

# BREEDING ECOLOGY OF A WILLOW FLYCATCHER POPULATION IN GRAND CANYON, ARIZONA

BRYAN T. BROWN, National Park Service, P. O. Box 41058, Tucson, Arizona 85717  
(present address: P. O. Box 3741, Tucson, Arizona 85722)

The Willow Flycatcher (*Empidonax traillii*) is a widely distributed, summer resident insectivore breeding across most of the United States and southern Canada (A.O.U. 1983). The subspecies of Willow Flycatcher occurring in the arid southwestern United States and extreme northwestern Mexico, *E. t. extimus* Phillips (1948), has decreased substantially in numbers in the past few decades (Hunter et al. 1987, Unitt 1987). This reduction is attributable primarily to a loss of riparian habitat and secondarily to brood parasitism by Brown-headed Cowbirds (*Molothrus ater*; Unitt 1987). In Arizona, the Willow Flycatcher is rare and restricted to riparian habitat, but bred formerly in dense willows (*Salix* spp.) and marshy areas at both low and high elevations throughout the state (Monson and Phillips 1981). The steepest decline in numbers of Willow Flycatchers in the Southwest has occurred in Arizona, where fewer than 50 pairs are known to remain (Unitt 1987). Unitt (1987) found this subspecies of Willow Flycatcher to be rarer than many species of birds legally designated as endangered, but that no study of its breeding biology existed.

This study documents the abundance, distribution, and breeding biology of a small Willow Flycatcher population along the Grand Canyon section of the Colorado River. This population is of special interest because it is the largest population known in Arizona (Unitt 1987) and is isolated by over 100 and 250 km, respectively, from the nearest known Willow Flycatcher populations at Havasu Creek and in the White Mountains of Arizona (Carothers and Johnson 1975, Unitt 1987). The entire population is located within Grand Canyon National Park, an ecological preserve.

## STUDY AREA

The study area (Figure 1) was the 360-km riparian corridor of the Colorado River through Grand Canyon National Park, Arizona, from Lees Ferry (River Mile 0) downstream to Diamond Creek (River Mile 225). River Miles are place names from Stevens (1983). Glen Canyon Dam, 25 km upstream of Lees Ferry, has caused substantial changes in the study area since its completion in 1963 (Turner and Karpisack 1980).

The riparian corridor consists of two distinct vegetative communities. The old high-water zone (OHWZ) includes those habitats above the pre-dam high-water line that persisted after completion of the dam as a relict community. The OHWZ is dominated by honey mesquite (*Prosopis glandulosa*) and catclaw acacia (*Acacia greggii*) and contains smaller amounts of netleaf hackberry (*Celtis reticulata*) and redbud (*Cercis occidentalis*). The new high-water zone (NHWZ) is a new riparian community that has developed since 1963 in the zone previously scoured by floods. The NHWZ is dominated by the exotic

## WILLOW FLYCATCHER BREEDING ECOLOGY

tamarisk (*Tamarix chinensis*); associated native vegetation includes coyote willow (*Salix exigua*), Goodding willow (*S. gooddingii*), arrowweed (*Tessaria sericea*), seepwillow (*Baccharis* spp.), and reed (*Phragmites communis*).

### METHODS

I surveyed the study area by boat for Willow Flycatchers in late May and June, 1982-1987, using song counts (Bull 1981) to census singing birds from 0800 to 1200 hours daily. Approximately 15-20 km of the study area were censused per day. The Colorado River for most of its length through the Grand Canyon is a swift, flatwater stream without the rapids and associated background noise that would interfere with song counts. This is especially true along those portions of the river supporting extensive riparian vegetation, where singing Willow Flycatchers could be detected easily on both sides of the river by an observer on a boat in midstream.

I considered birds resident if they sang repeatedly from an exposed perch in territorial fashion (Serena 1982). All songs were assumed to represent singing males, even though female Willow Flycatchers may also sing on the breeding grounds, at least in Canada (Seutin 1987). Song counts were supplemented by ground censuses and by intensive nest searches in areas where Willow Flycatchers occurred consistently from year to year: Saddle Canyon to Kwagunt Creek, and Cardenas Marsh. I spent approximately 4 days searching both areas each year.

Nests were located by systematic ground searches of both riparian zones by up to six skilled observers. I took the following data on each nest: height above ground; distance from nest to water; species, height, and diameter at breast height (dbh) of the plant supporting the nest; species of adjacent plants; date and time; nest contents; and presence or absence of brood parasitism by Brown-headed Cowbirds. I observed nests only once a season, for periods not exceeding 3 days each.

I measured habitat variables in 0.04-ha circular plots (radius 11.2 m) centered at nests (James and Shugart 1970, James 1971, Collins 1981). In each plot I measured maximum canopy height to the nearest 1 m, total number of trees (defined as woody vegetation  $> 7.5$  cm dbh), and perimeter of edge, defined as the border between a patch of vegetation and an open area (Martinka 1972). I identified and counted shrubs in two perpendicular arm-length transects (north-south, east-west) at breast height across the center of each plot. Shrubs included woody vegetation at least 1.5 m tall with a dbh of  $< 7.5$  cm. Shrub counts were also taken in similar plots located a random distance (20-35 m) and direction away from nest plots for comparison of shrub species composition between nest sites and adjacent habitat.

The length of one breeding cycle is 28.5 days: 4 days to lay an average clutch of four eggs (Bent 1963, Walkinshaw 1966), 12 days average incubation time (King 1955), and 12.5 days average nestling time (King 1955). I assumed that clutches containing less than the average number of eggs were incomplete. I assumed nests to be at the mid-point of incubation (the point at which the probability of error in determining egg age was lowest) if they contained a full clutch.

# WILLOW FLYCATCHER BREEDING ECOLOGY

## HISTORICAL BACKGROUND

Because the study area is difficult to reach, the status, abundance, and distribution of Willow Flycatchers there prior to the construction of Glen Canyon Dam is poorly known. The first bird checklist for Grand Canyon National Park listed Willow Flycatcher as a rare migrant, with no known breeding record (Grater 1937). Woodbury and Russell (1945) reported two records from the

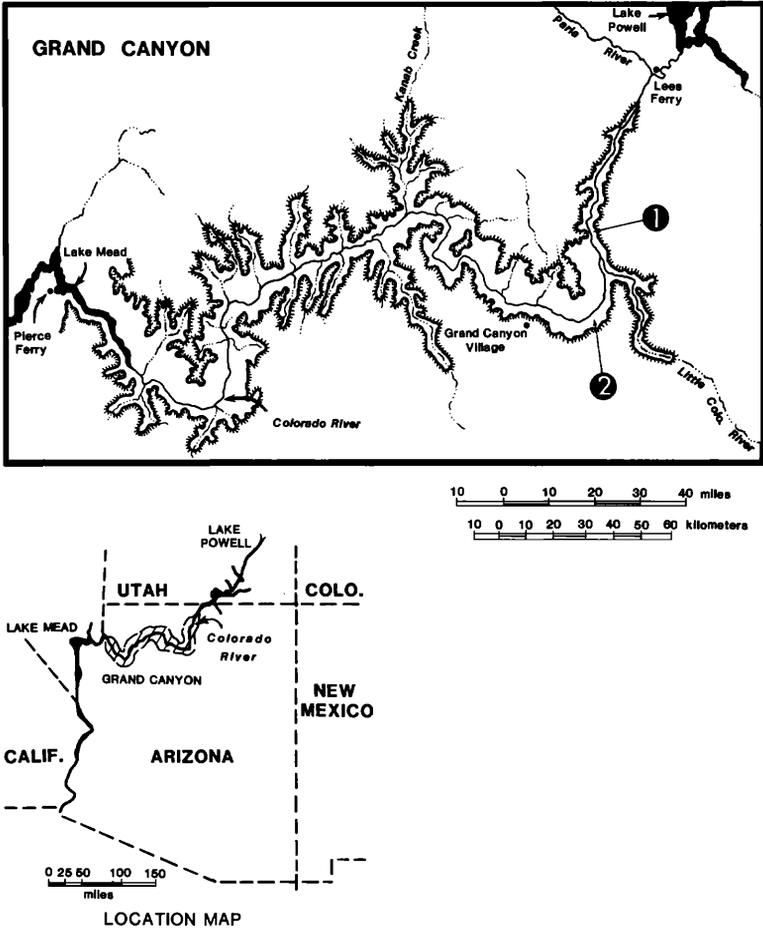


Figure 1. Distribution of Willow Flycatchers along the Colorado River in Grand Canyon, Arizona, 1982-1987. Circled numbers represent the two areas where Willow Flycatchers occur: 1, Saddle Canyon to Kwagunt Creek; 2, Cardenas Marsh.

## WILLOW FLYCATCHER BREEDING ECOLOGY

river: a summer resident female collected 2 miles downriver of Lees Ferry on 7 June 1933 and an abandoned Willow Flycatcher nest collected from a "tamarisk among willows" near Lees Ferry on 18 August 1936. The nest contained one rotten cowbird egg. The first ornithologist to traverse the Grand Canyon by boat was Robert W. Dickerman (Monson 1953), who collected two Willow Flycatchers, one each at Lees Ferry and at the mouth of the Little Colorado River, 16-17 June 1953. Behle and Higgins (1959) identified the Willow Flycatcher as a common summer resident in riparian vegetation along the river immediately upstream of Lees Ferry. This area was later inundated by Glen Canyon Dam.

Completion of the dam and subsequent changes in downstream riparian habitats ensured that the original abundance and distribution of Willow Flycatchers in the study area would never be known. Systematic surveys of riparian birds in the Grand Canyon began in the 1970s, when Carothers and Sharber (1976) reported that the Willow Flycatcher was a rare summer resident, with only one known breeding pair, at Cardenas Marsh. One of this pair was incubating eggs on 12 July 1971 (Carothers and Johnson 1975). Carothers and Johnson also thought that small breeding populations of Willow Flycatchers occurred (at least formerly) on tributary streams such as Havasu and Deer creeks, but were not able to document their occurrence.

## RESULTS AND DISCUSSION

### Distribution

Breeding Willow Flycatchers occur in two distinct sections of the study area (Figure 1). The upstream section extends 15 km from Saddle Canyon (River Mile 47; elevation 860 m) downstream to Kwagunt Creek (River Mile 56; elevation 840 m). This section supports the largest (ca. 100-150 ha) and best-developed tract of riparian habitat between Lees Ferry and Phantom Ranch (River Mile 89), a distance of 150 km by river. The lower section, at the mouth of Cardenas Creek (River Mile 71; elevation 800 m), is Cardenas Marsh, a small (2 ha), isolated marsh surrounded by well-developed riparian vegetation. Willow Flycatchers were not heard or seen at any other localities during the 6-year study period.

### Population Density

The number of singing Willow Flycatchers detected in the study area increased from 2 in 1982 to 11 in 1986, then declined to 7 in 1987 (Table 1). The 1986 count was a tenfold increase over the single pair detected during similar censuses (1974-1976) by Carothers and Sharber (1976). The most substantial increase during my study was in the section between Saddle Canyon and Nankoweap Creek, where the annual number of singing birds consistently increased from one to eight from 1982 to 1986 (Table 1).

For several reasons, I believe that the singing Willow Flycatchers encountered during the study were summer residents. Singing birds were counted only if they were observed to sing repeatedly from an exposed perch in territorial fashion (Serena 1982). Over the 6-year study period, at least one-third of all singing birds detected had active nests in their territories (Table 1). Finally,

WILLOW FLYCATCHER BREEDING ECOLOGY

**Table 1** Populations of Willow Flycatchers along the Colorado River in the Grand Canyon, 1982-1987, as Indicated by Song Counts and Discovery of Active Nests\*

Location	No. singing males/year					
	1982	1983	1984	1985	1986	1987
Section 1						
Saddle Canyon to Nankoweap Cr.	1	4	3	7	8	4
Nankoweap Cr. to Kwagunt Cr.	0	0	0	0	1	0
Section 2						
Cardenas Marsh	1	0	1	1	2	3
Annual totals	2	4	4	8	11	7
No. active nests found/year	2	0	2	4	2	2

Annual numbers of active nests found represent those nests discovered during nest searches, not the total number of nests present. Extremely high water levels in 1983 flooded all Willow Flycatcher habitat to a depth of ca. 2 m and curtailed nest searches.

the majority of males detected each year were within 100 m of locations where singing Willow Flycatchers had been observed in the previous year or years.

Nevertheless, the possibility exists that some of the singing male Willow Flycatchers censused during the study period were migrants. Phillips et al. (1964) noted that although the summer resident (i.e., *E. t. extimus*) population of Willow Flycatchers is the first to arrive and begins breeding in Arizona in May, *E. t. brewsteri* occurs (at least in southern Arizona) as a migrant until mid-June. Serena (1982) also reported that migrant Willow Flycatchers may sing and exhibit characteristically territorial activity such as chasing.

Seutin's (1987) finding that both male and female Willow Flycatchers sing, at least in Canada, raises questions about the accuracy of surveys based on song. If female Willow Flycatchers are found to sing in the Southwest, future research on song frequency of females might enable the calculation of a correction factor to reduce this potential source of error.

**Nest Placement**

Twelve active Willow Flycatcher nests were found during the study period (Table 1), but habitat and nest-site measurements were taken at only eight. Nest heights above ground ranged from 1.5 to 4.5 m (median = 3.3 m; *N* = 12). Distances of nests from the river ranged from 0 to 75 m (median = 7 m; *N* = 12); one nest was built over water. Ten of 12 nests were located within 15 m of the river. The maximum distance from any nest to the river could have not exceeded 100 m, the maximum width of the riparian zone at nest sites. Distances from nests to the nearest vegetation edge ranged from 0 to 11 m (median = 6.5 m; *N* = 8).

All twelve nests were in tamarisk, the dominant woody plant of the river corridor. Height of tamarisk shrubs in which nests were placed ranged from 4 to 7 m (median = 6m; *N* = 8); dbh of those plants ranged from 3 to 9 cm (median = 6 cm; *N* = 8). Tamarisk was also the woody plant most often adjacent to the plant in which the nest was located (frequency = 0.81), fol-

## WILLOW FLYCATCHER BREEDING ECOLOGY

lowed by coyote willow (frequency = 0.16) and seepwillow (frequency = 0.03).

### Breeding Habitat

All Willow Flycatcher nests were located in the tamarisk-dominated NHWZ community. Likewise, all singing birds and all identified Willow Flycatcher territories were located in the NHWZ. Habitat characteristics at nest sites varied considerably (Table 2). The habitat around nest sites was dense stands of tamarisk and coyote willow shrubs with a median canopy height of 7 m and few trees (Table 2). Tamarisk was the most abundant woody plant, dominating the habitat around 75% of the nest sites; coyote willow was dominant at 25% of the nests. The median frequency of tamarisk shrubs composing the habitat around nest sites (0.85) was significantly greater than the median frequency of tamarisk shrubs in adjacent habitat (0.37) (two-tailed Wilcoxon signed rank test,  $P = 0.034$ ). These stands are primarily even-aged, structurally homogeneous stands of tamarisk or mixed tamarisk-willow at the river's edge. Extensive areas of apparently suitable habitat exist along the river between Saddle Canyon and Kwagunt Creek but are unoccupied by Willow Flycatchers.

### Nesting Chronology

Willow Flycatcher nests under construction or containing eggs were discovered between 30 May and 15 June. From the data gathered at these nests, I calculated the length of the breeding season (period when eggs or young are in the nest) to extend from 2 June to 10 July. Nest construction for most pairs was underway by 27-30 May. However, the breeding season extends through late July in Nebraska (Holcomb 1972), Ohio (Holcomb 1974), Washington (King 1955), and southern California (Unitt 1987). Data from this study may have failed to identify nests from the latter half of the breeding season because of the lack of field work in late June and July. Carothers and Johnson (1975) reported finding an active Willow Flycatcher nest with eggs being incubated on 12 July 1971 in my study area, indicating that the breeding season there may extend through 1 August.

**Table 2** Characteristics of Willow Flycatcher Breeding Habitat at 0.04-ha Circles Centered at Nest Sites\* along the Colorado River in the Grand Canyon, 1982-1986

Variable	Minimum	25% Quartile	Median	75% Quartile	Maximum
Max. canopy height (m)	6	6	7	8	9
Trees/0.04 ha	0	1	3	5	37
Total shrubs/0.04 ha	180	318	338	843	2105
Tamarisk shrubs/0.04 ha	95	160	280	580	745
Willow shrubs/0.04 ha	25	33	55	150	580
Edge perimeter/0.04 ha (m)	1	10	17	24	45

\*  $N = 8$  in all cases.

## WILLOW FLYCATCHER BREEDING ECOLOGY

### Brood Parasitism by Brown-headed Cowbirds

Eight of the 12 Willow Flycatcher nests discovered were examined for brood parasitism by Brown-headed Cowbirds. Four (50%) of the eight nests contained cowbird eggs. Three of the four nests contained one cowbird egg; the remaining nest contained two cowbird eggs.

Willow Flycatchers responded to cowbird parasitism in several ways. At least two nests were abandoned after a cowbird egg was laid in them. One pair apparently removed cowbird eggs from a parasitized nest, as indicated by fresh cowbird eggshells found directly beneath the nest. Finally, another pair responded to parasitism by layering over a cowbird egg (and a flycatcher egg) with fresh nesting material and laying a new clutch in the modified nest. The subsequent clutch was also parasitized.

Serena (1982) and Unitt (1987) suggested that high rates of brood parasitism by cowbirds contributed to Willow Flycatcher declines or local extirpations in California. Low cowbird parasitism rates have been reported from Michigan (5%; Walkinshaw 1966) and Nebraska (8%; Holcomb 1972). The Willow Flycatcher population in my study area increased from 1982 to 1986 despite a 50% cowbird parasitism rate. Nevertheless, cowbird parasitism may be partially responsible for the absence of Willow Flycatchers in large tracts of apparently suitable habitat along the Colorado River.

### Management Implications

Tamarisk is a valuable nesting resource for Willow Flycatchers along the Colorado River in Grand Canyon, and management actions to control, reduce, or eliminate tamarisk from this locale should be considered carefully. However, Willow Flycatchers do not use tamarisk for nesting elsewhere in the remainder of their historic range in Arizona (W. C. Hunter pers. comm.). Tamarisk is used for nesting in some mid-elevation riparian areas along the Rio Grande in New Mexico (Hundertmark 1978). Further research on tamarisk use by nesting Willow Flycatchers is needed to determine if elevational or geographic trends exist.

The extent of riparian vegetation in which Willow Flycatchers nest was reduced by 35-40% from 1980 to 1985 by streambank erosion caused by large water releases from Glen Canyon Dam (Pucherelli 1987). Continued erosion could reduce the amount of available habitat further. Water releases from Glen Canyon Dam should be managed in such a way as to minimize streambank erosion and the potential loss of Willow Flycatcher breeding habitat. The Willow Flycatcher population in the Grand Canyon section of the Colorado River should be monitored annually to assess its size and the long-term effects of cowbird parasitism and habitat change.

### SUMMARY

I studied the breeding ecology of a small Willow Flycatcher population along the Grand Canyon section of the Colorado River, Arizona, in May and June, 1982 to 1987. The population increased from 2 singing birds in 1982 to 11 in 1986 but declined to 7 in 1987. All nests ( $N = 12$ ) discovered were located in tamarisk. Breeding habitat was dense stands of tamarisk and coyote willow

## WILLOW FLYCATCHER BREEDING ECOLOGY

shrubs within 15 m of the river with a median canopy height of 7 m and few trees. The frequency of tamarisk constituting nest-site habitat was significantly greater than the frequency of tamarisk in adjacent riparian habitat. The known breeding season extended from 2 June to 10 July but may extend to 1 August. Four of eight nests were parasitized by Brown-headed Cowbirds. I recommend continued monitoring of the Willow Flycatcher population and the release of water from Glen Canyon Dam in such a way as to minimize streambank erosion and subsequent loss of breeding habitat.

### ACKNOWLEDGMENTS

I thank Susan C. Jones, Kenneth J. Kingsley, and Marie McGee for their assistance during field work. Special thanks to Dugald Bremner, Brian Dierker, Helen Kalevas, Lauren Lucas, Tom Moody, and Mike Yard of Humphrey Summit Associates, Flagstaff, for logistical support. Michael W. Trosset provided statistical advice. I thank Martha Hahn and John Thomas of the National Park Service and David L. Wegner of the Bureau of Reclamation for their encouragement and support throughout this study. John P. Hubbard, William C. Hunter, Gale Monson, and Philip Unitt commented on an early draft of this manuscript. This work is part of the Glen Canyon Environmental Studies program funded by the Bureau of Reclamation and the National Park Service.

### LITERATURE CITED

- American Ornithologists' Union. 1983. Check-list of North American Birds. 6th ed. American Ornithologists' Union, Lawrence, KS.
- Bent, A. C. 1963. Life Histories of North American Flycatchers, Larks, Swallows, and Their Allies. Dover, New York.
- Behle, W. H., and Higgins, H. G. 1959. The birds of Glen Canyon, in Ecological Studies of Flora and Fauna in Glen Canyon (A. M. Woodbury, ed.), pp. 107-133. Univ. Utah Anthropol. Pap. 40 (Glen Canyon Series No. 7).
- Bull, E. L. 1981. Indirect estimates of abundance of birds. *Studies Avian Biol.* 6:76-80.
- Carothers, S. W., and Johnson, R. R. 1975. Recent observations on the status and distribution of some birds of the Grand Canyon region. *Plateau* 47:140-153.
- Carothers, S. W., and Sharber, N. J. 1976. Birds of the Colorado River, in An Ecological Survey of the Riparian Zone of the Colorado River between Lees Ferry and Grand Wash Cliffs (S. W. Carothers and S. W. Aitchison, eds.), pp. 109-122. Colorado River Tech. Rep. 10, Grand Canyon National Park, Grand Canyon, AZ.
- Collins, S. L. 1981. A comparison of nest-site and perch-site vegetative structure for seven species of warblers. *Wilson Bull.* 93:542-547.
- Grater, R. K. 1937. Check-list of Birds of Grand Canyon National Park. *Nat. Hist. Bull.* 8, Grand Canyon Nat. Hist. Assoc., Grand Canyon, AZ.
- Holcomb, L. C. 1972. Traill's Flycatcher breeding biology. *Nebr. Bird Rev.* 40:50-68.
- Holcomb, L. C. 1974. The influence of nest building and egg laying behavior on clutch size in renests of the Willow Flycatcher. *Bird-Banding* 45:320-325.
- Hundertmark, C. A. 1978. Breeding birds of Elephant Butte Marsh. *N. M. Ornithol. Soc. Publ.* 5.
- Hunter, W. C., Ohmart, R. D., and Anderson, B. W. 1987. Status of breeding riparian-obligate birds in southwestern riverine systems. *W. Birds* 18:10-18.

## WILLOW FLYCATCHER BREEDING ECOLOGY

- James, F. 1971. Ordination of habitat relationships among breeding birds. *Wilson Bull.* 47:215-236.
- James, F., and Shugart, H. 1970. A quantitative method of habitat description. *Aud. Field Notes* 24:727-736.
- King, J. R. 1955. Notes on the life history of Traill's Flycatcher (*Empidonax traillii*) in southeastern Washington. *Auk* 72:148-173.
- Martinka, R. R. 1972. Structural characteristics of Blue Grouse territories in southwestern Montana. *J. Wildlife Mgt.* 36:498-510.
- Monson, G. 1953. The spring migration. Southwest region. *Aud. Field Notes* 7:320-322.
- Monson, G., and Phillips, A. R. 1981. Annotated Checklist of the Birds of Arizona. Univ. Ariz. Press, Tucson.
- Phillips, A. R. 1948. Geographic variation in *Empidonax traillii*. *Auk* 65:507-514.
- Phillips, A. R., Marshall, J., and Monson, G. 1964. The Birds of Arizona. Univ. Ariz. Press, Tucson.
- Pucherelli, M. J. 1987. Evaluation of riparian vegetation trends in the Grand Canyon using remote sensing techniques. Unpublished Glen Canyon Environmental Studies report to U. S. Bureau of Reclamation, Upper Colorado Region, P. O. Box 11568, Salt Lake City, Utah 84147.
- Serena, M. 1982. The status and distribution of the Willow Flycatcher (*Empidonax traillii*) in selected portions of the Sierra Nevada, 1982. Wildlife Mgt. Admin. Rep. 82-5, Calif. Dept. Fish and Game, Sacramento.
- Seutin, G. 1987. Female song in Willow Flycatchers (*Empidonax traillii*). *Auk* 104:329-330.
- Stevens, L. E. 1983. The Colorado River in Grand Canyon: A Comprehensive Guide. Red Lake Books, Flagstaff, AZ.
- Turner, R. M., and Karpiscak, M. M. 1980. Recent vegetation changes along the Colorado River between Glen Canyon Dam and Lake Mead, Arizona. U.S. Geol. Surv. Professional Pap. 1132.
- Unitt, P. 1987. *Empidonax traillii extimus*: An endangered subspecies. *W. Birds* 18:137-162.
- Walkinshaw, L. H. 1966. Summer biology of the Traill's Flycatcher. *Wilson Bull.* 78:31-46.
- Woodbury, A. M., and Russell, H. N. 1945. Birds of the Navajo country. *Bull. Univ. Utah* 35:1-157.

Accepted 18 December 1987



Willow Flycatcher

· Sketch by Brian Evans

Use of skin for drawing courtesy of Museum of Southwestern Biology (Albuquerque, New Mexico)