

ECOLOGY OF A SIERRA NEVADA POPULATION OF WILLOW FLYCATCHERS

MARY ANNE FLETT, 1764 Newell Avenue, Walnut Creek, California 94595

SUSAN D. SANDERS 133 North Street, Woodland, California 95695

Willow Flycatchers (*Empidonax traillii*) have declined in California, and much of the state's population is now restricted to meadows in the Sierra Nevada (Harris et al. 1987, Serena 1982). To understand the factors contributing to their decline and to develop recommendations to protect and enhance the flycatchers' habitat, we studied a Sierra Nevada population of Willow Flycatchers in the late spring and summer of 1986. In this paper, we present preliminary information on Willow Flycatcher nesting success, territory and habitat characteristics, and effects of livestock grazing. We conclude with some management recommendations based on this study and the results of a distributional survey also conducted in the summer of 1986 (see Harris et al. 1987).

STUDY SITES

Perazzo Meadows and Lacey Valley are in the Little Truckee River drainage approximately 32 km northwest of the town of Truckee, Sierra County, California. These meadows are at an elevation of 2010 m on the east slope of the Sierra Nevada in Tahoe National Forest. Both are wet meadows with perennial streams running through them and are surrounded by lodgepole pine (*Pinus murrayana*) forest. Willow clumps (*Salix* sp.) are scattered in patches throughout the meadows.

Perazzo Meadows is over 350 ha in size. We confined our study to the eastern 60 ha of this extensive meadow system. Lacey Valley, approximately 3 km east of Perazzo Meadows, extends over 90 ha. These two meadows support the largest population of breeding Willow Flycatchers in northern California (Serena 1982).

METHODS

Our field work extended from early June to late August 1986. We observed 13 pairs of Willow Flycatchers and 6 additional singing males, at least 2 of which were unpaired. Birds were observed from dawn to mid-morning, and the location and behavior of Willow Flycatcher individuals, pairs, or families were recorded. These observations were the basis for determining the breeding status of individuals, nest locations, habitat use, and territorial boundaries. We spent 186 hours observing the birds. To facilitate observations and identify individuals, we captured 16 Willow Flycatchers in mist nets and banded them with unique color combinations.

We regularly checked nests to follow the fate of eggs and nestlings. Recorded characteristics of nests included height, location in willow clumps, and foliage density at the nest. We assessed foliage density by placing a 1 m square board behind the nest, pacing back about 5 m, and estimating the percentage of

WILLOW FLYCATCHER ECOLOGY

the board obscured by willow twigs and leaves. Because nests were placed near the outer edge of willow clumps and the clumps were impenetrable, we made foliage density measurements at the nests from the outside of the clumps.

To determine the boundaries of the territories of paired males, we recorded the locations of perches from which males repeatedly sang and measured the distances between those perches. We considered the area enclosed by the outermost singing perches to be the male's territory. Since territories shifted during the different phases of the breeding season, we mapped and measured territorial boundaries only when a nest containing eggs or nestlings was within the territory. We measured 8 territories in the two study sites.

To assess habitat characteristics of Willow Flycatcher territories, we estimated the percentage of each territory covered by willows, standing or running water, and trees. Using the technique described above, we measured willow foliage density at 0-1 m and 1-2 m above the ground at 10 sites throughout the territory. Since foliage on shrubby willows normally extends to the ground, measurements taken at 0-1 m were intended to document the effects of livestock browsing on the lower portions of the willows. Because Willow Flycatchers at our study sites place their nests approximately 1.5 m from the ground, measurements at 1-2 m were taken to assess the vigor and amount of foliage at heights appropriate for nesting. These measurements were taken every 5 m for 50 m along the outer edge of the longest willow clump in the territory. Circumference of the willow clumps generally did not exceed 50 m.

On 31 separate days we observed the cattle in Perazzo Meadows by walking through the study area and recording the number of cows in the open and in willows. We made similar observations of sheep at Lacey Valley, but because of the late arrival of the flock and its habit of traveling as a unit, we were able to observe it on only 4 of 13 days spent searching for it. We noted associations of Brown-headed Cowbirds (*Molothrus ater*) with the livestock.

RESULTS AND DISCUSSION

Breeding Chronology

Willow Flycatchers arrived by early to mid-June and established territories by late June. The first eggs were laid by mid-June and the young hatched by 30 June. The first young fledged on 15 July. Clutches were still being laid in mid- to late July, and the last young fledged on 13 August. Territories began breaking down the week of 28 July, and the last breeding Willow Flycatchers departed by the end of August.

Nest and Egg Success

Table 1 summarizes data from 11 Willow Flycatcher nests at Perazzo Meadows and Lacey Valley. The average number of fledglings per nest was 1.3 ($n = 11$, s.d. = 1.3). The total number of young fledged was 14 or 15 (we are uncertain whether 3 or 4 young fledged from nest number 5). For 5 of the 11 nests, we had complete egg-to-fledgling data. The total egg-to-fledgling success rate for these 5 nests was 29%. There was little difference in success rates between Perazzo Meadows and Lacey Valley. Willow Flycatchers at Perazzo Meadows produced an average of 1.6 fledglings per nest

WILLOW FLYCATCHER ECOLOGY

Table 1 Numbers of Willow Flycatcher Eggs, Nestlings, and Fledglings Produced from 11 Nests at Perazzo Meadows and Lacey Valley, 1986

Nest	Location	No. eggs	No. nestlings	No. fledglings
1	Lacey	3	0	0
1A	Lacey	?	1	0
2	Perazzo	3	3	0
3	Lacey	?	4	3
5	Perazzo	?	4	3-4
6	Perazzo	?	2	1
8	Perazzo	3	1	1
9	Perazzo	2	1	1
10	Lacey	?	3	0
11	Lacey	3	2	2
13	Perazzo	?	3	3
Total		31?	24	14-15
Mean no. of fledglings per nest: 1.35				
Egg-to-fledgling success: 29%				
Perazzo Meadows: 25%				
Lacey Valley: 33%				

($n = 6$, s.d. = 1.4) and had an egg-to-fledgling success rate of 25%. At Lacey Valley the flycatchers produced an average of 1.0 fledglings per nest ($n = 5$, s.d. = 1.4), resulting in an egg-to-fledgling success rate of 33%. Stafford and Valentine (1985) followed 8 Willow Flycatcher nests over 2 years in the southern Sierra Nevada and found a range of egg-to-fledgling success rates between 25% and 38%. Stafford and Valentine's estimated success rates and ours are low compared to Nice's (1957) estimate of 45% for open-cup nesters.

The cause of nest failure is known for 4 of the 11 nests. Nest 1 at Lacey Valley was precariously placed at the outermost edge of a willow clump. We found it tipped over and the eggs in fragments on the ground below it. The nest was destroyed either by heavy gusts of wind or by a predator; there were no livestock present then to account for the nest upset. Nestlings in nests 1A and 10 were found dead after a severe hailstorm on 25 July. Nest 2 was parasitized by a Brown-headed Cowbird. The only other published observation of parasitism of a Willow Flycatcher nest by the cowbird in the Sierra Nevada occurred in 1960 (Gaines 1977). The single cowbird in nest 2 fledged successfully, but its 3 Willow Flycatcher nestmates died within several days of hatching. These 3 Willow Flycatchers represented more than 10% of the total number of nestlings produced in the two sites in 1986. If all three nestlings had fledged, the egg-to-fledgling success rate in the two sites would have been 50% instead of 29%.

WILLOW FLYCATCHER ECOLOGY

Nest Characteristics

All Willow Flycatcher nests were in willows, even though lodgepole pines were present in some territories. The birds placed their open-cup nests at a mean of 1.3 m above the ground ($n = 11$, range = 0.90-1.75 m, s.d. = 0.28 m) and at a mean of 1.0 m from the top of the willow shrub ($n = 11$, range = 0.50-1.50 m, s.d. = 0.27 m). Willow foliage density in the vicinity of the nest averaged 63% ($n = 11$, range = 10-90%, s.d. = 29%).

Nine of the 11 nests were placed at a mean distance of 1.68 m from the edge of a willow clump ($n = 9$, range = 0.60-2.40 m, s.d. = 0.57 m). Two of the 11 nests were deeper within a willow clump, but even these nests were close to livestock trails that tunneled through the willows. The distances of these nests from the outer edge of the willow clumps were 6.75 and 7.0 m, but the distances to the nearest livestock trails were only 1.5 and 2.5 m.

Territory Size and Characteristics

The average territory size for a paired Willow Flycatcher male was about 3000 m² ($n = 8$, range = 800-7000 m², s.d. = 2000 m²). Males spent most of their time singing or foraging from a few high perches on their territories. The average number of singing perches per territory was 6 ($n = 8$, range = 5-9, s.d. = 2.5). If tall lodgepole pines or snags were available within the territories, males used them more often than willows for singing and foraging perches. Males and females did most of their flycatching from perches within the territory, although they occasionally foraged beyond territorial boundaries. The average percentage of the territory covered by willow clumps was 46% ($n = 8$, range = 16-80%, s.d. = 23%). Foliage density was 64% at 0-1 m (range = 44-78%, s.d. = 13%) and 80% at 1-2 m ($n = 8$, range = 74-96%, s.d. = 7%). These measurements and those taken at the nests show that foliage was fairly dense where Willow Flycatchers bred in these study sites. Standing and/or running water was present on all territories early in the season and remained on some through the end of the summer. Other studies (Harris et al. 1987, Stafford and Valentine 1985) confirm that the presence of free water is an important aspect of Willow Flycatcher habitat.

Effects of Livestock

Approximately 150 cattle arrived at Perazzo Meadows in late June. Cattle foraged mainly in the open meadow, but a small percentage were usually observed in or near willow clumps. An average of 3.8% ($n = 31$, range = 0-6%, s.d. = 4.4%) of the cattle were typically found in willow clumps, creating trails within the clumps in their search for shade and forage. Stafford and Valentine (1985) report that 3 out of 8 Willow Flycatcher nests in their study sites were probably destroyed by cattle. We have no data suggesting nest upsets by livestock, but the placement of nests in willow clumps made them all potentially vulnerable to disturbance because they were built near the edge of willow clumps and low enough to be knocked over by cattle.

One thousand sheep arrived at Lacey Valley in mid-July, after most Willow Flycatchers had finished nesting. During 4 observations of the flock, we noted that sheep were always accompanied by flocks of 5-50 Brown-headed

WILLOW FLYCATCHER ECOLOGY

Cowbirds that foraged in the immediate vicinity of the flock and even perched on the backs of the sheep. These data suggest that the arrival of sheep and their cowbird associates could cause an increase in Willow Flycatcher nest parasitism if the flock's presence coincided with the peak of egg-laying.

MANAGEMENT RECOMMENDATIONS

Designate the Willow Flycatcher as a Threatened or Endangered Species in California

Willow Flycatchers need the legal protection that state Threatened or Endangered status would provide. In California, the range and numbers have been dramatically reduced and the population shows no sign of recovery (Harris et al. 1987).

Acquire and Manage Existing Willow Flycatcher Habitat

Most Sierra Nevada meadows that support breeding Willow Flycatchers are managed for livestock grazing rather than for wildlife resources. Sierra Nevada meadows are vulnerable to inundation by hydroelectric projects, to housing or recreational development, and to livestock grazing. Montane meadows that support Willow Flycatchers should be protected by conservation easements with landowners or by land purchases or exchanges. In particular, efforts should be made to acquire and protect the meadow system along the Little Truckee River. These meadows support the second largest population of Willow Flycatchers in the state, and the population in them is declining.

Reduce or Eliminate Grazing in Willow Flycatcher Habitat

Livestock grazing can adversely affect willows and other shrubs (Taylor 1986). Duff (1979) found that exclusion of grazers yielded an increase in the middle story of willows, the favored nesting height of Willow Flycatchers. Streambank trampling and soil compaction associated with overgrazed riparian areas could affect the water table and reduce free water, an important aspect of Willow Flycatcher habitat in California. Definitive guidelines that would establish the appropriate level, timing, and duration of livestock grazing on meadows or riparian areas supporting Willow Flycatchers do not exist. A single set of specific guidelines would not be applicable to all meadow and riparian habitat because of differences in elevation, vegetation, soils, slopes, and hydrology. Further studies are needed to determine grazing levels and to create monitoring and management plans suitable for protection and enhancement of Willow Flycatcher habitat. Until such plans are available, land managers should implement a general policy of reducing grazing on meadows and riparian areas that support Willow Flycatchers, especially during the nesting season in June and July. Effective enforcement of this policy will require implementation of the first two recommendations made above.

Reduce or Eliminate Brown-headed Cowbirds in Willow Flycatcher Habitat

Because Willow Flycatchers in California are so few, single incidents of nest parasitism can have significant impacts on Willow Flycatcher populations.

WILLOW FLYCATCHER ECOLOGY

Because of the close association of Brown-headed Cowbirds with livestock, eliminating grazing in Willow Flycatcher habitat could alleviate nest parasitism by cowbirds. Studies to document further the effects of cowbird nest parasitism on Willow Flycatchers are necessary.

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