

Saltcedar and Southwestern Willow Flycatchers: lessons from long-term studies in central Arizona

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Saltcedar and Southwestern Willow Flycatchers: lessons from long-term studies in central Arizona.

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Abstract

The endangered Southwestern Willow Flycatcher (*Empidonax traillii extimus*: SWWF) is a riparian-obligate bird that breeds only in dense, typically wet riparian vegetation. Since the mid-1990s, biologists have discovered a substantial number of flycatchers breeding in habitat dominated by exotic saltcedar (*Tamarix ramossisima*) in sites across Arizona, New Mexico, Nevada, and Utah. Today, approximately 25 percent of SWWF breeding sites, supporting one-third of the roughly 1,300 known flycatcher territories, are in saltcedar-dominated sites. A widely held belief is that this saltcedar habitat must be sub-optimal for the SWWF. Therefore, studies were conducted to determine if there are negative effects to SWWFs breeding in saltcedar. Although diet of flycatchers in native and saltcedar habitats differs, dietary differences are not proof that food resources are limiting or insufficient in one habitat compared to the other. Long-term studies of flycatcher physiology, immunology, site fidelity, productivity, and survivorship found no evidence that nesting in saltcedar-dominated habitat is detrimental to Southwestern Willow Flycatchers at breeding sites in central Arizona. It is likely that saltcedar habitats vary with respect to suitability for breeding flycatchers across their range, just as do native habitats; therefore, results from a single study or site may not be applicable across the ranges of the SWWF or saltcedar. Ultimately, multiple long-term studies over a large geographic area must be compared to determine the relative suitability of native and saltcedar habitats at the landscape scale.

Keywords

American Southwest; birds; endangered species; exotic species; habitat use; invasive species; riparian; saltcedar; southwestern willow flycatcher; tamarisk; United States

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Introduction

The Southwestern Willow Flycatcher (*Empidonax traillii extimus*: SWWF) is a federally-listed endangered species that breeds in dense, typically wet riparian vegetation in parts of the southwestern United States (Sogge and Marshall 2000; USFWS 2002). The fact that SWWFs breed in both native and saltcedar (*Tamarix ramosissima*) dominated habitats has generated much interest, primarily due to perceived conflicts between the control/eradication of saltcedar and the goal of SWWF conservation (DeLoach and others 2000). Some (for example Hunter and others 1988) have reported that the value of saltcedar as bird habitat varies among bird species and geographic regions. Others (for example, DeLoach et al. 2000) hypothesized that SWWF use of saltcedar is limited, and that flycatchers breeding in saltcedar experience inadequate food resources and lowered productivity compared to those in native habitats. Therefore, we examined data from several large-scale and long-term studies being conducted by the U.S. Geological Survey and the Arizona Game and Fish Department, in order to better understand the extent to which flycatchers breed in saltcedar, and the ecological ramifications of their doing so.

Flycatcher Use Of Saltcedar: Nature, Geography, And Extent

Within its range, the SWWF is distributed among roughly 150 riparian breeding sites along rivers, streams, lakes, and marshes; currently, the known population is estimated at just over 1,300 pairs (Sogge and others 2003; USGS unpublished data). Based on recent distribution data, the breeding range of the SWWF overlaps greatly with the core range of saltcedar ([fig. 1](#)). Given this spatial overlap, the potential for SWWFs to use saltcedar habitats is high.

Some of the first reports of SWWF nesting in saltcedar were from New Mexico in the 1970s (Hubbard 1987; S. Williams pers. comm.), with a few additional records by the late 1980s and early 1990s (for example, Brown 1988; Maynard 1994). Today, SWWFs are known to breed

in saltcedar-dominated habitats throughout much of the flycatcher's range (Sogge and others 2003; USGS unpublished data; [fig. 1](#)), and saltcedar habitats account for 25 percent of breeding sites and approximately 30 percent of known flycatcher territories. Clearly, SWWFs use saltcedar extensively.

SWWFs do not breed in all types of saltcedar habitats - a fact sometimes presented as evidence that saltcedar is “avoided”, or is not as suitable as native habitats (DeLoach and others 2000). However, the same is true of native vegetation - not all native riparian habitats or patches are used by flycatchers. Flycatchers typically breed in only a subset of riparian habitats – whether native or saltcedar dominated (Sogge and Marshall 2000; USFWS 2002). In fact, saltcedar vegetation used by breeding SWWFs generally has similar structural characteristics to the native habitats in which they breed – dense structure, high canopy cover, tall stature, and mesic and/or near surface water.

Southwestern Willow Flycatcher Site Selection And Fidelity

Roosevelt Lake, in central Arizona, currently hosts the largest known population of breeding SWWF (USGS unpublished data). Here, flycatchers returning each year from their wintering grounds have an opportunity to choose from a mosaic of riparian habitat types, including native and saltcedar dominated. Over the course of our 1996 to 2004 joint Arizona Game and Fish Department/U.S. Geological Survey study (for example, Newell and others 2003; Smith and others 2004), flycatchers bred in native, saltcedar, and mixed habitats. Each year, some flycatchers settle into saltcedar patches even though potential territory locations are still available in nearby native patches (and are later occupied by other flycatchers). This argues against a hypothesis that saltcedar is only used when native vegetation is not available.

It is commonly assumed that a species can determine the suitability of different habitat types, and choose the “better” habitat (Wiens 1989). If SWWFs are making choices based on suitability of habitat, we would expect higher rates of settlement and site fidelity in the “best” habitat. Based on capture and resighting of banded flycatchers (see Newell and others 2003), we examined the degree to which SWWFs at Roosevelt Lake returned each year to the type of habitat in which they bred the previous year. From 1996 through 2003, 65 percent of returning adults first encountered (and banded) in native patches (n = 66) moved in subsequent years to saltcedar or mixed patches. However, only 37 percent of returning flycatcher adults first banded in saltcedar habitats (n = 152) subsequently moved to other habitat types. This pattern does not support a hypothesis that flycatchers prefer native habitats (at a local scale), or that saltcedar habitat at Roosevelt Lake is of poorer quality than native habitat (assuming that flycatchers can accurately perceive quality differences).

Ramifications Of Saltcedar Use By Flycatchers

Clearly, flycatchers often choose to breed in saltcedar habitat at Roosevelt Lake. DeLoach and others (2000) proposed that flycatchers may use saltcedar even though it is a lower quality habitat. Therefore, we examined several lines of evidence to determine if flycatchers choosing to breed in saltcedar are suffering negative physiological, survivorship, or reproductive consequences.

Flycatcher Diet and Physiology

Drost and others (2001) compared the food habits of SWWFs breeding in saltcedar and native (willow; *Salix* spp.) habitats, and reported a statistically significant *difference* in diet. This difference has been suggested as evidence that flycatcher diet in saltcedar habitat is of poorer quality than in native habitat (DeLoach and others 2000). However, the fact that there is a

difference does not necessarily equate to “better” or “worse”, in terms of diet quality. Indeed, flycatcher diet is highly variable overall, with statistically significant differences among years, month, sexes, and even ages (Drost and others 2003; USGS unpublished data).

Physiological studies of blood chemistry provides a way to evaluate whether these diet difference actually impact SWWFs. Fat storage, blood glucose level, hematocrit, and other measures reflect a bird’s nutritional and energetic state, and poor nutritional state or high stress can be detected from their immunological condition. A recent study of 13 physiological and immunological parameters (Owen and Sogge 2002) found no evidence that flycatchers breeding in saltcedar are in poorer physiological condition than those in native habitats. This indicates that SWWFs are able to obtain sufficient food in the saltcedar habitats studied, and that dietary differences do not equate to habitat quality differences.

Flycatcher Productivity and Nest Success

DeLoach and others (2000) suggest that, based on their assumption that saltcedar habitats are low quality, flycatcher nest success and productivity will be lower in saltcedar than in native patches. To test this, we calculated female productivity (the total number of young fledged per female per year) for SWWFs breeding at Roosevelt Lake from 2001 to 2003, and found no significant difference in productivity between saltcedar and native habitats (T-test, $p = 0.37$; [table 1](#)).

Flycatcher Survivorship

Another way in which saltcedar could prove detrimental to flycatchers is if birds breeding in saltcedar suffer reduced survivorship compared to those in native habitats. Therefore, we estimated the maximum likelihood survivorship rate of adults and nestlings, using the program MARK (White and Burnham 1999), based on the return rates of 429 adults and 249 nestlings banded from 1996 to 2003 at Roosevelt Lake. Neither juvenile not adult survivorship differed

significantly between native and saltcedar habitats, with both age groups having nearly identical survivorship in both habitats ([table 1](#)).

Conclusions

Our studies found no evidence for a negative effect of saltcedar on SWWFs breeding at Roosevelt Lake. However, saltcedar habitats vary with respect to suitability for breeding flycatchers, just as do native habitats (USFWS 2002). Therefore, saltcedar may prove to be suitable flycatcher habitat in some areas (such as Roosevelt Lake), yet less so or not at all in others - such as in portions of the lower Colorado River, where its structure and micro-climate conditions may preclude flycatcher nesting (DeLoach and others 2000). A similar difference in habitat suitability was reported by Hunter and others (1988), who found that saltcedar was a relatively unimportant habitat for birds on the lower Colorado River, yet consistently among the most important for riparian birds (including the Yellow-billed Cuckoo; *Coccyzus americanus*) along the Pecos River, NM.

Ultimately, multiple long-term studies over a large geographic area must be compared to determine the relative suitability of native and saltcedar habitats at the landscape scale. The difference in suitability of saltcedar habitats underscores the fact that site-specific details and context are important. Therefore, saltcedar control and/or riparian restoration efforts should be evaluated on a site-specific basis, and pre- and post-action monitoring conducted to determine if ecological goals are being met (USFWS 2002).

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Table 1. Reproductive success and annual survivorship estimates for Southwestern Willow Flycatchers breeding in native and saltcedar-dominated habitats at Roosevelt Lake, Arizona. Differences in productivity and survivorship are not significant based on T-test ($p = 0.37$) and confidences interval overlap, respectively.

Variable	Native Habitat	Saltcedar Habitat
Productivity per female per year (2001 – 2003)	Mean = 1.2 ± 0.4 (SE) n = 18 females	Mean = 1.3 ± 0.3 (SE) n = 23 females
Annual survivorship probability: adult (1996 – 2003)	Mean = 0.66 ± 0.05 (SE) 95% CI = 0.55 – 0.75 n = 66 adults	Mean = 0.60 ± 0.03 (SE) 95% CI = 0.54 – 0.67 n = 152 adults
Annual survivorship probability: nestling to adult (1996 – 2003)	Mean = 0.3 ± 0.15 SE 95% CI = 0.11 – 0.64 n = 25 adults	Mean = 0.28 ± 0.09 (SE) 95% CI = 0.14 – 0.48 n = 64 adults

Figure 1. Distribution of known Southwestern Willow Flycatcher breeding sites (circles), and the core geographic distribution of saltcedar (*Tamarisk ramossissima*) in the Southwest (dashed ellipse). The larger circles are flycatcher breeding sites that are dominated by saltcedar vegetation.

