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

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

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

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

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

Growing human populations and demands on natural resources throughout the tropics pose threats to the winter habitats of many neotropical migrants (Terborgh 1989), including the Willow Flycatcher. Although a topic of concern (Morse 1980, Holmes and Sherry 1992), the availability of wintering habitat, and the nature and extent of impacts and threats to that habitat, have received little research attention. Central America has experienced a long history of disturbance from various land use practices, and high rates of deforestation and growing human populations have caused dramatic changes to the Pacific lowlands, which comprise the majority of the winter range of the Willow Flycatcher. Although deforestation and slash-and-burn agriculture were practiced in some areas during pre-conquest periods (Katz 1972, Coates 1997), the arrival of the Spanish in the 1500s initiated largerscale changes through the introduction of intensive agricultural techniques and livestock. Even greater landscape changes, including some of the highest rates of deforestation worldwide, have occurred in the past 40–60 years in association with rapid human population growth (Jones 1990, Houghton et al. 1991, Hartshorn 1992).

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

METHODS

STUDY AREA

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

SELECTION OF SURVEY LOCATIONS

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

HABITAT SURVEYED

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

SURVEY TECHNIQUE

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

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

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

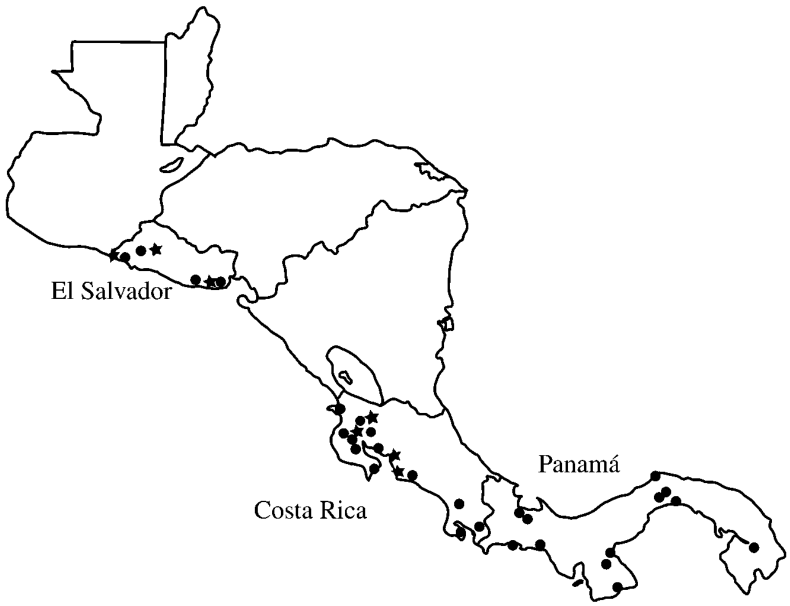

FIGURE 1. Willow Flycatcher winter survey locations in El Salvador, Costa Rica, and Panama. Dots indicate areas with one location; stars indicate areas with two locations.

the year with the largest number of flycatcher detections.

RESULTS

SURVEY EFFORTS

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

RESPONSE TO TAPE PLAYBACK

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

HABITAT CHARACTERISTICS

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

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

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

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

THREATS

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

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

Agricultural crops from small-scale and large-scale farms were grown within 200 m of 69 of the 154 survey sites, including 39% of occupied sites (Table 1). Agricultural and silvicultural crops found at survey sites included sugar cane, oil palm, rice, teak, and other commercial crops, as well as crops grown on small subsistence farms such as sorghum, corn, beans, and melons. Large-scale commercial crops dominated large areas of lowland landscapes, and occupied winter habitats generally remained only as small fragmented patches surrounded by agricultural land (Fig. 4).

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

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

DISCUSSION

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

HABITAT

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

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

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

SURVEY TECHNIQUE AND EFFORT

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

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

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

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

Cattle Grazing and Agricultural Activities

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

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

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

FIGURE 4. Willow Flycatcher winter habitat along Quebrada Pese, Panama. Sugar cane plantations surround the gallery forest and woodland.

growth of permanent towns and villages and conversion of native habitats to pasture land. This conversion from wooded areas to pasture has been one of the most significant changes in land use throughout Latin America (Hartshorn 1992, Kaimowitz 1996); overall, from 1981 to 1990, more than 75 million ha of forested land were converted to cattle pastures (Houghton et al. 1991). We found flycatchers using grazed areas that still contained scattered woody vegetation; thus, the presence of cattle itself did not preclude presence of flycatchers. However, cattle ranching can cause major impacts to Willow Flycatcher habitat. The most extensive habitat impacts occur from the practice of clearing entire areas of shrubs and trees to create open pastures. These intensively cleared pastures are maintained by removing woody vegetation, rendering the site unsuitable for wintering Willow Flycatchers. Although grazing may have created Willow Flycatcher habitat by opening up areas in otherwise dense forests, lands intensively

FIGURE 5. Willow Flycatcher habitat at Laguna El Jocotal, El Salvador. Site was approximately 400 m from water at the time of surveys, but contained standing water from September through November.

managed for cattle pasture do not preserve or provide Willow Flycatcher winter habitat.

Large-scale permanent agriculture has also been encroaching on wetland habitats in Central America since the 1500s (Browning 1971), with modern agricultural practices playing a major role in the conversion of wetlands and woodlands, and the degradation and contamination of lowland areas (Murray 1994, Biesanz et al. 1999). Streams and rivers were diverted for irrigation, and in many areas, fertile wetlands were drained completely to make way for large-scale plantations and export crops such as cotton, rice, and African oil palm. As a result, freshwater wetlands are increasingly scarce along the Pacific slopes of Central America. Like intensive cattle grazing, most agricultural fields are cleared of trees and shrubs, rendering them unsuitable as Willow Flycatcher habitat. The few remaining trees (usually only one or two individuals wide) at these fields are generally planted along property lines and fence lines, or are remnant of the riparian forest once found along *quebradas* bordering the fields. Without the other key components of flycatcher habitat nearby, such strips of trees do not comprise suitable flycatcher habitat.

Our cursory examination revealed a high potential for agrochemical impacts at some sites in El Salvador (Laguna de Olomega, Laguna El Jocotal, Laguna San Juan, and Barra de Santiago) and Costa Rica (Bebedero, Canas, and Coto 44), where vegetable crops and sugar cane fields are in close proximity to shorelines, riverbanks, and major irrigation canals. Agrochemicals are widely used on crops throughout Central America; however, their effects on the surrounding environments and ultimately their effects on Neotropical migrants have not been well studied. These pesticides and herbicides leach into rivers and streams and/or enter the water directly as run-off. Although organochlorides such as DDT are rarely used in Costa Rica, Panama, and El Salvador, other highly toxic pesticides and herbicides are common. Many chemicals, though less persistent than organochlorides, can accumulate to toxic levels in birds, decrease local faunal diversity, and cause declines in insect populations (Eisler 1985b, Hooper et al. 1990, Iolster and Krapovickas 1999). If overwintering habitat suitability for insectivorous migrants, such as the Willow Flycatcher, is related to insect availability, agrochemicals that reduce local insect populations may increase competition for food, increase foraging costs, and reduce fat reserves and overall fitness (Gard and Hooper 1995).

The Role of Protected Areas

Neotropical migrants require suitable sites in which to over-winter, and protection of wintering habitat is one method to help ensure their conservation. However, conservation of natural resources and the establishment of national parks and preserves face many obstacles in Central America, including government and international funding constraints, lack of environmental education, and high demands on remaining natural resources. Furthermore, most protected areas are located in high elevation cloud forests, lowland rainforests, tidal and salt-water marshes, and coastal mangroves; thus, they do not include suitable Willow Flycatcher winter habitat. As of 2000, 14 of 24 Central American Ramsar sites (wetlands of international importance) were located in El Salvador, Costa Rica, and Panama (totaling 425,366 ha); only seven (one in El Salvador, four in Costa Rica, and two in Panama) contain freshwater *lagunas* or seasonally inundated floodplains (Ramsar List 2001) with potential for suitable Willow Flycatcher habitat. There may be a perception that the freshwater wetland areas that persist in Pacific lowland agricultural areas are so heavily impacted that they are of low habitat value and not deserving of conservation attention or funds; this is certainly not the case for the wetlands that support wintering Willow Flycatchers.

Despite administrative protection, deforestation and contamination continue to plague existing protected areas occupied by Willow Flycatchers. One example is Laguna El Jocotal in El Salvador, which was designated a nationally protected area in 1996, and is the country's only Ramsar site (Ramsar List 2001). In 2000, the El Salvador Ministry of Environment and Natural Resources acknowledged contamination and over-fishing at El Jocotal (Joma 2000); local park personnel now patrol the *laguna*, but regulations are rarely enforced. During our surveys, cattle were seen grazing the shorelines and in shallow waters. Local residents use the *laguna* to wash laundry with harsh detergents, and plastic containers from bleach and other products were seen along the shoreline. Despite such challenges, the protection of wetlands and associated habitat, even with minimal regulation, may be an important step for preserving the Willow Flycatcher.

Recommendations for Future Studies

The relative lack of observations and records of Willow Flycatchers on the wintering grounds is in part due to the difficulties in positively identifying *Empidonax* species, and many general inventories, Christmas bird counts, and lists provided by birders and ornithologists identify flycatchers only to the genus *Empidonax.* In order to develop and prioritize conservation and management strategies for the Willow Flycatcher, we need a better understanding of its distribution and ecology on the wintering grounds. Our study provides Willow Flycatcher distribution data for some areas of El Salvador, Costa Rica, and Panama, but many unsurveyed areas remain and may contain suitable habitat. Additional surveys are needed, particularly at the northern and southern extents of the winter range and along a wider range of elevations.

Quantitative habitat studies are needed to better understand habitat requirements and to more precisely identify habitat availability on the winter range. It would also be valuable to determine if remote-sensing data and GIS can be used to accurately identify areas of wintering habitat. Research is needed to determine if distribution and habitat use vary by sex and/or subspecies, to document overwinter survivorship, and to characterize the effects of seasonal water changes on habitat selection. Studies are also needed to determine if flycatchers move, within and between sites, in response to seasonal changes in the presence of surface water/saturated soil. Ongoing studies at relatively large flycatcher sites in Costa Rica (Koronkiewicz and Sogge 2000) suggest winter territoriality, and high return rates and site fidelity for wintering Willow Flycatchers. Comparative studies are needed to determine if this is also true for smaller, more isolated, and/or more fragmented winter habitats throughout the flycatcher's winter range.

Finally, quantitative data are needed to more accurately assess the threat of land management practices, particularly agrochemical use, to wintering Willow Flycatchers and their habitat. Our survey project was not designed to detect the presence of agrochemicals or other environmental contaminants in flycatchers or their habitats, or to determine what effects such chemicals might have on wintering flycatchers. Given our observations of contaminated waterways, and the nature and extent of the agricultural activities that occur near wintering sites, detailed contaminant studies are warranted. Chemical analysis of water and/or soil samples at flycatcher wintering sites could identify areas where contaminants pose a threat. Furthermore, as has been done on the breeding grounds (Mora et al. *this volume*), chemical analysis of insects and surrogate bird species at wintering sites would help determine if contaminants are likely accumulating at harmful levels within locally wintering flycatchers.

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APPENDIX. WILLOW FLYCATCHER WINTER SURVEY EFFORT AND RESULTS FOR EL SALVADOR, COSTA RICA, AND PANAMA, JANUARY AND FEBRUARY 1998–2000

Country	Survey location	Year	Coordinates	Number of sites surveyed	Survey hours	Number of Willow Fly-catchers detected	Flycatchers per survey hour
El Salvador	Rio Paz, Ahuachapan	2000	N 13°47.71′ W 90°06.77′	1	1	4	4.00
	Rio Guayapa, Ahuachapan	2000	N 13°43.32′ W 89°59.06′	1	1.1	24	21.82
	La Barra de Santiago, Ahuachapan	2000	N 13°41.52′ W 89°56.58′	1	8.4	35	4.17
	Lago Coatepeque, Santa Ana	2000	N 13°50.82′ W 89°34.18′	1	1.5	0	0.00
	Colima, Cuscatlan	2000	N 14°02.75′ W 89°07.39′	2	3.4	10	2.94
	Suchitoto, Cuscatlan	2000	N 13°58.34′ W 89°01.54′	2	7.0	13	1.86
	Bosque Nancuchiname, Usulutan	2000	N 13°20.48′ W 88°43.14′	1	2	30	15.00
	Laguna de Olomega, San Miguel	2000	N 13°19.94′ W 88°01.18′	11	11.9	30	2.52
	Laguna de San Juan, San Miguel	2000	N 13°22.08′ W 88°09.58′	1	2.6	35	13.46
	Laguna El Jocotal, San Miguel	2000	N 13°19.15′ W 88°14.59′	7	11.9	93	7.82
El Salvador total				28	50.8	274	
Costa Rica	Parque Nacional Santa Rosa, Guanacaste	1999	N 10°51.10′ W 85°36.88′	5	21.5	0	0.00
	Bebedero, Guanacaste	1998	N 10°21.12′ W 85°10.50′	4	24.5	1	0.04
	Canas, Guanacaste	1999	N 10°21.21′ W 85°5.96′	2	13.8	0	0.00
	Tempate, Guanacaste	1999	N 10°22.10′ W 85°43.18′	4	23.2	1	0.04
	Parque Nacional Palo Verde, Guanacaste	1999	N 10°20.90′ W 85°16.92′	5	22.4	0	0.00
	Bolson, Guanacaste	1999	N 10°21.31′ W 85°25.17′	5	43.4	26	0.60
	Puerto Humo, Guanacaste	1999	N 10°17.97′ W 85°24.98′	2	12.8	1	0.08
	Santa Cruz, Guanacaste	1999	N 10°19.74′ W 85°38.97′	5	34.6	26	0.75
	Solimar, Guanacaste	1999	N 10°16.54′ W 85°8.80′	5	21.5	54	2.51
	Hojancha, Guanacaste	1998	N 10°6.30′ W 85°22.01′	3	8.6	0	0.00
	Punta Piedra, Guanacaste	1998	N 9°42.57′ W 85°1.00′	3	9.1	0	0.00
	Chomes, Puntarenas	1999	N 10°4.16′ W 84°53.96′	4	23.0	28	1.22
	Boca de Barranca, Puntarenas	1999	N 9°53.42′ W 84°40.75′	4	15.0	9	0.60
	Tarcoles/Agujas, Puntarenas	1999	N 9°51.05′ W 84°33.90′	6	18.3	3	0.16
	Punta Coyote, Caletas	1999	N 9°45.59′ W 85°16.07′	4	9.8	8	0
	Rio Palo Seco, Puntarenas	1999	N 9°34.35′ W 84°18.70′	8	26.6	26	0.98
	Buenos Aires, Puntarenas	1999	N 9°6.65′ W 83°20.46′	13	28.7	0	0.00

APPENDIX. CONTINUED.

Country	Survey location	Year	Coordinates	Number of sites surveyed	Survey hours	Number of Willow Fly-catchers detected	Flycatchers per survey hour
	San Vito, Puntarenas	1999	N 8°49.65′ W 82°57.04′	3	5.8	0	0.00
	Coto Colorado/44, Puntarenas	1999	N 8°33.72′ W 82°57.47′	8	32.4	10	0.31
	Puerto Jimenez, Puntarenas	1999	N 8°30.93′ W 83°17.65′	7	33.5	9	0.29
Costa Rica total				100	428.5	202	
Panama	Road to Almirante, Bocas del Toro	2000	N 9°00.24′ W 82°15.99′	2	2.8	0	0.00
	Río Guabo, Bocas de Toro	2000	N 8°56.99′ W 82°11.29′	2	2	0	0.00
	San Felix/Las Lajas, Chiriqui	2000	N 8°10.61′ W 81°51.63′	3	5.6	7	1.25
	Paris, Herrera	1999	N 8°6.18′ W 80°34.01′	3	13.0	0	0.00
	Pese, Herrera	2000	N 7°53.20′ W 80°32.43′	1	4.8	14	2.92
	Tonosi, Los Santos	2000	N 7°26.85′ W 80°22.32′	3	19.7	18	0.91
	Tocumen Marsh, Panama	2000	N 9°04.09′ W 79°22.43′	2	10.9	8	0.73
	Gamboa, Panama	2000	N 9°07.24′ W 79°43.61′	2	5.1	3	0.59
	Boca de Pacora, Panama	2000	N 9°02.30′ W 79°18.17′	2	2.5	0	0.00
	Lago Alajuela, Colon	2000	N 9°11.40′ W 79°33.97′	2	2.3	0	0.00
	Portobelo, Colon	2000	N 9°33.95′ W 79°34.58′	1	2	4	2.00
	El Real, Darien	2000	N 8°06.40′ W 77°43.98′	3	11.3	12	1.06
Panama total				26	82.0	66	