

A Summary of Observed Physical Deformities in the Willow Flycatcher: 1996-2000



Photo by Michelle Davis, U.S. Geological Survey

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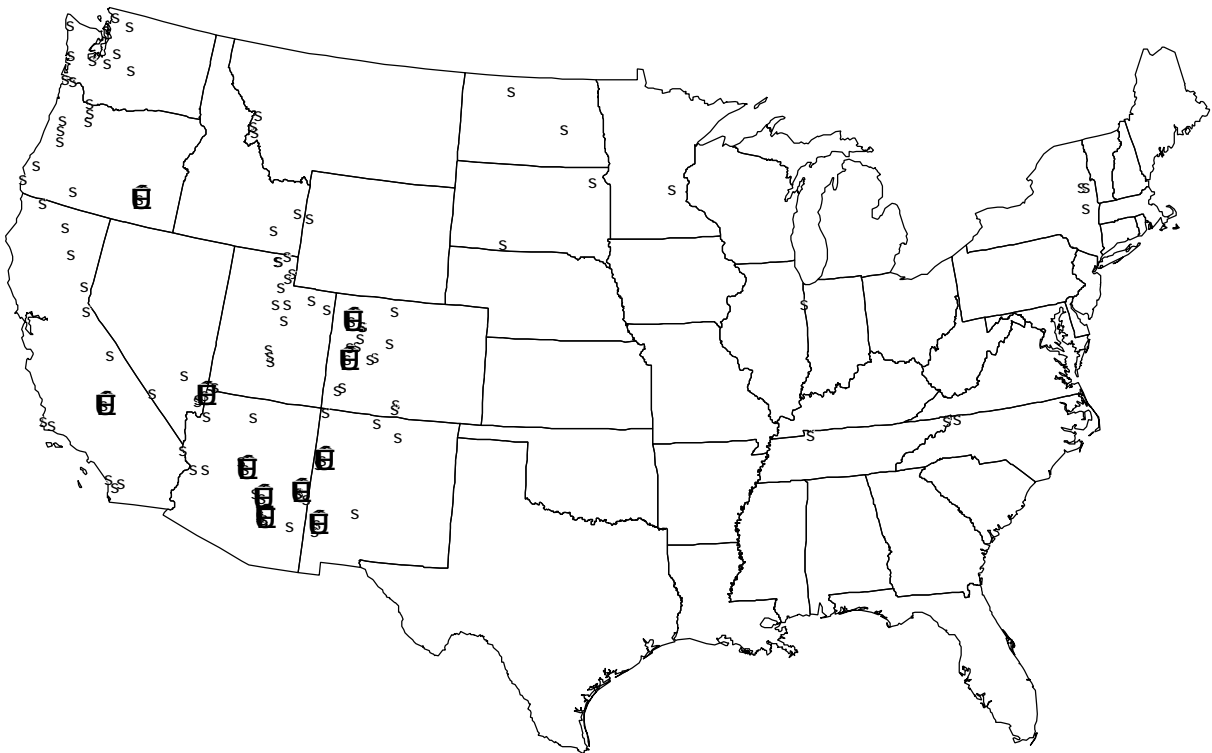
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Introduction

Since 1996, the willow flycatcher research program at the Colorado Plateau Field Station (CPFS) has conducted a number of studies (e.g., see Paxton and Sogge 1996, Owen and Sogge 1997, Drost et al. 1998, Langridge and Sogge 1998, Busch et al. 2000, Luff et al. 2000, Paxton 2000) that entailed the capture and banding of Willow Flycatchers (*Empidonax traillii*). These studies have been focused primarily in the southwestern states, but have included sites throughout much of the willow flycatcher's range (Figure 1). During these studies, project biologists captured a number of willow flycatchers that had obvious beak and eye deformities. These deformities were found at a variety of sites in the southwest, and prompted concern about the impacts of these deformities and the potential causative factors such as low genetic diversity and/or environmental toxins.

The purpose of this report is to (1) provide a brief summary of the deformities observed during our studies, (2) describe deformities noted by other willow flycatcher researchers, and (3) compare these deformities with available information in the scientific literature. We do not know the mechanism behind these abnormalities, but hope that this summary spurs additional interest in, and research about, possible causes.

Figure 1. Locations of sites where USGS CPFS staff have captured and banded willow flycatchers, 1996 - 2000. Filled stars represent sites where CPFS or other biologists noted willow flycatcher bill or eye deformities. Open circles are sites where deformities were not observed. See Appendix 1 for details of deformities.



Types of Deformities Observed

We observed two primary types of deformities:

Bill deformities: Bill deformities generally involved birds with (a) upper mandibles that were shorter than lower mandibles (Figure 2), and/or (b) mandibles that were offset laterally (left or right) so that the upper and lower mandibles did not align together (Figure 3). When the mandibles were offset laterally, the entire front part of the skull appeared asymmetric as though one side was slightly underdeveloped.

Eye deformities: Eye deformities involved missing eyes on the left side of the bird's face. On these birds, there was no appearance injury, trauma, or infection. Rather, the eye region on the left side of the face appeared sunken and hollow. No photographs of eye deformities were available.



Figure 2. Willow Flycatcher (from Gila River, NM) with upper mandible shorter than lower mandible. Side view (left) and top view (right). Photos by Michelle Davis, USGS.



Figure 3. Willow Flycatcher (from Escalante State Wildlife Area, Co) with upper mandible and lower mandible laterally offset. Side view (left) and top view (right). Photos by Jen Owen, USGS.

Types and Patterns of Deformities

Rate of Deformities

Of 1,170 willow flycatchers banded from 1996 through 2000, we observed 15 (1.4 % of total) that had bill or eye deformities (see Appendix 1 for details of each bird). The percentage of deformed birds varied from >1 to 2.6% per year (Table 1).

Table 1. The number of willow flycatchers captured by USGS Colorado Plateau Field Station and noted with deformities, 1996 – 2000.

Year	Total Number Captured	Number With Deformities	Percent of Captured With Deformities
1996	148	2	1.4
1997	234	6	2.6
1998	255	1	0.4
1999	256	5	2.0
2000	277	1	0.4
TOTAL	1170	15	1.4

Types of Deformities

We observed bill deformities more frequently than eye deformities (1.2 % vs 0.2 %, respectively; Table 2), with cross-bill and laterally offset bill deformities being equally common. See Appendix 1 for details on each individual.

Table 2. The types and numbers of bill and eye deformities (n=15 total) observed during USGS Colorado Plateau Field Station banding efforts, 1996 – 2000.

Type	Detail	Number	Percent of Total Captures	Percent of Deformities
Bill	Upper mandible longer than lower	4	0.3 %	27 %
	Upper and lower mandible laterally offset	4	0.3 %	27 %
	Both of the above	3	0.26 %	20 %
	Upper mandible reddish and bumpy (in nestling)	2	0.17 %	13 %
Eye	Missing Eye	2	0.17 %	13 %

Geographic Differences

Most flycatchers (n = 1006; 86 % of total) were captured in the greater southwestern United States (Arizona, New Mexico, southern California, Colorado, Utah, Nevada). The remainder (n = 164; 14 % of total) were from other sites throughout much of the contiguous United States (Figure 1). All beak and eye deformities were observed in the southwest (1.4 % deformity rate); and none (0 % deformity rate) elsewhere in the flycatcher's range. Thirteen of the 15 (87 %) deformities we observed were found within the range of the southwestern willow flycatcher (*E. t. extimus*), as defined by Unitt (1987) and Browning (1993).

Age Differences

We found deformities in 12 of 952 (1.3 %) of adults, and 3 of 214 (1.4 %) nestlings (including one recently fledged bird).

Gender Patterns

Among birds of known gender (n = 531), the deformity rate was similar among females (4 of 287 = 1.4 %) and males (5 of 244 = 2.0 %).

Other Reports of Willow Flycatcher Bill and Eye Deformities

In addition to observations by USGS Colorado Plateau Field Station staff, other researchers have informed us of willow flycatcher deformities.

San Pedro River, Arizona: John Kolazai (Arizona Game and Fish Department) observed a recently fledged flycatcher with a laterally crossed bill near the Aravaipa Creek confluence with the San Pedro River. The fledgling's parents had been previously banded and showed no sign of deformities.

Virgin River, Nevada: Robert McKernan (San Bernardino County Museum) reported a nestling willow flycatcher (which successfully fledged) with a laterally crossed bill at the Virgin River near Mesquite, Nevada.

Kern River, California: Mary Whitfield (Southern Sierra Research Station) has banded 96 adult and 346 nestling southwestern willow flycatchers during her 1988 – 2000 studies at the Kern River. She has noted three deformities - all in 1998. An adult male with a laterally crossed bill fathered two nestlings (each with a different females and in a different nest) that had laterally crossed bills (lower mandible crossed to the right). The following year this same male produced normal young (but with a different female). These three flycatchers result in a deformity rate of 0.7 % (0.23 % for adults; 0.45 % for nestlings) at the Kern River.

Malheur NWR, Oregon: During the course of over 10 years of willow flycatcher research at Malheur NWR, Jim Sedgwick (US Geological Survey, Midcontinent Ecological Science Center) has banded more than 1000 adult and 2,500 nestling flycatchers. During this time, he has observed only one deformed adult (one mandible longer than the other) and no deformed nestlings. This would equate to a deformity rate of less than 0.1 % for adults and 0 % for nestlings (0.03% overall).

Bolson, Costa Rica: Thomas Koronkiewicz (USGS Colorado Plateau Field Station) reported an adult, captured at a wintering site in Costa Rica, that had an unusual lower mandible which was very thin and translucent near the base. The North American breeding location for this adult is unknown.

Discussion

Bill deformities are rare in birds, or at least are rarely observed and reported. The most pronounced abnormalities probably cause early mortality, and thus have a low likelihood of ever being seen. Those that we see are generally the deformities that the individuals have been able to survive with, often until adulthood.

Craves (1994) synthesized many of the reports of passerines with deformed bills, and noted genetic or developmental causes, chemical pollutants, injury, or disease as the most likely possible causes. Unfortunately, it is seldom possible to determine the cause of any particular deformity. This is the case for the willow flycatcher deformities that we observed – any one or more of these could be contributing factors.

In all likelihood, there is no single factor responsible for all the abnormalities. For example, though collision injuries could generate the bill and eye deformities we observed in adult flycatchers, this could not be a factor in the bill deformities of the nestlings reported in Arizona and in California. Genetics may be a factor in those cases where a deformed adult had deformed offspring (reported once each in Arizona and the Kern River), but in other cases deformed young have normal appearing parents (though this does not completely exclude genetics as a factor). Furthermore, Busch et al. (2000) found that willow flycatcher populations in the southwest appear to retain substantial genetic variability, casting doubt on genetic inbreeding as a likely factor. Agricultural chemicals are widely used in the vicinity of many willow flycatcher breeding sites in the southwest (Marshall and Stoleson 2000), and are even more widespread on at least some of the flycatcher's Central and South America wintering grounds (Koronkiewicz et al. 1998). Potentially harmful chemicals (e.g., selenium, mercury, etc.) occur naturally, or as a product of human activities such as mining, in some of the southwestern watersheds where flycatcher deformities have been observed (Marshall and Stoleson 2000). However, the possibility of chemical pollutants as a factor, based simply on their presence, does not provide proof of their role. Additional research is clearly needed to determine if and where chemical pollutants may be adversely affecting the willow flycatcher.

It is also possible that the level of deformities (1.4 %) that we report here may be a “normal” level of deformities for this species. However, it is a higher rate than Pomeroy's (1962 *in* Craves 1994) estimate of less than 0.5% for most wild birds. Craves (1994) noted that bill deformities may be more prevalent in some types of birds (e.g., Incteridae, Mimidae) than others. However, flycatcher deformities have not been noted in journal articles or other reports (even where the flycatcher has been studied extensively outside of the southwest). Therefore, we believe that willow flycatchers are not generally a “deformity prevalent” species. This belief is supported by the restricted distribution of the deformities (all but the one in Malheur, OR were found in the southwest), and the greater rate in the southwest. If a species were prone to “naturally occurring” deformities, it would be expected that this would occur more or less equally throughout its range. Based on these considerations, the flycatcher deformities we and other flycatcher researchers observed may reflect a higher than normal deformity rate in some breeding populations of this species, especially within the range of *E.t. extimus*.

As noted above, a deformity does not clearly equate to impaired survivorship. Four of 8 (50%) deformed adult flycatchers that we observed at our regularly monitored study sites survived to the following year, which is well within the range of overall adult survivorship noted in Arizona (Luff et al. 2000). Similarly, the deformed adult male noted at the Kern River in 1998 returned to breed in 1999 and 2000. In at least three cases, nestlings with deformed bills successfully fledged. In a paper based on 10 years of general bird banding work (approximately 30,000 birds), Michener and Michener (1936) reported that deformed bills were “almost as common as injured legs” (for which they give no actual rate), and speculated that most bill abnormalities are due to injuries. They also believed that birds are often able to adapt to leg injuries and bill abnormalities. However, it is important to remember that the deformities or abnormalities that we observe are those that allow the bird to survive long enough *to be observed*. Deformities severe enough to greatly reduce survival could be occurring, but would not be as likely to be observed.

In addition to the bill and eye deformities noted above, our banding crew captured several adult willow flycatchers with toe abnormalities. One flycatcher in East Canyon, Utah was missing one of its middle toenails when captured. Near Mountain City, Tennessee, one flycatcher was missing the middle front toenail on its right leg, and the outer toenail on its left foot was very short (>1 mm). Another flycatcher at the same site was missing its inner toenail on the right foot, and the center toenail on its left foot. Because foot injuries are sometimes relatively common among birds (Michener and Michener 1936), we note them here but do not consider these toe abnormalities to be of concern.

Acknowledgements

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Appendix 1. Summary of observed Willow Flycatcher deformities.

Year	Site	State	Band #	Age	Sex	Deform Type	Description	
Observed by USGS Colorado Plateau Field Station personnel; 1996 - 2000								
1996	San Pedro River (Cook's Lake)	AZ	1740-91614	A	M	Bill	Upper mandible shorter than lower mandible	Ret
1996	Escalante St. Wildl. Area	CO	1740-91645	Fl	U	Bill	Bill crossed laterally 1-2 mm	
1997	Greer	AZ	1590-97260	A	F	Bill	Bill crossed laterally 1-2 mm	Ret
1997	San Pedro River (Cook's Lake)	AZ	1590-97267	A	M	Eye	Left eye missing, sunken in and hollow	No
1997	Roosevelt Lake	AZ	1590-97312	A	M	Eye	Left eye missing, sunken in and hollow	No
1997	Camp Verde	AZ	1590-97322	A	F	Bill	Upper mandible shorter than lower mandible	No
1997	Zuni Pueblo	NM	1590-97230	A	M	Bill	Bill crossed laterally 1-2 mm	
1997	Rio Blanco Lake	CO	1590-97426	A	U	Bill	Bill crossed laterally 1-2 mm and upper mandible smaller than lower mandible	
1998	Gila River – Cliff	NM	2070-21031	A	F	Bill	Upper mandible shorter than lower mandible	
1999	Roosevelt Lake	AZ	1710-20335	A	F	Bill	Upper mandible 3-4 mm shorter than lower mandible and twisted to left. Lower mandible twisted at tip.	Fer (see 2000)
1999	Roosevelt Lake	AZ	1710-20289	N	U	Bill	Upper mandible reddish and bumpy	Yo No
1999	Roosevelt Lake	AZ	1710-20290	N	U	Bill	Upper mandible reddish and bumpy	Yo No
1999	San Pedro River (Indian Hills)	AZ	1710-20227	A	M	Bill	Upper mandible shorter than lower mandible and twisted to the right	Rec
1999	San Pedro River (Aravaipa)	AZ	1710-20477	A	U	Bill	Bill crossed laterally; lower mandible twisted 12 mm to left; entire bill slightly curved to left	No
2000	Gila River – Kearny	AZ	1710-20375	A	U	Bill	Upper mandible shorter (8.8 mm) than lower (9.2 mm)	
Observed by other willow flycatcher researchers.								
1997 ?	Virgin River, Mesquite	NV		N	U	Bill	Bill crossed laterally	Suc
1998	Kern River	CA		A	M	Bill	Bill crossed laterally (“slightly”)	Ret tw Wh
1998	Kern River	CA		N	U	Bill	Bill crossed laterally; lower mandible crossed to right	Die Ke
1998	Kern River	CA		N	U	Bill	Bill crossed laterally; lower mandible crossed to right	Fle fro
Unk	Malheur NWR	OR		A	U	Bill	Bill crossed laterally	Dat
2000	San Pedro River (Aravaipa)	AZ	Unbanded	Fl	U	Bill	Mandibles crossed laterally	Bot Ko

Age: A = Adult, Fl = Recently Fledged, N = Nestling Sex: M = Male, F = Female, U = Unknown