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Chapter 7:
Migration and Winter Ecology

The willow flycatcher (*Empidonax traillii*) is a Neotropical migrant that breeds in North America, but winters in Central and northern South America. Little specific information is known about migration and wintering ecology of the southwestern willow flycatcher (*E. t. extimus*) (Yong and Finch 1997). Our report applies principally to the species as a whole and not just to the endangered subspecies. In this chapter, we describe timing of migration, migration routes, stopover behavior and ecology, winter distribution, and migration and winter habitats of the willow flycatcher species complex. We also explore the topic of possible threats to migrating and wintering flycatchers associated with habitat loss and pesticide use.

A round-trip journey of 2,000 to over 5,000 miles, depending on departure locations and destinations of individuals, is required by willow flycatchers to migrate between their wintering areas and breeding grounds. Migration and wintering periods account for over half of the annual cycle of the flycatcher and are thus important for understanding the ecology, population changes, and distribution of willow flycatchers. Resource limitations, habitat disturbances, and inclement weather can reduce survivorship of Neotropical migrants during winter and migration periods (Rappole 1995, Moore *et al.* 1995), but data clarifying these relationships with respect to willow flycatchers are limited. While most protection and recovery efforts in the United States emphasize the breeding grounds, conservation strategies for the willow flycatcher would be incomplete if we neglected attention to threats and management actions on the wintering and migration grounds (e.g., Moore 2000). Population declines of the southwestern willow flycatcher may be related to problems that arise during any part of the species' annual cycle.

Migration Ecology

Willow Flycatcher Identification During Migration

Willow flycatchers are difficult to distinguish from alder flycatchers (*Empidonax alnorum*) in the field during migration (Stein 1963, Pyle *et al.* 1997) except by song, and subspecies of willow flycatchers are even more difficult to distinguish from each other (Hubbard 1987, 1999). Most individuals of willow and alder flycatchers can be separated in the hand using Stein's (1963) formula, which combines several wing measurements and bill length. To demonstrate that the migrants captured on the middle Rio Grande were willow flycatchers, Finch and Kelly (1999) applied Stein's formula and found that 88.5% of birds identified as willow flycatchers could be confirmed as willow rather than alder flycatchers (Figure 7-1). Given that Stein's formula only separates 90% of birds known to

be willow flycatchers (Stein 1963), that the presence of an alder flycatcher has never been confirmed in New Mexico (Williams 1997), and that young willow flycatchers are less distinguishable from alder flycatchers than adults, Finch and Kelly (1999) concluded that unconfirmed birds captured along the middle Rio Grande were also likely to be willow flycatchers.

Reference to specimen skins increases the probability of accurately identifying live individuals of different subspecies in the hand (Hubbard 1999, Unitt pers. comm.). Yong and Finch (1999) note, however, that collecting voucher specimens of endangered species is generally not approved under endangered species permits, limiting the availability of this option for identifying willow flycatcher subspecies captured in the Southwest. According to Unitt (1987), 90% of birds in which primary 10 is longer than primary 5 are the *E. t. traillii* subspecies and 90% of birds in which primary 10 is shorter than primary 5 are western (e*xtimu*s, *brewsteri*, or *adastus*). Using Unitt's primary-feather criteria to distinguish subspecies, we analyzed 253 middle Rio Grande migrants for this paper and found that 99 (20%) sorted into the eastern subspecies (*E. t. traillii*) class (P10 > P5). Owing to the difficulty of obtaining reference specimens of endangered species, Yong and Finch (1997, 1999) attempted to separate net captures of all four subspecies of willow flycatchers during migration using wing, tail, wing formula (relative length of flight feathers), coloration of the head and neck and its contrast with the back, and the contrast between the breast-band and the throat based on Unitt's (1987) analyses, but these measures do not guarantee accurate identifications (Hubbard 1999). Finch and Kelly (1999) applied principal components analysis of tail length, wing length, bill length, wing formula, and tarsus length of migrant willow flycatchers but found no single or combination of morphological features that readily distinguished among subspecies.

An unpublished report by Unitt (1997) provides further assistance and clarification in separating subspecies, and a peer-reviewed publication of his analysis would aid in resolving discrepancies in methods for identifying willow flycatcher subspecies. At this time, however, we conclude that in the absence of voucher specimens or proven methods to verify subspecies identification, willow flycatcher subspecies should be lumped together when reporting migration results in the Southwest.

Migration Routes

The willow flycatcher as a species breeds as far north as Alaska and winters as far south as northern South America (Unitt 1997). Stevenson (1957) reported that

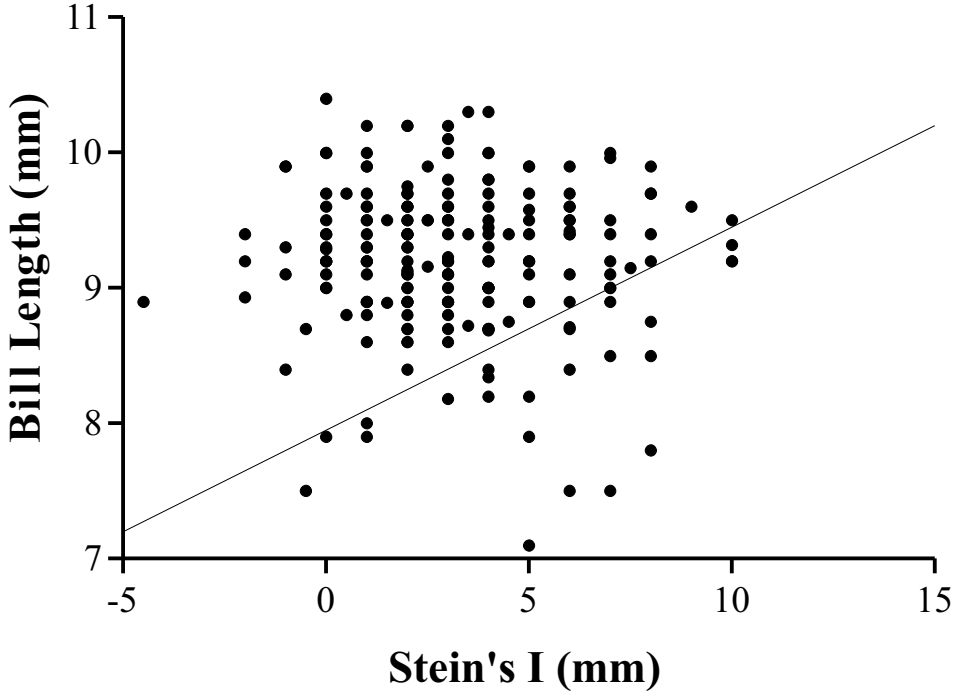

Figure 7-1. Bill length plotted against Stein's I [(length of longest primary minus length of the 6th primary) - length of the 5th primary - length of the 10th primary)]. The equation of the line is bill length = 7.95 + 0.15(I). Stein found that this line separated 90% of Willow and Alder Flycatchers. (Data from the middle Rio Grande, Finch and Kelly 1999).

trans-gulf migration of *Empidonax* flycatchers was not uncommon, but adequate support for use of this migration pattern by the willow flycatcher has not been established. Spring migration route(s) of the willow flycatcher from its winter range in the Neotropics to the United States and Canada are not well-known. Bond (1979) listed the willow flycatcher as a vagrant in Cuba, Isle of Pines, and Jamaica in September and October, and Sturgis (1928) reported it as a spring migrant through the Panama Canal Zone (a semi-Caribbean locale). On the other hand, willow flycatchers were not recorded on Grand Bahama Island (Emlen 1977), Cuba (Barbour 1923, Davis 1941), Haiti and the Dominican Republic (Whitmore and Sales 1931), British Guyana (Blake 1950), or the islands off Venezuela (Voous 1957).

McCabe (1991) suggested a circum-Gulf migration pattern, in which the alder flycatcher leap-frogged the willow flycatcher in establishing winter range, based on studies by Gorski (1969, 1971) and a range map by Fitzpatrick (1980) that showed the wintering distribution of alder flycatchers as disjunct from that of willow flycatchers and lying more to the south. Miller *et al.* (1957) recorded *E. t. traillii*, in spring from the Mexican east coast states of Oaxaca, Tamaulipas and Veracruz, and from Guerrero, Michoacan, Chiapas and Baja California on the west coast in fall. Rappole *et al.* (1979) proposed two different routes for willow and alder flycatchers based on captures of 181 migrant willow-alder flycatchers in Texas (48 km north of Corpus Christi) and 113 in Los Tuxtlas, Veracruz in fall, and 14 willow-alder flycatchers in Texas and 136 in Veracruz in spring migration. They suggested that spring migration is a westerly inland route following the western coastal plain and mid-elevations of the Sierra Madre Oriental of Mexico northward, whereas fall migration followed a western Gulf coast route.

In the Southwest, mist-netting studies and flycatcher surveys show than many willow flycatchers use riparian habitats along rivers and tributaries during migration. Greater effort is needed to survey non-riparian areas to determine extent of willow flycatcher migration and stopover use of other habitats. According to William Haas (pers. comm.), "many willow flycatchers in southern California migrate through scrub (including coastal sage scrub), agricultural valleys that are minimally riparian, and other open woodlands (especially where Mexican elderberry is common)". Willow flycatchers sing during spring migration making spring migrants easier to distinguish from other *Empidonax* flycatchers than fall migrants. Major drainages where migrating willow flycatchers have been regularly recorded in spring include the Colorado River (Rosenberg *et al.* 1991, Sogge *et al.* 1997; McKernan and Braden 1999), the San Juan River (Johnson and Sogge 1997, Johnson and O'Brien 1998), and the Green River (M. Johnson unpubl. data). In New Mexico, the willow flycatcher is known to migrate regularly in spring and fall along the Rio Grande (Yong and Finch 1997, Finch and Kelly 1999) and the Pecos River (Hubbard 1987), and occurs regularly as a migrant in the southwestern-most desert region and the eastern-most plains region of the state (Hubbard 1987).

Arrival and Departure Dates

Other subspecies of the willow flycatcher migrate through the breeding range of the southwestern subspecies, making accurate identification of arrival and departure dates of *extimus* difficult (Unitt 1987, Yong and Finch 1997, Hubbard 1999). In addition to subspecies differences in migration timing, variation in age, sex, body condition, and point of departure can influence migration arrival and departure dates (Yong and Finch 1997). Male willow flycatchers are reported to arrive on the breeding grounds before females (Bent 1942, Walkinshaw 1966). In the middle Rio Grande valley of New Mexico, adult willow flycatchers migrated through a week earlier (August 26) on average than hatching-year birds (September 2) (Yong and Finch 1997). In addition, spring and fall migration dates of willow flycatchers can vary greatly from year to year (e.g., by as many as 29 days for spring arrivals in Wisconsin (McCabe 1991), further complicating interpretations of subspecies migration periods.

Arrival and departure dates of willow flycatchers vary in relation to the latitude where the birds are recorded. Based on literature records, McCabe (1991) concluded that earliest and latest spring arrival dates of the willow flycatchers at 30-35 degrees north latitude were April 27 and May 11, respectively, whereas at 46-50 degrees north latitude, earliest and latest dates were May 26 and June 14, respectively. Earliest and latest fall departure dates were August 25 and October 8, respectively at 30-35 degrees north latitude and August 27 and September 30 at 46-50 degrees (McCabe 1991).

In Big Bend National Park, Texas, the willow flycatcher is an uncommon spring migrant from May 11-May 28 (Wauer 1985). Hubbard (1987) reported that May 5 was the earliest verified date that willow flycatcher arrived in New Mexico. Southwestern willow flycatchers usually arrive on breeding grounds between early May and early June (Muiznieks *et al.* 1994, Maynard 1995). The typical arrival date of *extimus* in southern California and southern Arizona is the first week of May (Phillips *et al.* 1964, Unitt 1987), but breeding *extimus* has been detected at Prado Reservoir as early as late April (William Haas pers. comm. citing Loren Hays pers. comm.). In the Grand Canyon, Arizona, the earliest record of a male *extimus* on a breeding territory was May 8, although

most resident breeding males were detected the third week of May (Sogge *et al.* 1997). In south-central Arizona, some *extimus* arrive as early as the third week in April (Paradzick *et al.* 1999). Yong and Finch (1997) reported that the dates of first and last captures of spring-migrating willow flycatchers netted in the central Rio Grande valley of New Mexico were May 13 and June 8, respectively. We found that spring migration (all subspecies) on the middle Rio Grande peaked in the first week of June, although flycatcher numbers and migration schedules varied by year (1994 to 1997) and by site (Figure 7-2a, b).

The spring migration of *extimus* is earlier than that of the more numerous *brewsteri* (Unitt 1987). *Brewsteri* migrants typically appear 10-15 May (Garrett and Dunn 1981), peaking in numbers through southern California around 1 June (Unitt 1987) and are still migrating north until about 20 June, depending on weather patterns (Garrett and Dunn 1981). Northbound migrants of *brewsteri* as well as other subspecies travel through areas where *extimus* has already begun breeding. To prevent mistaking other subspecies as resident *extimus* breeders, repeated surveys should be conducted from June 20-July 15 (Unitt 1987).

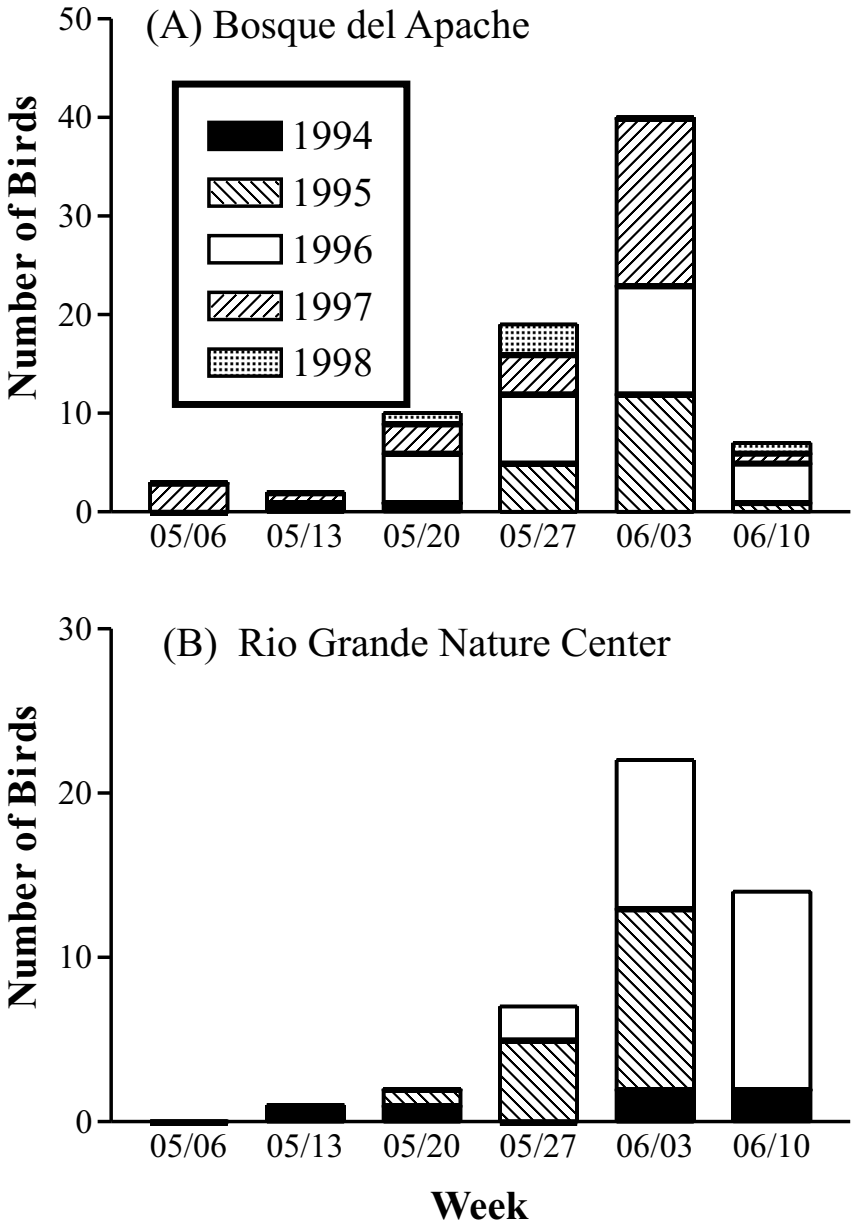

Figure 7-2. Number of willow flycatchers captured by date and year at (A) the Bosque del Apache National Wildlife Refuge (1994-1998) and (B) Rio Grande Nature Center (1994-1996), New Mexico during spring migration (data from Finch and Kelly 1999 and unpublished).

Wauer (1985) reported that the willow flycatcher was a fairly common fall migrant from July 21-September 24 each year at Big Bend National Park, Texas. Fall *brewsteri* migrants arrive in southern California by July 18 (Unitt 1987) when resident *extimus* pairs are still breeding. Earliest records reviewed by Hubbard (1987) for autumn migrants in New Mexico were July 27 (Ft. Bayard), July 29 (Cedar Crest) and July 30 (Hachita). Along the middle Rio Grande, the latest fall capture date for willow flycatchers was September 16 (Yong and Finch 1997). Our observations suggest that fall numbers of willow flycatchers, at least in the middle Rio Grande valley, can vary greatly by year and site (Figure 7-3a, b). Variation in fall numbers from year to year may be related to yearly differences in nesting success, fledgling survival, weather patterns, predation rates, or a combination of factors. Yong and Finch (1997) suggest that habitat differences among sites in the same drainage are most likely to explain site-to-site variation in migration volume. Habitat probably does not explain individual differences in migration timing within each season (Figure 7-2 *in* Finch and Kelly 1999).

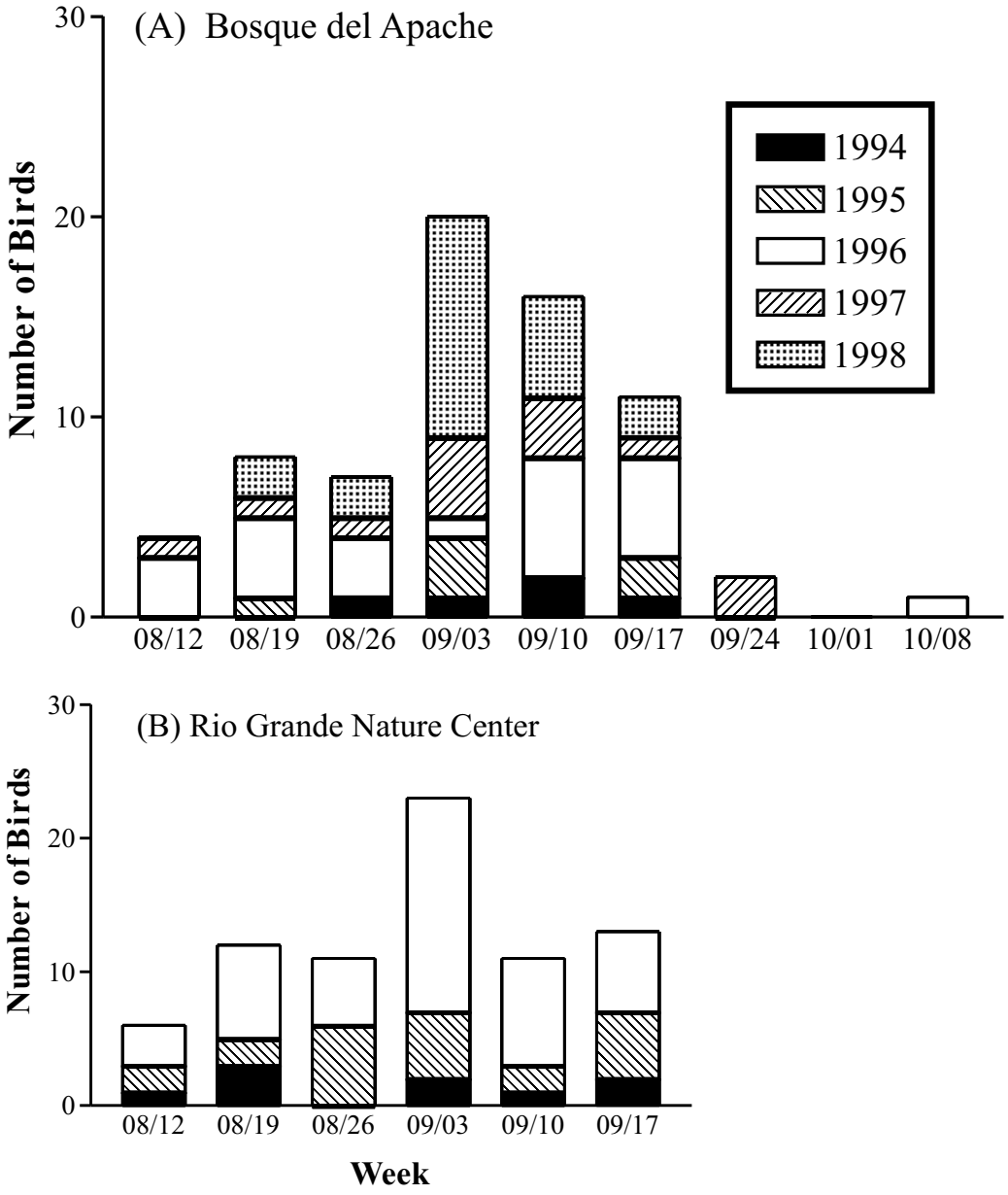

Figure 7-3. Number of willow flycatchers captured by date and year at (A) the Bosque del Apache National Wildlife Refuge (1994-1998) and (B) Rio Grande Nature Center(1994-1996), New Mexico during fall migration (data from Finch and Kelly 1999 and unpublished).

Fat Storage and Body Condition During Migration

Small landbird migrants deposit fat stores before their long-distance flights to prepare for the high energy demands of migration. Migratory birds can deposit fat stores of up to 30-50% of lean body mass (Berthold 1975). However, small landbird migrants, especially Neotropical long-distance migrants such as the willow flycatcher, generally do not deposit enough fat to fly nonstop between breeding and wintering areas. In their study of stopover migrants along the middle Rio Grande, Yong and Finch (1997) reported that 50% of the 84 willow flycatchers sampled in spring and fall had no observable subcutaneous fat stores. Average body mass of migrant willow flycatchers on the middle Rio Grande was 12.7 g and ranged from 10.3 to 15.9 g. Body mass significantly differed among fat classes. Using Pennycuick's (1989) estimator, Yong and Finch computed that average potential flight ranges for all willow flycatchers captured at their study sites was 225 km, but flight ranges were estimated at 257 km to 404 km or higher for flycatchers having fat stores.

Low fat stores could be caused by depletion of fat during nocturnal migration, which according to Moore and Kerlinger (1987), can vary in relation to wind direction and precipitation. Alerstam and Lindstrom (1990) proposed that stopover migrants may maintain low fat stores to minimize the energetic costs of flying with unnecessary weight. Owing to low fat stores, willow flycatchers may be constrained to feed at stopover sites to make progress toward their breeding or wintering destination. Based on low recapture rate (8% of total captures) and the short duration (within one day) between capture and recapture, Yong and Finch (1997) concluded that stopover length of willow flycatchers was relatively brief compared to many other species. About 70% of willow flycatchers were captured between 0700 and 0900 (spring and fall combined) along the middle Rio Grande. Average body mass of recaptures in the middle Rio Grande valley was 12.4 g at initial capture and 12.6 g at last capture, or an average change of 1.6% body mass/day. Body mass tended to be positively associated with daily time of capture in spring and fall.

Average body mass of willow flycatchers captured in spring was significantly higher than that of fall captures along the middle Rio Grande (Yong and Finch 1997). If hatching-year birds weighed less then adults, then age may explain differences in body mass between fall and spring captures. However, adults and hatching-year birds did not differ in body mass in fall. Although body mass did not vary by capture date within spring and fall migration periods, declines in wing length through spring and fall and increases in condition index (mass/wing length-3) during spring migration suggested that flycatcher condition and wing size may be related to departure times (and travel distances) of different groups or subspecies of flycatchers. Differences in departure times of sexes, and influences of interactions between sex, age, and subspecies, may also partially explain variation in body condition and wing length during spring and fall migrations.

Habitat Use During Migration

Karr (1976) recorded willow flycatchers in two shrub habitats of Panama in September, October, January and April. In Veracruz, Mexico, fall and spring willow flycatcher migrants were commonly captured in tall, evergreen tropical forest of various seral stages (Rappole *et al.* 1979). Further north near Corpus Christi, Texas, fall migrants were common in Aransas River floodplain forest but spring migrants used this forest type and/or route less frequently (Rappole *et al.* 1979). At Big Bend National Park, Texas, specimens of the willow flycatcher were taken at sites with water present during spring migration (Wauer 1985).

In New Mexico, migrating willow flycatchers have been recorded in a diversity of habitats. In the Cliff-Gila valley of southwestern New Mexico, migrants use broadleafed riparian forests with canopies composed of box-elder (*Acer negundo*), Fremont cottonwood (*Populus fremontii*), Arizona sycamore (*Platanus wrightii*), and Goodding's willow (*Salix gooddingii*), and understories of mostly native species such as *Rhus trilobata*, *Amorpha fruticosa*, shrub willow (*Salix* spp.), seep willow (*Baccharis glutinosa*), Arizona alder (*Alnus oblongifolia*) (Stoleson and Finch pers. obs.). Along the middle Rio Grande, migrating willow flycatchers use cottonwood woodlands with understories composed of native and/or exotic shrubs such as Russian olive (*Elaeagnus angustifolia*), saltcedar (*Tamarix ramosissima*), New Mexico olive (*Floresteria neomexicana*), willow (*Salix* spp.), and saltbush (*Atriplex* spp.); monotypic saltcedar habitats; irrigation ditches; and agricultural fields (Yong and Finch 1997). Migrant flycatchers have been captured in mist nets along mowed and unmowed water-conveyance channels dominated by coyote willow (*Salix exigua*) and seep willow (Finch *et al.* 1998, Finch and Kelly 1999). Hubbard (1987) reported migrant use of a desert grassland/shrubland site in the southwestern part of the state, and lake and drier sites in the eastern plains grasslands (Hubbard 1987).

A greater variety and distribution of habitats, including non-riparian vegetation, are used by willow flycatchers during migration than during breeding. Migration habitats may lack key components important for breeding birds such as the presence of standing water or moist soils and suitable patch size and structure.

Where native and non-native riparian habitats are present together, some evidence suggests that migrating flycatchers favor native vegetation, especially willow (Yong and Finch 1997, Finch *et al.* 1998, Finch and Kelly 1999). Yong and Finch (1997) reported that willow flycatcher capture rates varied substantially among riparian habitat types during spring migration as well as in fall. In a study comparing stopover use among five habitats along the middle Rio Grande, Finch and Kelly (1999) reported that capture rates of willow flycatchers were higher in unmowed coyote willow than in cottonwood, saltcedar, agricultural edge, and disturbed (previously-mowed) channel willow. A greater number of willow flycatchers were captured in disturbed willow along channels than in other habitats owing in part to greater banding effort in channel willow. Comparing relative habitat use by willow flycatchers to net hours of effort, Finch *et al.* (1998) and Finch and Kelly (1999) found that generally greater percentages were captured in disturbed and undisturbed willow along channels than expected based on the percent effort devoted to banding in that habitat. In contrast, fewer willow flycatchers were captured in agricultural edge and cottonwood habitats than that expected by netting effort expended.

Capture rates of migrant willow flycatchers may vary among habitats in relation to inter-habitat differences in food supplies within and among seasons. DeLay *et al.* (1999) found a positive association between the relative abundance of migrant willow flycatchers and the relative abundance of aerial insects in one year of a two-year study. No relationship was detected between foliage insects (beetles, plant bugs) and flycatcher abundance in either year. Arthropod abundance varied by year, season, and habitat. Habitat differences in arthropod abundance were evident during the period of spring migration but not in fall. In spring, mean numbers of arthropods per trap were highest in willow, intermediate in cottonwood, and lowest in saltcedar. The results of this study suggest that spring migration schedules and stopover habitat-use patterns by willow flycatchers may be influenced by food availability or by cues such as weather that predict *en-route* food supplies.

If food supply varies among habitats during migration periods, fat condition and body mass may depend on how successfully migrants select foraging habitats with plentiful food during stopover. Yong and Finch (1997) reported that body mass and fat condition of stopover willow flycatchers tended to differ by habitat, with heaviest birds captured in willow. However, Finch and Kelly (1999) reported that fat scores and body masses of willow flycatchers did not differ among native and non-native habitats, nor between disturbed (mowed) and undisturbed coyote willow during spring and fall migrations along the middle Rio Grande. Because sample sizes of flycatchers in these studies were small, we suggest that the relationships among habitat, food supply, and body condition during migration be investigated further.

Wintering Ecology

Distribution

Little information is known about the wintering habits of the willow flycatcher, let alone of the subspecies *extimus*. Early accounts did not distinguish between this species and the alder flycatcher. Instead, the two species were collectively described as wintering from south Mexico south through northern Argentina (Meyer de Schauensee and Phelps 1978). More recently, however, it has been recognized that the alder flycatcher alone reaches mid-South America (Howell and Webb 1995), wintering in Brazil, Bolivia, Ecuador, Peru, and northern Argentina (Stotz *et al.* 1996). In Central America, *E. alnorum* occurs only as a transient during migration (Ridgely 1976, Howell and Webb 1995). In contrast, *E. traillii*'s primary wintering grounds are Mexico from the state of Nayarit south and all of Central America (Peterson and Chalif 1973, Stiles and Skutch 1989, Howell and Webb 1995).

In Mexico and northern Central America, the willow flycatcher appears to be restricted to the Pacific Slope (Howell and Webb 1995). From Honduras south, its distribution is less known, but it appears to be present on both the Atlantic and Pacific slopes (see Stiles and Skutch 1989, Howell and Webb 1995). In Costa Rica, the willow flycatcher winters primarily on the Pacific Slope, but it may be found on the Caribbean Slope as well (Stiles and Skutch 1989). Its occurrence as far south as Panama has been well documented by Gorski (1969). Whether the willow flycatcher reaches northern South America has been debated (Gorski 1971, Stotz *et al.* 1996). Hilty and Brown (1986) do not exclude the possibility that in extreme northwest Columbia the wintering resident is *traillii* rather than *alnorum*. Everywhere else in Columbia, however, *alnorum* may replace *traillii*. Unitt (pers. com.) somewhat disagrees with this view, suggesting that the wintering distribution of the willow flycatcher includes instead all of Columbia and northwestern Venezuela while the wintering distribution of the alder flycatcher is disjunct and lies to the south, mainly in Bolivia and Peru.

On its wintering grounds in southwestern Mexico, northern Central America, and Panama, the willow flycatcher is described as fairly common to common (Ridgely 1976, Howell and Webb 1995). In Costa Rica, however, it appears to be generally uncommon as a winter resident (Stiles and Skutch 1989), except perhaps in the northwestern region of Guanacaste (see Koronkiewicz *et al.* 1998).

Based on a recent evaluation of flycatcher museum skins collected on the wintering grounds, Unitt (1997) suggested that the different subspecies co-occur rather than segregate during the winter. The relative proportions of each subspecies to the total population in a wintering area is likely to vary (Sogge pers. comm.). In addition, information is needed on whether males and females winter separately or together.

Habitat

Although varied, the primary wintering habitats for *E. traillii* indicate a preference for semi-open brushy areas often near water. Both Ridgely (1976) and Hilty and Brown (1986) contrast the habitat preference of the willow and alder flycatchers with that of other *Empidonax* spp. such as the Acadian flycatcher (*E. virescens*), the latter group being more strongly associated with woodlands and forests. The list of habitats where wintering *E. traillii* has been recorded includes thickets, shrubby clearings, second-growth scrub, woodland and forest edges, coastal lowlands, and riparian woodlands (Land 1970, Edwards 1972, Peterson and Chalif 1973, Hilty and Brown 1986, Stiles and Skutch 1989, Stotz *et al.* 1996). Habitats used by wintering flycatchers range from humid to semi-arid sites.

In Mexico, wintering flycatchers were found chiefly in coastal lowlands comprised of edge, open woodland, or scrubby habitats (Edwards 1972). A strong association between willow flycatchers and standing water has been described in Panama (Gorski 1969) and Costa Rica (Koronkiewicz *et al.* 1998). In Panama, Gorski (1969) found them in transitional and edge areas, typically near a wetland. In Costa Rica and Panama, willow flycatchers were recorded in lagunas and freshwater wetlands, muddy seeps, wet pastures, slow or meandering rivers, and oxbows, which were often bordered by fields, dense shrubby vegetation, and small groves (Koronkiewicz *et al.* 1998; Koronkiewicz and Whitfield 1999). Specific habitat elements of flycatcher wintering habitat were standing or sluggish water, patches of dense shrubs, stringers or patches of trees, and open to semi-open areas. Dense woody shrubs 1-2 m in height (e.g., *Mimosa* sp. and *Cassi*a sp.) that bordered wetlands were commonly used by willow flycatchers in winter.

Deforestation has been recognized as an important threat for many Neotropical migratory species (Finch 1991, Sherry and Holmes 1993). In light of its habitat associations, however, the susceptibility of the willow flycatcher to deforestation *per se* remains to be established. In Costa Rica, threats to this bird and its habitat may instead consist of livestock grazing, chemical use, and alteration of wetlands due to water diversion and encroachment by plantations (Koronkiewicz *et al.* 1998).

Behavior

Willow flycatchers defend winter territories for foraging, with winter and breeding territories measuring approximately the same size (Gorski 1969). Winter territories may remain relatively constant over the winter (Koronkiewicz and Whitfield 1999). With the onset of the dry season in Panama, however, individuals move to another area and establish new territories (Gorski 1969). Koronkiewicz *et al.* (1998) noted that in northwestern Costa Rica, surface waters are more widespread in the early part of the winter. As the dry season progresses, the availability of standing water diminishes, and the distribution of willow flycatchers may become more restricted.

Further research is needed to determine whether individual flycatchers return each winter to the same site or territory. Territoriality suggests that winter resource(s) may be limiting, at least some of the time, and therefore, territorial flycatchers may be defending one or more resources such as food, water, or perch sites. In Costa Rica, willow flycatchers forage within the dense foliage of woody shrubs (Koronkiewicz *et al.* 1998). Winter diet consists primarily of small insects, which they capture after a short aerial pursuit, or a sally down to the ground, or upward in the foliage (Koronkiewicz *et al.* 1998).

In general, the *fitz-bew* song is rarely heard spontaneously on the wintering grounds (Hilty and Brown 1986, but see Koronkiewicz *et al.* 1998). The *kit* or *whit* note is the call usually observed (Ridgely 1976). Willow flycatchers are apparently more aggressive in winter than alder flycatchers when confronted with playback recordings of their own songs (Gorski 1969, 1971).

Possible Threats

Landbird migrants face a variety of obstacles and threats during migration including inclement weather, landscape barriers, predators, limited food and water, and discontinuity of stopover habitat (see Moore 2000). The probability of a successful migration is likely to be increased when stopover habitats are managed with distances between stopovers in mind. Assuming flycatchers can fly nonstop about 225 km on average (up to 404 km using fat reserves) (estimated by Yong and Finch 1997), then distances between stopover habitats that exceed 225 km may be difficult for many flycatchers to negotiate. Fragmentation of stopover habitats along migration routes may therefore be a potential threat to successful migration and survival of willow flycatchers. Finch *et al.* (1998) and Finch and Kelly (1999) suggest that increasing cycle length of vegetation mowing or eliminating mowing and clearing activities along channels and ditches may improve stopover habitats for migrating flycatchers.

In some habitats, fragmentation that results in smaller habitat patches can increase predation risk at songbird nests. It is possible that predation risk for adult songbird migrants also increases with patch size although data specific to willow flycatchers during any part of their annual cycle are lacking. Given that southwestern riparian habitats are naturally discontinuous, the relationship between predation probability and habitat patch size may be weaker than in habitats naturally occurring as large blocks.

Invasion of exotic shrubs such as saltcedar and Russian olive may affect migration success and habitat use patterns if stopover habitat quality is reduced (Finch and Yong 2000). Although some evidence suggests that migrating willow flycatchers use native habitats such as willow and cottonwood more frequently than introduced habitats such as saltcedar and agricultural fields (Finch *et al.* 1998, Finch and Kelly 1999), habitats dominated by woody exotics supply more structural continuity and food resources for migration than open habitats dominated by grasses and forbs, or man-made sites of riprap banks and urban lots (Kelly and Finch 1999).

Birds eliminate water during migration, and stopovers provide the opportunity to replenish lost body fluids. The presence or absence of available water may influence migration routes, stopover probabilities, and time spent in stopovers. Willow flycatchers are commonly reported in migration near water sources. Water limitations caused by drought, irrigation, and water management activities may pose a problem for migrating flycatchers, and ensuring that water is always present in habitats used by flycatchers may be the best management solution.

Koronkiewicz and Whitfield (1999) reported that the primary threat to flycatcher wintering habitat is loss related to agricultural activities. Winter flycatcher habitats are susceptible to conversion to man-made landscapes used as livestock pastures, clearings, and agricultural plantations. Draining of wetlands used by wintering willow flycatchers will accelerate conversion to habitats associated with drier conditions. Given that wintering flycatchers frequently use habitats associated with standing or slow-moving water, reduction of water and wetlands through irrigation, draining, damming, and habitat conversion may impact survival of willow flycatchers in winter.

Wintering flycatchers forage in wetlands adjacent to, or near agricultural areas that are treated with chemicals (Koronkiewicz *et al.* 1998). They are therefore potentially exposed to these chemicals through the food they eat. Willow flycatcher deformities (Paxton *et al.* 1997) recorded on the breeding grounds may be linked to toxins ingested during any period of the annual cycle. Deformities are not reported from all southwestern willow flycatchers suggesting that deformities may be associated with site-specific effects.

Protection of riparian habitats where the flycatcher winters and migrates needs to be increased (Finch and Yong 2000). Increased research and awareness of the flycatcher's habitat requirements in winter and migration will improve management efforts. Loss and degradation of known wintering sites used by flycatchers should be avoided. Discussions with local managers and landowners may help to prevent serious habitat losses on the wintering grounds, but increased funds and incentives are needed before these concerns are likely to be addressed in a serious way. Cooperative international ventures involving governments of multiple countries and coalitions and nongovernment organizations such as Partners in Flight, Audubon Society, and World Wildlife Fund should be pursued to protect and restore wintering habitats. Along migration routes, denuded river and ditch banks and wetland edges can be substantially improved by allowing them to grow riparian vegetation in place of riprap or cement (Finch *et al.* 1998). Maintaining or adding water in or adjacent to winter and stopover riparian habitats is desirable. The presence of water can influence local arthropod abundance. Arthropods are food through the winter and supply energy for replenishing fat stores during migration.

Further research on migration routes used by flycatchers is needed to improve efforts to protect and restore habitats and recover flycatcher populations. A better understanding of wintering distribution and habitat use patterns by flycatchers is also needed for conserving winter habitats. Increased emphasis on conservation and protection of winter and migration habitats should not supplant habitat management goals and activities on the breeding grounds.

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