordinates (using hand-held GPS units), land ownership and management (if discernable), elevation, and length of each survey transect. We also recorded general habitat characteristics including distance to surface water and/or saturated soil, dominant tree and plant species, estimated canopy height, and topography. Genus and species of trees, shrubs, and herbaceous vegetation were noted when known. We recorded time and location of Willow Flycatcher detections; during 1998 and 1999 Costa Rica surveys, we noted whether each flycatcher was detected before or after the tape broadcast, and type of initial and subsequent response to playback during the survey. In cases where a site was surveyed in more than one year, we report only the results for

FIGURE 1. Willow Flycatcher winter survey locations in El Salvador, Costa Rica, and Panama. Dots indicate areas with one location; stars indicate areas with two locations.

the year with the largest number of flycatcher detections.

RESULTS

Survey Efforts

We surveyed a total of 42 survey locations between 1998 and 2000: 10 in El Salvador, 20 in Costa Rica, and 12 in Panama (Fig. 1; Appendix). We conducted surveys at 154 different survey sites for a total of 561 survey hrs. We detected 542 Willow Flycatchers at 28 of the 42 survey locations; approximately half (N = 274) of the total flycatcher detections occurred in El Salvador, despite fewer survey hours spent in that country (Appendix). We found flycatchers at 75% of the historical locations we surveyed.

Response to Tape Playback

Flycatchers responding to tape-playback gave a variety of vocalizations including (per vocalization terminology of Stein 1963 and Gorski 1969) *fitz-bews, whitts, wheeps, creets/breets,* and *churr/kitters.* In Costa Rica during 1998 and 1999, 70% of flycatchers initially responded by calling (*whitts* or *wheeps*) and 30% gave the characteristic *fitz-bew* song. When we continued to broadcast vocalizations in the immediate proximity of calling flycatchers, 60% of calling flycatchers eventually sang. Thus, overall, 70% of detected Willow Flycatchers sang in response to tape-playback. Flycatchers were generally most responsive prior to 1000 hrs.

Habitat Characteristics

Occupied winter Willow Flycatcher habitat was characterized by four main habitat components: (1) standing or slow moving freshwater and/or saturated soils; (2) patches or stringers of trees; (3) woody shrubs; and (4) open areas such as pastures, savannas, or bodies of water bordering forest edges (Fig. 2). With the exception of three sites in El Salvador, no flycatchers were found at survey locations lacking one or more of these major habitat components. All occupied habitats were situated in low-lying areas that experience seasonal inundation during the rainy season, when flycatchers generally arrive at the wintering sites. Habitat types in which we did not detect flycatchers included dry uplands, woodlands and forests along fast moving streams and rivers, *Parkinsonia*-dominated freshwater wetlands, brackish tidal wetlands and mangroves, and forest interior. Occupied flycatcher habitats ranged in elevation from 0–250 m. We did not detect Willow Flycatchers at survey sites at the two higher elevation locations (Lago Coatepeque, El Salvador [730 m], and San Vito, Costa Rica [>2000 m]), which contained all four of the winter habitat components.

The freshwater/saturated soil component at occupied sites consisted of *lagunas,* muddy seeps, *esteros,* slow-moving *quebradas,* reservoirs, and associated floodplain areas that contained aquatic and emergent vegetation. Al-

FIGURE 2. Willow Flycatcher winter habitat at Laguna de Olomega, El Salvador, showing the four main habitat components of standing freshwater, woody shrubs, patches of trees, and open areas.

though they varied greatly in size and shape, 74 of the 77 occupied sites retained water into the dry season when surveys were conducted; *lagunas, esteros,* and reservoirs contained water year-round. Wet areas were typically bordered by woody and herbaceous shrubs (primarily *Mimosa* sp.), patches or stringers of trees, savanna-woodland edges, second-growth woodlands, pasture lands, and/or agricultural areas. Woody shrubs were generally 1–3 m high and ranged from dense impenetrable thickets to sparse and widely scattered in distribution. The tree component consisted primarily of deciduous species, although in wetland areas trees usually retained most of their leaves throughout the year. Average canopy height of tree patches and stringers ranged from 6–15 m, with emergent trees such as large guanacaste (*Enterlobium cyclocarpum*) and ceiba (*Ceiba pentandra*) ranging from 20–35 m in height. Except for reservoirs and along the Panama Canal, seasonal flooding inundated the bordering floodplains and vegetation. Although these inundated areas contained standing water through October or November, the sites and bordering floodplains tended to dry up as the dry season progressed.

Threats

All of the sites occupied by Willow Flycatchers had been altered by historical and current human activity, and many were relatively small areas surrounded by altered landscapes that continue to encroach on remnant "natural" habitat. Sites were heavily disturbed, and human impacts such as deforestation and burning were evident. Land-altering practices seen at survey sites included cattle grazing, small- and large-scale agriculture, draining of wetlands via irrigation canals, woodcutting for fuel, logging, urban expansion, and erosion. During surveys in Costa Rica, two occupied flycatcher sites were destroyed; one was bulldozed shortly after we surveyed the site, the other cut down while we were trying to capture and band flycatchers (Fig. 3). Both areas were converted to short grass pasture.

Evidence of cattle grazing was seen in and around 127 of the 154 survey sites, including 92% of occupied sites (Table 1). Although heavily defined cattle trails were common, the intensity of grazing and its effects on flycatcher habitat varied among occupied sites. We found Willow Flycatchers at some sites where cattle grazed among scattered shrubs, small trees, and/or patches of mixed herbaceous vegetation, but not at grazed sites where woody vegetation was absent.

Agricultural crops from small-scale and large-scale farms were grown within 200 m of 69 of the 154 survey sites, including 39% of occupied sites (Table 1). Agricultural and silvicultural crops found at survey sites included sugar cane, oil palm, rice, teak, and other commercial crops, as well as crops grown on small subsistence farms such as sorghum, corn, beans, and melons. Large-scale commercial crops dominated large areas of lowland landscapes, and occupied winter habitats generally remained only as small

fragmented patches surrounded by agricultural land (Fig. 4).

Trash and pollutants, such as plastic containers and bags, gasoline, and laundry and dish detergents, were present in and around rivers, streams, and *lagunas* at 27 of 154 survey sites, including 26% of occupied sites (Table 1). We also noted evidence of agrochemical contamination of waterways. In Costa Rica, major irrigation canals through the extensive sugar, rice, and oil palm plantations at Bebedero, Canas, and Coto 44 were marked with signs that read, "No Swimming—Contaminated."

In El Salvador, only two survey locations were within protected areas: Bosque Nancuchiname and Laguna El Jocotal. Although La Barra de Santiago in El Salvador is also a nationally protected area, all occupied Willow Flycatcher habitat was found outside of the borders. In Costa Rica, we did not detect Willow Flycatchers at the two survey locations within National Park boundaries, but flycatchers were found at locally-protected sites at Bolson, Santa Cruz, and Solimar. None of our Panama survey locations were located within protected areas.

DISCUSSION

Because Willow Flycatcher subspecies are distinguished by slight morphological and color differences (Unitt 1987), we could not confidently differentiate among subspecies during our field surveys. However, because Unitt (1997) examined 578 museum specimens of "Traill's Flycatcher" taken during migration or in winter and found no geographical segregation among wintering *E. traillii* subspecies, we believe that our data apply to all subspecies, including *E. t. extimus*. Ecological segregation, such as might occur if different subspecies use different habitats within the local landscape, could mean that our results are not equally applicable to all subspecies. Although such ecological segregation has not been demonstrated to date, it is worthy of additional consideration and research.

Habitat

Our habitat descriptions, although qualitative in nature, identified what appear to be key components of wintering Willow Flycatcher habitat. Despite differences in overall size, shape, and plant species composition, Willow Flycatcher wintering sites consistently included standing or slow moving freshwater (or saturated soils), woody shrubs, patches and/or stringer of trees, and open areas (Fig. 2). These components also characterize many flycatcher breeding habitats, especially in the southwestern U.S. (Sogge and Marshall 2000).

Occupied wintering Willow Flycatcher habitat was always found near freshwater *lagunas*, lakes, marshes, wetlands, slow moving rivers or streams, and seasonally inundated savannas and pastures. The only exceptions occurred at three survey sites in El Salvador, where the nearest water or saturated soils were an estimated 400–600 m from the sites. However, although water was not present during our January surveys (Fig. 5), the sites were flooded from September through November when flycatchers first arrive. Similar dramatic seasonal change occurs throughout the Pacific lowlands. Flycatchers arrive during the *invierno*, when many occupied sites are inundated by up to 6 m of water. By January and February, the *verano* is underway and local water levels are much reduced so that some retain only limited surface water and/or saturated soils. The fact that water is present at all sites when flycatchers arrive suggests it is an important factor in winter habitat selection. Koronkiewicz and Sogge (2000) found that flycatchers remained at wintering sites even after sites had dried substantially, and that the distribution of flycatchers within sites remained constant despite major changes in the distribution and amount of wet areas.

The tree and shrub components of Willow Flycatcher winter habitat varied in relative proportion among sites. Patches and/or stringers of trees varied in size and shape, and the shrub component at occupied sites ranged from dense to sparse and/or scattered. At many sites, especially those in Costa Rica, *Mimosa* sp. formed dense impenetrable thickets, whereas other sites in Panama and El Salvador contained very few shrubs. Flycatchers foraged and roosted among dense shrubs at some sites (T. Koronkiewicz, pers. obs.), and sang and foraged from exposed perches along tree lines and forest and woodland edges. As on the breeding grounds (Sedgwick and Knopf 1992), trees may provide flycatchers exposed perches from which to forage, and defend and view their habitat. Open areas, also reported as a component of many Southwestern Willow Flycatcher breeding habitats (Sogge and Marshall 2000, Allison et al. *this volume*), may provide aerial foraging space.

Survey Technique and Effort

Wintering Willow Flycatchers' response to tape-playback was similar to that described for breeding flycatchers (Sogge et al. 1997a). Because eliciting song is useful in verifying species identification, and because many flycatchers were not detected until after the survey tape was played, we consider tape-playback surveys (including the use of multiple calls and songs) to be a critical tool for effectively locating Willow Flycatchers on the wintering grounds.

FIGURE 3. Occupied Willow Flycatcher winter habitat along the Rio Corozal in Puerto Jimenez, Costa Rica. All of the Willow Flycatcher habitat was removed and converted to short grass pasture during the course of our surveys in 1999. The bulldozer can be seen at the center of the photo.

It was not our goal to conduct complete censuses of Willow Flycatchers at our sites, and our results do not reflect actual flycatcher abundance. Over the course of our work, we altered our survey methods based on initial results to increase survey efficiency. During 1998 and 1999, our Costa Rica surveys were conducted in a wide variety of habitat types, many of which did not support wintering flycatchers. In contrast, we focused our 2000 surveys in El Salvador and Panama on habitat types in which we found wintering flycatchers during the previous two years in Costa Rica. In El Salvador and Panama, we also enlisted the assistance of local ornithologists who provided valuable logistical information and identified areas most likely to contain suitable flycatcher habitat. This more focused approach and additional survey experience allowed us to survey more effectively in El Salvador (5.4 flycatchers/survey hr) and Panama (0.8 flycatchers/survey hr) than we had previously done in Costa Rica (0.5 flycatchers/survey hr). Thus, differences in the numbers of flycatchers and/or rates of flycatcher detections (Appendix) in each country cannot be used as an index of actual abundance or density.

The lack of historical records and recent reports for wintering Willow Flycatchers at high elevation suggested that elevation may limit flycatcher distribution; thus, almost all (152 of 154) of our survey sites were located below 250 m. However, in January of 2001, five Willow Flycatchers were recorded spontaneously singing at approximately 430 m near Lago de Güija, El Salvador (W. Rodríguez, pers. comm.), suggesting that additional surveys covering a wider range of elevations are warranted.

Cattle Grazing and Agricultural Activities

Historically, cattle ranching along the Pacific lowlands promoted the establishment and

TABLE 1. The Number of Sites at Which Different Types of Human Impacts Were Noted During Willow Flycatcher Winter Surveys in 1998–2000

		Type of human impact		
		Cattle grazing	Agriculture	Trash and pollutants
Occupied sites	El Salvador (N = 25)	24	16	18
	Costa Rica (N = 41)	40	11	1
	Panama (N = 11)	7	3	1
	Total (N = 77)	71	30	20
Unoccupied sites	El Salvador (N = 3)	2	2	0
	Costa Rica (N = 59)	46	28	4
	Panama (N = 15)	8	9	3
	Total (N = 77)	56	39	7