Male Wilson's Warbler with Amputated Foot Successfully Forages and Raises Brood of Young

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ABSTRACT

A color-banded male Wilson's Warbler (*Wilsonia pusilla*) was observed to secure a territory successfully, attract a mate, obtain food, and raise young, even though the foot and distal tarsus of one leg were amputated. The bird's ability to survive and raise young in spite of a severe leg and foot injury is similar to circumstances reported for Willow Flycatchers (*Empidonax traillii*) and many non-passerine species. Measurement of the Wilson's Warbler's intact tarsus, compared with the stump of its amputated tarsus, suggested that irritation from a standard USFWS aluminum band may have contributed to the amputation. Adaptations for foraging while airborne in passerine species such as flycatchers and Wilson's Warblers may facilitate their survival following severe leg and foot injuries, while passerines not so adapted might survive less well.

INTRODUCTION

Investigators using U.S. Fish and Wildlife Service (USFWS) flat aluminum bands and butt-end plastic color bands generally have assumed a minimal rate of injury to the legs of birds because of the bands, and most extended studies have reported a two percent or less injury rate (Marion and Shamis 1977, Nisbet 1991, Reed and Oring 1993, Amat 1999). Some bird populations or species have been relatively more susceptible to band injury, however. For example, one banded population of Piping Plovers (*Charadrius melodus*) sustained an 11% (5/45) incidence of foot loss (J. Sidle and G. Lingle in Reed and Oring 1993), while several different species of parrots and parakeets banded with USFWS flat aluminum bands sustained nearly a 90% (25/28) rate of leg injury (Meyers 1994). Generally gulls, terns, and shorebirds have been thought to sustain higher rates of band-related leg injury than other taxa (Marion and Shamis 1977), a possible result of wet mud or sand from substrates they inhabit lodging under their bands and causing irritation (J. Sheppard, pers. comm.). Until recently there have been relatively few reports of leg or foot injury to passerine species attributable to USFWS butt-end aluminum bands, and none attributable to butt-end plastic bands (Sedgwick and Klus 1997). However, Sedgwick and Klus (1997) reported that nearly 10% of 617 returning color-banded Willow Flycatchers (*Empidonax traillii*) had sustained leg injuries. These injuries resulted in foot amputation in 33% (20/60) of injured legs, and most other leg injuries were considered severe. Fifty-eight percent (35/60) of injuries were to legs banded with color bands alone, but only 7% (4/60) to legs banded with USFWS bands alone.

In spite of presumed debilitation because of severe leg injury and loss of feet, several studies report that leg-injured birds often can forage, survive, and sometimes even raise young, in spite of their injuries (Nisbet 1991, Reed and Oring 1993, Meyers 1994, Sedgwick and Klus 1997, Amat 1999). We report here observations of a male Wilson's Warbler (*Wilsonia pusilla;* the individual hereafter referred to as 'the male') with an amputated distal tarsus and foot. The injury appeared to have been caused by leg irritation associated with a standard, butt-end USFWS flat aluminum band. We further report that the injury seemed to have minimal effect on the male's ability to forage, hold a territory, attract a mate, and successfully raise a brood, although we did not

determine if the male successfully copulated or was a genetic parent of its brood.

METHODS AND RESULTS

This study is based on observations made during 1997 and 1998 in the Tilden Nature Area, Tilden Park, East Bay Regional Park District, Contra Costa County, California (study area described in Gilbert 1994). Gilbert captured the male on 17 Apr 1997 and placed one butt-end USFWS #0A band on its left leg, and two butt-end celluloid size XF color bands (A. C. Hughes Ltd., Middlesex, England) on its right leg. At time of banding, no unusual circumstance, such as an overlapped aluminum band, was noted. The male was mated at time of banding, and the pair subsequently constructed two sequential nests. The first nest failed, but the replacement nest fledged three young. Gilbert observed feeding of young at both nests in 1997, and noted no leg injury to the male through time of fledging from the second nest, after which time observations ceased.

Gilbert observed the male singing on its 1997 territory on 10 Apr 1998 and identified the bird by the two color bands on its right leg. The male had no aluminum band on the left leg, however, and the leg was shortened and the foot missing. The male had difficulty balancing on perches, especially when first landing, and tended to crouch with its single foot directly beneath its body. On 11 Apr the male became mated with a female different from that of 1997.

We saw the male regularly over the next few months, sometimes intruding (as did other males) into neighboring territories where fertile females were constructing nests. On 30 Jun we located a nest, containing three eggs, belonging to the male and its mate. Based on the date of discovery, the nest likely would have been a replacement effort following at least one earlier nesting failure. All three eggs in the nest hatched on late 10 or early 11 Jul, and both parents first fed the nestlings on 11 Jul, and daily until fledging (apparently late on 20 Jul). Many first-day feedings by both parents were through regurgitation, although they also delivered some small, whole insects. On 11 Jul the male spread its left wing over the edge of the nest as it fed the young, and that apparently supported the bird as it balanced on its right leg. After 11 Jul, however, the male fed the young without spreading its left wing. We observed no regurgitative feeding by either parent after 11 Jul. During 10 days of brood care we recorded the male making over 50% more feeding trips than did the female (Table 1). Similarly, the male's hourly feeding rate was over half again as great as that of the female (Table 1). The male also appeared to bring larger amounts of food during each nest visit than did its mate.

On 20 Jul we netted, examined, measured, and photographed the male. Although we did not weigh the bird, it appeared to be in good health and not emaciated. The male's intact right tarsus measured 18.0 mm, and the stub of its left tarsus measured 10.2 mm (Fig. 1). The male's cloacal protuberance (cp) volume [height x (π x (width/2)^2)] was 81 4 mm^3.

DISCUSSION

The frequency of "natural" foot amputations among Wilson's Warblers captured in the wild apparently is low or non-existent, e.g., none was found among approximately 2,000 unbanded spring migrants captured at a banding station in the southern California desert (J. Sheppard, pers. comm.). The height of a USFWS #0A band is 5.6 - 5.8 mm, and approximately 7.8 mm of bone was missing from the distal end of the male's left tarsus. The amputation thus occurred within about 2 mm of the proximal end of the USFWS band, suggesting that irritation associated with the band may have caused the amputation. Such irritation could be the result of a microscopic defect on the band's inner surface, or from foreign material lodged between the band and leg (J. Sheppard, pers. comm.). The male's amputated tarsus was the only leg injury noted among 24 recorded returns of color-banded Wilson's Warblers to our study area over five years (W. Gilbert, unpubl.). Out of 99 color-banded Orange-crowned Warbler (*Vermivora celata)* returnees to our study area over 18 years, no leg or foot injury has been observed (W. Gilbert, unpubl.). Our data are too few to determine if leg injuries among our banded Wilson's Warblers occur with regularity, or approach frequencies reported in a population of Willow Flycatchers

Table 1. Relative effort of a male Wilson's Warbler and its mates in provisioning three nestlings during each of two successive years.

	1997		1998	
	Male (uninjured)	Female*	Male (injured)	Female
% of total feeding trips	73.8	26.2	61.2	38.8
	(n = 225)		(n = 224)	
# feeding trips x h^{-1}	9.2 ± 0.8 SE	3.3 ± 0.4 SE	10.5 ± 1.3 SE	6.7 ± 1.0 SE
	(n = 18)		(n = 13)	

* Female mates in 1997 and 1998 were different individuals.

(Sedgwick and Klus 1997). Our data for Orange-crowned Warblers suggests that band-related leg injuries are low or non-existent in our study population.

The injured male Wilson's Warbler's difficulties in landing and balancing on perches were similar to those of Willow Flycatchers with amputated or disabled feet (Sedgwick and Klus 1997). However, the male's apparent good health and body mass, and its ability to provision young, indicate that its foraging efficiency was at least adequate to sustain basic life and brood care functions. An ability to forage, in spite of amputated or disabled legs or feet, also has been reported for Common Terns (*Sterna hirundo;* Nisbet 1991), Spotted Sandpipers (*Actitis macularis;* Reed and Oring 1993), Willow Flycatchers (Sedgwick and Klus 1997), and for an Orange-crowned Warbler (leg strained during banding; W. Gilbert, unpubl.).

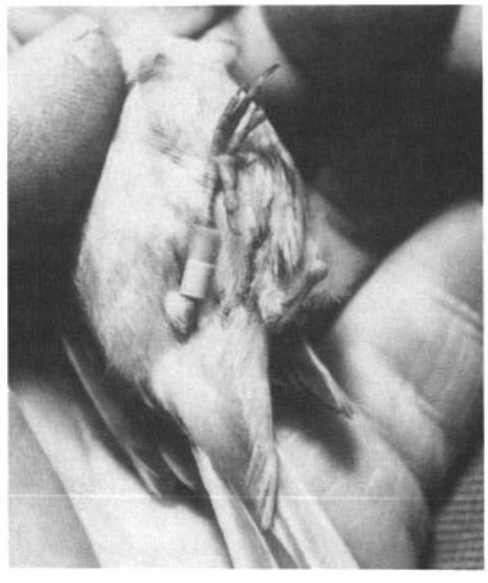

Figure 1. Male Wilson's Warbler with an amputated left foot and distal tarsus. Bird was in good health and provisioning nestlings at time of recapture.

The leg-injured Wilson's Warbler male we observed secured and held a territory, attracted a mate, and raised young. Its contribution to feeding young in 1998 was greater than that of its mate, a relationship also noted in 1997 (Table 1). Additionally, the male's mean hourly feeding rate in 1998 actually was greater than that of 1997 (although significance undetermined). The mate's feeding contribution relative to its mate compared favorably with those of male Wilson's Warblers at other nests; these can be as low as 30% (Stewart 1973). The ability to feed young in spite of leg injury also has been reported for Common Terns (Nisbet 1991), Spotted Sandpipers (Reed and Oring 1993), and Willow Flycatchers (Sedgwick and Klus 1997). As in our study, however, none of these previous studies determined if leg-injured males successfully copulated or genetically fathered the young in their nests. The male's cp volume (81.4 mm^3) was less than a third the mean maximum (269.3 mm^3 ±12.1 SE: n=10) attained by males at our study site, but over 50% greater than the mean cp volume of unmated, early-season males (50.0 mm^3 ± 5.9 SE: n=12, Ammon and Gilbert 1999). The fact that the male's cp was swollen at all, however (and considering probable late-season cp recru- descence), suggests that the male probably had been able to produce sperm, at least during the earlier breeding season.

In spite of the ability of some leg-injured birds to survive and carry out normal life functions over the short term, long-term survival of at least some individuals may be impaired. Of five footless Spotted Sandpipers, none was resighted in subsequent years (Reed and Oring 1993). Patagially-marked Orange-fronted Parakeets (*Aratinga (aurea) canicularis*) also banded with USFWS flat aluminum leg bands (which caused

high injury rates) were resighted less often than those without the leg bands (Meyers 1994). Year-to-year return rates for leg-injured, banded adult Willow Flycatchers were significantly lower than for uninjured, banded adults (Sedgwick and Klus 1997). Leg injuries similarly could reduce long-term survival in Wilson's Warblers. Gilbert did not observe the leg-injured male Wilson's Warbler return to its breeding territory after 1998, in spite of comprehensive observations through 2001. However, return rates to the study area for uninjured banded individuals also were low for the three-year period (W. Gilbert, unpubl.).

Band-related leg injuries and foot loss do not appear to be distributed randomly across avian taxa, and Marion and Shamis (1977) suggest that charadriiforms may suffer more such injury than other groups. Although passerines are banded in relatively great numbers, there are relatively few reports of band-related leg injuries (Sedgwick and Klus 1997). Possibly, however, such injuries to passerines are more frequent than generally assumed, but go unnoticed because injured individuals often do not survive long. This especially could be true for species such as towhees and some sparrows which are greatly dependent on legs and feet for foraging. However, species such as flycatchers and Wilson's Warblers, which can forage while hovering or sallying (Stewart et al. 1977, Eckhardt 1979), may better survive severe leg injury.

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