Appendix D.
Southwestern Willow Flycatcher Habitat[1]

A. Introduction

The distribution and abundance of a species across a landscape depends in part on the distribution and abundance of suitable habitat. If basic resource needs such as food, water, and other biological and physical features are not present, then that species is excluded from the area. Scarcity of suitable habitat is often the primary reason for the status of most rare and endangered species. An understanding of an endangered species' habitat is crucial to effective management, conservation and recovery.

The southwestern willow flycatcher (*Empidonax traillii extimus*) breeds in relatively dense riparian habitats in all or parts of seven southwestern states, from near sea level to over 2000 m (6100 ft). Although other willow flycatcher subspecies that occur in cooler, less arid regions may breed in shrubby habitats away from water (McCabe 1991), *E.t. extimus* breeds only in dense riparian vegetation near surface water or saturated soil. Other habitat characteristics such as dominant plant species, size and shape of habitat patch, canopy structure, vegetation height, and vegetation density vary widely among sites. This document presents an overview of southwestern willow flycatcher breeding habitat, with an emphasis on gross vegetation characteristics. There have been few quantitative studies of flycatcher habitat (but see Whitfield and Strong 1995, Whitfield and Enos 1996, Spencer et al. 1996, McKernan and Braden 1999, Stoleson and Finch 1999, Uyehara and Whitfield 2000, McKernan and Braden 2001). Therefore, this document focuses on qualitative information on plant species composition and structure. Although many of the details of vegetation characteristics differ among breeding sites, this document describes those elements or attributes that are shared by most.

B. What Is "Habitat"?

Birds and bird communities have played a major role in the development of the concept of habitat, yet specific definitions of the term habitat are often vague and/or differ from one another (Block and Brennan 1993). However, a common theme among different definitions and terms is that "habitat" includes the physical and biological environmental attributes that influence the presence or absence of a bird species (Morrison et al. 1992). Habitat involves many components in addition to composition and structure of vegetation. The distribution and abundance of species are influenced by environmental features (climate, food, extent of habitat), predation, competition, parasitism, disease, disturbance, past history and even random chance (Wiens 1989b). Research is usually focused on those habitat components

[1]This document is adapted from Sogge and Marshall 2000. (See Literature Cited)

that are most easily or reliably quantified and/or considered most likely to influence the bird community. No single study can address all of the factors that may influence bird species presence in an ecosystem.

Many factors affect how a species selects habitat, and these factors do not act equally for all species or even for all populations of a single species (Wiens 1989a, 1989b). A species' morphological and physiological traits allow it to exploit certain resources and therefore, certain habitats (Morrison et al. 1992). Life-history or behavioral traits such as foraging and mating strategies are also factors that influence a species' habitat selection (Hansen and Urban 1992). Proximate factors such as song perches, nest sites, and the structure and composition of the vegetation determine whether a bird settles in a habitat. These are part of a habitat selection "template" (Wiens 1989a) that results from both an individual's genetic makeup and information learned. Ultimately, the suitability of a particular habitat is reflected by reproductive success and survivorship. Mere occupancy of a habitat does not confirm the habitat is optimal, only that it meets the (perhaps minimal) selection template for those individuals breeding there. There has yet to be developed a comprehensive habitat model for the southwestern willow flycatcher that enables one to determine which breeding habitats, or parts of a single breeding patch, are better than others based on vegetation characteristics alone.

C. Breeding Habitat

Breeding habitats of the southwestern willow flycatcher vary across its range, in structure and species makeup of vegetation, characteristics of water associated with the site, elevation, and other factors. However, the accumulating knowledge of flycatcher breeding sites reveals important areas of similarity. These constitute the basic concept of what is suitable breeding habitat. These areas of similarity, or habitat features, are each discussed below, with examples from the field. First, it is helpful to state them in general terms to create a basic understanding of what is habitat.

The southwestern willow flycatcher breeds in riparian habitats along rivers, streams, or other wetlands, where relatively dense growths of trees and shrubs are established, near or adjacent to surface water or underlain by saturated soil. Throughout the range of the flycatcher, these riparian habitats tend to be rare, widely separated, small and/or linear locales, separated by vast expanses of arid lands. Common tree and shrub species comprising nesting habitat include willows (*Salix* sp.), boxelder (*Acer negundo*), tamarisk (aka saltcedar, *Tamarix ramosissima*), and Russian olive (*Eleagnus angustifolia*) (Grinnell and Miller 1944, Phillips 1948, Phillips et al. 1964, Whitmore 1977, Hubbard 1987, Unitt 1987, Whitfield 1990, Brown and Trosset 1989, Brown 1991, Sogge et al. 1993, Muiznieks et al. 1994, Maynard 1995, Stoleson and Finch 1999, Paradzick et al. 1999, Uyehara and Whitfield 2000, McKernan and Braden 2001).

Habitat characteristics such as plant species composition, size and shape of habitat patch, canopy structure, vegetation height, and vegetation density vary across the subspecies' range. However, regardless of the plant species composition or height, occupied sites usually consist of dense vegetation in the patch interior, or an aggregate of dense patches interspersed with openings. In most cases this dense vegetation occurs within the first 3 - 4 m (10-13 ft) above ground. These dense patches are often interspersed with small openings, open water or marsh, or shorter/sparser vegetation, creating a mosaic that is not uniformly dense.

Southwestern willow flycatchers nest in thickets of trees and shrubs ranging in height from 2 m to 30 m (6 to 98 ft). Lower-stature thickets (2-4 m or 6-13 ft tall) tend to be found at higher elevation sites, with tall stature habitats at middle and lower elevation riparian forests. Nest sites typically have dense foliage at least from the ground level up to approximately 4 m (13 ft) above ground, although dense foliage may exist only at the shrub level, or as a low dense canopy. Nest sites typically have a dense canopy. Canopy density at nest sites include the following values: 74% on the Kern River, CA (Uyehara and Whitfield 2000 and pers. comm.), less than 50% to 100% (but generally 75%-90%) on the lower Colorado River (McKernan and Braden 1999), 89% to 93% in AZ (Spencer et al. 1996), and 84% on the Gila River, NM (Stoleson and Finch 1999). The diversity of nest site plant species may be low (e.g., monocultures of willow or tamarisk) or comparatively high. Nest site vegetation may be even– or uneven–aged, but is usually dense (Brown 1988, Whitfield 1990, Muiznieks et al. 1994, McCarthey et al. 1998, Sogge et al. 1997a, Stoleson and Finch 1999, McKernan and Braden 2001). On the Gila River, NM, Stoleson et al. (1998) found differences between occupied and unoccupied habitats that were near one another and were generally similar. Occupied sites had greater foliage density, greater canopy cover, and greater numbers of trees than unoccupied sites. Unoccupied sites had fewer shrubs and saplings, more open canopies, and greater variability in these characteristics. Historically, the southwestern willow flycatcher probably nested primarily in willows, buttonbush (*Cephalanthus occidentalis*), and seepwillow *(Baccharis* sp.*)*, sometimes with a scattered overstory of cottonwood (*Populus* sp.) (Grinnell and Miller 1944, Phillips 1948, Whitmore 1977, Unitt 1987). Following modern changes in riparian plant communities, the flycatcher still nests in native vegetation where available, but also nests in thickets dominated by tamarisk and Russian olive (Hubbard 1987, Brown 1988, Sogge et al. 1993, Muiznieks et al. 1994, Maynard 1995, Sferra et al. 1997, Sogge et al. 1997a, McKernan and Braden 1999).

Nesting willow flycatchers of all subspecies generally prefer areas with surface water nearby (Bent 1960, Stafford and Valentine 1985, Harris et al. 1987), but *E. t. extimus* almost always nests near surface water or saturated soil (Phillips et al. 1964, Muiznieks et al. 1994). At some nest sites surface water may be present early in the breeding season but only damp soil is present by late June or early July (Muiznieks et al. 1994, M. Whitfield, Kern River Research Center, in litt.–1993, J. and J. Griffith, Griffith Wildlife Biology, in litt.–1993). At some breeding sites, water may be present in most years but absent in others, especially during drought periods or if reservoir levels recede (see Section 7 below). Ultimately, a water table close enough to the surface to support riparian vegetation is necessary. In some cases a site may dry out, but riparian vegetation and nesting flycatchers may persist for a short time (one or two breeding seasons) before they are eventually lost.

1. General Vegetation Composition And Structure

Southwestern willow flycatcher breeding habitat can be broadly described based on plant species composition and habitat structure. These two habitat characteristics are the common denominators most conspicuous to human perception, but are not the only important components. However, they have proven useful in describing known breeding sites, evaluating suitable survey habitat, and in predicting where breeding flycatchers may be found.

The following habitat descriptions are organized into three broad habitat types - those dominated by native

vegetation, by exotic vegetation, and those with mixed native and exotic plants. These broad habitat descriptors reflect the fact that southwestern willow flycatchers now inhabit riparian habitats dominated by both native and non-native plant species. Tamarisk and Russian olive are used as nesting substrates. In some cases, flycatchers are breeding in locations where these species form the dominant canopy species or occur in nearly monotypic stands. Table 1 presents data on flycatcher habitat use from throughout this subspecies' range. Data on the most conspicuous plant species were collected in conjunction with population data at 221 sites across the bird's range (Table 1), and demonstrate the widespread use of riparian habitats comprised of both native and exotic trees and shrubs. A breeding site was considered "dominated" by either native or exotic plants if they comprised an estimated ≥60% of vegetation volume of shrubs and small trees. Table 1 does not reflect an analysis of flycatcher selection of either native- or exotic-dominated communities in relation to the availability of these habitats across the landscape.

Table1. The number of known southwestern willow flycatcher territories located within major vegetation/habitat types, by state. Data are from Sogge et al. 2002, based on last reported habitat and survey data for all sites where flycatchers were known to breed, 1993-2001.

	State						
Vegetation Type	AZ	CA	CO	NM	NV	UT	Total
Native (>90%)	33	172	37	194	32	0	468
Mixed native/exotic (>50 native)	102	52	0	50	27	0	231
Mixed exotic/native (>50% exotic)	140	1	0	3	14	3	161
Exotic (>90%)	79	0	0	11	0	0	90
Unreported	5	31	0	0	0	0	36
Total	359	256	48	258	73	3	986

[1]see Appendix Q for full list of data sources.

Narrative descriptions of the general vegetation types used throughout the southwestern willow flycatcher's range are provided below. These vegetation descriptions focus on the dominant tree and shrub components. The habitat types described below include a continuum of plant species composition (from nearly monotypic to mixed species) and vegetation structure (from simple, single stratum patches to complex, multiple strata patches). Because pictures are often much more effective than verbal descriptions at conveying the general nature of a riparian patch, we include one or more photographs of each type of occupied breeding habitat (See Appendix). The intent of the descriptions and photographs is to provide a basic understanding of the types of habitat occupied by the flycatcher, not to create a standardized definition or classification. All

known breeding sites are not described or illustrated, so every potential variant is not shown. However, the sites presented capture most of the known range of patch floristics, structure and size.

2. Native Vegetation Dominated

Approximately half of southwestern willow flycatcher territories are in patches dominated by native trees and shrubs, especially willows (*Salix* spp.). The floristic and gross structural variation of occupied native-dominated habitats is quite broad. Occupied sites vary from monotypic, single strata patches to multi-species, multi-layered strata with complex canopy and subcanopy structure. Overall, sites differ substantially with elevation, and are treated separately below.

Low to Mid-Elevation Native Sites

General characteristics: These sites range from single plant species to mixtures of native broadleaf trees and shrubs including (but not limited to) Goodding's *(Salix gooddingii*) or other willow species, cottonwood, boxelder, ash (*Fraxinus* spp.), alder (*Alnus* spp.), and buttonbush. Average canopy height can be as short as 4 m (13 ft) or as high as 30 m (98 ft). Gross patch structure is generally characterized by individual trees of different size classes, often forming a distinct overstory of cottonwood, willow or other broadleaf tree with recognizable subcanopy layers and a dense understory of mixed species. However, although some descriptions of flycatcher breeding habitat emphasize these multi-species, canopied associations, flycatchers also breed at sites with tall (>5 m/16 ft) monotypic willow. Exotic or introduced trees and shrubs may be a rare component at these sites, particularly in the understory. In an unusual site along the upper San Luis Rey River in San Diego County, CA, willow flycatchers breed in a streamside area dominated by live oak (*Quercus agrifolia*), where willows once predominated but were reduced by a phreatophyte control program several decades ago and are now regenerating (W. Haas, pers. comm.).

Examples

South Fork of the Kern River at Lake Isabella, Kern County, CA., elevation 780 m (2558 ft) (see Whitfield and Enos 1996, Whitfield 2002). This is one of the largest tracts of native-dominated flycatcher habitat in the Southwest (Figure 1). The site includes roughly 500 ha (1235 ac) of riparian woodland dominated by a dense overstory of red willow (*Salix laevigata*) and Gooding's willow, interspersed with open areas often dominated by nettle (*Urtica dioica*) and mule fat (*Baccharis salicifolia*), cattails (*Typha* spp.) and tules (*Scirpus* spp.). Canopy height is typically from 8 to 12 m (26-39 ft). This site has numerous river channels, sloughs, and marshes that provide surface water and saturated soils across a relatively broad floodplain throughout most of the breeding season (Figure 2).

Santa Ynez River, Santa Barbara County, CA., (see Holmgren and Collins 1995). Willow flycatchers breed at several areas along the perennial Santa Ynez River between Buellton (elevation approximately 150 m or 490 ft) and the ocean. These species-rich riparian sites (Figure 3) are comprised of red willow, black cottonwood (*Populus trichocarpa*) and box elder with dense, shrubby thickets of willows (*Salix lasiolepis* and *S. exigua*), mulefat, poison oak (*Toxicodendron diversilobum*) and blackberry (*Rubus spp.*).

San Pedro River, Pinal County, AZ., elevation 600 m (see Spencer et al. 1996, McCarthey et al. 1998, Smith et al. 2002). Several flycatcher breeding sites along this riparian system are dominated primarily by Fremont cottonwood *(P. fremontii*) and Goodding's willow (Figure 4). Understory is comprised of younger trees of these same species, with tamarisk (*Tamarix ramosissima*) as a minor component in some areas. Overstory canopy height averages 15 to 20 m (49-65 ft). Open water, marshes and seeps (including cattail and bulrush), and saturated soil are present in the immediate vicinity.

Gila River, Grant County, NM., elevation 1,480 m (4854 ft) (see Skaggs 1996, Cooper 1997, Stoleson and Finch 1999). One of the largest known population of breeding southwestern willow flycatchers is found in a series of narrow riparian patches distributed over a 13 km (8 mi) stretch of the Gila River. Flycatchers breed in two distinct structural types; riparian scrub and riparian forest. Riparian scrub (Figure 5) is dominated by 4 to 10 m (13-33 ft) tall shrubby willows and seepwillow (*Baccharis glutinosa*) that grow along the river bank or in old flood channels. These shrub strips are sometimes less than 10 m (33 ft) wide and rarely more than 20 m (66 ft). Riparian forest patches (Figure 6) were 100 to 200 m wide (328-650 ft), and dominated by trees such as Fremont cottonwood, Goodding's willow, Arizona sycamore (*Plantanus wrightii*) and boxelder. Understory includes young trees of the same species. Canopy height generally ranges between 20 and 30 m (33-98 ft). Much of this forest vegetation is sustained by water from the river and small, unlined water diversions that function much like a dendritic stream system. To the extent that more specifically quantified data on vegetation structure have been developed, that information comes from this population. Skaggs (1996) found that 90% of territories occurred in Mixed Broadleaf Riparian Forest (Brown et al. 1979), which locally were expressed as "...dense, multi-layered canopies." Greatest foliage density was at heights of 3-13m (10-42 ft), and canopy cover (>2 m height) averaged 95%. In both Mixed Broadleaf Riparian Forest and Mixed Narrowleaf Riparian Scrub, Skaggs found approximately 600 stems/ha of dominant trees. Herbaceous groundcover and understory were not quantified. In comparing nest sites and unused sites in the Cliff-Gila Valley, Stoleson and Finch (1999) found that nest sites were significantly higher in average canopy cover, foliage density at 3-10 m, patchiness, and number of tree stems per unit area. Nest sites were significantly lower in average ground cover, average canopy height, and total basal area of woody stems. Ground cover is probably lower at nest sites because of the high degree of canopy closure or, as at the Kern River, due to standing water.

High-Elevation Native Sites

General characteristics: As a group, these sites are more similar than low elevation native sites. Most high elevation (≥1900 m or 6232 ft) breeding sites are comprised completely of native trees and shrubs, and are dominated by a single species of willow, such as coyote willow (*Salix exigua*) or Geyer's willow (*S. geyeriana*). However, Russian olive is a major habitat component at some high elevation breeding sites in New Mexico. Average canopy height is generally only 3 to 7 m (10-23 ft). Gross patch structure is characterized by a single vegetative layer with no distinct overstory or understory. There is usually very dense branch and twig structure in lower 2 m (6.5 ft), with high live foliage density from the ground to the canopy. Tree and shrub vegetation is often associated with sedges, rushes, nettles and other herbaceous wetland plants. These willow patches are usually found in mountain meadows, and are often associated with stretches of stream or river that include many beaver dams and pooled water.

Examples

Little Colorado River near Greer, Apache County, AZ., elevation 2530 m (8298 ft) (see Spencer et al. 1996, Langridge and Sogge 1997, McCarthey et al. 1998). This 14 ha (34.5 ac) site is a mosaic of dense, shrubby Geyer's willow (Figure 7), dense herbaceous ground cover, and open water. The river and associated beaver ponds create marshes, wet meadows and saturated soil conditions. Average willow canopy height is 4 to 6 m (13-20 ft). The willow matrix is a combination of clumps and thin strips 3 to 5 m (10-16 ft) wide. The shrubby vegetation is structurally composed of a single layer of live vegetation, with dense branch and twig structure and high live foliage density from ground level to canopy. Habitat surrounding the broad valley is primarily ponderosa pine (*Pinus ponderosa*) and scattered houses and cabins.

Alamosa National Wildlife Refuge, Alamosa County, CO., elevation 2,290 m (8000 ft) (see Owen and Sogge 1997). This site includes a series of mostly small habitat patches distributed along several kilometers of the upper Rio Grande. The river is narrow, and winds through the generally flat landscape. The shrubby vegetation (Figure 8) is dense, almost monotypic willow, with small amounts of cottonwood present in a few patches. Shrub height is typically 3-4 m high, with some larger emergent cottonwoods at some, but not all, patches.

3. Exotic Vegetation Dominated

Exotic plant species such as tamarisk and Russian olive were not introduced or widespread in southwestern riparian systems until approximately 100 years ago. Thus, southwestern willow flycatchers evolved in and until fairly recently (from an evolutionary perspective) bred exclusively within thickets of native riparian vegetation. However, as the widespread loss and modification of native riparian habitats progresses, the flycatcher is found breeding in some exotic-dominated habitats. From the standpoint of flycatcher productivity and survivorship, the suitability of exotic-dominated sites is not known. Flycatcher productivity in at least some exotic-dominated sites is lower than in some native-dominated habitats (Sferra et al. 1997, Sogge et al. 1997a), but higher at other locations (McKernan and Braden 1999). However, other factors such as small riparian patch size may have greater effects on productivity at those sites.

Southwestern willow flycatchers do not nest in all exotic species that have invaded and sometimes dominate riparian systems. For example, flycatchers do not use tree of heaven (*Ailanthus altissima*). Even in the widespread tamarisk, flycatchers tend to use only two discreet forms - low stature tamarisk found in the understory of a native cottonwood-willow gallery forest or the tall (6 - 10 m or 19-33 ft) mature stands of tamarisk that have a high percentage of canopy closure.

Most exotic habitats range below 1,200 m (3,940 ft) elevation. As a group, they show almost as much variability as do low elevation native-dominated sites. Most exotic sites are nearly monotypic, dense stands of exotics such as tamarisk or Russian olive that form a nearly continuous, closed canopy (with no distinct overstory layer). Canopy height generally averages 5 to 10 m (16 - 33 ft), with canopy density uniformly high. The lower 2 m (6.5 ft) of vegetation is often very difficult to penetrate due to dense branches. However, live foliage density may be relatively low from 0 to 2 m (6.5 ft) above ground, but increases higher in the canopy.

Examples

Roosevelt Lake, Gila County, AZ., elevation 640 m (2100 ft) (Sferra et al. 1997, McCarthey et al. 1998, Smith et al. 2002). Two of the largest known southwestern willow flycatcher populations in Arizona breed in large, contiguous stands of dense, mature tamarisk at the Tonto Creek and Salt River inflows to Roosevelt Lake (Figures 9 and 10). Along the Salt River inflow, flycatchers breed in several patches of essentially monotypic saltcedar (as well as in more native-dominated patches nearby). Tamarisk-dominated patches at the Tonto Creek site include a few scattered, large cottonwood trees that emerge above the tamarisk canopy, which averages 8 to 12 m (26 - 40 ft) in height. Within the patches, there are numerous small openings in the canopy and understory. As is often the case in such mature tamarisk stands, there is little live foliage below a height of 3 to 4 m (10-14 ft) within the interior of the patch (although live foliage may be continuous and thick at the outer edges of the patch), and virtually no herbaceous ground cover. However, numerous dead branches and twigs provide for dense structure in the lower 2 to 3 m (6-10 ft) strata (Figure 11). In normal or wet precipitation years, surface water is adjacent to or within the tamarisk patches.

Colorado River in Grand Canyon, Coconino County, AZ., elevation 850 m (2788 ft) (see Sogge et al. 1997). The willow flycatcher breeding sites along the Colorado River in the Grand Canyon (Figure 12) are very small (0.6 to 0.9 ha), dense patches of mature tamarisk, bordered on the upslope side by acacia (*Acacia greggii*) and along the river's edge by a thin band of sandbar willow (*Salix exigua*). Tamarisk canopy height averages 8 to 12 m (26-40 ft). Live foliage is dense and continuous along the edge of the patch, but within the patch interior does not begin until 2 to 4 m (10-14 ft) above ground. A dense layer of dead branches and twigs provides for a thick understory below the live vegetation. These sites have almost no herbaceous understory due to a dense layer of fallen tamarisk branches and leaf litter. All patches are no further than 5 m (16.4 ft) from the river's edge.

4. Mixed Native and Exotic Habitats

General characteristics: Many southwestern willow flycatcher breeding sites are comprised of dense mixtures of native broadleaf trees and shrubs (such as those listed above) mixed with exotic/introduced species such as tamarisk or Russian olive. The exotics are often primarily in the understory, but may be a component of overstory. At several sites, tamarisk provides a dense understory below an upper canopy of gallery cottonwoods, forming a habitat that is structurally similar to the cottonwood-willow habitats in which flycatchers historically nested. A particular site may be dominated primarily by natives or exotics, or be a more-or-less equal mixture. The native and exotic components may be dispersed throughout the habitat or concentrated in distinct, separate clumps within a larger matrix. Sites almost always include or are bordered by open water, cienegas, seeps, marshes, and/or agricultural runoff channels. However, during drought years surface water at some sites may be gone early in the breeding season. Generally, these habitats are found below 1,200 m (3940 ft) elevation.

Examples

Rio Grande at San Juan Pueblo, Rio Arriba County, NM., elevation 1,716 m (5,630 ft)) (see Maynard 1995,

Cooper 1997). In this locale, southwestern willow flycatchers breed in a habitat that includes a scattered overstory of cottonwood, with subcanopies and understories comprised of Russian olive and coyote willow. The Russian olive averages 8 to 12 m (26-40 ft) in height, and the willows 3.5 to 6 m (12-20 ft). River channels, diversion ditches, old river oxbows, and associated marshy areas are present within and adjacent to the site (Figure 13).

San Pedro River, Pinal County, AZ., elevation 600 m (1968 ft) (see Spencer et al. 1996, McCarthey et al. 1998). Parts of the extensive riparian tracts of the lower San Pedro River are dominated by cottonwood and willow, but include substantial amounts of dense tamarisk. In some cases, the tamarisk occurs as a dense understory amidst a cottonwood, willow, ash or boxelder overstory (Figure 14), while in others it borders the edge of the native vegetation (Figure 15). Overall canopy height ranges from 10 to 18 m (33-59 ft).

Verde River at Camp Verde, Yavapai County, AZ., elevation 940 m (3,083 ft) (see SWCA 2001). Southwestern willow flycatchers breed here in a mixture of willow, cottonwood, and tamarisk habitat (Figure 16). Most of the territories are found in a cluster of dense mature tamarisk 6 to 8 m (19.5-26 ft) tall that is bordered by narrow bands of young willow, which in turn is surrounded on one side by a large (>50 ha) stand of mature cottonwoods and willows (15-20 m tall) with little understory. Although the patch itself is located on a sandy terrace approximately 4 m (13 ft) above typical summer river level, the Verde River flows along the eastern edge of the patch and a small intermittently flowing irrigation ditch provides water to a small pond adjacent to the tamarisk and willows. Patches of herbaceous ground cover are scattered throughout the site, but are absent under the tamarisk canopy.

Virgin River, Washington County, UT., elevation 1,100 m (3,608 ft) (USFWS unpubl. data). Along one portion of Virgin River riparian corridor near St. George, flycatchers breed in a mixture of dense willow, Russian olive and tamarisk near an emergent marsh (Figure 17). The native trees form a tall overstory 10-12 m (33-40 ft) high, which is bordered by a shorter (10-12 m or 33-40 ft) band of tamarisk, and a strip of 4 to 8 m (13-26 ft) tall willow. The stretch of occupied habitat is approximately 60 m (197 ft) wide and 100 m (328 ft) long, and is located in an old meander channel through which the river no longer flows. In normal and wet years return channels and river flows seasonally inundate the base of the vegetation.

5. Standard Biotic Vegetation Classifications And Descriptions

In addition to the above habitat descriptions, existing systematic classification systems for biotic and vegetative communities are also helpful to generally categorize southwestern willow flycatcher habitats. The system developed by Brown et al. (1979) as supplemented by Brown (1982) is widely used and provides valuable habitat descriptions. Flycatcher habitats can be placed into the broad biomes and series noted below. Because of local variations in relative abundance of plant species, individual sites will vary in community/ series, association and subassociation (see Brown 1982 for discussion). Below is a listing of several major biotic communities, with subordinate classifications, and examples of known flycatcher habitat areas (Numerical identifiers follow Brown et al. 1979; all in Nearctic Realm).

Lower Elevation Habitats

224 Tropical-Subtropical Swamp, Riparian, and Oasis Forests

224.5 Sonoran Riparian and Oasis Forests

224.53 Cottonwood-Willow Series (historical lower Colorado River, San Pedro River AZ)

234 Tropical-Subtropical Swamp and Riparian Scrub

234.7 Sonoran Deciduous Swamp and Riparian Scrub

234.72 Saltcedar Disclimax Series (current lower Colorado River)

223 Warm Temperate Swamp and Riparian Forests

232.2 Interior Southwestern Riparian Deciduous Forest and Woodland series

223.21 Cottonwood-Willow series

223.22 Mixed Broadleaf series (Gila River, Gila-Cliff Valley, NM)

223.3 Californian Riparian Deciduous Forest and Woodland

223.31 Cottonwood-Willow Series (Kern, Santa Margarita and Santa Ynez Rivers, CA)

223.32 Mixed Broadleaf Series (San Luis Rey River CA)

233 Warm Temperate Swamp and Riparian Scrub

233.2 Interior Southwestern Swamp and Riparian Scrub

233.21 Mixed Narrowleaf Series (Gila-Cliff Valley, NM)

233.22 Saltcedar Disclimax Series (Roosevelt Lake AZ, Grand Canyon AZ)

233.221 *Tamarix chinensis* -Mixed Deciduous association (Verde and San Pedro Rivers AZ)

Upper Elevation Habitats

231 Arctic-Boreal Swampscrubs

231.6 Rocky Mountain Alpine and Subalpine Swamp and Riparian Scrub series (Greer, Alpine, AZ)

232 or the Cold Temperate Swamp and Riparian Scrubs biome

or 232.2 Plains and Great Basin Swamp and Riparian Scrub series

232.3 Rocky Mountain Riparian Scrub (Beaver Creek, CO)

222 Cold Temperate Swamp and Riparian Forests

222.3 Rocky Mountain Riparian Forest (Beaver Creek, CO)

Several sites described in the preceding discussion lie at middle elevations, and have Russian olive as a major habitat component, with varying amounts of tamarisk and/or native trees and shrubs also present. Examples include: the Rio Grande River at San Juan Pueblo, (elevation 1,716 m / 5,630 ft); the Virgin River, UT (elevation 1,100 m /3608 ft). While these sites do not neatly fit into the current categories of Brown et al. (1979), they could most appropriately be characterized as being related to the 233.22 Saltcedar Disclimax Series, *Tamarix chinensis* -Mixed Deciduous association.

6. Patch Size and Shape

The riparian patches used by breeding flycatchers vary in size and shape. They may be relatively dense, linear, contiguous stands or irregularly-shaped mosaics of dense vegetation with open areas. Southwestern willow flycatchers nest in patches as small as 0.1 ha (0.25 ac) along the Rio Grande (Cooper 1997), and as large as 70 ha (175 ac) in the upper Gila River in New Mexico (Cooper 1997).

To summarize characteristics of breeding patch size, we extracted information on patch size values from the following sources: Maynard 1994, Sogge 1995, Cooper 1996, Cooper 1997, Sogge et al. 1997a, Ahlers and White 1998, Paradzick et al. 1999, Johnson and Smith 2000, Paradzick et al. 2000, Ahlers and White 2001, Gallagher et al. 2001, SWCA 2001, Arizona Game and Fish Department unpublished data, and USGS unpublished data. Mean reported size of flycatcher breeding patches was 8.6 ha (21.2 ac) (SE = 2.0 ha; range = 0.1 - 72 ha; 95% confidence interval for mean = 4.6 - 12.6; n = 63 patches). The majority of sites were toward the smaller end, as evidenced by a median patch size of 1.8 ha. Mean patch size of breeding sites supporting 10 or more flycatcher territories was 24.9 ha (62.2 ac) (SE = 5.7 ha; range = 1.4 - 72 ha; 95% confidence interval for mean = 12.9 - 37.1; n = 17 patches). Aggregations of occupied patches within a breeding site may create a riparian mosaic as large as 200 ha (494 ac) or more, such as at the Kern River (Whitfield 2002), Roosevelt Lake (Paradzick et al. 1999) and Lake Mead (McKernan 1997). Based on the number of flycatcher territories reported in each patch, it required an average of 1.1 ha (2.7 ac) (SE = 0.1 ha; range = 0.01 - 4.75; 95% confidence interval for mean = 0.8 - 1.3; n = 63 patches) of dense riparian habitat for each territory in the patch. Because breeding patches include areas that are not actively defended as territories, this does NOT equate to an average territory size.

In some cases where a series of flycatcher breeding sites occur as closely distributed but non-contiguous patches of riparian vegetation, individuals show strong fidelity to that stretch of river but move readily among patches - between and within years. This movement and mixing of individuals occurs to such a degree that the entire reach of river appears to function as a single patch. An example of this is found along the lower San Pedro River and nearby Gila River confluence (English et al. 1999, Luff et al. 2000); here, the occupied habitat patches have an average nearest-neighbor distance of approximately 1.5 km (1 mile) (SD = 1.1 km, Range = 0.03 - 3.9; USGS unpublished data).

Flycatchers often cluster their territories into small portions of riparian sites (Whitfield and Enos 1996, Paxton et al. 1997, Sferra et al. 1997, Sogge et al. 1997b), and major portions of the site may be occupied irregularly or not at all. Recent habitat modeling based on remote sensing and GIS data has found that breeding site occupancy at reservoir sites in Arizona is influenced by vegetation characteristics of habitat adjacent to the actual occupied portion of a breeding site (Arizona Game and Fish Dept, unpublished data), therefore, unoccupied areas can be an important component of a breeding site. It is currently unknown how size and shape of riparian patches relate to factors such as flycatcher site selection and fidelity, reproductive success, predation, and brood parasitism.

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

7. Presence of Water and Hydrological Conditions

In addition to dense riparian thickets, another characteristic common to the vast majority of flycatcher nesting sites is that they are associated with lentic water (quiet, slow-moving, swampy, or still) or saturated soil. Occupied sites are often located in situations such as along slow-moving stream reaches, at stream backwaters, in swampy abandoned oxbows/ marshes/cienegas, and at the margins of impounded water, including the inflows of streams into reservoirs. Where flycatchers occur along moving streams, those streams tend to be of relatively low slope (or gradient), i.e., slow-moving with few (or widely spaced) riffles or other cataracts. The apparent association between southwestern willow flycatcher habitat and quiet water likely represents the relationship between the requirements of the bird for certain vegetation characteristics and patch size/shape, and the hydrological conditions that allow those conditions to develop. Lentic water conditions may also be important in influencing the insect prey base of the flycatcher.

Flycatcher habitat becomes established because of water flow conditions that result from the following factors (not in order of importance): seasonality/duration, gradient, width of flow, depth of flow, hydraulic roughness, sediment particle sizes for bed and banks, suspended sediment load, channel cross sectional morphology, longitudinal morphology (pool and riffle, rapids, step pools), vegetation in the channel, channel sinuosity, and channel pattern (single thread, braided, compound). It is not possible to define "suitable" or "potential" flycatcher habitat with specific values or configurations for just one or several of these factors (e.g., gradient or channel pattern), because all these factors are related to one other. The range and variety of flow conditions that will establish and maintain flycatcher habitat can arise in free flowing streams differing substantially in these factors. Also, flow conditions that will establish and maintain flycatcher habitat can be achieved in regulated streams, depending on scale of operation and the interaction of the primary physical controls. Still, very generally flycatcher habitat tends to occur along streams of relatively low gradient. However, the low gradient may exist only at the habitat patch itself, on streams that are generally steeper when viewed on the large scale (e.g., percent gradient over miles or kilometers). For example, obstructions such as logjams, beaver dams, or debris deposits from tributaries may partially dam streams, creating relatively quiet, lentic pools upstream.

By definition, the riparian vegetation that constitutes southwestern willow flycatcher breeding habitat requires substantial water. Further, hydrological events such as scouring floods, sediment deposition, periodic inundation, and groundwater recharge are important for the flycatcher's riparian habitats to become established, develop, and be recycled through disturbance. It is critical to keep in mind that in the southwest, hydrological conditions at a site can vary remarkably within a season and between years. At some locations, particularly during drier years, water or saturated soil is only present early in the breeding season (i.e., May and part of June). At other sites, vegetation may be immersed in standing water during a wet year, but be hundreds of meters from surface water in dry years. This is particularly true of reservoir sites such as the Kern River at Lake Isabella, Tonto Creek and Salt River at Roosevelt Lake, and the Rio Grande near Elephant Butte Reservoir. Human-related factors such as river channel modifications (e.g., by creation of pilot channels) or altered subsurface flows (e.g., from agricultural runoff) can temporarily or permanently dry a site. Similarly, where a river channel has changed naturally (Sferra et al. 1997), there may be a total absence of water or visibly saturated soil for several years. In such cases, the riparian vegetation and any flycatchers breeding within it may persist for several

years. However, we do not know how long such sites will continue to support riparian vegetation and/or remain occupied by breeding flycatchers.

In the geographical setting of the southwest, most streams descend from the higher elevations of their upper watersheds at relatively high slope or gradient. Drainages descend toward the lowlands through valleys and canyons where streamflow is in a single-thread channel, confined by steep banks, steep upland slopes, and/or canyon walls. Under these conditions even floodwaters do not spread far laterally from the banks, but rise vertically between the confining slopes or canyon walls. Flood-scour zones often are present at the stream margins, where riparian vegetation is absent or frequently removed. The zone of frequently-wetted land adjacent to the stream is relatively narrow, because the land rises steeply from the level of typical base streamflow (Figure 18). Also, high-gradient streams possess high erosive energy. Soil and sediment comprising streambanks is often coarse, cobbly, bouldery, or even bedrock. Such soil/sediment types are rarely associated with the wet, dense vegetation of willow flycatcher habitat. Under all the above conditions, riparian vegetation is seldom dense enough to provide flycatcher breeding habitat. Riparian vegetation is often present in much narrower configurations, usually a relatively narrow, linear growth with inadequate width to constitute willow flycatcher habitat.

In contrast, streams of lower gradient and/or more open valleys have a greater tendency to support potential willow flycatcher habitat patches. As streams reach the lowlands, their gradients typically flatten out. Simultaneously, the surrounding terrain often opens up into broader floodplains. Under such conditions streams meander back and forth, higher flow events spread shallowly across the floodplain, backwaters develop, and abandoned channels from previous stream alignments persist, often with moist conditions and riparian vegetation. The permanently-wetted perimeter of the stream (by either surface or subsurface water) is much more extensive and wider. The sediments of a lower floodplain are capable of retaining much more subsurface water, being deeper, finer, and extending farther laterally from the active stream channel. Riparian plant communities that are wider, more extensive, and more dense are able to develop. Conditions like these lower floodplains also develop where streams enter impoundments, either natural (e.g., beaver ponds) or human-made (reservoirs). Low-gradient stream conditions may also occur high in watersheds, as in the marshy mountain meadows supporting flycatchers in the headwaters of the Little Colorado River near Greer, Arizona.

In summary, suitable southwestern willow flycatcher habitat is less likely to occur in steep, confined streams as are found in narrow canyons. Flycatcher habitat is more likely to develop, and in more extensive patches, along lower gradient streams with wider floodplains. However, exceptions to this generality indicate that relatively steep, confined streams can also support significant flycatcher habitats. The San Luis Rey River in California supports a substantial flycatcher population, and stands out among flycatcher habitats as having a relatively high gradient and being confined in a fairly narrow, steep-sided valley. The San Luis Rey may not be an eccentric exception to typical flycatcher habitat settings, but instead an indication of the true range of potential habitat. Although stream gradient (and even vegetation) seem unusual there, the many other factors of hydrology and vegetation characteristics allow flycatchers to thrive. Finally, it is important to note that even a steep, confined canyon or mountain stream may present local conditions where just a portion of an acre or hectare of flycatcher habitat may develop. Such sites are important individually, and in aggregate. Flycatchers are known to occupy very small, isolated habitat patches, and may occur in fairly high densities within those patches.

Recovering and conserving such sites may be an important contribution to recovering the flycatcher.

8. Other Habitat Components

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

9. What Is <u>Not</u> Willow Flycatcher Breeding Habitat

Cottonwood-willow gallery forests that are devoid of an understory and that appear park-like do not provide breeding habitat for southwestern willow flycatchers. Similarly, isolated, linear riparian patches less than approximately 10 m (33 ft) wide do not provide breeding habitat. However, mosaics made up of aggregations of these small, linear riparian "stringers"may be used by breeding flycatchers, particularly at high elevations. Short stature (< 4 m or <13 ft) tamarisk stands as well as sparse stands of tamarisk characterized by a scattering of trees of any height also do not provide breeding habitat for flycatchers. Finally, riparian mesquite woodlands ("bosques') do not provide willow flycatcher breeding habitat, although they may be adjacent to (typically upland) nesting habitat (See Figures 18 - 20). At Ash Meadows National Wildlife Refuge, a unique exception is found where flycatchers nest in a tamarisk-mesquite association.

10. Potential Habitat

Loss of habitat is one of the primary causes for the endangered status of the southwestern willow flycatcher. As a result, a fundamental question to be addressed in recovering the bird is "where can suitable breeding habitat be re-established?" Suitable habitats arise from areas of potentially suitable habitat.

Potentially suitable habitat (hereafter "potential habitat") is defined as a riparian system that does not currently have all the components needed to provide conditions suitable for nesting flycatchers (as described above), but which could - if managed effectively - develop these components over time. **Regenerating potential habitats** are those areas that are degraded or in early successional stages, but have the correct hydrological and ecological setting to be become, under appropriate management, suitable flycatcher habitat. **Restorable potential habitats** are those areas that could have the appropriate hydrological and ecological characteristics to develop into suitable habitat if not for one or more key stressors, and which may require active abatement of stressors in order to become suitable. Potential habitat occurs where the flood plain conditions, sediment characteristics, and hydrological setting provide potential for development of dense riparian

vegetation. Stressors that may be preventing regenerating and restorable habitats from becoming suitable include, but are not limited to, de-watering from surface diversion or groundwater extraction, channelization, mowing, recreational activities, over-grazing by domestic livestock or native ungulates, exotic vegetation, and fire.

11. Unsuitable Habitat

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

12. The Importance of Unoccupied Suitable Habitat and Potentially Suitable Habitat.

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

13. Sources of Water Sustaining Breeding Sites

Although some flycatcher breeding sites are along lakes, streams, or rivers that are relatively unimpacted by human activities, most of the riparian vegetation patches in which the flycatcher breeds are supported by various types of supplemental water including agricultural and urban runoff, treated water outflow, irrigation or diversion ditches, reservoirs, and dam outflows (Table 2). Although the waters provided to these habitats might be considered “artificial”, they are often essential for maintaining the habitat in a suitable condition for breeding flycatchers. However, reliance on such water sources for riparian vegetation persistence may be problematic because the availability of the water (in quantity, timing, and quality) is often subject to dramatic change based on human use patterns; there is little guarantee that the water will be available over the long-term.

Table 2. Southwestern willow flycatcher sites dependent on supplemental water to sustain the habitat. Supplemental water type is indicated by an "X" if known and a "?" if uncertain. Sites listed would likely deteriorate in quality if supplemental water supply was terminated. Natural riparian systems where these sites occur may have supported southwestern willow flycatchers prior to disturbance, although they may have been distributed differently. In some cases, even though sites are supported by supplemental water, greater damage may be simultaneously occurring by other activities in the area (e.g., overdrafting).

Management Unit	Site Code	Agricultural / urban runoff	Sewage treatment facility or effluent outflow[1]	Irrigation or diversion canal[2]	Reservoir / dam[3]	Regulated flows[4]
Kern	KEKERN			X	X	
Mojave	MOUPNA		?			
Santa Ynez	SYVAND		X		X	
	SYBUEL	X				
	SYGIBR				X	
Santa Clara	STSATI	X			X	
Santa Ana	SAPRAD	X	X		X	
	SASNTI		X			
San Diego	SOSMCR	X	X			
	SMFALL				X	
	SMCAPE		X			
	LFAFL		X			
	SLPILG		X			
	SLGUAJ	X				
	SLSUP					X
	SLCOUS	X				
	SDSADI	?				?
	SDBATT	?				?
	SDTICA	?				?
	AHMACA	X				
	SOLALA	X				
	SUCAGO					X
Upper San Juan	SJWICR		X			
Little Colorado	LCNUTR			X		
Middle Colorado	COGC50L					X
	COG65L					X
	COG71L					X
	CO246L					X
	CO259R					X
	CO265L					X
	CO266L					X
	CO268R					X
	CO268L					X
	CO270L					X

Table 2, Continued. Southwestern willow flycatcher sites dependent on supplemental water to sustain the habitat. Supplemental water type is indicated by an "X" if known and a "?" if uncertain. Sites listed would likely deteriorate in quality if supplemental water supply was terminated. Natural riparian systems where these sites occur may have supported southwestern willow flycatchers prior to disturbance, although they may have been distributed differently. In some cases, even though sites are supported by supplemental water, greater damage may be simultaneously occurring by other activities in the area (e.g., overdrafting).

Management Unit	Site Code	Agricultural / urban runoff	Sewage treatment facility or effluent outflow[1]	Irrigation or diversion canal[2]	Reservoir / dam[3]	Regulated flows[4]
	CO272R					X
	CO273L					X
	COMEAD				X	X
Virgin	VIMESQ	X				
	VILAME				X	
	VIGEOR		X			
	VILITT	X				
Pahranagat	NLKEYP			X		
	PANRRA	X				
	PAPAHR				X	
Hoover-Parker	COBLAN					X
	COBRLA					?
	COHAVA				X	X
	COTOPO					X
	COTRAM					X
	COWACO				X	X
Bill Williams	BSLOBS				X	
	BWALMO				X	
	BWBUCK					X
	BWDEMA				X	X
	BWGEMI					X
	BWMONK					X
	SNSMLO				X	
Parker-Mexico	COADOB					X
	COCIBO					X
	COCLLA					X
	CODRAP					X
	COEHRE					X
	COFERG				X	X
	COGILA					X
	COMITT					X
	COPICA					X

Table 2, Continued. Southwestern willow flycatcher sites dependent on supplemental water to sustain the habitat. Supplemental water type is indicated by an "X" if known and a "?" if uncertain. Sites listed would likely deteriorate in quality if supplemental water supply was terminated. Natural riparian systems where these sites occur may have supported southwestern willow flycatchers prior to disturbance, although they may have been distributed differently. In some cases, even though sites are supported by supplemental water, greater damage may be simultaneously occurring by other activities in the area (e.g., overdrafting).

Management Unit	Site Code	Agricultural / urban runoff	Sewage treatment facility or effluent outflow[1]	Irrigation or diversion canal[2]	Reservoir / dam[3]	Regulated flows[4]
	COTAYL					X
	COWALK					X
Upper Gila	GIFORT			X		
	GIUBAR			X		
Mid Gila / San Pedro	GIKRNY		X			
	GIPIEA	X				
	SPINHI	X				
	SRCOTT				X	
	SRSALT				X	
	SRSCHN				X	
	SRSCHS				X	
	TOTONT					
Verde	VECAVE			X		
	VEISTE				X	
	VETAVA		X	X		
San Luis Valley	RIALAM			X		
	RIMSCP			X		
Upper Rio Grande	CHPARK			X		
	CNGUNO			X		
	RILACA				X	
	RILARI	X				
	RIGARC			X		
	RISAJU	X		X		
Middle Rio Grande	RIBOSQ			X		
	RISAMA			X	X	

[1]Pond, treated or untreated effluent. [2]Channel edge, overflow, outflow, and/or seepage.

[3]Backed up water, reservoir edge. [4]Including pumped or piped in water.

D. Migration and Wintering Habitat

The migration routes used by southwestern willow flycatcher are not well documented. *Empidonax* flycatchers rarely sing during fall migration, so that means of distinguishing species is not available. However, willow flycatchers (all subspecies) sing during spring migration. As a result, willow flycatcher use of riparian habitats along major drainages in the southwest has been documented (Sogge et al. 1997b, Johnson and O'Brien 1998, McKernan and Braden 2001). Migrant willow flycatchers may occur in non-riparian habitats and/or be found in riparian habitats that are unsuitable for breeding. Such migration stopover areas, even though not used for breeding, may be critically important resources affecting local and regional flycatcher productivity and survival.

Although little is known specifically about southwestern willow flycatcher wintering habitats, recent wintering ground surveys allow a general description of the habitats used by *Empidonax traillii* in general. Willow flycatchers can be distinguished from other *Empidonax* flycatchers on wintering grounds by the subtle distinguishing field marks, and because on wintering grounds they do emit characteristic calls, occasionally including the territorial "fitz-bew" song (Gorski 1969, Koronkiewicz et al. 1998). Unitt (1997) found no evidence that the various willow flycatcher subspecies are separated geographically on the wintering grounds. And although distinguishing the flycatcher subspecies in the field is not possible (except by in-hand examination by experts), wintering habitats occupied by any willow flycatchers are therefore likely to be representative of the southwestern subspecies. The flycatcher winters in Mexico and Central America, where they are known to sing and defend winter territories, and northern South America (Phillips 1948, Gorski 1969, McCabe 1991, Koronkiewicz et al. 1998, Unitt 1999). Popular literature on the birds of Mexico, Central, and South America describes willow flycatcher wintering habitat as humid to semi-arid, partially open areas such as woodland borders (Stiles and Skutch 1989, Howell and Webb 1995, Ridgely and Gwynne 1989). Second growth forest, brushy savanna edges, and scrubby fields with hedges as at plantations are also used. Looking specifically for wintering willow flycatchers in Panamá, Gorski (1969) found them in transitional and edge areas, often with a wetland (river, wet field) nearby. Similarly, in Costa Rica and Panamá, Koronkiewicz et al. (1998) and Koronkiewicz and Whitfield (1999) found willow flycatchers in lagunas and intermittent freshwater wetlands, muddy seeps, seasonally inundated savanna/pasture and sluggish rivers, meandering waterways and oxbows. They only found willow flycatchers in areas that consisted of these four main elements: 1) Standing or slow-moving water and wetland flora; 2) Patches of dense woody shrubs; 3) Patches and/or stringers of trees; 4) Open to semi-open areas. The most commonly used vegetation used was patches of dense woody shrubs (*Mimosa* sp. and *Cassia* sp.) approximately 1-2 m (3-7 ft) tall, bordering and extending into wet areas. In early 1999, a southwestern willow flycatcher banded on breeding grounds in southern Nevada was recaptured on wintering grounds in the Guanacaste region of northwestern Costa Rica (Koronkiewicz pers. comm). Wintering range and habitat requirements are areas of much-needed research for the southwestern willow flycatcher. See Appendix E for more detailed information.

14. Summary and Conclusion

Southwestern willow flycatchers breed in substantially different types of riparian habitat across a large elevational and geographical area. Breeding patch size, configuration, and plant species composition can vary dramatically across the subspecies' range. However, certain patterns emerge and are present at most sites. Regardless of the plant species composition or height, occupied sites always have dense vegetation in the patch interior. In most cases this dense vegetation occurs within the first 3 - 4 m (10-13 ft) above ground. Canopy cover is usually very high - typically 80% or greater. These dense patches are often interspersed with small openings, open water, or shorter/sparser vegetation, creating a mosaic that is not uniformly dense. Nesting habitat patches will tend not to be very narrow, as single rows of trees bordering a small stream. In almost all cases, slow-moving or still surface water and/or saturated soil will be present at or near breeding sites during wet or normal precipitation years. The ultimate measure of habitat suitability is not simply whether or not a site is occupied. Suitable habitats are those in which, with other significant stresses absent (e.g., cowbird parasitism), flycatcher reproductive success and survivorship results in a stable or growing population. Without long term data showing which sites have stable or growing populations, we cannot determine which habitats are suitable or optimal for breeding southwestern willow flycatchers. Some occupied habitats may be acting as population sources, while others may be functioning as population sinks (Pulliam 1988).

Unfortunately, a habitat model or template that specifically describes flycatcher breeding habitat is not available at this time. Our understanding of what is "suitable" is confounded by several observations. Even very experienced flycatcher researchers have seen what they consider to be suitable habitat go unoccupied. Specifically, at the Kern River, Whitfield (pers. comm.) notes that many individuals are not resighted as yearlings, but are resighted in later years as older breeders. This suggests that some yearling birds, although they are reproductively mature, exist as non-breeding "floaters." This would seem to be due to a shortage of breeding habitat; however, the experienced impression of researchers is that substantial amounts of "suitable" but unoccupied habitat are available. These observations likely suggest that there are subtleties of habitat suitability that researchers have not yet discerned. Even that likelihood is confused by the effects of the species' rarity, and slight tendency to be a semi-colonial nester.

E. Literature Cited

Please see Recovery Plan Section VI.