Winter Distribution of the Willow Flycatcher (*Empidonax traillii*) in Ecuador and Northern Mexico

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EXECUTIVE SUMMARY

Concern for the southwestern willow flycatcher (*Empidonax traillii extimus*) has stimulated increased research, management, and conservation of the species on its North American breeding grounds. To supplement current knowledge of breeding populations, recent studies in Latin America (Koronkiewicz et al. 1998; Koronkiewicz and Whitfield 1999; Koronkiewicz and Sogge 2000; Lynn and Whitfield 2000, 2002; Nishida and Whitfield 2003, 2004) have focused on wintering ecology. We extended these efforts by surveying for willow flycatchers from 8–24 December, 2004 in northern Mexico and 18–28 January, 2005 in Ecuador. Our goals were to identify territories occupied by wintering willow flycatchers, describe habitat in occupied areas, collect blood and feather samples, collect colorimeter readings, relocate banded individuals, and identify threats to willow flycatcher populations on the wintering grounds.

We spent a total of 103.7 survey hours at 30 survey sites in northern Mexico and Ecuador. In northern Mexico, we surveyed four new locations and revisited three locations from our initial 2002 surveys of Mexico. We detected a minimum of 52 willow flycatchers (Sinaloa = 2, Nayarit = 50). In Mexico, occupied habitat was found along the Pacific coast lowlands. In Ecuador, we revisited locations that had been surveyed annually since 2003 (except Sani, which was surveyed 2004–2005) and found high willow flycatcher densities at a new location along the Río Coca. During surveys, we detected 53 willow and 9 alder flycatchers (*Empidonax alnorum*). Occupied habitat in Ecuador was found primarily on river islands along the Río Napo. These islands were dominated by a mix of caña (*Gynerium sagittatum*) and *Tessaria*. We attempted to band flycatchers at detection sites and spent 104.9 banding hours to catch 41 willow and one possible alder flycatcher. While in Ecuador, we were only able to resight four of 23 banded willow flycatchers (17.4%). This is low when compared to resighting rates for Costa Rica (43% at Bolsón, 77% at Chomes; Koronkiewicz 2002) or southern Mexico (64% Guerrero, Oaxaca, and Chiapas; Nishida and Whitfield 2004). We were able to recapture two previously banded willow flycatchers (San Blas, Mexico and Hacienda Johanna, Ecuador). Both were banded by our survey teams during previous years and were located in the same territories.

Currently it appears that the amount of wintering willow flycatcher habitat in Mexico, Central America and Ecuador is not a limiting factor. However, this observation based conjecture needs to be tested with a multiple scale habitat analysis conducted in several different countries. The potential for alteration and loss of habitat are the two most significant threats to willow flycatchers on the wintering grounds. In Mexico, willow flycatchers often use habitats that are affected either by agriculture or cattle ranching. In Ecuador, willow flycatchers use primary successional habitat that is both created and destroyed by flooding. This habitat occurs primarily on river islands along the Río Napo in a region that may be threatened by oil extraction and mining operations. Our work indicates

that many aspects of wintering distribution and ecology of willow flycatchers are still unknown, including the potential impacts of natural and human-related disturbance. We recommend five avenues for future studies: 1) expanded survey coverage in Nicaragua, Venezuela and Peru; 2) further assessment of return rates and site fidelity; 3) use of colorimetric and genetic techniques to identify the subspecies and sex of captured individuals: 4) multiple scale habitat analysis in wintering areas in Mexico, Central America and Ecuador and 5) investigation of the effects of pesticides and agriculture on willow flycatcher individuals and populations.

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INTRODUCTION

Willow flycatchers (*Empidonax traillii*) are neotropical migrants that breed throughout most of the United States and southern Canada. After three to four months on their breeding grounds, they migrate to Latin America. They spend their winters in north-central Mexico through Central America to northern South America. Although willow flycatchers spend the majority of their life south of the United States border, not enough is known about the distribution and ecology of the species on its wintering grounds.

There are four recognized subspecies of willow flycatcher (*Empidonax traillii adastus, E. t. brewsteri, E. t. traillii, E. t. extimus*) (Unitt 1987, Browning 1993). The southwestern subspecies (*E. t. extimus*) has declined to such an extent that it is listed as federally endangered (USFWS 1995). *E. t. extimus* is a riparian obligate currently found in the southwestern United States (Unitt 1987, Sogge et al. 1997). Habitat degradation is considered the major cause of population declines in the southwest (Unitt 1987, Whitfield and Sogge 1999).

Although only *E. t. extimus* is federally listed, it is difficult to focus winter habitat conservation and management research only on the southwestern subspecies. Willow flycatcher subspecies are virtually impossible to differentiate in the field with the only visual differences being slight variations in color and morphology. Since there is no way to reliably separate the subspecies on the wintering grounds, it is important to gather as much information about the distribution and ecology of the entire species throughout Latin America.

Increased demands on natural resources resulting from the proliferation of human populations have the potential for serious threats to wintering habitat for willow flycatchers. In Mexico, ranching was introduced in the 1500s with the arrival of the Spanish which initiated large scale changes upon the landscape as ranching became one of Mexico's most important industries (Dusenberry 1963, Lynn and Whitfield 2002). Even more destructive landscape changes have occurred in Mexico during recent times, especially in the last 40–60 years with the explosion in human populations. During this period, Mexico has had some of the highest rates of deforestation worldwide (Jones 1990, Houghton et al. 1991, Hartshorn 1992). Habitat loss and pesticide use are suspected as possible threats to willow flycatchers on their wintering grounds (USFWS 1995, Koronkiewicz et al. 1998, Lynn and Whitfield 2002).

In the western Amazonian lowlands, about 95% of the forests have been converted to agricultural lands with banana plantations accounting for most of this (Rachowiecki 2001). The top three exports of Ecuador are oil, bananas, and shrimp. In addition, a large road system was built through and fragmented forests in the Eucadorian Amazonian lowlands since the discovery of oil. Colonists followed the roads and triggered an exponential increase in forest destruction for logging and cattle ranching (Rachowiecki 2001).

According to breeding bird surveys, all subspecies of willow flycatchers have declined across their breeding range from 1966 to 2003 (Sauer 2003). Threats to the populations and current management needs have been identified within the breeding ranges of the western subspecies of willow flycatchers (Unitt 1987, Finch and Stoleson 2000, Green et al. 2003). However, to effectively manage the population in perpetuity, we need to identify management needs on the wintering grounds as well. An understanding of willow flycatcher winter habitat characteristics and the effects of current land use practices is crucial to identify the limiting factors affecting flycatcher populations in Latin America.

OBJECTIVES

To improve understanding of the distribution and ecology of the willow flycatcher in Latin America, we had six objectives:.

1. Locate and describe occupied willow flycatcher winter habitat in northern Mexico and Ecuador.
2. Identify and compare common habitat characteristics.
3. Obtain blood samples for future work on subspecies and gender determination.
4. Obtain feather samples for identification of a geographic signature using stable isotopes.
5. Collect colorimeter readings for future work on subspecies determination.
6. Identify and describe any potential threats to wintering flycatchers and their habitats.

METHODS

STUDY AREAS

Survey sites were selected based on willow flycatcher distribution information gathered from museum specimen records (Unitt 1997), field guides (Howell and Webb 1995, Ridgely and Greenfield 2001) and ornithologists familiar with the areas, including Steven N.G. Howell (1999 pers comm.), Paul Coopmans (1998, 2002 pers comm.), Marco Gonzales, and Xico Vega Picos (2004 pers comm.). Within each geographical location, we selected several habitat patches as sites to conduct surveys. Only sites readily accessible by roads, rivers or other transportation corridors were considered.

Mexico
We surveyed 21 sites in seven different geographic locations in northern Mexico (two sites were previously visited in 2002, the other 19 sites were new). Survey locations occurred along the Pacific lowlands of northern Mexico. Latitudes and longitudes extended from 25° 34' N, 108° 27' W at Guasave, Sinaloa to 21° 32' N, 105° 13' W at San Blas, Nayarit. Elevations ranged from 0–200 m above sea level. The Pacific lowlands are characterized by two distinct seasons of wet and dry. These seasons are of roughly equal duration. *Invierno*, the rainy season, lasts from May until October and is followed by *Verano*, the dry season, from November until April. We surveyed the sites during the dry season from December 8 to December 24.

Ecuador
Nine sites in five different geographical locations were surveyed in eastern Ecuador (seven of nine sites were surveyed from 2003–2004). The Sani site was surveyed annually starting in 2004, and surveys along the Río Coca were added in 2005. Surveys conducted at Hacienda Johanna near Tena were located in secondary forest and pasture bordered by secondary forest. All other surveys occurred on river islands along either the Río Napo or Río Coca in primary successional habitat. Latitudes ranged from 00° 27' S at Sani to 01° 04' S at Jatun Sacha. Longitudes extended from 077° 49' W at Hacienda Johanna near Tena to 076° 12' W at Sani. Elevations ranged from 220–540 m above sea level. Seasonality in Ecuador varies by region. Our surveys all occurred in the northern Oriente region of Ecuador. In general, the dry season lasts from December through March and the rainy season lasts from April through November in the northern Oriente. Our surveys in Ecuador occurred in January, during the early part of the dry season. The climate of this region is considered hot and humid. Temperatures range from 20–30 degrees Celsius combined with a minimum humidity of 80% and precipitation levels consistently over 3,000 mm annually (Smith 1996).

SURVEY TECHNIQUE

Surveys were conducted from 8–24 December, 2004 in the Mexican states of Sinaloa and Nayarit and from 18–28 January, 2005 in the Napo and Orellana provinces of Ecuador. Our survey protocol followed Sogge et al (1997) with slight modifications for use on the wintering grounds (Koronkiewicz and Whitfield 1999, Nishida and Whitfield 2003). Initially, observers would listen quietly for 1–3 minutes for any spontaneous vocalizations. MP3 players were used to broadcast willow flycatcher vocalizations at volumes similar to naturally singing birds. Song was broadcast for 15–30 seconds followed by a 2–4 minute listening period. Transects were walked through the vegetation if possible or along the periphery if not. Playback stations were spaced 20–40 m apart depending on the density of the vegetation. Sites were only considered willow flycatcher habitat if a "fitz-bew" vocalization was heard. If a flycatcher was located, but not confirmed as a willow flycatcher, transects were interrupted to obtain an affirmation of species identity. However, these interruptions were limited to a maximum of 30 minutes.

We measured distances to the nearest town, road, or other landmark using Garmin© hand-held GPS (Global Positioning System) units, maps, or the car's odometer reading. We used the GPS units to: measure the length of each survey, determine elevation, record both survey and detection coordinates, and determine the distance between detections and/or capture of individuals between years. We recorded the start time, duration, and location of each willow or alder flycatcher (*Empidonax alnorum*) detection. We recorded whether a bird was detected prior to or after taped broadcast, its band status, its response or indifference to conspecific vocalizations, and any additional behavior observed while surveying. For each site we recorded general habitat characteristics including distance to water sources, genera of dominant trees and shrubs, estimated canopy heights, severity of human related disturbance, and evidence of any other threats to flycatcher persistence (Appendix 1). Genus and species of trees, shrubs, and herbaceous vegetation were included when known. We included sketches of each survey site depicting the survey route, important landmarks, water sources, and areas where flycatchers were detected. Land ownership and management information was included whenever possible.

Sites in Ecuador were surveyed previously for willow and alder flycatchers (2003–2004). Therefore surveying for new flycatchers was an ancillary and not primary objective during 2005 surveys. Since new flycatchers were discovered while attempting to resight previously banded willow flycatchers, all survey hours in Ecuador were a combination of survey and resighting efforts. Also, vocalizations of alder flycatcher were played in locations where alder flycatchers were seen previously or if the "pit" vocalization was heard. Playing alder flycatcher vocalizations always preceded those of willow flycatchers since the latter is considered behaviorally dominant over the former (Stein 1963, Prescott 1987). Sites were only considered alder flycatcher habitat if the "fee-bee-o" vocalization was heard.

Banding Technique

Banding efforts occurred during the morning from sunrise until flycatcher activity waned (typically between 6–11 am). Since time was often the limiting factor, banding locations were chosen based on accessibility of the site, proximity to other willow flycatchers, and catchability of individuals (presence of suitable habitat to erect nets combined with the behavior and flight pattern of the bird). We used playback of pre-recorded willow flycatcher vocalizations to lure birds into mist nets. Two speakers were placed on either side of the net to entice birds following the methods described by Sogge et al (2001). Once a flycatcher was captured, an aluminum USFWS band was placed on the right leg. In previous years, this band was silver in color but starting in 2004, we changed to USFWS band anodized a bronze color so that flycatchers banded on the wintering grounds could be easily distinguished from those banded by others. We collected blood samples for subspecies analysis using a toenail clip technique and stored blood in a 2% sodium dodecyl sulfate buffer solution. Body, primary covert, and the fifth primary feathers were collected for isotope analysis. Measurements taken included wing chord and tail length, culmen width and length, fat score, flight feather wear, molt patterns, and weight. When possible, birds with extreme wing chord measurements were given a preliminary assessment of sex. Differences in flight feather wear patterns were used to ascertain age whenever feasible. In addition, colorimeter measurements were taken on the feathers of the crown and back. We recorded capture and processing times and used a Garmin hand-held GPS unit to mark the location. We spent greater effort capturing unbanded flycatchers in Mexico than in Ecuador because most of the sites in Mexico had not previously been surveyed.

RESULTS

Survey Effort

In 2004, we conducted surveys from 8–24 December in the states of Sinaloa and Nayarit, Mexico. During 2005, we conducted surveys from 18–28 January in the Napo and Orellana provinces of Ecuador. Because willow flycatcher activity and response to playback are greatest between 0600–1000 and 1600–1800 hours, we limited our surveys to these times whenever possible. Only 5.1% of the total survey hours fell outside the times deemed optimal (5.3 of 103.7 survey hours). In addition, these digressions were only permitted if weather conditions seemed mild enough for flycatchers to still be active beyond the suggested time cutoff.

Table 1: Willow flycatcher survey efforts

Survey Location [a,b,c]	Sites Surveyed	Number of Surveys	Survey Hours	Banding Hours	Total Hours
Ecuador					
Hacienda Johanna[a]	1	4	10.0	10.9	20.9
Jatun Sacha[a]	1	2	5.2	5.6	10.8
Moñdana[a]	2	7	8.8	11.3	20.2
Coca[a]	2	5	11.3	11.0	22.2
Sani[b]	3	6	12.4	24.0	36.4
Subtotal	**9**	**24**	**47.7**	**62.8**	**110.5**
Mexico					
Guasave	1	1	2.5	N/A	2.5
Guamuchil[c]	4	6	12.9	N/A	12.9
Culiacan	3	5	4.1	N/A	4.1
Mazatlan [c]	4	8	9.1	N/A	9.1
Teacapan	4	7	10.2	N/A	10.2
El Novillero	3	4	7.3	10.8	18.1
San Blas [c]	2	5	9.9	31.3	41.2
Subtotal	**21**	**36**	**56.0**	**42.1**	**98.1**
Total	**30**	**60**	**103.7**	**104.9**	**208.6**

[a] Sites surveyed annually since 2003
[b] Sites surveyed annually since 2004
[c] Sites also surveyed during 2002

Mexico

We conducted 36 surveys during 56.0 survey hours (Table 1, Appendix 2). We detected a minimum of 52 willow flycatchers (Table 2) at 42.9% of locations (3 of 7 locations) and 38.1% of sites (8 of 21 sites). Sinaloa and Nayarit were quite different with regards to willow flycatcher residence. We detected willow flycatchers at 77.8% of survey sites in Nayarit (7 of 9 sites) and only 8.3% of sites in Sinaloa (1 of 12 sites). We revisited three locations from initial surveys conducted in 2002. Similar numbers of willow flycatchers were found at all previously surveyed locations (Guamuchil: n_{02} = 2, n_{04} = 0 ; Mazatlan: $n_{02,04}$ = 0; San Blas: n_{02} = 30, n_{04} = 35).

Table 2: Willow flycatcher detections and banding data for northern Mexico

Survey Location	Dates: (December, 2004)	Detected	Banded
Guasave, Sinaloa	12	0	0
Guamuchil, Sinaloa	10–12	0	0
Culiacan, Sinaloa	13	0	0
Mazatlan, Sinaloa	8–9	0	0
Teacapan, Sinaloa	21–22	2	0
El Novillero, Nayarit	23–24	15	8
San Blas, Nayarit	15–20	35	16
Total		**52**	**24**

Ecuador

We conducted 24 surveys during 47.7 survey hours (Table 1, Appendix 3). We detected a minimum number of 53 willow flycatchers (Table 3) at 100% of locations (5 of 5 locations) and 88.9% of sites (8 of 9 sites). These high detection rates should not be used for comparisons as we were revisiting locations known to have high willow flycatcher densities based on two previous years of surveys. We detected a minimum of 9 alder flycatchers at 60.0% of the locations (3 of 5 locations) and 44.4% of the sites (4 of 9 sites). Relative densities of willow flycatchers were much higher than those of alder flycatchers during all three years of the study. In 2003, we detected 4.3 times as many, surveys in 2004 detected 5.8 times more, and 2005 surveys detected 5.9 times more willow than alder flycatchers.

Table 3: Willow and alder flycatcher detections in Ecuador (N = Napo, O = Orellana)

Survey Location	Dates:	Willow Flycatchers		Alder Flycatchers	
	(January, 2005)	Detected	Banded	Detected	Banded
Hacienda Johanna, N	18–20	7	4[a]	0	0
Jatun Sacha, N	21–23	4	2	0	0
Mondaña, N	18–20	7	2	1	0
Coca, O	21–24	23	5	3	0
Sani, O	26–28	12	4	5?	1?
Total		**53**	**17**	**9**	**1**

[a]Includes one recaptured willow flycatcher

RESIGHTING AND BANDING RESULTS

We captured 41 to 42 willow flycatchers in Ecuador (n = 17 or 18, January 2005) and northern Mexico (n = 24, December 2004) during 104.9 banding hours. In addition, we captured one possible alder flycatcher, and were able to recapture two willow flycatchers (n = 1, Mexico; n = 1 Ecuador). Colorimetry readings, along with blood and feather samples were collected from all captured *Empidonax* flycatchers.

In Mexico, we looked for previously banded willow flycatchers in Guamuchil and San Blas. Both of these survey locations were initially visited during 2002 surveys and willow flycatchers were captured (Guamuchil, n = 2; San Blas, n = 6). We were unable to relocate banded willow flycatchers at Guamuchil as the original study site was flooded. In San Blas, we recaptured one banded willow flycatcher occupying the same territory as 2002. Though we did try to relocate previously banded flycatchers, the sample size was too low and the time between site visits (almost three years) to make any comparisons with other datasets. With the low sample size from 2002, resighting was not the main objective. Instead, we focused on capturing enough flycatchers for future resighting efforts.

In Ecuador, we resighted four of 23 previously banded willow flycatchers (17.4%) during 2005. Results from 2004 were similar with one of six previously banded willow flycatchers being resighted (16.7%). However, we were reluctant to use preliminary 2004 results for comparison due to the inherent complications with low sample sizes. Three of the four resighted flycatchers were located at or near the previous year's net site (Hacienda Johanna, n = 1; Jatun Sacha, n = 2). The banded individual at Coca was detected 75 m from the closest net location. We could not recapture this flycatcher to determine the precise location of original capture because it was net savvy and showed little response to taped playback. The three other banded willow flycatchers may have been the same individuals showing site fidelity between years, however, we were unable to recapture these birds to confirm the unique nine digit number on their leg. We were able to recapture one individual at Hacienda Johanna. This willow flycatcher indeed was captured in the same territory both 2004 and 2005. No banded willow flycatchers were detected near Mondaña or Sani.

During 2005, we resurveyed the same areas from previous years and attempted to return to all previous known net locations. We found unbanded willow flycatchers within 50 m of locations where marked willow flycatchers were previously caught and banded (Hacienda Johanna, n = 2; Jatun Sacha, n = 2; Mondaña, n = 2; Coca, n = 3). Comparing surveys near the Sani Lodge, flycatcher locations between years were quite different. Willow flycatchers located during 2005 surveys were a minimum of 110 m from 2004 net locations. One alder flycatcher was banded at Sani during the 2004 surveys. In 2005, we found unbanded alder (30 m) and willow flycatchers (60 m) located near where the alder flycatcher was previously banded.

General Habitat Characteristics

Winter habitat for willow flycatchers has been described as of a combination of four main habitat components: standing or slow moving water and/or saturated soils, patches or stringers of trees, woody shrubs, and open areas (Koronkiewicz et al. 1998; Koronkiewicz and Whitfield 1999; Koronkiewicz and Sogge 2000; Lynn and Whitfield 2000, 2002; Lynn et al. 2003; Nishida and Whitfield 2003, 2004). In Mexico, all sites surveyed for willow flycatchers contained all four habitat components. Sites were located near slow-moving rivers, lagunas, and associated floodplains with aquatic and emergent vegetation. These seasonally inundated floodplains were bordered by any combination of the following vegetative growth: woody shrubs, patches or stringers of trees, savanna-woodland edge, second-growth woodland, pasture, and agricultural lands. Despite the apparent availability of suitable habitat, willow flycatchers were not detected at most survey sites, especially in Sinaloa.

In Ecuador, we found willow flycatchers in areas that contained at least three of the four habitat components. All survey sites contained standing or slow moving freshwater, saturated soils, and were in close proximity to flowing rivers. Also present were side channels with varying amounts of water remaining into the dry season. Rivers in western Amazonia flood annually. During the height of flooding, water levels may rise as much as thirteen meters (Goulding et al. 1996). Flooding occurs frequently, but is of short duration, and this combination causes lowland vegetation to be in a state of dynamic flux (Terborgh 1985). Occupied willow flycatcher habitat was primary successional vegetation dominated by two growth forms of caña (*Gynerium sagittatum*). In the western Amazon Basin, caña exists in both small and large morphs which differ considerably in physical form and mode of reproduction (Kalliola et al. 1992, Francis 2003). This only occurs in the western Amazon Basin and is not noted elsewhere in the distributional range of caña (Francis 2003). This native wild cane ranged in prevalence over the surrounding habitat anywhere from 60–95% and was quite variable in height (1–6 m). The next most dominant plant was *Tessaria* sp., which occurred in patches of short (1–3 m) to mid-sized (3–6 m) trees. The two forms of caña and *Tessaria* were collectively the dominant vegetation over much of the survey area and thus are referred to from now on as caña-*Tessaria* habitat. Caña stands in the western Amazon vary in density from 0.6 to 2.6 culms per m^2 (Francis 2003). Surveyors noted that across all revisited locations, caña stands visibly increased in both height and density between years. Patchily distributed shrubs (0.5–4 m) and scattered trees provided elevated perches throughout the caña-*Tessaria* layer.

NORTHERN MEXICO: SURVEY LOCATIONS

Guasave, Sinaloa

Surveys were conducted along a riparian strip following a braid of the Río Sinaloa east of Guasave. This river varied in width between 10–20 m and was flowing strongly during the time of the survey. The high undercut banks suggest larger volumes of faster flowing water move through the river during the rainy season. The river was bordered on both sides by human development. The east side was used for agriculture and cattle. There was a neighborhood along the west side of the river interspersed with large shade trees. The river itself was used as a garbage dump, bathroom, and local car wash. The vegetation along the west bank contained open patches of Bermuda grass (0.2 m) grading into *Mimosa* dominated shrub (2–4 m) covering the floodplains. In some areas, the *Mimosa* was covered in vines and impenetrable. In other areas, the shrub layer was interspersed with patches of willow saplings (*Salix* sp.), palo verde (*Cercidium* sp.), and cottonwoods (*Populus* sp.). The large cottonwoods (10–15 m) grew primarily along the west bank and hung over the shores of the river. Small islands were present within the Río Sinaloa. Most of these were sparsely vegetated and likely seasonally under water. However, a few river islands may have been more permanent and were covered by dense stands of young willow mixed with cane grass. Despite the presence of apparently suitable shrub habitat, no willow flycatchers were found near Guasave.

Guamuchil, Sinaloa

In February of 2002, habitat was surveyed south of Guamuchil at Laguna Aeropuerto. Habitat was described in 2002 (Lynn and Whitfield 2002) as dense shrub situated along a drainage ditch feeding into the northwest end of the laguna. The soils were characterized as extremely dry and there was an impenetrable barrier of shrub separating the habitat from the nearby park (Lynn and Whitfield 2002). When we returned to this site in December 2004, the survey area was completely submerged (Figure 1). The only bare ground was between the local park and the laguna. We used a GPS unit to determine that the capture locations of 2002 willow flycatchers were 1 km from the edge of the laguna. We talked with local policemen that confirmed the laguna as seasonal. They told us that since the laguna normally dries up between March and May, local residents had cut down all the large trees from June to August of 2004, in order to increase the water levels of the laguna. We surveyed riparian vegetation along a creek leading into the laguna, but could not locate any willow flycatchers, banded or

FIGURES

Figure 1. Former willow flycatcher locations in Guamuchil, Sinaloa, 2004 were flooded. Two willow flycatchers were banded during February, 2002 survey efforts, but these territories were under water in December, 2004. During the summer of 2004, locals had cut down all the large trees in order to increase water levels to this seasonal laguna.

Figure 2. Occupied willow flycatcher habitat in Tambora, Sinaloa, December 2004. This is the only site where surveyors detected willow flycatchers in Sinaloa.

Figure 3. Occupied willow flycatcher habitat at el Novillero, Teacapan, Nayarit, 2004.

Figure 4. Occupied willow flycatcher habitat in Quimichis, Teacapan, Nayarit, December 2004. Vegetation throughout the site was partially submerged.

Figure 5. Occupied willow flycatcher habitat at San Blas, Nayarit, December 2004. The herbaceous layer on the southeast was dominated by tall dried forbs that were patchily distributed.

Figure 6. Cows grazing in willow flycatcher habitat at San Blas during December 2004. There was evidence of vegetation clearing on the northeast side to increase grazing for cows.

Figure 1

Figure 2

Figure 3

Figure 4

Figure 5

Figure 6

otherwise. In addition, we surveyed habitat adjacent to the Río Mocorito, the Río Guamuchil, and along the shore of Presa Eustaguia Buella. No willow flycatchers were detected at any of these sites.

Culiacan, Sinaloa

We surveyed riparian vegetation alongside the Río Humaya and in the foothills of Imala. The Río Humaya was fast flowing and varied from 7–15 m wide. This river may occasionally flow faster as the banks were steep and deep ravines cut into the pasture. Large guamuchil trees (*Pithecellobium dulce*; 14–15 m) sporadically occurred and towered above the other riparian trees (6–8 m)which grew in stringers and were covered with vines. The pasture had been cleared for grazing and we could see fresh holes in the ground from recently uprooted trees. Small houses bordered the nearby road. In addition to signs of recent cattle activity, dogs and chickens were present. As the elevation increased, the habitat graded into drier *Acacia* dominated forest (3–4 m). Since we had a local Mexican biologist with us, he was able to help us identify much of the dominant vegetation which included chicura (*Ambrosia ambrosiodes*), toluache (*Datura* sp.), guasima (*Guazuma ulmifolia*), chinito (*Bombycilla* sp.), higuera (*Ficus carica*), mora (*Rubus* sp.), mala mujer (*Solanum* sp.), paela (*Caesalpinia platyloba*), mallow (*Malva* sp.), and two species of *Acacia* (*A. farnesiana*, *A. cochliacanta*). Though no willow flycatchers were detected at the time of surveys, the Mexican biologist brought us to sites where he had detected willow flycatchers in the past.

Mazatlan, Sinaloa

We surveyed three sites near the Mazatlan Airport and a fourth site along the coast on the other side of Mazatlan. The first two sites were along the road to Isla de Piedra, 500 m northwest from Hwy 15 leaving the airport. The first survey site was a low-lying seasonal wetland dominated by young salt cedar (*Tamarix* sp., 1.5 m) and *Acacia* (3 m). The water level appeared to be receding with patches of saturated mud and pools of standing water remaining. Canals bordered the adjacent road. Cattle tracks were present, but not much evidence of fresh browse. One area of the shallow wetland was used as a local dumpsite. The second survey site along the road to Isla de Piedra consisted of dense shrub dominated by *Acacia* and mangroves surrounding a small spring fed pond. These low-lying shrubs (3 m) and small trees (4.5 m) were smothered by vine cover, which made the vegetation impenetrable. The eastern quarter of the pond was dried out at the time of surveys. The surrounding area consisted of open palm plantation and mango orchards. The third survey site was located next to a propane station 13 km northwest of the Mazatlan airport. Trees (4–5 m) comprised only about 5% of the total vegetation cover and was dominated by an unknown species of Fabaceae. The dense shrub layer included, but was not limited to, *Mimosa*, *Cassia*, and palo verde (2–2.5 m). Deep gullies and other signs of erosion remained as evidence of seasonal inundation, but soils were dry at the time of surveys. Locals informed us that the area was used for cattle grazing from February through October. Our last survey site was on the other side of Mazatlan northwest of Zona Dorada and was located 4.6 km north of the bridge on Sabalo Cerritos. This area was comprised of a flat coastal coconut palm plantation (20–25 m) with an understory of shrub vegetation consisting of two species of *Acacia* (4 –5 m), *Mimosa* (3 m), some introduced garden variety plants, an introduced Fabaceae tree from the Philippines, among other unknown vegetation. Herbaceous growth (1.5 m) was dominated by vines, morning glory, and sea grape. This plantation and adjacent plots were for sale and potential development. No willow flycatchers were found at any sites near Mazatlan despite the presence of available habitat in both 2002 and 2004 surveys.

Teacapan, Sinaloa
Occupied willow flycatcher habitat was found 1.9 km north of Teacapan along the road to La Tambora. At the junction of these two roads, there was a mango orchard (8 m) adjacent to a coconut palm plantation (20 m) and cleared agricultural fields. Between the coconut palms and the cleared agricultural plots was a remnant strip of scrub only 20–30 m wide (Figure 2). Willow flycatchers were using this small remnant patch dominated by *Acacia* (2–3 m) and other unknown shrubs smothered with vines. There were patches of tall grasses and reeds (1.5 m) interspersed within the shrub layer, but otherwise the herbaceous understory was negligible. The soils were saturated and pools of stagnant water teeming with insect life were present. We also surveyed near a seasonally flooded laguna between Teacapan and Escuinapa, scrub habitat surrounding the cemetery in Teacapan, and the scrub understory of a coconut palm plantation at Rancho los Angeles. No willow flycatchers were detected at these locations despite the presence of more available habitat than what we found at nearby Tambora.

El Novillero, Nayarit
Willow flycatchers were found in at Playa Novillero in patches of remnant habitat between cultivated corn fields. Remnant patches of habitat bordered these fields and were bisected by *Mimosa* (2.5–3 m) filled quebradas. A labyrinth of trails had been cut through the habitat for livestock access and grazing (Figure 3). This low-lying area was seasonally inundated and dominated by several species of *Acacia* (3 m) and mangroves (4–5 m). Though it was dry in some spots, soils overall were saturated with shallow pools of water under mangrove patches and in the quebradas. On the road to Quimichis, willow flycatchers were found in a swamp-like area with standing water varying from 0.2–1.2 m in depth (Figure 4). The dominant vegetation was *Mimosa*, *Acacia*, and a large unidentified tree species (8–10 m). Shrubs (2–3 m) were growing directly in the standing water and had stilt roots. Next to the swamp were agricultural fields that had already been cleared.

San Blas, Nayarit

The two survey sites southeast of San Blas were located along a dirt road leading to a crocodile farm 2 km south of Matanchen. These areas were surveyed initially during 2002 surveys (February) and were revisited by survey teams in 2004 (December). Occupied willow flycatcher habitat found to the north of this road consisted of fenced-off areas of pasture with tall grasses and standing water. The fairly flat terrain had poor drainage and soils varied from saturated to 30 cm deep with retained water from the rainy season. Large pools of standing water were present and half of an entire pasture was submerged at the time of survey. In these seasonal lagunas, the vegetation was dominated by mangroves and *Ficus* (4–6 m) with the herbaceous layer consisting of reeds and cattails (1.5 m). The drier areas were dominated by mallow (*Malva sp*.), Bermuda (*Cynodon dactylon*), and an unidentified grass (1 m). These patchily distributed shrub areas were dominated by *Mimosa* and *Acacia* (3 m) and border wetland areas (Figure 5). The southeast side was bordered by tall semi-deciduous trees (12 m) interwoven with vines. The other sides were bordered by similar pasture plots with a mix of standing water and shrub vegetation. Overall, the vegetation and grounds were disturbed by cows. Both cows and horses were present during surveys (Figure 6). Surveyors in 2002 found 27 willow flycatchers north of the road. However, surveyors during 2004 only found 12 willow flycatchers in this same area. This includes one flycatcher present during both years of the survey (recaptured in 2004 at the same territory as in 2002). The five other flycatchers banded in 2002 were not relocated during 2004 surveys.

The area surveyed on the southeast side of the road was a lowland marshy area at the base of the foothills. The remnant scrub was used as pasture for cattle and agriculture. Small *Acacia* and other shrubs (1.5 m) were patchily distributed among a more uniform herbaceous layer (2–2.5 m). Shrubby areas were bisected by wet open pastures and small seasonal ponds. Patches of mangroves were concentrated within the wettest areas of the seasonally wet ponds. Shrub vegetation was dominated by *Acacia* and *Mimosa* (2–4 m) and was interspersed by exotics such as lime and papaya. To the northeast was a dense linear strip of riparian trees dominated by *Ficus* (10–12 m), willows, and other unknown trees. To the southeast were cleared agricultural fields and areas cleared for grazing. Upland areas were dominated by banana and coconut palm plantations. Surveyors in 2002 only found three willow flycatchers using habitat south of the road. Surveys during 2004 found 12 willow flycatchers in this same area. In addition, survey area was expanded during 2004 and an additional 11 willow flycatchers were found in the new area.

Surveys conducted in late January and early February of 2002 described the soils of the area as dry and cracked. It was noted then, however, that saturated soils were present below the surface. This area appears to be seasonally inundated as is evident from the difference in water levels between 2002 and 2004. Surveys conducted during mid-December of 2004 described the same area as a wetland with large ponds of retained rainwater. Water depth was noted to vary from deeply saturated soils to 0.3 m in some locations. Vegetation structure between surveys was quite different between years on both sides of the road. This could help account for the variation in flycatcher numbers between surveys. Vegetation was cleared for cattle grazing, especially on the north side of the road. In addition, on October 25, 2002, class four Hurricane Kenna hit San Blas with 140 mph winds (USA Today 2002). Damage to the vegetation (i.e. many dead trees) could still be seen in late 2004. Clearing for cattle and agriculture was noted both in 2002 and 2004 surveys.

ECUADOR: SURVEY LOCATIONS

Hacienda Johanna, Napo

Willow flycatcher habitat was located 4 km north of the town of Tena. This area, with rolling hills once covered with secondary forest, has been cleared of forest and converted to cattle pasture. Clusters of larger trees and shrubs remain in the swales and as a thin strip of secondary forest trees (12–15 m in height) as a border along the main road (1–2 trees wide on either side of the road). Trees included *Cecropia*, tree ferns (*Cyathea* sp.), moriche palms (*Mauritia flexuosa*), *Ceiba pentandra*, guavas (*Psidium* sp.), members of the families Rubiaceae, Melastomaceae, and Arecaceae, among others. Despite patches of remaining secondary forest, the landscape was predominantly grass (Poaceae) with a few sparse and isolated trees or shrubs scattered through wide expanses of open pasture. There was evidence of grazing and deep cow paths were embedded in the moist soil. Less denuded areas were dominated by two distinct species of unidentified grass (40 cm average and 1.5 m average). The tree lined main road received lots of traffic. Most traffic was from pedestrians or bicycles, but occasional cars as well. A branch of the main dirt road leads to an area with construction for a new hotel. Beyond the construction, this road continued down to the Río Misahuallí. During 2005 surveys, new construction was present on the west side of the road.

Initial surveys during 2003 were smaller in scale and only detected four willow flycatchers. Expanding the survey area in 2004 increased willow flycatcher detections and nine flycatchers were found. During 2005 surveys, only seven willow flycatchers were detected. Three of these detections were in the same territories (though not necessarily the same individuals) and four detections were in new territories. The three territories that were occupied in multiple years fell into three different categories: one banded bird in the same territory

FIGURES

Figure 7. Aerial view of river islands along the Rio Napo, Ecuador, 2005.

Figure 8. Dense caña-Tessaria habitat at Mondana, 2005 (there is a person standing on the edge for scale). Surveyors noticed an increase in the height and density of the vegetation between years.

Figure 9. Occupied willow flycatcher habitat at Juan Pio Montufar along the Rio Coca. This site was discovered during 2005 surveys.

Figure 10. Researchers wading across a river side channel near Sani, 2005. Note that this channel was completely dry in the morning, but flooded a few hours later.

Figure 11. Researchers taking colorimeter measurements from a willow flycatcher near Sani, Orellana, 2005.

Figure 12. A molting willow flycatcher captured near Sani, 2005. This flycatcher was molting the primary coverts of the right wing. Also, the primary and secondary flight feathers were brand new feathers (one of the primaries was collected for stable isotope analysis).

Figure 7

Figure 8

Figure 9

Figure 10

Figure 11

Figure 12

(definitely the same individual), one unbanded flycatcher located where an unbanded flycatcher was in 2004 (possibly same), and one unbanded bird in the same territory where a willow flycatcher was banded in 2004 (definitely different).

Jatun Sacha, Napo
Willow flycatchers were located on the northwest bank across the Río Napo from the main trail leading to Jatun Sacha. Flycatcher detections ranged from 275–675 m from this trail entrance. Habitat consisted of a strip of caña-*Tessaria* that varied from 30–60 m in width and started about 30–40 m from the Río Napo. This caña-*Tessaria* strip was bordered on one side by pebble covered beach leading to the Río Napo and on the other side by dense forest. The narrow strip of flycatcher habitat (1–2 m average height) was not densely vegetated and was easy to walk through with taller *Cecropia* and *Tessaria* trees (4–6 m) sparsely scattered throughout. The herbaceous layer was negligible. Human settlements were located nearby. Seven willow flycatchers were detected in 2004. The same area was resurveyed and only four willow flycatchers were detected in 2005. However, it should be noted that in 2004 when initial surveyors returned to capture flycatchers twenty days later, they could only locate six of the seven flycatchers.

Mondaña, Napo
Willow and alder flycatcher habitat surveyed consisted of two river islands on the Río Napo downstream from the village of Mondaña (Appendix 7). Both of these islands were revisited from previous surveys 2003–2004. The first island, Agua Santa, was located 2.5 km downstream from Mondaña on the east side of the Río Napo. The habitat formed linear strips 40 m wide bordered on both sides by streambeds. This gave the habitat an overall horseshoe appearance. The *Tessaria* (4–5 m) was quite dense and difficult to maneuver through. The herbaceous layer was negligible and habitat was surrounded by tall walls of trees (5–7 m) with dense caña (1–4 m) along the edges (Figure 8). Water levels varied between years on this island. Water levels appeared highest during 2004 surveys when water was never more than 25 m away (and often much closer as water was still flowing through rocky areas and stagnant pools of water remained in the sandy streambeds). During the time of 2003 and 2005 surveys, both streambeds were mostly dry with only some small remnant pools of water remaining from the rainy season. During 2003 surveys, one willow and one alder flycatcher were detected on this small island. In 2004, three new willow flycatchers were detected, but no alder flycatchers were located. During 2005, one alder flycatcher was detected and willow flycatchers were noticeably absent from surveys.

The second river island, Huachiyacu, was 4.2 km downstream from Mondaña and was a long, narrow, sandy island bordered by the Río Napo to the west and a mostly dry rocky channel to the east. The vegetation on the island was at the primary successional stage. Caña (approximately 1–4 m) was the dominant vegetation, followed by *Tessaria*. There were lots of shrubs which were mostly young *Tessaria* and *Mimosa* (approximately 1– 3 m) in the foreground. Further back were larger *Tessaria* trees (approximately 4–5 m) mixed with caña and scattered *Cecropia* (approximately 6–7 m). There were a series of shallow stagnant pools remnant of earlier flooding from the rainy season. There was a village to the east of the rocky channel located on higher ground. Comparisons between years are restricted to 2003 and 2005. During 2004, survey teams could not locate the 2003 survey area and surveyed around the village of Huachiyacu instead. It is possible that the 2003 survey areas were under water at the time. Surveys conducted in 2003 detected one alder and six willow flycatchers. During 2005 surveys of the same area, no alder and only five willow flycatchers were detected (plus two additional willow flycatchers that were detected outside the original study area).

Coca, Orellana

Occupied willow flycatcher habitat was located on a large river island along the south side of the Río Napo three km from the main bridge in Coca. This large river island was dominated by primary successional stage vegetation and was split into multiple islands depending on the water levels. Along the length of the sandy beach ran a partially dry secondary river channel where pools of water still remained from flooding during the rainy season. Soils in general were saturated with standing water prevalent throughout. Habitat patches consisted of linear strips (minimum width 100 m) of dense caña varying from 2.5 to 5 m in height. Though the landscape was dominated by caña, a few taller *Tessaria*, *Cecropia*, and Lauraceae trees (5–7 m) were scattered throughout. There also was an herbaceous layer (1 m) interwoven with Fabaceae vines. As the habitat approached the river, caña became less uniform, and was more patchily distributed over the landscape. There was not much evidence of human activity on this island. The same river island was surveyed 2003–2005. Surveys in 2003 found three alder and eight willow flycatchers. In 2004, eleven willow flycatchers were detected (no alder flycatchers). Surveys during 2005 found one alder and seven willow flycatchers.

Additional surveys were conducted on a river island just west of the small settlement of Juan Pio Montufar (Figure 9). This river island was located 8.4 km up the Río Coca and bordered the west shore of this river. The island was divided by a network of small channels varying from 10–25 m wide. Many of these secondary channels were still flowing at the time of surveys. However, water levels were shallow and habitat easily accessible. *Tessaria* (3–4 m) was the dominant species. Habitat was relatively open with scattered patches of *Cecropia*, *Tessaria*, and other trees (10 m) or shrubs (2 m). The understory was dominated by Poaceae grass (1 m) with a limited amount of caña. This island was first visited in 2005. A minimum of 16 willow and two alder flycatchers were detected.

Sani, Orellana

Willow flycatchers were located on a large river island 800 m upstream from the Sani turnoff along the Río Napo. This island consisted of two long narrow habitat patches (60 m x 150 m and 200 m x 1 km) separated by an area of open sandbar mixed with deep saturated mud (Figures 10 to 12). Habitat was early successional stage vegetation dominated primarily by caña followed by *Tessaria*, *Mimosa*, and *Cecropia*. The caña formed large patches of uniformly dense monocultures (2–3 m) as well as growing interspersed amongst the other vegetation. Guaba (*Inia* sp.) and guarango (*Parkia* sp.) trees (5–7 m) were restricted to the west side of the island. There were some relatively open areas on the east side of the island with *Tessaria* trees (5 m) and areas of open grass (1.5 m). The island was bordered by the Río Napo and a secondary channel. The first morning of surveys, this secondary channel was dry. However, by the time we finished surveying, the channel had flooded and water levels varied from 0.5 m to greater than 1.5 m. Surveys conducted during 2004 detected 13 willow and seven alder flycatchers. In 2005, ten willow and five alder flycatchers were detected in the same core survey area. However, an additional two willow flycatchers were detected outside of this core area.

POTENTIAL THREATS AND IMPACTS

Willow flycatcher habitat in Mexico and Ecuador was quite variable with regards to the degree and source of disturbance. All sites in Mexico, north and south, showed some sign of human derived perturbation while sites in Ecuador were affected more by seasonal flooding. Since 2005 surveys in Ecuador were a chosen subset of 2004 surveys locations, numbers used for comparison were taken from the larger and more representative pool of data collected in 2004.

Livestock encountered included cows, burros, pigs, sheep, and goats. In Mexico, signs of cattle and grazing were prevalent among willow flycatcher survey sites. The incidence of cattle grazing was similar between northern (83.0%) and southern (88.9%) Mexico. However, the latitudes varied in the severity of grazing pressures. Surveyors in southern Mexico 2003–2004 noted that roughly half of the study sites showed moderate to severe grazing pressures. In northern Mexico, less than a quarter of study sites showed moderate or severe grazing (20.8%). Clearing of vegetation was noted at study sites in Nayarit, Mexico.

Woody vegetation was removed to provide more herbaceous material for browse or to allow cattle greater access into dense scrub. In Ecuador, grazing was present at a minimum of study areas (13.3%) and only one site (< 0.5%) showed moderate to heavy grazing.

Willow flycatchers in Latin America were often detected at or adjacent to agricultural lands. At survey locations in northern Mexico, half of the study sites (50%) had some form of agriculture present. This is an increase from 2003–2004 surveys in southern Mexico during which agricultural crops were encountered at a third (33.3%) of study sites. Crops encountered in Mexico included mango, papaya, lime, bananas, guava, corn, and coconut palms. Commercial plantations cover large areas of coastal lowland Mexico. Remaining flycatcher habitat was often relegated to small fragmented patches within or adjacent to these large scale mango or coconut palm plantations. This contrasts with detections in Ecuador where food crops were present at only a few of the survey sites (16.7%). In addition, these encounters were limited to homesteads with small plots of subsistence crops such as manioc, corn, and bananas.

Other threats to willow flycatchers in Latin America involve the extraction or over-exploitation of resources. Given the limited time available, our direct evidence of these practices is both opportunistic and anecdotal. Surveyors encountered active gravel mining at various locations along the Río Napo and Río Misahuallí in Ecuador (2003–2005). Gravel mining was also encountered while looking for new survey locations along the Río Sinaola in Guasave. While traveling along the Río Napo, surveyors noticed local residents along the river's edge panning for gold. Evidence of oil operations were everywhere along the Río Napo: from the presence of sprawling oil towns such as Coca, to equipment and boats encountered along the Río Napo, to current seismic assessment for oil near the Yasuni National Park.

DISCUSSION

SURVEY EFFORT

Wintering surveys of willow flycatchers have been conducted in Panama, El Salvador, Costa Rica, Mexico, and Ecuador (1999–2005: Koronkiewicz and Whitfield 1999, Lynn and Whitfield 2002, Lynn et al 2003, Nishida and Whitfield 2003, Nishida and Whitfield 2004). Flycatchers detected per unit of effort can be used as a relative index for comparison between larger geographical regions (see Nishida and Whitfield 2003). Of the countries surveyed thus far, El Salvador (Lynn and Whitfield 2000) has been the most productive (6.9 flycatchers/survey hour) while Ecuador (Nishida and Whitfield 2003) was the least productive (0.8 flycatchers/survey hour).

Initially, survey results conducted in northern Mexico seem to indicate low densities of willow flycatchers relative to other areas surveyed in Latin America (0.9 flycatchers/survey hour). This result would place the northern states of Sinaloa and Nayarit, Mexico in the category of lowest detection rates. However, detection frequencies were vastly different between these two states (Sinaloa = 0.1 flycatchers/survey hour and Nayarit = 2.9 flycatchers/survey hour). Rates for Nayarit are similar to detection frequencies found during initial surveys that spanned the Pacific coast of Mexico (2.9 flycatchers/survey hour; Lynn and Whitfield 2002). Since available habitat was found in Sinaloa, low detection rates do not appear to be an indication of a lack of habitat. Rather, it may be that Sinaloa is the northern edge of the range for wintering willow flycatchers, possibly resulting in lower numbers of willow flycatchers wintering there. Surveys conducted in southern Mexico (4.4 flycatchers/survey hour; Nishida and Whitfield 2003) remain the most productive surveys in Mexico thus far.

Our detection frequencies in Ecuador increased in each successive year of the study (2003: 0.8 flycatchers/survey hour; 2004: 0.9 flycatchers/survey hour; 2005: 1.1 flycatchers/survey hour). Higher than normal detection frequencies during 2005 surveys is probably the result of a combination of different factors. That detection frequencies steadily increased between the three years of the study may indicate that surveyors were better able to detect flycatchers after successive years of experience and familiarity with conditions in Ecuador. Both willow and alder flycatchers were less responsive in Ecuador than other areas surveyed in Latin America. Surveyors were more aware of this during later years of the study and adjusted accordingly (i.e., longer listening periods, playback in both directions, and revisited sites when time allowed). However, during 2005, we revisited sites known to have higher densities of willow flycatchers in order to efficiently use time and resources to resight banded flycatchers. Higher detection frequencies during 2005 surveys undoubtedly were influenced by this selection of study sites. Therefore, these detection rates should be used for comparison with caution or not at all.

Resighting and Banding

During 2002, surveyors banded willow flycatchers along the Pacific coast of Mexico and eight willow flycatchers were banded in the states of Sinaloa and Nayarit. This sample size is too low to make any conjectures pertaining to site fidelity, especially considering the time between surveys (about 3 years), and the habitat differences between years at both capture sites. During 2004 surveys, we were only able to relocate one willow flycatcher which we recaptured 5 to 10 m from its original capture location in San Blas. We plan to return to northern Mexico during the winter of 2006 to resight banded willow flycatchers (2004, n = 24) at study sites, el Novillero and San Blas, Nayarit.

We searched for previously banded willow and alder flycatchers during surveys conducted in Ecuador during the winters of 2004–2005. Only five willow flycatchers were relocated during surveys the following years (n = 29, 17.2%). Resighting results were similar between years (2004 = 16.7%, Nishida and Whitfield, 2004; 2005 = 17.4%) despite the low sample size of banded flycatchers available during 2004. No banded alder flycatchers were resighted. These findings for Ecuador are low in comparison with results found by Koronkiewicz (2002) for willow flycatchers in Costa Rica (43% at Bolsón and 77% at Chomes) and results from southern Mexico (64%) by Nishida and Whitfield (2004). High return rates in Costa Rica were thought to indicate potentially high quality habitat able to support relatively larger or more stable populations (Winker et al. 1995, Koronkiewicz and Sogge 2000, Koronkiewicz 2002). However, lower resighting results in Ecuador do not necessarily indicate lower quality habitat. In fact, studies looking at habitat selection in Peru noted that areas dominated by *Tessaria* have a greater percentage of sallying insectivores (Terborgh 1985). Thus it is possible that the insect abundance is high enough that birds do not need to be territorial. Differences in the longevity of habitat and behavior may contribute to this variation in the ability to resight banded flycatchers.

Willow and alder flycatchers in Ecuador were predominantly detected in primary successional habitat on river islands along the Río Napo. This habitat is in a state of dynamic flux. The action of the meandering river is such that most of the vegetation in the floodplain is constantly undergoing primary succession (Terborgh 1985). This meander zone is characterized by flooding that is short of duration, but of frequent occurrence (Terborgh 1985). Primary successional habitat for flycatchers along the Napo is simultaneously being created and destroyed by seasonal flooding of the river. Surveyors in 2004–2005 watched water levels rise greater than 2 m in less than a day during the non-rainy season. In addition, the vegetation is fast-growing and therefore the vegetative stages themselves are ephermeral. *Tessaria* matures in just three or four years (Terborgh 1985). Flycatchers may be less tied to individual territories in Ecuador if habitat presence and quality change on a yearly basis or even possibly within seasons.

This instability in the presence and quality of habitat may also explain the lack of territorial response from flycatchers encountered in Ecuador. Flycatchers appeared to be less aggressive in behavior and often were not responsive to taped playback as compared to flycatchers encountered in Mexico or Central America. In general, it took longer to elicit a vocal response and a higher proportion of birds would not "fitz-bew" or "fee-bee-o" and therefore could not be positively identified as willow or alder flycatchers. With this decrease in response, it was also more difficult to get a look at the flycatcher's legs to determine band status. However, during 2005 we returned in successive days and all flycatchers found within 100 m of a former net site were identified as banded or unbanded. During all years of the study, we observed that flycatchers had large territories and/or moved considerable distances over a short period of time (Nishida and Whitfield 2003, 2004). Because of this observation, we attempted to get the band status of all flycatchers detected during surveys, but this was sometimes not possible due to a lack of response from individuals. Lower percentages of resighted willow flycatchers in Ecuador could potentially be attributed to banded individuals moving distances beyond the ranges covered by our current methods. Also flycatchers may have been present, but non-responsive and therefore eluded detection.

HABITAT

Winter willow flycatcher habitat in northern Mexico and Ecuador continues to follow patterns identified previously which indicate that flycatcher habitat in Latin America encompasses four components: standing or slow moving water and/or saturated soils, patches or stringers of trees, and open areas (Koronkiewicz et al. 1998; Koronkiewicz and Whitfield 1999; Koronkiewicz and Sogge 2000; Lynn and Whitfield 2000, 2002; Lynn et al. 2003). We further expanded this definition to include cane species: caña in Ecuador, paja canalera in Central America, or potentially other wild cane species in Latin America (Nishida and Whitfield 2003, 2004).

Willow flycatchers without exception were located in areas that were in close proximity to water and/or flooded by inundation during the rainy season. Our surveys were conducted during the dry season and flycatcher locations varied in the degree to which intermittent waters still were present or available. We suspect that when willow flycatchers select winter territories, water is much more prevalent. Studies of related acadian flycatchers (*Empidonax virescens)* in Panama, indicates that winter territory selection occurs before water dries up (Morton 1980). Surveys during winter (2004: December 8–25) in Mexico were conducted much earlier than previous surveys in Mexico (2002: January 31–February 22; 2003: February 8–26; 2004: February 19–March 7). This gave us the opportunity to view flycatcher sites before intermittent waters had dried appreciably. In Mexico, the dry season starts in November. Starting surveys earlier this year, we found large pools of standing water present at all occupied willow flycatcher locations. San Blas, Nayarit was visited mid December this winter and in early February during 2002 surveys. From surveyor's notes in 2002, soils were described as dry and cracked while the same area this winter was a wetland with large ponds of retained rainwater.

Potential Threats

Through the course of our winter willow flycatcher study (1999-2005), we have travelled through much of the Pacific coast of Mexico, El Salvador, Costa Rica and Panama. In addition, we have worked along a substantial portion of the Río Napo in Ecuador. Our general impression is that the amount of winter willow flycatcher habitat is not a limiting factor at this time. It appears that there are plenty of areas that are suitable, but are not occupied. However, it should be noted that we have not taken any habitat measurements and cannot identify which features willow flycatchers use for choosing their winter habitats. It could be that some of the areas that look suitable to us are not suitable for willow flycatchers.

Nevertheless, even though habitat does not appear to be a limiting factor now, the biggest threat to willow flycatcher populations on the wintering grounds are the complete loss of habitat or alteration of habitat which renders it unusable by flycatchers. Habitat loss and pesticide use have been suspected as possible threats to willow flycatchers on the wintering grounds (USFWS 1995, Koronkiewicz et al. 1998, Lynn and Whitfield 2002).

Agrochemicals are widely used on crops throughout Mexico and Central America. Often small farmers or campesinos in Latin America will try to reverse lower yields or loss of soil fertility through the adoption of chemical inputs that are inappropriately used (Loker 1996). Rather than ameliorating the situation, these methods usually cause further environmental degradation. In the Oriente region of Ecuador, African palm oil plantations use large amounts of pesticides and herbicides known to generate toxic runoff that then flow into the surrounding environment untreated (Kimerling 1991). It is suspected that insectivorous birds are affected by the accumulation of agricultural pesticides or mining by-products and may bioaccumulate these toxicants by feeding on contaminated insects (McCarty and Secord 2000, Mora et al. 2003). Since agrochemical use is ubiquitous throughout Latin America, the effects of different chemicals on willow flycatcher populations should be evaluated.

In the last decade, gold has been the most valuable resource exported from the Amazon Basin with revenues between one and three billion dollars (Goulding et al 1996). Most of the gold mining historically occurred in Brazil, but also occurs in Ecuador. Gold mining in Ecuador has the potential to increase in the future as oil reserves are depleted from the Oriente. Mercury is used to concentrate and isolate gold. Since mercury is cheap, there is little incentive to recover it and mercury waste is often released directly into the nearby rivers. Mercury pollution is tenacious and has longevity once introduced into the environment. Elevated mercury levels in flora and fauna may continue in contaminated areas long after the source of pollution has ceased (Rada et al. 1986, Eisler 1987). In addition, mercury bonds to inorganic particles suspended in the water and can be moved vast distances by currents (Goulding et al 1996). Seasonal flooding in Ecuador has the potential to carry the effects of mercury poisoning far from the original source. Another caveat is that there may be additive effects of mercury poisoning with pesticides or other chemicals that willow flycatchers might encounter. Mercury ingested in combination with compounds such as parthion or elements like cadmium and copper are known to have synergistically toxic effects (Hoffman et al. 1990, Calabrese and Baldwin 1993, Eisler 1987, King et al 2002). Drilling wastes are known to contain many toxic pollutants including copper, cadmium, and mercury; these wastes have been discharged into nearby rivers by oil companies since 1972 (Kimerling 1991).

Gravel mining was encountered along the Río Napo in Ecuador (2003–2005) and along the Río Sinaloa in northern Mexico. Depending on its scale and duration, gravel mining has the potential to change sedimentation patterns in rivers. Over 500 kilometers of roads have been built by the oil industry in the Oriente and road construction uses large amounts of gravel hauled in from the rivers (Kimerling 1991). In addition to disrupting the natural fluvial pattern of land formation, these roads exacerbate habitat loss and pollution. Ecuador has the highest rate of rainforest loss in South America (2.3% per year) as colonists in search of farmland follow behind the oil roads built to access drilling sites (Jufowsky 1991). In addition, these roads are regularly sprayed with heavy crude for maintenence and dust control (Kimerling 1991).

Drilling for oil in the Amazonian rainforest of Ecuador has a multitude of potential negative effects on willow flycatcher. Over a 20 year span, more than 19 billion gallons of waste has been dumped into the environment untreated and greater than 16.8 million gallons of crude oil has spilled into the watershed from ruptures in the main Trans-Ecuadorian Pipeline (Kimerling 1991, Miller 2003). Oil is quite toxic and can kill fish at a ratio of one gallon of oil to a million gallons of water (Kimerling 1991). Response to this toxicity may not be an immediate reaction. Research has shown that oil concentrations of 20 ppb can lead to high mortality in seabird eggs during the early stages of development (Kimerling 1991). Specific research has not been conducted with regards to the effects of these toxicities on willow flycatcher eggs or nestlings. However, deformities have been noticed on the breeding grounds with unknown explanations of their source. During breeding seasons from 1996–2000, a relatively high rate of flycatchers with physical deformities was documented (Sogge and Paxton 2000, King et al 2002).

Colonists typically follow the oil roads into the forest. The Ecuadorian government has encouraged this behavior by granting land titles to any settler who clears and cultivates the land and this has led to a deforestation rate of almost a million acres per year in the Oriente (CESR 1994). During surveys in Ecuador, we ran into minimal levels of human disturbance. However, with increasing numbers of campesinos flocking to the Oriente looking for lands to cultivate, this could change. A 1982 census showed that the Oriente's regional population had grown 4.9% per year (nearly double the national rate) with the sub-population near roads in oil-producing areas having increased by 8% annually (Kimerling 1991).

Recommendations for Future Studies

In order to effectively develop conservation and management strategies for willow flycatchers, we need a better understanding of the distribution and ecology of the willow flycatcher on its wintering grounds and along migratory routes. Our studies in Mexico and Ecuador (2003–2005) and previous studies in the Central American countries of El Salvador, Costa Rica, and Panama (Koronkiewicz et al. 1998; Koronkiewicz and Whitfield 1999; Koronkeiwicz and Sogge 2000; Lynn and Whitfield 2000, 2002; Lynn et al. 2003), have provided the first critical steps in this direction. We can build on this foundation of knowledge using two approaches:

1) Conduct surveys in other countries (e.g. Guatemala, Nicaragua, Colombia, and potentially Venezuela and Peru) in order to collect more data on genetics, stable isotopes and colorimetry. This would allow us to analyze the data on a continental scale, which is essential for understanding broad ecological and evolutionary patterns.

Since only one subspecies of willow flycatcher is federally listed as endangered, it is crucial to understand where this flycatcher overwinters and what habitat features are critical to its continuing survivorship in Latin America. Until now, we have relied on blood sample analysis cross-referenced with survey data to answer this question. Measurements using a colorimeter have the potential to garner results in the field to identify subspecies of willow flycatcher. During the 2004 breeding season, colorimeters were used measure plumage coloration on *E. t. extimus* and two other subspecies from seven sites located in Arizona, Nevada, Washington, and Oregon (Koronkiewicz pers comm.) and on willow flycatchers of unknown subspecies determination in Ecuador and Mexico during the winter. During the 2005 breeding season, there are plans to collect more colorimeter measurements from willow flycatchers in California, Colorado, New Mexico, Oregon, Washington and parts of the eastern U.S. (Koronkiewicz pers comm.). In addition, we will continue to collect colorimeter measurements from willow flycatchers captured in northern Mexico and Guatemala during the winter of 2006. Colorimeter measurements were successfully used to evaluate plumage coloration difference among sites, sexes, and age classes of Blue Tits (Figuerola et al. 1999). Preliminary results with willow flycatchers revealed significant plumage variation between the different subspecies, but also substantial variation between individuals of the same subspecies (Koronkiewicz pers comm.). With more data, this technique has the potential to identify unknown willow flycatcher to the subspecies level during migration as well as on the wintering grounds.

2) Collect more data on sites that we have already visited. Additional surveys in areas previously visited would allow for the collection of more specific information such as site fidelity or to assess habitat loss or change over time. Other questions that need to be addressed include overwintering survival rates of willow flycatchers, and whether distribution or habitat use vary by sex or subspecies.

We observed that flycatchers in Ecuador are less responsive to tape playback and speculate that may have larger territories, and move greater distances than flycatchers in Mexico and Central America. Resighting efforts in Ecuador were only able to relocate 17.2% of banded willow flycatchers. Currently it is unknown what is responsible for this low re-detection frequency. Lower responsiveness in conjunction with the suspected large distances traveled by flycatchers encountered on river island along the Río Napo, could make it extremely difficult to locate banded flycatchers even if they are indeed present. Recent studies on willow flycatchers in Utah and Arizona found that radio transmitters are diminutive enough now to be placed on birds as small as willow flycatchers without affecting survivorship (Paxton et al. 2003, Cardinal and Paxton 2005). Telemetry studies could be used to investigate questions of home range size and movement patterns for willow flycatchers in Ecuador.

Between season comparisons of habitat use with regards to water saturation and insect abundance warrants further study. The ramifications of seasonal variation in water saturation levels on habitat selection, habitat quality, and movement patterns are currently unknown. However, these factors may ultimately affect overall survivorship of willow flycatchers on their wintering grounds. In seasonal habitats, studies have shown that large numbers of tropical insects move between habitats in response to the differential disappearance of food through drying and dormancy (Janzen 1973, 1980). The effects of seasonal changes in water levels and insect food resources on overwintering willow flycatcher populations warrants further study.

Models could be developed combining GIS and remote-sensing technologies with data collected in the field. Field work for the US–Mexico international GAP Analysis project began during the fall of 1998 (Gonzales-Rebeles, et al 1998). However, work was scheduled to begin in the states adjacent to Texas (Coahuila and Chihuahua) and would not have much overlap with sites used by willow flycatchers. Since GAP analysis is an ongoing project, hopefully these efforts would eventually be expanded to include areas along the Pacific coast of Mexico as well. It would be valuable to determine what images are available and if remote-sensing data could be used to accurately identify wintering willow flycatcher habitat. If developed properly, this could be an important tool for detecting critical habitat for willow flycatchers to focus future studies or that may be threatened by land use changes.

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Appendix 1. 2004 Willow Flycatcher survey and detection forms.

Willow Flycatcher Winter Survey and Detection Form

Site Name (unique to each survey within same area, include town name)____

Mileage/direction to nearest landmark (Town, Road, etc.)____

Coordinates: Start: Lat./Long __________________________ UTM _________________________ Waypt. Name __________

Stop: Lat./Long __________________________ UTM__________________________ Waypt. Name __________

Elevation ________ (m) Total length of area surveyed: __________ (m / km) Ownership/Management:__________________

Observer(s)	Date (m/d/y) Survey time	Number of WIFLs Found	Number Detected Before Playback	Initial Vocalization: # Wifls	Number Wifls who gave Fitz bew	Photos Camera # & Photo #	Comments **Include** a description of photos taken, survey route or problems, and if WIFL detection was Visual, Aural, or Both
1 ___________ ___________ Length of area surveyed: _________	date start stop total hrs _____			Fitz bew Whitt Brrr Breet			
2 _________ _________ Length of area surveyed: _________	date start stop total hrs _____			Fitz bew Whitt Brrr Breet			
Overall Summary Total survey hrs__________							

Habitat Description (topography, vegetation, and seral stage) Please be as detailed as possible: ___________________________

____

____

____

Identify the 2-3 predominant trees/shrubs____

Estimated average height: Trees: ____________ (m) Shrubs: ____________ (m) Herbaceous Layer: ____________ (cm / m)

Was surface water or saturated soil at or near to site? **Yes** **No** (circle one) If yes, describe: ___________________________

____

Describe evidence of human or cattle activity, habitat impacts, and threats at the site: ____________________________________

____

____

____

<u>Willow Flycatcher Detections</u>

Time of detection: Begin _________ End____________ UTM:____

Detection coordinates: Lat. _________________ Long. ______________________ Waypt. Name _____________

Describe response and quality/nature of detection (did WIFL approach, sing strongly/weakly, how long, distance, lighting, wind)

____

Appendix 1 Continued

Additional Willow Flycatcher Detections: ____
____
____
____
____
____

Draw a sketch showing details of survey area and any flycatcher detections. Show the location and shape of the patch, useful landmarks, vegetation characteristics, approximate vegetation height and area, flycatcher location and movements, etc. Be certain to take photographs of the site.

List other bird species seen at this site: ____
____

Additional Comments: ____
____
____
____
____
____
____

PLEASE ATTACH ALL NOTES FROM YOUR FIELD NOTEBOOK

Appendix 2. Willow flycatcher survey details for northern Mexico in December 2004. Note that some areas were surveyed by teams and therefore some of the coordinates and/or distances listed are inclusive.

MP : Met Partway (Indicates that surveyor teams met in the middle, start coordinates are with one group and the end coordinates are with another)
S = E : Start is also the end because the survey was conducted in a circle

Surveyors: RdR = Rachel del Rio, MG = Marco Gonzales, SM = Shannon McNeil, CN = Catherine Nishida, OR = Oscar Ramirez-Rocha, DR = Daniel Ramos, AS = Ashley Sutton, MW = Mary Whitfield

Survey Location	Site	Date	Coordinates Start	Coordinates Stop	Time of Survey	Survey Hours	Surveyor	Number of Willow Flycatchers	Elevation (m)	Distance (km)
Guasave	1	12-Dec	25˚33.764' N 108˚27.335' W	25˚33.465' N 108˚27.155' W	0641-0910	2.5	DR, SM, RdR	0	19	0.6
Guamuchil	1	10-Dec	25˚27.545' N 108˚05.776' W	25˚28.027' N 108˚05.440' W	0643-1005	3.4	AS, RdR	0	40	1.3
	1	10-Dec	25˚27.034' N 108˚05.770' W	25˚27.545' N 108˚05.776' W	0709-1000	2.9	MW, SM	0	-	1.3
	2	10-Dec	25˚26.812' N 108˚05.013' W	25˚26.830' N 108˚05.189' W	0745-0826	0.7	CN, DR, OR	0	45	0.4
	3	11-Dec	25˚29.981' N 108˚04.082' W	25˚30.208' N 108˚04.086' W	0628-0745	1.3	CN, SM	0	60	0.5
	4	12-Dec	25˚28.478' N 108˚17.903' W	MP	0654-0930	2.6	AS, CN	0	12	1.9
	4	12-Dec	MP	25˚29.694' N 108˚17.549' W	0654-0900	2.1	MW, OR	0	-	1.7
Culiacan	1	13-Dec	24˚51.814' N 107˚16.239' W	24˚51.897' N 107˚16.230' W	0704-0804	1.0	CN, DR, OR	0	68	0.3
	2	13-Dec	24˚51.282' N 107˚11.713' W	MP	0745-0835	0.8	MW, RdR, MG	0	130	0.3
	2	13-Dec	MP	24˚51.282' N 107˚11.713' W	0745-0835	0.8	AS, SM	0	-	0.3

Appendix 2 continued

Survey Location	Site	Date	Coordinates Start	Stop	Time of Survey	Survey Hours	Surveyor	Number of Willow Flycatchers	Elevation (m)	Distance (km)
Culiacan	3	13-Dec	24˚48.726' N 107˚08.255' W	S = E	1000-1035	0.6	MW, RdR, MG	0	148	0.5
	3	13-Dec	24˚48.716' N 107˚08.421' W	24˚48.726' N 107˚08.255' W	0940-1030	0.8	AS, SM	0	198	0.5
Mazatlan	1	8-Dec	23˚09.918' N 106˚17.541' W	MP	0700-0735	0.6	MW, RdR	0	6	0.5
	1	8-Dec	MP	23˚11.395' N 106˚23.464' W	0702-0755	0.9	AS, SM	0	-	0.5
	2	8-Dec	23˚11.396' N 106˚23.465' W	MP	0945-1030	0.8	MW, RdR	0	5	0.4
	2	8-Dec	MP	23˚11.396' N 106˚23.465' W	0945-1030	0.8	AS, SM	0	-	0.4
	3	8-Dec	23˚11.618' N 106˚18.375' W	23˚11.596' N 106˚18.435' W	0654-0917	2.4	CN, DR, OR	0	11	1.1
	4	9-Dec	23˚18.153' N 106˚29.317' W	23˚18.226' N 106˚ 29.232' W	0716-0809	0.9	CN, DR, OR	0	5	0.4
	4	9-Dec	23˚17.615' N 106˚28.553' W	23˚17.724' N 106˚28.136' W	0654-0820	1.4	AS, SM	0	10	0.7
	4	9-Dec	23˚17.643' N 106˚28.568' W	23˚17.555' N 106˚28.755' W	0653-0820	1.5	MW, RdR	0	7.5	0.4
Teacapan	1	21-Dec	22˚39.093' N 105˚47.974' W	MP	0639-0740	1.0	AS, RdR	0	5	0.4
	1	21-Dec	MP	22˚39.061' N 105˚47.999' W	0645-0745	1.0	MW, SM	0	-	0.7
	1	21-Dec	22˚38.761' N 105˚48.533' W	22˚38.633' N 105˚48.436' W	0622-0750	1.5	CN, DR, OR	0	3	0.7

Appendix 2 continued

Survey Location	Site	Date	Coordinates Start	Coordinates Stop	Time of Survey	Survey Hours	Surveyor	Number of Willow Flycatchers	Elevation (m)	Distance (km)
Teacapan	2	21-Dec	22°31.908' N 105°44.150' W	22°31.930' N 105°44.235' W	0835-0937	1.0	CN, DR	0	0	0.5
	3	22-Dec	22°48.067' N 105°49.181' W	22°48.067' N 105°49.181' W	0705-0905	2.0	MW, AS, RdR	0	0	1.7
	3	22-Dec	22°47.846' N 105°49.580' W	22°48.125' N 105°50.042' W	0655-0910	2.3	SM, OR	0	-	2.0
	4	22-Dec	22°33.725' N 105°44.879' W	22°33.647' N 105°44.879' W	0650-0816	1.4	CN, DR, OR	2	3	0.7
El Novillero	1	23-Dec	22°23.402' N 105°36.277' W	22°23.402' N 105°36.277' W	0644-0849	2.1	CN, DR	0	3	1.0
	2	23-Dec	22°23.695' N 105°34.618' W	22°23.484' N 105°34.791' W	0645-1050	4.1	MW, RdR	11	3	0.9
	2	23-Dec	22°23.651' N 105°34.855' W	22°23.634' N 105°34.724' W	0651-0715	0.4	AS, SM	0	-	0.3
	3	24-Dec	22°23.781' N 105°33.059' W	22°23.773' N 105°33.013' W	0630-0715	0.8	CN, DR	4	10	0.2
San Blas	1	15-Dec	23°31.691' N 105°13.134' W	23°31.810' N 105°13.318' W	0740-0941	2.0	AS, RdR, OR	8	5	1.5
	2	16-Dec	21°31.755' N 105°13.049' W	MP	0650-0914	2.4	RdR, SM	4	0	0.6
	2	16-Dec	MP	21°31.965' N 105°13.310' W	1015-1055	0.7	RdR, SM	0	-	0.2
	3	16-Dec	21°31.681' N 105°13.004' W	21°31.674' N 105°12.908' W	0656-0945	2.8	CN, DR, OR	11	0	0.9
	4	18-Dec	21°31.698' N 105°12.993' W	21°31.691' N 105°13.108' W	0820-1022	2.0	CN, DR	12	0	1.0

Appendix 3. Willow flycatcher survey details for Ecuador in 2005. Since one of our objectives was to resight banded birds, hours below were combined survey and resighting hours. New flycatchers were often detected during efforts to resight banded flycatchers.

Surveyors: MC = Monica Cevallos, EC = Emily Cohen, RdR = Rachel del Rio, PH = Phil Heavin, TK = Tom Koronkiewicz, CN = Catherine Nishida, DW = Dave Wilamowski, MY = Misael Yanez

Survey Location	Site	Date	Coordinates		Time of Survey	Survey Hours	Surveyor	Number of Willow Flycathers	Elevation (m)	Distance (km)
			Start	Stop						
Hacienda Johanna	1	18-Jan	00˚ 57.374' S 077˚ 35.488' W	00˚ 57.807' S 077˚ 48.740' W	0600-0945	3.8	PH, RdR	2	539	1.2
	1	18-Jan	00˚ 57.969' S 077˚ 48.806' W	00˚ 57.609' S 077˚ 48.503' W	0600-1000	4.0	EC, MC	4	517	1.5
	1	19-Jan	00˚ 57.609' S 077˚ 48.503' W	00˚ 57.969' S 077˚ 48.806' W	0605-0635	0.5	EC, MC	0	526	0.2
	1	20-Jan	00˚ 57.372' S 077˚ 48.665' W	00˚ 57.437' S 077˚ 48.745' W	0600-0745	1.8	EC, MC	1	527	0.7
Jatun Sacha	1	22-Jan	01˚ 03.346' S 077˚ 37.334' W	01˚ 03.302' S 077˚ 36.913' W	0620-0930	3.2	EC, MC	3	380	0.8
	1	23-Jan	01˚ 03.302' S 077˚ 36.913' W	01˚ 03.180' S 077˚ 36.764' W	0645-0845	2.0	EC, MC	1	380	0.4
Mondaña	1	18-Jan	00˚ 51.142' S 077˚ 13.467' W	00˚ 51.060' S 077˚ 13.952' W	0615-0946	3.5	CN, DW	5	300	1.8
	1	18-Jan	00˚ 51.131' S 077˚ 13.763' W	00˚ 51.142' S 077˚ 13.467' W	0615-0635	0.3	TK, MY	0	300	0.3
	1	19-Jan	00˚ 50.951' S 077˚ 13.403' W	00˚ 51.058' S 077˚ 13.838' W	0845-1026	1.7	DW, MY	1	300	1.1
	1	19-Jan	00˚ 51.119' S 077˚ 13.818' W	00˚ 50.951' S 077˚ 13.403' W	1018-1038	0.3	TK, CN	0	300	-
	1	20-Jan	00˚ 51.058' S 077˚ 13.838' W	00˚ 51.132' S 077˚ 13.486' W	0610-0634	0.4	CN, DW	1	300	-

Appendix 3 continued

Survey Location	Site	Date	Coordinates Start	Coordinates Stop	Time of Survey	Survey Hours	Surveyor	Number of Willow Flycathers	Elevation (m)	Distance (km)
Mondaña	2	19-Jan	00˚ 51.395' S 077˚ 14.750' W	00˚ 51.253' S 077˚ 14.880' W	0606-0657	0.9	TK, MY	0	300	0.8
	2	19-Jan	00˚ 51.395' S 077˚ 14.750' W	00˚ 51.117' S 077˚ 14.986' W	0606-0750	1.7	CN, DW	0	300	0.7
Coca	1	21-Jan	00˚ 28.511' S 076˚ 57.303' W	00˚ 28.601' S 076˚ 57.059' W	0623-0942	3.3	TK, MY	6	250	1.0
	1	21-Jan	00˚ 28.511' S 076˚ 57.303' W	00˚ 28.553' S 076˚ 57.163' W	0620-0930	3.2	CN, DW	1	250	0.8
	1	22-Jan	00˚ 28.575' S 076˚ 57.408' W	00˚ 28.641' S 076˚ 57.163' W	0554-0933	0.7	DW, MY	0	250	-
	1	23-Jan	00˚ 28.537' S 076˚ 57.309' W	00˚ 28.576' S 076˚ 57.414' W	0715-0910	1.9	CN, DW	0	250	-
	2	24-Jan	00˚ 22.744' S 076˚ 59.539' W	00˚ 22.992' S 076˚ 59.322' W	0628-0840	2.2	DW, MY	15	260	1.6
Sani	1	26-Jan	00˚ 26.927' S 076˚ 16.156' W	00˚ 27.141' S 076˚ 16.424' W	0615-0930	3.3	EC, MC	3	230	0.7
	1	26-Jan	00˚ 27.141' S 076˚ 16.424' W	00˚ 27.270' S 076˚ 16.622' W	0617-0957	3.7	CN, DW	3	230	1.2
	1	27-Jan	00˚ 27.129' S 076˚ 16.447' W	00˚ 27.281' S 076˚ 16.721' W	0610-0835	2.4	CN, DW	1	227	0.8
	2	27-Jan	00˚ 27.281' S 076˚ 18.721' W	00˚ 26.981' S 076˚ 16.329' W	0940-1010	0.5	CN, DW	2	220	0.2
	3	28-Jan	00˚ 29.238' S 076˚ 18.953' W	00˚ 29.117' S 076˚ 18.583' W	0640-0845	2.1	CN, DW	1	220	0.8
	3	28-Jan	00˚ 29.137' S 076˚ 18.685' W	00˚ 29.093' S 076˚ 18.630' W	0630-0700	0.5	EC, MC	2	220	0.1

Appendix 4. Bird species list compiled during Willow Flycatcher survey efforts in Northern Mexico, December 2004. For a more complete list of bird species that winter in these areas, see Howell and Webb 1999.

Location Codes:

1 Guasave, Sinaloa
2 Guamuchil, Sinaloa
3 Culiacan, Sinaloa
4 Mazatlan, Sinaloa
5 Teacapan, Sinaola
6 el Novillero, Nayarit
7 San Blas, Nayarit

Common Name	**Latin Name**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Rufous-bellied Chachalaca	*Ortalis wagleri*			X	X			X
Black-bellied Whistling-Duck	*Dendrocygna autumnalis*		X					X
Ruddy Duck	*Oxyura jamaicensis*		X		X			
Greater White-fronted Goose	*Anser albifrons*		X					
American Wigeon	*Anas americana*	X						
Blue-winged Teal	*Anas discors*				X			X
Cinnamon Teal	*Anas cyanoptera*				X			
Green-winged Teal	*Anas crecca*				X			
Lesser Scaup	*Aythya affinis*		X					
Golden-cheeked Woodpecker	*Melanerpes chrysogenys*							X
Gila Woodpecker	*Melanerpes uropygialis*	X		X	X	X	X	
Ladder-backed Woodpecker	*Picoides scalaris*			X				
Belted Kingfisher	*Megaceryle alcyon*	X	X	X			X	X
Green Kingfisher	*Chloroceryle americana*	X	X			X		X
Groove-billed Ani	*Crotophaga sulcirostris*		X		X	X	X	X
Lesser Roadrunner	*Geococcyx velox*		X					
Mexican Parrotlet	*Forpus cyanopygius*				X			
White-fronted Parrot	*Amazona albifrons*			X				X
Broad-billed Hummingbird	*Cynanthus latirostris*			X				

Appendix 4 continued

Common Name	Latin Name	1	2	3	4	5	6	7
Violet-crowned Hummingbird	*Amazilia violiceps*		X					
Plain-capped Starthroat	*Heliomaster constantii*			X				
Ruby-throated Hummingbird	*Archilochus colubris*							X
Allen's Hummingbird	*Selasphorus sasin*					X		
Barn Owl	*Tyto alba*					X		
Buff-collared Nightjar	*Caprimulgus ridgwayi*					X	X	
Rock Dove	*Columba livia*	X	X		X			
Mourning Dove	*Zenaida macroura*		X	X	X	X		
White-winged Dove	*Zenaida asiatica*			X	X	X	X	X
Inca Dove	*Columbina inca*	X	X	X	X			
Common Ground-Dove	*Columbina passerina*		X		X	X	X	X
Ruddy Ground-Dove	*Columbina talpacoti*							X
Common Moorhen	*Gallinula chloropus*	X	X			X		
American Coot	*Fulica americana*		X		X		X	X
Wilson’s Snipe	*Gallinago delicata*	X			X			X
Greater Yellowlegs	*Tringa melanoleuca*		X		X		X	X
Spotted Sandpiper	*Tringa macularia*	X	X	X			X	X
Willet	*Catoptrophorus semipalmatus*						X	
Least Sandpiper	*Calidris minutilla*				X		X	X
Dunlin	*Calidris alpina*				X			
Northern Jacana	*Jacana spinosa*	X				X	X	X
Black-necked Stilt	*Himantopus mexicanus*	X	X		X		X	X
Killdeer	*Charadrius vociferus*		X		X			X
Ring-billed Gull	*Larus delawarensis*			X				
Caspian Tern	*Sterna caspia*		X	X				
White-tailed Kite	*Elanus leucurus*		X					

Appendix 4 continued

Common Name	**Latin Name**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Cooper's Hawk	*Accipiter cooperii*							X
Common Black Hawk	*Buteogallus anthracinus*			X				X
Grey Hawk	*Asturina plagiata*	X	X		X	X	X	X
Short-tailed Hawk	*Buteo brachyurus*							X
Zone-tailed Hawk	*Buteo albonotatus*							X
Crested Caracara	*Polyborus plancus*		X	X	X	X		X
American Kestrel	*Falco sparverius*	X	X	X	X	X	X	
Peregrine Falcon	*Falco peregrinus*	X						X
Least Grebe	*Tachybaptus dominicus*					X	X	
Anhinga	*Anhinga anhinga*							X
Neotropic Cormorant	*Phalacrocorax brasilianus*		X	X			X	X
Double-crested Cormorant	*Phalacrocorax auritus*		X					
Tricolored Heron	*Egretta tricolor*						X	X
Little Blue Heron	*Egretta caerulea*							X
Snowy Egret	*Egretta thula*		X	X			X	X
Great Blue Heron	*Ardea herodias*		X	X	X	X	X	X
Great Egret	*Ardea alba*		X	X			X	X
Cattle Egret	*Bubulcus ibis*		X		X	X		X
Green Heron	*Butorides virescens*		X				X	
Bare-throated Tiger-Heron	*Tigrisoma mexicanum*					X		
White Ibis	*Eudocimus albus*		X					X
White-faced Ibis	*Plegadis chihi*					X		X
Roseate Spoonbill	*Platalea ajaja*						X	X
American White Pelican	*Pelecanus erythrorhynchos*		X				X	X
Black Vulture	*Coragyps atratus*	X	X	X	X		X	X
Turkey Vulture	*Cathartes aura*	X	X	X	X	X	X	X

Appendix 4 continued

Common Name	Latin Name	1	2	3	4	5	6	7
Wood Stork	*Mycteria americana*						X	X
Magnificent Frigatebird	*Fregata magnificens*			X	X	X		
Willow Flycatcher	*Empidonax traillii*					X	X	X
Western Flycatcher	*Empidonax* sp.			X		X		X
Black Phoebe	*Sayornis nigricans*	X	X		X			
Vermilion Flycatcher	*Pyrocephalus rubinus*	X	X	X	X	X	X	X
Ash-throated Flycatcher	*Myiarchus cinerascens*			X		X		
Tropical Kingbird	*Tyrannus melancholicus*		X	X	X	X	X	X
Cassin's Kingbird	*Tyrannus vociferans*	X	X	X				X
Thick-billed Kingbird	*Tyrannus crassirostris*			X	X	X	X	X
Social Flycatcher	*Myiozetetes similis*	X	X	X		X		X
Great Kiskadee	*Pitangus sulphuratus*		X	X	X	X	X	X
Rose-throated Becard	*Pachyramphus aglaiae*			X				
Loggerhead Shrike	*Lanius ludovicianus*		X	X				
Bell's Vireo	*Vireo bellii*		X		X	X		X
Western Warbling-Vireo	*Vireo swainsonii*			X				
Purplish-backed Jay	*Cyanocorax beecheii*			X				
Black-throated Magpie-Jay	*Calocitta colliei*			X				X
Sinaloa Crow	*Corvus sinaloae*				X	X	X	X
Rufous-backed Robin	*Turdus rufopalliatus*			X				
European Starling	*Sturnus vulgaris*	X						
Northern Mockingbird	*Mimus polyglottos*	X	X	X	X	X	X	X
Curve-billed Thrasher	*Toxostoma curvirostre*	X		X	X		X	
Marsh Wren	*Cistothorus palustris*							X
Happy Wren	*Thryothorus felix*	X		X	X	X		
Sinaloa Wren	*Thryothorus sinaloa*					X		

Appendix 4 continued

Common Name	Latin Name	1	2	3	4	5	6	7
House Wren	*Troglodytes aedon*				X			
Verdin	*Auriparus flaviceps*		X					
Blue-grey Gnatcatcher	*Polioptila caerulea*	X	X	X	X	X	X	X
Black-capped Gnatcatcher	*Polioptila nigriceps*			X				
Mangrove Swallow	*Tachycineta albilinea*					X		
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	X	X			X	X	X
Barn Swallow	*Hirundo rustica*							X
House Sparrow	*Passer domesticus*	X	X				X	
Lesser Goldfinch	*Carduelis psaltria*		X	X		X		
House Finch	*Carpodacus mexicanus*	X	X	X	X			
Lincoln's Sparrow	*Melospiza lincolnii*		X		X	X	X	X
White-crowned Sparrow	*Zonotrichia leucophrys*	X	X					
Savannah Sparrow	*Passerculus sandwichensis*							X
Clay-colored Sparrow	*Spizella pallida*		X					
Lark Sparrow	*Chondestes grammacus*		X	X	X	X		
Green-tailed Towhee	*Pipilo chlorurus*	X	X	X				
Rusty-crowned Ground-Sparrow	*Melozone kieneri*						X	
Orange-crowned Warbler	*Vermivora celata*	X	X	X	X	X	X	X
Nashville Warbler	*Vermivora ruficapilla*							X
Yellow Warbler	*Dendroica petechia*			X		X	X	X
Yellow-rumped Warbler	*Dendroica coronata*						X	X
Black-throated Grey Warbler	*Dendroica nigrescens*		X	X	X			
Black-and-white Warbler	*Mniotilta varia*			X			X	
American Redstart	*Setophaga ruticilla*					X		X
Northern Waterthrush	*Seiurus noveboracensis*						X	
MacGillivray's Warbler	*Oporornis tolmiei*		X	X	X			X

Appendix 4 continued

Common Name	**Latin Name**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Common Yellowthroat	*Geothlypis trichas*		X		X	X	X	X
Grey-crowned Yellowthroat	*Geothlypis poliocephala*						X	
Wilson's Warbler	*Wilsonia pusilla*		X	X	X		X	X
Yellow-breasted Chat	*Icteria virens*				X	X	X	X
Rosy Thrush-Tanager	*Rhodinocichla rosea*					X		
Summer Tanager	*Piranga rubra*		X	X	X		X	X
Western Tanager	*Piranga ludoviciana*		X					
Blue-black Grassquit	*Volatinia jacarina*					X	X	X
White-collared Seedeater	*Sporophila torqueola*		X		X	X	X	X
Ruddy-breasted Seedeater	*Sporophila minuta*							X
Yellow Grosbeak	*Pheucticus chrysopeplus*				X			
Northern Cardinal	*Cardinalis cardinalis*		X		X	X		
Pyrrhuloxia	*Cardinalis sinuatus*			X				
Blue Grosbeak	*Guiraca caerulea*		X		X	X	X	X
Varied Bunting	*Passerina versicolor*			X				
Painted Bunting	*Passerina ciris*						X	
Yellow-winged Cacique	*Cacicus melanicterus*			X	X			X
Streak-backed Oriole	*Icterus pustulatus*		X	X	X	X	X	
Bullock's Oriole	*Icterus bullockii*				X			
Hooded Oriole	*Icterus cucullatus*	X	X		X	X		
Orchard Oriole	*Icterus spurius*						X	X
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*		X					
Red-winged Blackbird	*Agelaius phoeniceus*		X					X
Great-tailed Grackle	*Quiscalus mexicanus*	X	X		X	X	X	X
Bronzed Cowbird	*Molothrus aeneus*							X
Brown-headed Cowbird	*Molothrus ater*				X			X

Appendix 5. Bird species list compiled during Willow Flycatcher surveys in Ecuador, January 2005 (Note: since survey locations were visited during winters 2003–2005, this list is a compilation from multiple years of surveys). For a more complete list of bird species that winter in these areas, see Ridgeley and Greenfield, 2001.

Common Name	**Latin Name**	**Hacienda Johanna**	**Jatun Sacha**	**Mondaña**	**Coca**	**Sani**
Little Tinamou	*Crypturellus soui*	X	X			
Undulated Tinamou	*Crypturellus undulatus*					X
Speckled Chachalaca	*Ortalis guttata*			X	X	
Muscovy Duck	*Cairina moschata*					X
Lafresnaye's Piculet	*Picumnus lafresnayi*	X				
Yellow-tufted Woodpecker	*Melanerpes cruentatus*	X				X
Little Woodpecker	*Veniliornis passerinus*			X		
Spot-breasted Woodpecker	*Colaptes punctigula*	X				
Crimson-crested Woodpecker	*Campephilus melanoleucos*			X		
Scarlet-crowned Barbet	*Capito aurovirens*			X		
Gilded Barbet	*Capito auratus*	X				
Ivory-billed Araçari	*Pteroglossus azara*	X				
Chestnut-eared Araçari	*Pteroglossus castanotis*		X			
White-throated Toucan	*Ramphastos tucanus*				X	
Black-fronted Nunbird	*Monasa nigrifrons*				X	
Swallow-wing	*Chelidoptera tenebrosa*			X		
Rufous Motmot	*Baryphthengus martii*	X	X			
Ringed Kingfisher	*Megaceryle torquata*		X	X		X
Amazon Kingfisher	*Chloroceryle amazona*	X	X	X		X
Green Kingfisher	*Chloroceryle americana*		X			
Little Cuckoo	*Piaya minuta*			X		
Greater Ani	*Crotophaga major*	X				X
Smooth-billed Ani	*Crotophaga ani*	X	X	X	X	X

Appendix 5 continued

Common Name	Latin Name	Hacienda Johanna	Jatun Sacha	Mondaña	Coca	Sani
Blue-and-yellow Macaw	*Ara ararauna*				X	
Chestnut-fronted Macaw	*Ara severa*			X	X	
White-eyed Parakeet	*Aratinga leucophthalmus*		X			
Dusky-headed Parakeet	*Aratinga weddellii*		X			
Blue-winged Parrotlet	*Forpus xanthopterygius*	X		X		
Cobalt-winged Parakeet	*Brotogeris cyanoptera*	X	X	X		
Yellow-crowned Parrot	*Amazona ochrocephala*			X		
Orange-winged Parrot	*Amazona amazonica*					X
Mealy Parrot	*Amazona farinosa*					X
White-collared Swift	*Streptoprocne zonaris*	X	X	X	X	
Short-tailed Swift	*Chaetura brachyura*		X	X	X	
Fork-tailed Palm-Swift	*Tachornis squamata*			X	X	X
Great-billed Hermit	*Phaethornis malaris*	X				
White-bearded Hermit	*Phaethornis hispidus*				X	
Black-throated Mango	*Anthracothorax nigricollis*			X	X	
Striped Owl	*Asio clamator*					X
Sand-colored Nighthawk	*Chordeiles rupestris*				X	
Pauraque	*Nyctidromus albicollis*		X		X	
Blackish Nightjar	*Caprimulgus nigrescens*		X	X		
Ladder-tailed Nightjar	*Hydropsalis climacocerca*		X	X	X	X
Pale-vented Pigeon	*Columba cayennensis*		X		X	X
Plumbeous Pigeon	*Columba plumbea*		X			
Ruddy Pigeon	*Columba subvinacea*				X	X
Ruddy Ground-Dove	*Columbina talpacoti*	X	X	X	X	X
Blue Ground-Dove	*Claravis pretiosa*			X	X	

Appendix 5 continued

Common Name	Latin Name	Hacienda Johanna	Jatun Sacha	Mondaña	Coca	Sani
Black-banded Crake	*Anurolimnas fasciatus*					X
Grey-necked Wood-Rail	*Aramides cajanea*			X		
Blackish Rail	*Pardirallus nigricans*	X				
Greater Yellowlegs	*Tringa melanoleuca*		X	X	X	X
Spotted Sandpiper	*Tringa macularia*		X	X	X	X
Least Sandpiper	*Calidris minutilla*			X		
Wattled Jacana	*Jacana jacana*	X				
Collared Plover	*Charadrius collaris*			X		X
Pied Lapwing	*Vanellus cayanus*	X	X	X		X
Black Skimmer	*Rynchops niger*					X
Yellow-billed Tern	*Sterna superciliaris*					X
Osprey	*Pandion haliaetus*				X	X
Swallow-tailed Kite	*Elanoides forficatus*	X	X	X		
Snail Kite	*Rostrhamus sociabilis*					X
Slender-billed Kite	*Rostrhamus hamatus*					X
Roadside Hawk	*Buteo magnirostris*	X	X	X	X	X
Black Caracara	*Daptrius ater*	X	X	X	X	X
Yellow-headed Caracara	*Milvago chimachima*	X	X	X	X	X
Laughing Falcon	*Herpetotheres cachinnans*			X	X	
Bat Falcon	*Falco rufigularis*			X		
Peregrine Falcon	*Falco peregrinus*				X	
Neotropic Cormorant	*Phalacrocorax brasilianus*		X			
Snowy Egret	*Egretta thula*		X	X	X	X
Cocoi Heron	*Ardea cocoi*					X
Great Egret	*Ardea alba*	X	X		X	X

Appendix 5 continued

Common Name	Latin Name	Hacienda Johanna	Jatun Sacha	Mondaña	Coca	Sani
Cattle Egret	*Bubulcus ibis*	X	X			
Striated Heron	*Butorides striatus*	X	X	X	X	X
Green Heron	*Butorides virescens*			X		
Roseate Spoonbill	*Platalea ajaja*					X
Black Vulture	*Coragyps atratus*	X	X	X	X	X
Turkey Vulture	*Cathartes aura*	X	X	X	X	X
Greater Yellow-headed Vulture	*Cathartes melambrotus*			X		X
King Vulture	*Sarcoramphus papa*					X
Common Tody-Flycatcher	*Todirostrum cinereum*	X				
Yellow-crowned Tyrannulet	*Tyrannulus elatus*		X			
Mottle-backed Elaenia	*Elaenia gigas*	X	X	X	X	X
Lesser Wagtail-Tyrant	*Stigmatura napensis*					X
Fuscous Flycatcher	*Cnemotriccus fuscatus*				X	
Alder Flycatcher	*Empidonax alnorum*		X	X	X	X
Willow Flycatcher	*Empidonax traillii*	X	X	X	X	X
Drab Water-Tyrant	*Ochthornis littoralis*		X			
Pied Water-Tyrant	*Fluvicola pica*			X		
Long-tailed Tyrant	*Colonia colonus*		X			
Eastern Sirystes	*Sirystes sibilator*				X	
Tropical Kingbird	*Tyrannus melancholicus*	X	X	X	X	
Eastern Kingbird	*Tyrannus tyrannus*				X	X
Variegated Flycatcher	*Empidonomus varius*			X		
Streaked Flycatcher	*Myiodynastes maculatus*			X		
Social Flycatcher	*Myiozetetes similis*	X	X	X	X	X
Lesser Kiskadee	*Philohydor lictor*	X		X		

Appendix 5 continued

Common Name	Latin Name	Hacienda Johanna	Jatun Sacha	Mondaña	Coca	Sani
Great Kiskadee	*Pitangus sulphuratus*	X		X	X	X
Black-tailed Tityra	*Tityra cayana*			X		
Black-crowned Tityra	*Tityra inquisitor*		X			
Barred Antshrike	*Thamnophilus doliatus*				X	
Castelnau's Antshrike	*Thamnophilus cryptoleucus*					X
Warbling Antbird	*Hypocnemis cantator*	X				
Lesser Hornero	*Furnarius minor*			X	X	X
Dark-breasted Spinetail	*Synallaxis albigularis*			X	X	
White-bellied Spinetail	*Synallaxis propinqua*				X	X
Plain-crowned Spinetail	*Synallaxis gujanensis*		X	X		X
Parker’s Spinetail	*Cranioleuca vulpecula*				X	
Orange-fronted Plushcrown	*Metopothrix aurantiacus*	X				
Crested Foliage-gleaner	*Automolus dorsalis*				X	
Cinnamon-throated Woodcreeper	*Dendrexetastes rufigula*		X	X		
Ocellated Woodcreeper	*Xiphorhynchus ocellatus*	X				
Red-eyed Vireo	*Vireo olivaceus*	X				
Violaceous Jay	*Cyanocorax violaceus*		X			X
Black-billed Thrush	*Turdus ignobilis*	X	X	X	X	X
Black-capped Donacobius	*Donacobius atricapillus*	X	X			
House Wren	*Troglodytes aedon*	X	X			
White-winged Swallow	*Tachycineta albiventer*		X	X	X	X
Brown-chested Martin	*Phaeoprogne tapera*	X				
Grey-breasted Martin	*Progne chalybea*	X				
Blue-and-white Swallow	*Pygochelidon cyanoleuca*	X				
White-banded Swallow	*Atticora fasciata*	X	X	X	X	

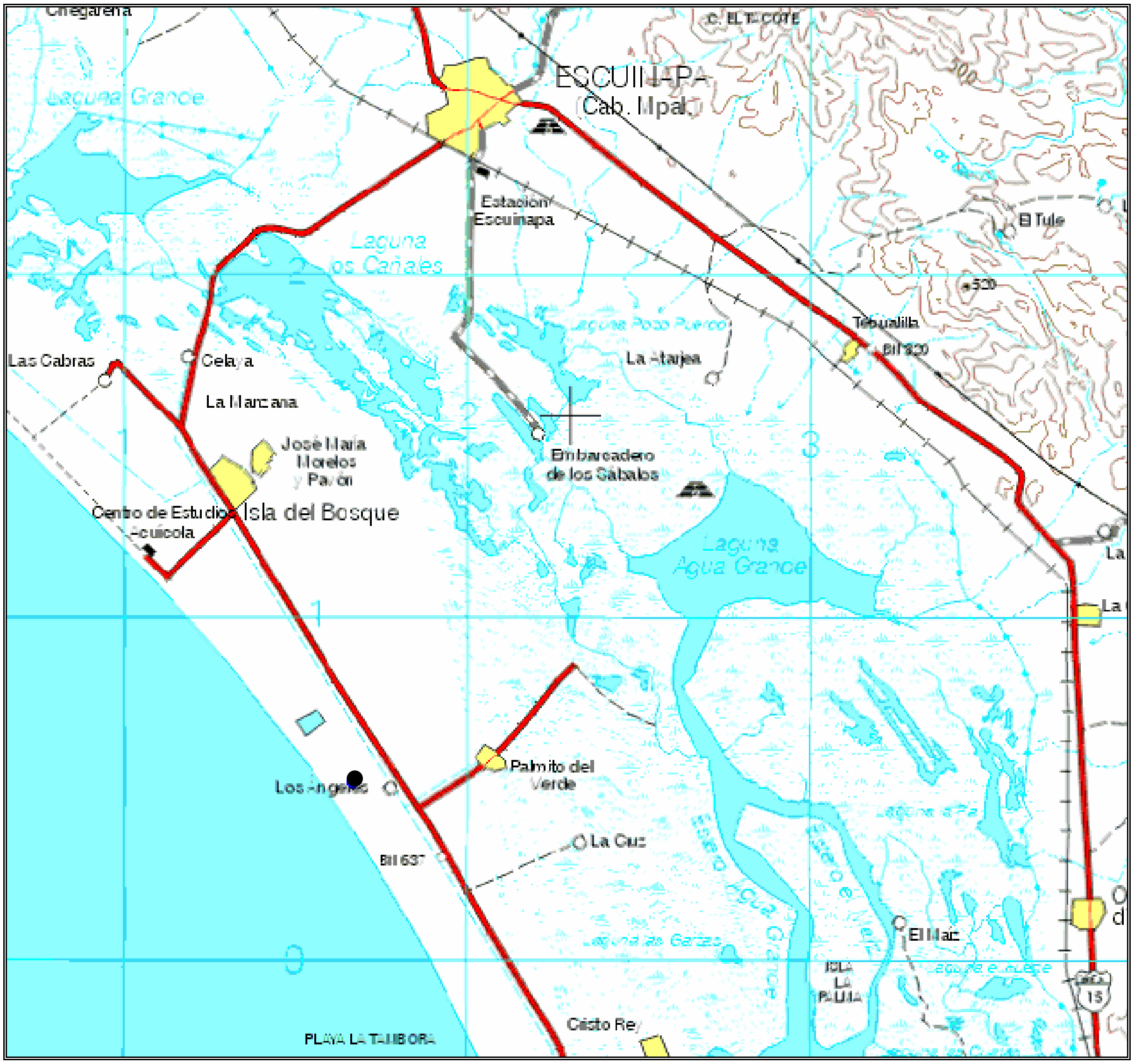
Appendix 5 continued

Common Name	Latin Name	Hacienda Johanna	Jatun Sacha	Mondaña	Coca	Sani
Southern Rough-winged Swallow	*Stelgidopteryx ruficollis*		X	X	X	X
Olivaceous Siskin	*Carduelis olivacea*	X				
Yellow-browed Sparrow	*Ammodramus aurifrons*	X	X	X	X	X
Tennessee Warbler	*Vermivora peregrina*	X				
Blackpoll Warbler	*Dendroica striata*	X		X		
American Redstart	*Setophaga ruticilla*	X				
Bananaquit	*Coereba flaveola*	X				
Magpie Tanager	*Cissopis leveriana*	X	X	X	X	X
Orange-headed Tanager	*Thlypopsis sordida*		X			X
White-shouldered Tanager	*Tachyphonus luctuosus*	X				
Red-crowned Ant-Tanager	*Habia rubica*	X				
Summer Tanager	*Piranga rubra*	X	X			
Scarlet Tanager	*Piranga olivacea*	X				
Masked Crimson Tanager	*Ramphocelus nigrogularis*					X
Silver-beaked Tanager	*Ramphocelus carbo*	X	X	X	X	X
Blue-grey Tanager	*Thraupis episcopus*	X	X	X	X	
Palm Tanager	*Thraupis palmarum*	X	X	X		
Thick-billed Euphonia	*Euphonia laniirostris*	X				
Orange-bellied Euphonia	*Euphonia xanthogaster*	X				
Blue-necked Tanager	*Tangara cyanicollis*	X				
Yellow-bellied Dacnis	*Dacnis flaviventer*	X				
Swallow Tanager	*Tersina viridis*	X				
Blue-black Grassquit	*Volatinia jacarina*	X	X		X	X
Variable Seedeater	*Sporophila corvina*		X			
Caquetá Seedeater	*Sporophila murallae*			X		

Appendix 5 continued

Common Name	Latin Name	Hacienda Johanna	Jatun Sacha	Mondaña	Coca	Sani
Lesson's Seedeater	*Sporophila bouvronides*	X	X		X	
Black-and-white Seedeater	*Sporophila luctuosa*	X	X			X
Chestnut-bellied Seedeater	*Sporophila castaneiventris*	X	X	X	X	X
Large-billed Seed-Finch	*Oryzoborus crassirostris*	X				
Lesser Seed-Finch	*Oryzoborus angolensis*	X	X			
Yellow-faced Grassquit	*Tiaris olivacea*			X		
Greyish Saltator	*Saltator coerulescens*	X	X	X	X	X
Blue-black Grosbeak	*Cyanocompsa cyanoides*					X
Russet-backed Oropendola	*Psarocolius angustifrons*	X		X		
Yellow-rumped Cacique	*Cacicus cela*	X	X	X	X	
Solitary Cacique	*Cacicus solitarius*			X		
Yellow-winged Cacique	*Cacicus melanicterus*					X
Oriole Blackbird	*Gymnomystax mexicanus*	X	X	X	X	X
Red-breasted Blackbird	*Leistes militaris*	X				
Shiny Cowbird	*Molothrus bonariensis*				X	
Giant Cowbird	*Scaphidura oryzivora*		X			

Appendix 6**.** Topographical map of Teacapan, Sinaloa, Mexico. Escuinapa Quad F1305, Instituto Nacional de Estadistica Geografia E Informatica de Mexico; scale: 1:250,000. Major contour are at 100 meters. Black dots depict detection sites.



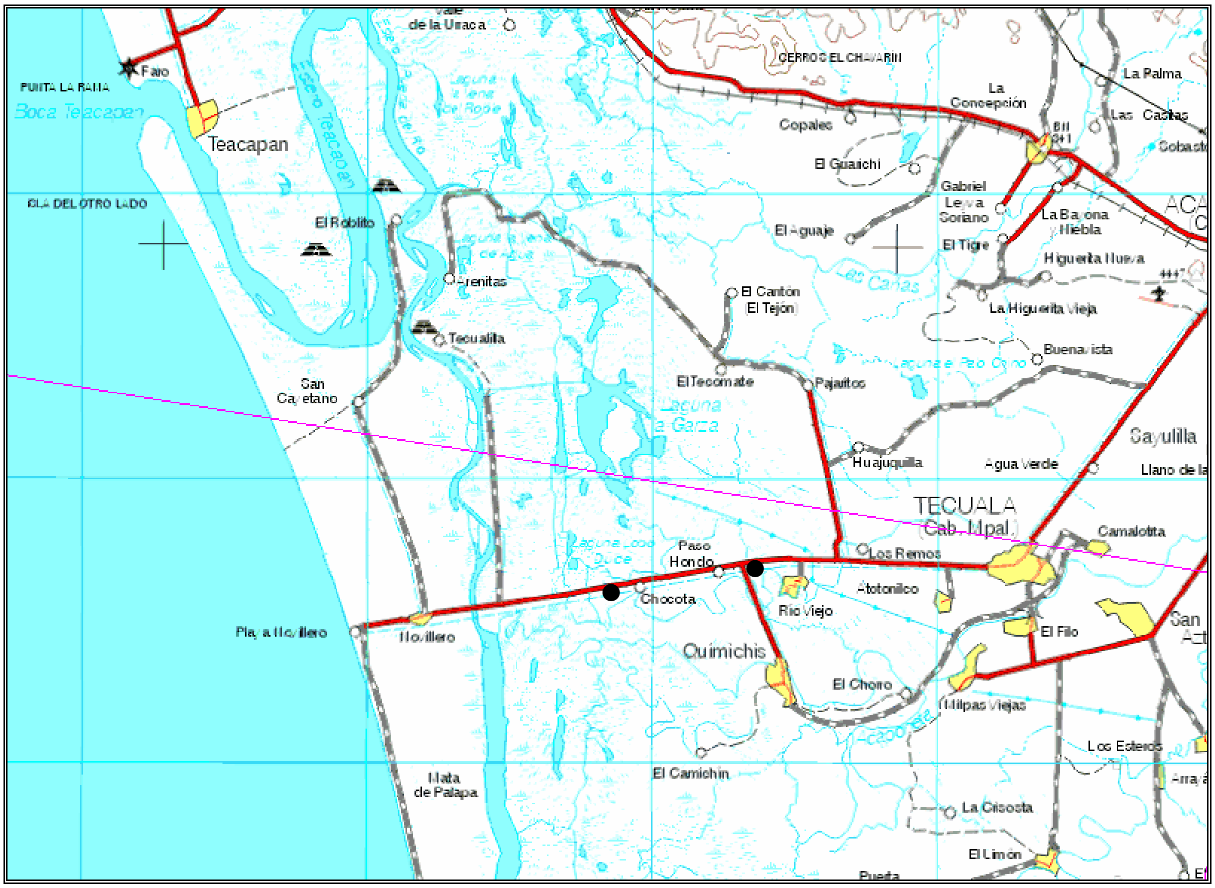
Detection Site: Teacapan, Sinaloa, Mexico

Number of Willow Flycatchers detected: 2

Mileage/direction to nearest landmark: About 1.9 km SSE from Teacapan and approximately 250 m down La Tambora Road.

Detection coordinates: 22° 33.665' N 105° 44.865' W

Appendix 7**.** Topographical map of Novillero, Nayarit, Mexico. Escuinapa Quad F1305, Instituto Nacional de Estadistica Geografia E Informatica de Mexico; scale: 1:250,000. Major contour lines are 100 meters. Black dots depict detection sites.



Detection Sites: Novillero, and Quimichis Nayarit, Mexico

Number of Willow Flycatchers detected: Novillero: 11; Quimichis: 4

Mileage/direction to nearest landmark:

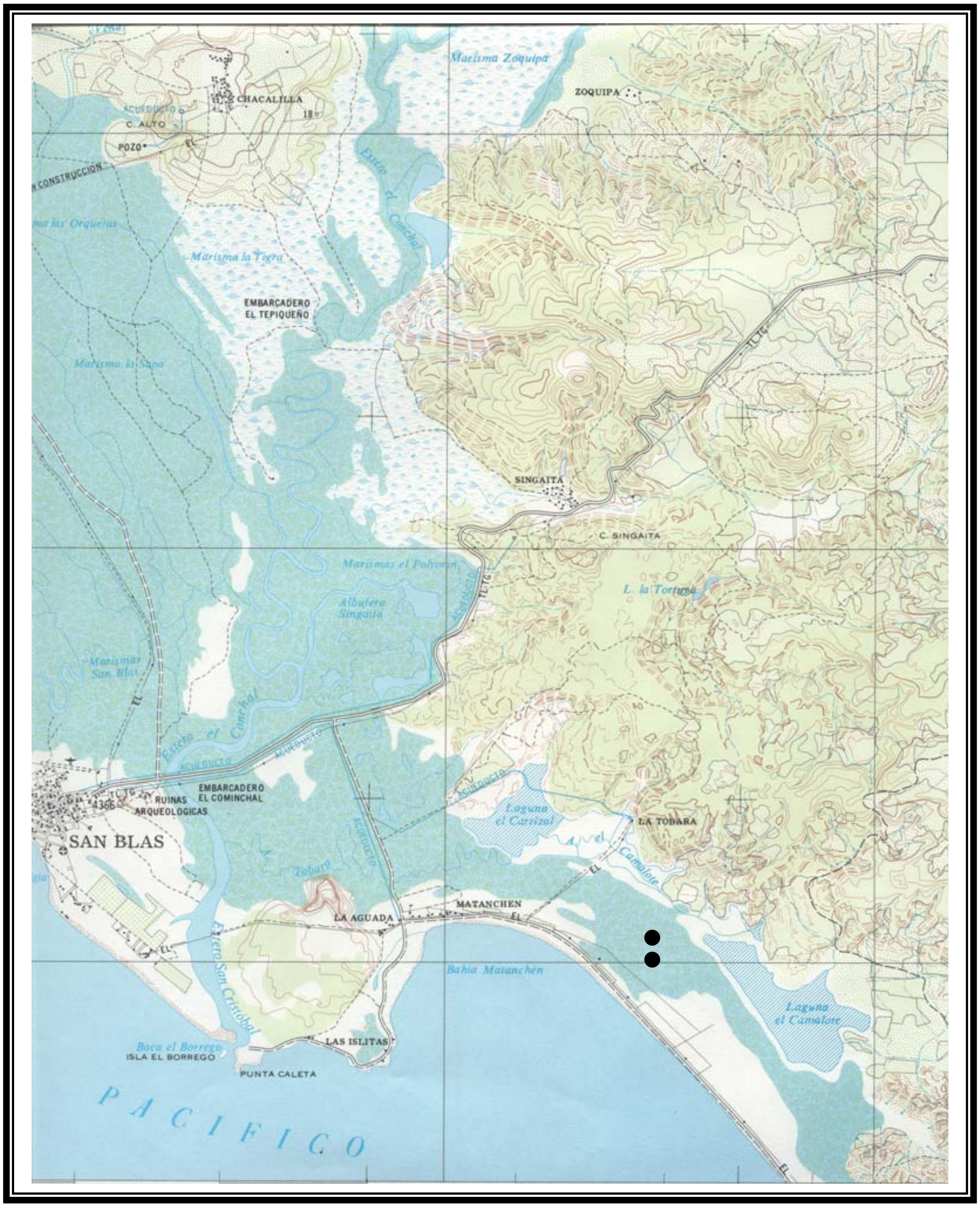
Novillero: Approximately 7 km East of Novillero, on South side of road.

Quimichis: 9.5 km east of Novillero and approximately 0.5 km down road to Quimichis.

Detection coordinates: Novillero: 22° 23.637' N 105° 34.667' W

Quimichis: 22° 23.787' N 105° 33.057' W

Appendix 8. Topographical map of San Blas, Nayarit, Mexico. San Blas Quad F13C29, Instituto Nacional de Estadistica Geografia E Informatica de Mexico; scale: 1:50,000. Major and supplementary contour lines are 20 and 10 meters, respectively. Black dots depict detection sites.



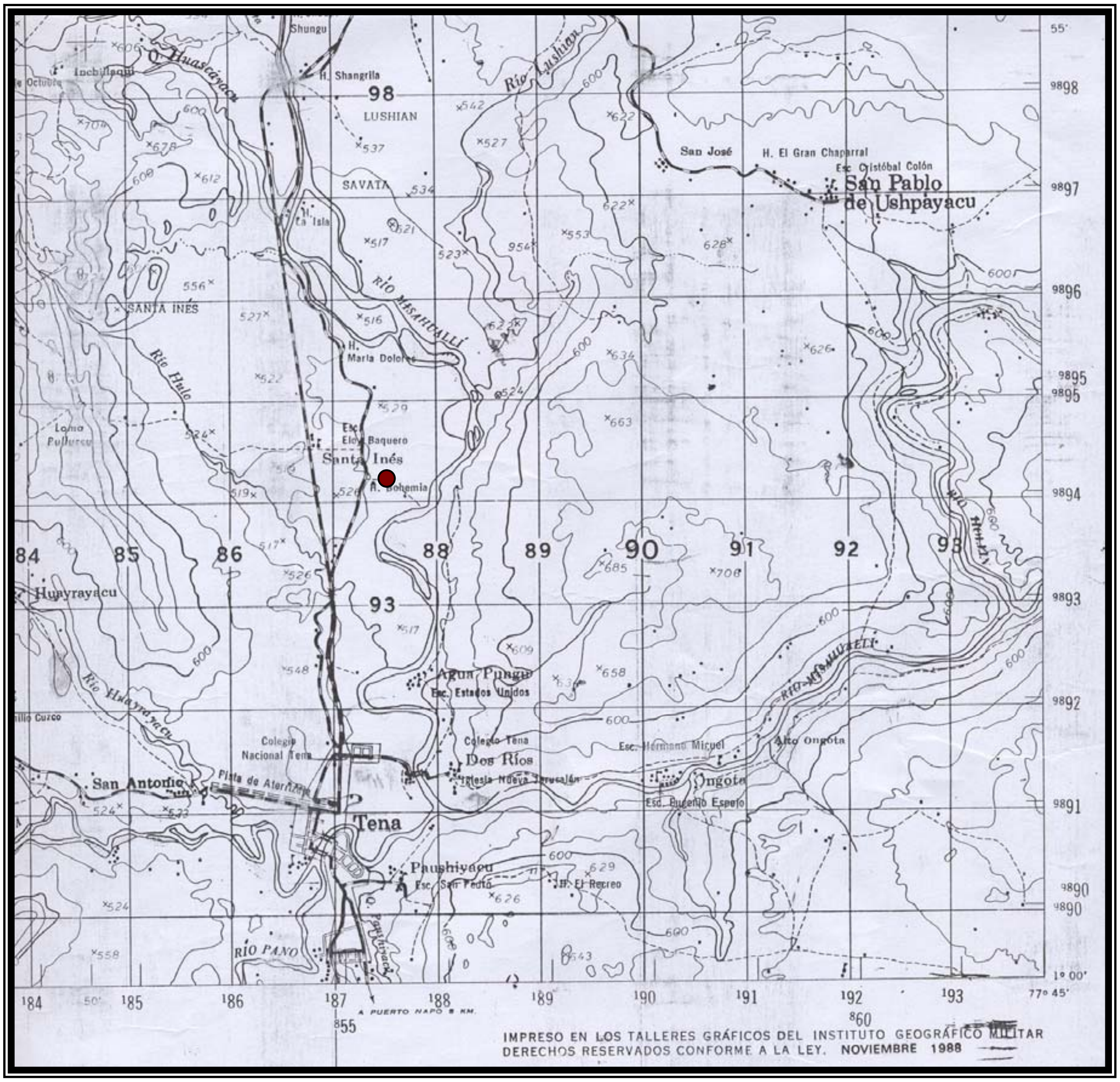
Detection Site: Cocodrilario Road, San Blas, Nayarit, Mexico

Number of Willow Flycatchers detected: 35

Mileage/direction to nearest landmark: Approx. 2 km south of Matachen on the road to the crocodile farm

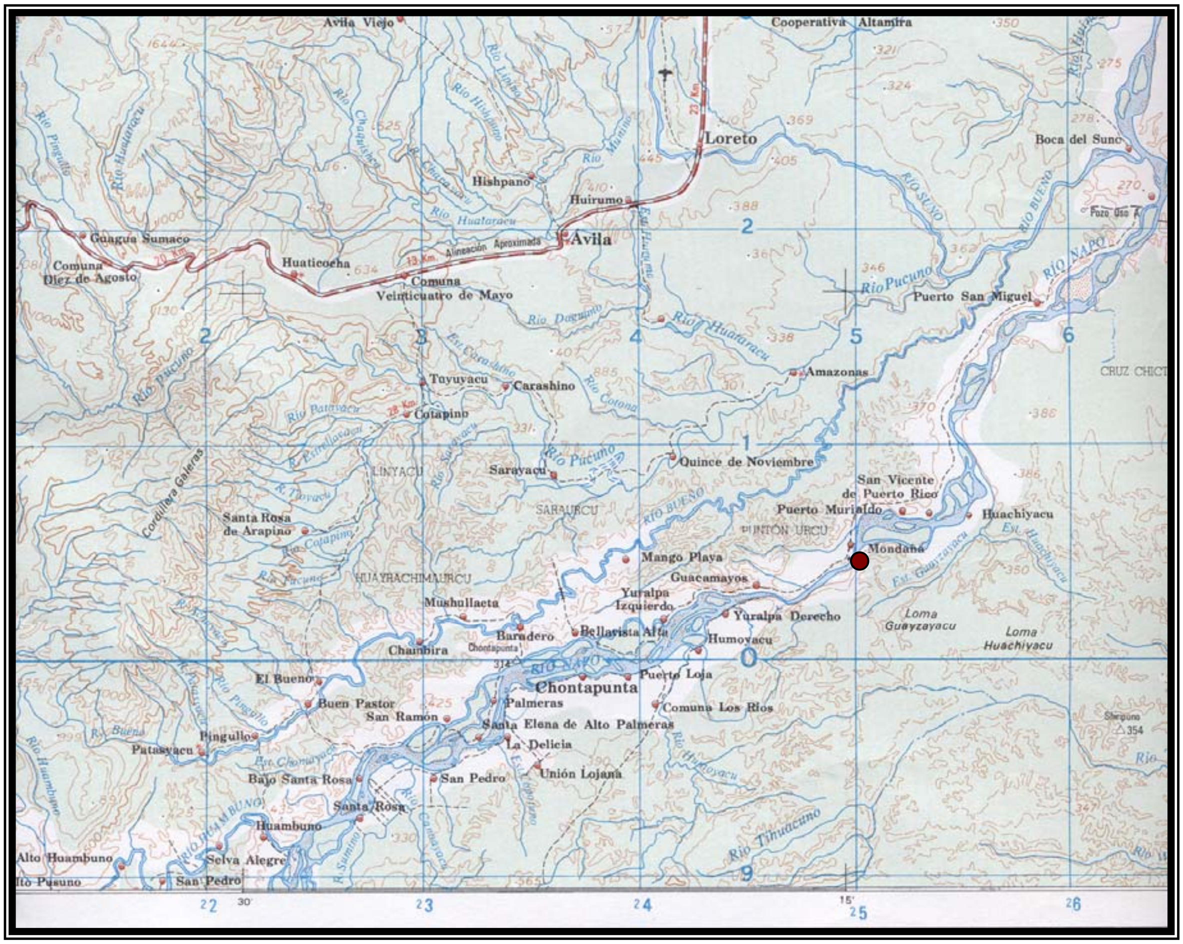
Detection coordinates: 21°31.965' N 105°13.310' W

Appendix 9. Topographical map of Hacienda Johanna, Napo Province, Ecuador. Tena Quad 4091-III, Instituto Geografico Militar en coloboracion con el Interamerican Geodectic Survey; scale: 1:50,000. Major contour lines are 40 meters. A maroon dot depicts the detection site.



Detection Site: Río Misahuallí
Number of Willow Flycatchers Detected: 7
Mileage/direction to nearest landmark: 4 km North of Tena
Detection coordinates: 00° 57.95' S, 077° 48.72' W

Appendix 10. Topographical map of Moñdana, Napo Province, Ecuador. Tena Quad SA18-1, Instituto Geografico Militar en coloboracion con el Interamerican Geodectic Survey; scale: 1:250,000. Major contour lines are 100 meters. A maroon dot depicts the detection sites (actually two river islands, but cannot delineate into two at this map scale with the relatively small size of the islands).



Detection Site: Mondaña

Number of Willow Flycatchers Detected: 7

Mileage/direction to nearest landmark: 3 km downstream of Mondaña

Detection coordinates: 00° 51.12' S, 077° 13.82' W

Appendix 11. Topographical map of Coca, Orellana Province, Ecuador. Puerto Francisco de Orellana Quad 4292-IV, Instituto Geografico Militar en coloboracion con el Interamerican Geodectic Survey; scale: 1:50,000. Major contour lines are 20 meters. A maroon dot depicts the detection site the second site is just off the map.

Detection Sites: Coca 1 & Coca 2

Number of Willow Flycatchers Detected: Coca 1: 8 Coca 2: 16

Mileage/direction to nearest landmark:

Coca 1: 3 km from the Coca Bridge

Coca 2: Approximately 8.5 km upstream the Río Coca

Detection coordinates: Coca 1: 00° 28.60' S, 076° 57.11' W

Coca 2: 00° 22.992' S, 076° 59.322' W