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DISTRIBUTION, HABITAT PREFERENCES, AND REPRODUCTIVE SUCCESS OF ARIZONA BELL'S VIREO (*Vireo bellii arizonae*) ALONG THE LOWER COLORADO RIVER IN 1981[1/]

by

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ABSTRACT

This study, to describe the distribution and habitat preferences of Bell's Vireos (*Vireo bellii arizonae*) along the California bank of the lower Colorado River, and to document the impact of Brown-headed Cowbirds (*Molothrus ater*) on vireo nesting success, was conducted from April to July 1981. Thirty-five territorial males or pairs were located, usually at sites dominated by stands of young willow (*Salix gooddingii*) or lush honey mesquite (*Prosopis glandulosa*). Salt cedar (*Tamarix chinensis*), arrowweed (*Pluchea sericea*) and the giant reed (*Phragmites communis*) all are apparently discriminated against as nesting habitat by vireos. The birds did not appear to be occupying all available habitat along the river. Cowbirds were found to have a negative effect on vireo nesting success, parasitizing five of nine nests located. In addition, cowbird males were more often associated spatially with vireo territories than expected on the basis of chance alone.

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RECOMMENDATIONS

1) Designate *Vireo bellii arizonae* an endangered species in California.

2) Preserve existing riparian habitat in areas known to support Bell's Vireos along the Colorado River, particularly north and south of Needles.

3) Encourage the development of new nesting habitat by supporting programs of salt cedar removal and revegetation with willows and honey mesquite. Require these species to be planted as mitigation for projects which clear riparian vegetation from along the river.

4) Control Brown-headed Cowbirds locally to relieve brood parasite pressure on small and declining populations of vireos.

5) Continue monitoring the numbers of breeding Bell's Vireos along the lower Colorado. Initiate banding studies to elucidate patterns of population turnover and individual fidelity to breeding areas between years.

INTRODUCTION

California harbors breeding populations of two subspecies of Bell's Vireo (Vireo bellii). The Least Bell's Vireo (V. b. pusillus) formerly occurred as a common summer resident of riparian sites along the coast from San Diego to southern Santa Clara County, and inland throughout the San Joaquin and Sacramento valleys; satellite populations nested in suitably mesic habitats in Owens and Death valleys and along the eastern edge of the Mohave Desert mountain ranges (Goldwasser 1978). Today, both the numbers and the range of this subspecies have been greatly diminished, presumably due to habitat loss as well as nest parasitism by the Brown-headed Cowbird (Molothrus ater) (Grinnell and Miller 1944, McKaskie 1969, Gaines 1978, Goldwasser 1978, Goldwasser et al. 1980, Gray and Greaves 1980). This decline was first noted in the mid 1940's (Grinnell and Miller 1944). By 1980 the entire known breeding population of Least Bell's Vireos in California constituted only 139 pairs, and mostly occurred south of Santa Barbara (Goldwasser et al. 1980). The Least Bell's Vireo has been classified as Endangered by the California Fish and Game Commission and the U.S. Secretary of Interior.

The second subspecies, the Arizona Bell's Vireo (V. b. arizonae), formerly nested abundantly in the riparian vegetation of the lower Colorado River valley. In 1910 Grinnell (1914) spent 3 months surveying the plants and animals of the lower Colorado and estimated that one singing male occupied every 200 yards of willow habitat along the river's edge. Subsequent changes in many aspects of the riparian environment along the Colorado have been correlated with a major decline in the California population of Arizona Bell's Vireos. By the early 1960's the species was reported to be scarce everywhere along the Lower Colorado (Monson 1960, Phillips et al. 1964). By 1980 it was estimated that no more than fifty pairs of vireos nested on the combined California and Arizona sides of the river, south of Davis Dam (Edwards 1980). This vireo is considered to be a bird of special concern by the California Department of Fish and Game and the Western Field Ornithologists (Remsen 1978). The present study was initiated to document the number of Arizona Bell's Vireos remaining in California, and to describe their distribution, habitat preferences, and nesting success along the lower Colorado River.

METHODS

Male Bell's Vireos are loud and persistent singers and can be reliably located by ear from the time they establish territories in late March or April through at least the beginning of July. Territorial males were censused along the natural 274 km transect formed by the California bank of the Colorado River from the Nevada border to Mexico. In addition, vireo censuses were conducted in those few areas of prime habitat which occur along the Colorado away from the river proper, such as the cottonwood (Populus fremontii) and willow (Salix gooddingii) habitat found along the All-American Canal, Copper Basin Wash, Whipple Wash, and Piute Creek; and the honey and screwbean mesquite (Prosopis glandulosa and P. pubescens) habitat around Lost Lake and on

the Soto Ranch north of Needles. Whenever possible (from the Nevada border south to Needles; 3.2 km south of Parker Bridge to 1.6 km south of Agnes-Wilson Bridge; most of Cibola Wildlife Refuge; the "Shantytown" habitat north of Laguna Dam) surveys were conducted on foot, mostly along levee roads. Alternatively, viroes were censused from a small boat drifting a few meters from the California bank of the river. A recording of a Bell's Vireo was played when approaching a patch of habitat suitable for vireos in order to reliably elicit a response if a male bird were present.

Along with the location of singing males, the following data were collected: a description of the dominant species and general structure of vegetation found on vireo territories, the presence or absence of Brown-headed Cowbirds in the vicinity of territories, and the number of cowbirds seen or heard over the course of an entire census period. Whenever possible, vireo nests were located in order to document breeding success and the incidence of cowbird parasitism.

All surveys were conducted from 10 April to 18 June 1981. Nesting data were collected from 13 May to 10 July 1981.

RESULTS AND DISCUSSION

Distribution of Arizona Bell's Vireo along the lower Colorado River

Thirty-five male Bell's Vireos were located in California during this study (Table 1). All of these males may have had mates: in all cases where nest searches were conducted (11 of 35 territories), two vireos were observed on the territory. However, it is important to recognize that an uneven sex ratio may characterize the very small populations described in this study purely on the basis of chance. As a possible example of this, two of the six male vireos singing on the Arizona side of Cibola National Wildlife Refuge remained unmated through the entire 1981 breeding season.

Most males (32/35) defended territories located within 100 m of the river's edge, presumably because this represents the most productive zone of riparian habitat. Two individuals occupied sites in an unusually lush stand of honey mesquite (Prosopis glandulosa) on the Soto Ranch property, approximately 1.5 km west of the river. A final pair of vireos was found in a well-developed stretch of willow habitat along Piute Creek, about 35 km west of the river and separated from it by more than 30 km of arid basin and range habitat. This pair may represent the easternmost known pair of pusillus rather than the westernmost known pair of arizonae. However, the distinction is largely academic. The two subspecies are ordinarily distinguished by their breeding ranges, which, in this case, is intermediate.

The distribution of Bell's Vireos along the California portion of the Colorado River is not uniform (Table 2). Males were found in just two fairly restricted areas, from the Nevada border south to the beginning of Topock Gorge, and from just south of the Big River development (near Parker, Arizona) to 0.8 km

Table 1. Location of Arizona Bell's Vireo Territories Along the California Side of the Lower Colorado River, 1981

	Location San Bernardino County	Distance from River (meters)
1.	0.1 km S of NE corner of the Soto Ranch mesquite tract	1500
2.	0.1 km E of NE corner of the Soto Ranch mesquite tract	1500
3.	1.8 km S of the Nevada border along levee rd.	50-100
4.	0.8 km N of the first road south of the North Needles Compressor Station, along levee rd.	0-50
5.	0.1 km S of no. 4	0-50
6.	2.6 km S of Russell Bros. main irrigation pump, along levee rd. (50 m S of first inlet S of pump)	50-100
7.	0.3 km S of no. 6 (just S of second inlet S of pump)	0-50
8.	1.9 km N of Wetmore Trailer Park boat ramp, along levee rd.	0-50
9.	0.1 km S of Wetmore Trailer Park boat ramp	50-100
10.	0.05 km S of no. 9	50-100
11.	Just S of Needles, 0.1 km N of U.S.G.S. water flow monitoring station	0-50
12.	0.2 km S of no. 11	0-50
13.	0.8 km S of U.S.G.S. water flow monitoring station, S of Needles	50-100
14.	0.1 km S of no. 13	50-100
15.	0.1 km N of Havasu N.W.R. northern boundary	50-100
16.	0.05 km S of Havasu N.W.R. northern boundary	0-50
17.	About 4.8 km N of Beal Slough, near fourth (from south) of series of riprapped jetties	0-50

Table 1 (cont.)

	Location	Distance from River (meters)
	San Bernardino County	
18.	0.05 km S of southernmost of series of riprapped jetties, about 4.0 km N of Beal Slough	0-50
19.	About 2.4 km N of Beal Slough, 80 m N of power/ phone lines crossing the river	0-50
20.	0.1 km S of power/phone lines	0-50
21.	0.1 km S of no. 20	0-50
22.	0.1 km S of no. 21	0-50
23.	0.3 km N of north end of Beal Slough	100
24.	0.15 km S of no. 23	100
25.	0.225 km S of no. 23	100
26.	0.015 km N of northeast corner of Beal Slough	0-50
27.	0.15 km NW of juncture of Beal Slough and river, on west bank of slough proper	0-50
28.	1.0 km S of mouth of Beal Slough	0-50
29.	1.0 km S of gas pipeline crossing river just south of Interstate 40	0-50
30.	Along Piute Creek, about 0.1 km N of honey mesquite grove near the old fort	35 km
	Riverside County	
31.	3.8 km N of Agnes-Wilson Rd., along levee rd.	0-50
32.	3.6 km N of Agnes-Wilson Rd., along levee rd.	0-50
33.	1.9 km N of Agnes-Wilson Rd., along levee rd.	0-50
34.	0.075 km SE of no. 33	100
35.	0.8 km S of Agnes-Wilson Rd., along levee rd.	0-50

Table 2. Distribution of Male Arizona Bell's Vireos Along the Lower Colorado River from Nevada to Mexico, 1981

(North to South) River Division	Number of Vireos California Side	Arizona Side[1]
Mohave Valley (including the Soto Ranch)	28	6
Topock Gorge	1	0
Havasu (including Copper Basin and Whipple Washes)	0	0
Parker (including Lost Lake)	5	3
Palo Verde	0	0
Cibola	0	6[2]
Imperial (including Taylor and Ferguson Lakes)	0	0
Laguna	0	0
Yuma (including the All-American Canal)	0	0
Other: Piute Creek	1	--
TOTAL	35	15+

[1] Not based, in general, on formal surveys

[2] Represents a complete census

south of the Agnes-Wilson Bridge. It is interesting that within these two enclaves vireos strongly tended to clump, with two to four males typically occupying a stretch of approximately 400 to 800 meters. The clumped pattern was most striking south of Needles, where stretches of vegetation supporting vireos were consistently separated by large tracts of seemingly identical but unoccupied habitat. Two explanations for such clumping were apparent: 1) young males may preferentially establish terri-tories in the vicinity of their natal areas; 2) an important criterion of "good" nesting habitat for Bell's Vireos may be the occurrence of nearby sing-ing males or pairs of vireos. It is significant that both alternatives pre-dict that Bell's Vireos will be conservative in repopulating areas from which they have been eliminated, at least as long as the areas where birds do breed remain below carrying capacity.

Relatively little effort was expended in documenting the occurrence of Bell's Vireos in Arizona, apart from noting males audible from across the river. More consistent information was available for the Parker, Palo Verde, and Cibola divisions, where regular riparian bird censuses were conducted along fixed transects by the biologists of the Colorado River Project, Center for Environmental Studies, Arizona State University. In general, vireo densities on the Arizona side of the river appear to parallel those on the California side (Table 2). Assuming this to be the case, the entire Bell's Vireo population of the lower Colorado River Valley may have consisted of no more than 80 pairs in 1981.

Habitat Preferences and Limitation

Bell's Vireo territories have been reported to be dominated by a wide array of plant species. In the eastern part of their range, breeding habitat includes wild plum, hazel, alder, haws, dogwood, and willow (Bent 1950). California birds are most commonly associated with willow clumps, but also have been reported to use oak woodland and chaparral (Goldwasser 1978, 1981; Gray and Greaves 1980). In all cases, however, a low (<3 m), dense layer of vegetation is present, and used almost exclusively both for nesting and foraging (Bent 1950; Goldwasser 1978, 1981).

Most of the riparian vegetation occurring along the lower Colorado River should be structurally suitable for Bell's Vireos, consisting of dense stands of shrubs or shrubby trees, and woody perennial herbs such as arrowweed (Pluchea sericea) and seep-willow (Baccharis glutinosa). Most communities are dominated by the enormously successful exotic, salt cedar (Tamarix chinensis), in conjunction with native honey and screwbean mesquites. South of Taylor Lake the river margin frequently supports a dense growth of the giant reed, Phragmites communis. Large cottonwoods and willows are rare, with less than 500 acres of well-developed cottonwood community persisting along the entire lower Colorado (Ohmart et al. 1977). Stands of young willow, the habitat which Grinnell (1914) associated most closely with Bell's Vireos, are today virtually absent along the river. In 1981, their most extensive development occurred sporadically from just south of Needles to approximately Beal Slough, in an area where conditions (water salinity, depth of water table) apparently favor the regeneration of willow on dredge spoil.

The dominant plant species were noted and their importance ranked at each Bell's Vireo territory located (Table 3). A few territories were dominated by just two species, and in these cases no record was made of a third-ranking species. These data on habitat suggest:

1) Willow thickets were highly favored by the Bell's Vireos as nesting habitat. Despite the limited occurrence of willow, over half the territories examined were dominated by this species. Very few (less than 9%) of the territories incorporated willows as a secondary or tertiary vegetative component, despite the fact that in all areas (with the exception of Piute Creek) willows occurred in patches, interspersed with other species of plants. This strenthens the conclusion that vireos select willows over other types of vegetation.

2) In lieu of willows, vireos preferentially occupied dense stands of honey mesquite, or mixed growths of screwbean and honey mesquite. The relative importance of screwbean mesquite may have been biased however, by the sheer abundance of pubescens growing north of Needles and, particularly, south of Parker. Vireos were regularly found in honey mesquite habitats without an admixture of screwbean mesquite, but never vice-versa. This apparent preference for honey over screwbean mesquite may reflect the thicker foilage and more compact profile of the former species as it typically grows along the Colorado. In addition, honey mesquite develops leaves a week or two earlier than screwbean in the spring. On 27 March 1981, when the first Bell's Vireos were heard singing on the Cibola N.W.R., the leaves of many honey mesquites in the Blythe area had expanded to 50 percent or more of their final volume. On this same date, screwbean mesquites were entirely leafless. The possibility that honey mesquite affords superior foraging potential early in the breeding season also may explain why some honey mesquite occurred on nearly all (94%) of the Bell's Vireo territories in this study.

3) Bell's Vireos along the Colorado River do not appear to nest in areas dominated either by salt cedar or arrowweed. Arrowweed may be unsuitable primarily because it dies back in fall, and is just beginning to regenerate when vireos establish nesting territories in the spring. In the case of salt cedar, the sticky, salty exudate which coats most of the plant may be objectionable to many small passerines (Bertin Anderson, pers. comm.). The salty foilage of Tamarix also appears to constitute an inferior food resource for native phytophagous insects, especially larvae (NMSU Agricultural Bulletin 1977). Along the Colorado, salt cedar has been documented to support a smaller mass of both insects and avian insectivores as compared with the average for all riparian communities (Cohan et al. 1978). The common occurrence of some salt cedar on vireo territories (60%) undoubtedly reflects its near ubiquity in Colorado River riparian habitats today.

The one male vireo found singing on a territory dominated by salt cedar was apparently unsuccessful in attracting a mate and disappeared prematurely from the site. This individual was first recorded on 13 April, just west of the north bridge on the Cibola N.W.R. He was gone from the site by 24 April, at approximately the same time that a singing male was first heard (on 5 May) in

Table 3. Relative Rankings of Dominant Plant Species on 35 Arizona Bell's Vireo Territories, According to Approximate Percent Cover

	Number of Territories			
Species	Ranked First	Ranked Second	Ranked Third	Noted on Territory
Willow	18	2	1	21 (60%)
Honey Mesquite	8	13	12	33 (94%)
Screwbean Mesquite	9	9	5	23 (66%)
Salt Cedar	0	8	13	21 (60%)
Arrowweed	0	3	2	5 (14%)

a honey mesquite-dominated area, 8 to 10 km south of the north bridge site and less than 2 km north of three previously established males. This second bird occupied the honey mesquite site for at least the next two months, remaining unmated through this time.

4) No Bell's Vireos were associated with stands of Phragmites which frequently dominate the river margin from Taylor Lake south to Morelos Dam. The reed is apparently unsuitable for use by nesting pairs.

The Bell's Vireo population along the lower Colorado does not appear to be limited by the availability of suitable nesting habitat. While the recent spread of salt cedar may have degraded the quality of Bell's Vireo habitat along the river, this species is known to make use of salt cedar-dominated areas along the Rio Grande in New Mexico (Tom Hildebrandt, pers. comm.). In addition, vireos do not seem to be saturating either willow habitat south of Needles, or mesquite habitats occurring along the river from Nevada through the Cibola N.W.R., and near Yuma. In the case of Cibola, the numbers of resident vireos may have declined within the last few years, despite the apparently unchanged character of the habitat over this same period (compare Edwards 1980 with data presented here).

It would be unjustified, however, to conclude that habitat destruction and alteration have played no role in the decline of Bell's Vireos along the Colorado. Riparian areas which have been cleared for agriculture or urban developments are normally unsuitable for use by Bell's Vireo. In addition, agricultural development has probably been critical in encouraging the proliferation of Brown-headed Cowbirds, which reduce the reproductive success of Bell's Vireos through nest parasitism (see following section). In fact, the rate of parasitism may increase much more rapidly than the actual rate of agricultural development, since the latter presumably serves to simultaneously increase the number of cowbirds and decrease the number of riparian passerines which the cowbirds parasitize. Finally, Bell's Vireos don't appear to breed in non-native habitats such as stands of pure salt cedar. They consequently suffer a reduction in either immediate reproductive success and/or long-term fitness because of the large quantity of habitat dominated by exotic vegetation. Data bearing upon these points are lacking, not least because the birds seem disinclined to participate in the necessary natural experiments.

The Impact of Cowbird Parasitism

The Brown-headed Cowbird was rare to uncommon in California prior to this century. The noted field ornithologist Lyman Belding spent 15 years in the Central Valley, from 1875 to 1890, without seeing a single cowbird (Belding 1890). The proliferation of this species was and is correlated with the development of agriculture and ranches and the associated clearing of native forest and riparian vegetation. Ninety years after Belding's report, the winter population of cowbirds in the northern Sacramento and San Joaquin valleys was conservatively estimated at 200,000 individuals (Laymon 1980).

Cowbirds are obligate nest parasites; females lay eggs in the nests of other species, relying on the other birds to incubate and raise cowbird nestlings. It has been experimentally demonstrated that female cowbirds prefer to parasitize nests containing host eggs smaller than their own (King 1979). This may indicate that a smaller bird is less likely to be strong enough to defend its nest or eject a foreign egg from the nest (Rothstein 1975). The size difference between cowbird chicks and the much smaller nestlings of many passerines, including vireos, also makes it more likely that the latter will be eliminated in competition for food and space at the nest (Mayfield 1977, Best and Satuffer 1980).

Female cowbirds typically copulate at the song perch of a male in the early morning, soon after laying an egg in a host nest. This schedule presumably reflects the extraordinary fecundity of cowbird females, which lay four or more eggs each week from late April or early May to July in northern California (Payne 1973). In southern Ontario (Canada), the average female cowbird has been estimated to produce forty eggs over a 56 day period, from early May to late June (Scott and Ankney 1980). Such high fecundity suggests that even a small number of cowbirds may have a significant deleterious effect on the breeding success of vulnerable host species.

The negative impact of cowbird parasitism on the nesting success of Bell's Vireos has been abundantly documented (Bennett 1917, Mumford 1952, Nolan 1960, Goldwasser 1978, Gray and Greaves 1980, Salata 1981). Vireos respond to the presence of a cowbird egg in their nest in any of three ways: 1) they incubate the egg and raise the cowbird chick, almost invariably at the expense of their entire brood; 2) they abandon the nest; or 3) They remove the cowbird egg from their nest before it hatches. Of these, only the third alternative is wholly adaptive from the standpoint of the vireo; it is also by far the rarest to be implemented (Goldwasser 1978, Gray and Greaves 1980).

In California, the rate of cowbird parasitism has been shown to vary, probably as a function of the local density of cowbirds in relation to the numbers of potential hosts, including Bell's Vireos. In the Mono Debris Basin, Santa Barbara County, the proportion of vireo nests found to fail because of cowbird activities was relatively low, constituting only 7 percent of 1979 and 17 percent of 1980 nests. However, the Basin is unusual among known California breeding areas for Bell's Vireos in being "perhaps the most isolated from the effects of human activities, as well as the most buffered because of its isolation from the coincidental pressures associated with humanity" (Gray and Greaves 1980). Outstanding among such pressures are the grain fields and feed lots which foster cowbirds; in recent years only 12 to 18 cowbirds occupied the Basin, as opposed to approximately 50 pairs of Bell's Vireos. Elsewhere in California, Bell's Vireos appear to be subject to much higher rates of parasitism. Cowbirds accounted for a minimum 33 percent of vireo nest failures in one recent study (Goldwasser 1978), while 7 of 15 active vireo nests found on the Camp Pendleton Marine Corps base in 1981 were parasitized (Salata 1981).

Variation in the rate of cowbird parasitism has been shown to have a temporal as well as a spatial component. In northern California, only 10 to 12 percent of female cowbirds begin to lay eggs as early as the end of April (Payne 1973). Along the lower Colorado, Finch (1981) first noted parasitism of Abert's Towhees on 24 April in 1980. Cowbird reproduction declines sharply in northern California in late June and July, coincident with a decrease in the numbers of nesting host birds and the onset of the postnuptial molt (Payne 1973). This in turn means that Bell's Vireos are usually subject to less parasitism of their second brood in June-July, than their first, in May-June (Goldwasser 1978, Gray and Greaves 1980).

The relative distributions of Bell's Vireos and Brown-headed Cowbirds in selected areas along the lower Colorado River was noted (Table 4). Two generalizations are supported by these data:

1) Cowbirds occur in all areas utilized by Bell's Vireos along the lower Colorado. These nest parasites were most abundant where extensive tracts of agricultural land occurred in close proximity to riparian habitat, such as on the Cibola N.W.R. or Soto Ranch. However, cowbirds also were consistently observed in areas where riparian vegetation was extensively contiguous with desert habitat such as at Piute Creek, along Copper Basin Wash near Lake Havasu, and south of Needles into Topock Gorge.

2) Cowbirds were more often associated with Bell's Vireos than expected purely by chance alone. This was most noticeable in areas with relatively low densities of cowbirds, particularly north and south of Needles, and south of Park Moabi. This association may reflect the direct attraction of cowbirds to sites occupied by one of the noisiest and most persistent singers of the lower Colorado avifauna.

Of the nine nests found along the lower Colorado River, at least five had been parasitized (Table 5). Of these, only one was located in an area (south of the Agnes-Wilson Road) with a relatively high local density of cowbirds. From these data it seems fair to conclude that cowbirds are effectively reducing vireo nesting success, even in areas of relatively low cowbird densities. Only one vireo pair of seven showed evidence of reacting to parasitism by abandoning a nest in which a cowbird egg had been laid. This pair may also have removed a cowbird egg from a previous clutch of three (Table 5; 22 May nest) since Bell's Vireos normally lay a clutch of four, and cowbird females commonly remove a host egg before laying one of their own (Rothstein 1975).

The Decline of Arizona Bell's Vireos Along the Lower Colorado River

As elsewhere in California, Bell's Vireos have greatly declined along the lower Colorado River. A number of interrelated factors may have contributed to this trend.

Table 4. Distribution of Brown-headed Cowbirds With Respect To Arizona Bell's Vireos Along the Lower Colorado, 1981

Date	Area	Length of Transect (km)	No Male Cowbirds	No. Male Vireos	No. Male Vireos Singing Near Cowbirds
21 April	N of Needles	2.4	3	3	0
23 April	N of Needles	4.5	3	4	2
25 April	N of Wilson Rd.	5.4	14	5	2
26 April	S of Earp	4.2	6	0	--
3 May	Cibola N.W.R.	1.0	7	3	2
8 May	S of Water Wheel	1.6	3	0	--
13 May	S of Needles	4.8	2	6	2
19 May	Copper Basin Wash	4.0	2	0	--
21 May	Soto Ranch	4.0	14	2	1
29 May	S of Park Moabi	2.7	3	1	1
30 May	Piute Creek	3.2	2	1	1
1 June	S of Wilson Rd.	4.0	6	0	--

Table 5. Incidence of Cowbird Parasitism of Arizona Bell's Vireo Nests Along the Lower Colorado, 1981

Date	Locality	Nest Contents
13 May	S of Needles	4 vireo chicks
14 May	S of Agnes-Wilson Rd.	1 cowbird chick
20 May	S of Needles	3 vireo eggs; 1 cowbird egg (warm)
22 May	S of Needles	3 vireo chicks
23 May	N of Needles	1 cowbird chick
20 June	S of Needles (same pair as 22 May)	3 vireo eggs; 1 cowbird egg (cold)
22 June	N of Needles	2 vireo eggs; 1 cowbird egg (warm)
9 July	S of Needles (same pair as 20 May)	4 vireo chicks
10 July	S of Needles	4 vireo chicks

Clearing riparian vegetation for the purposes of recreational, agricultural, and urban development has reduced available breeding habitat for many species of riparian birds, including the Bell's Vireo. Agricultural development also has fostered the proliferation of a nest parasite, the Brown-headed Cowbird, to which the vireos are still largely vulnerable.

The undammed lower Colorado was a river of violent extremes, flooding enormously in the spring and drying to a trickle by late summer. Spring floods periodically scoured away soil and vegetation from the river's edge, and deposited fresh sand, ideal habitat for the proliferation of young willows and cottonwoods (Ohmart et al. 1977). The former has repeatedly been singled out as the preferred nesting habitat for Bell's Vireos in California (Goldwasser 1978, Gray and Greaves 1980). Damming the river at once ended the enormous seasonal variation in the river's flow, and broke the cycle of alluvial erosion and renewal which produced ideal Bell's Vireo nesting habitat.

The cessation of annual flooding, coupled with the development of irrigation systems, resulted in increasingly saline riparian soils, as well as ground and river water. High salinity has, in turn, promoted the establishment of salt cedar along vast stretches of the river (Ohmart et al. 1977, Cohan et al. 1978). While Bell's Vireos may be able to make use of salt cedar as nesting habitat, they appear to discriminate against it for this purpose.

A number of characteristics may render Bell's Vireos particularly vulnerable to reproductive losses because of brood parasitism. They do not make use of cavities for nesting, nor do they construct covered nests. Their small size may make it relatively difficult for them to defend a nest successfully against cowbirds or to remove cowbird eggs once they are deposited; the very small size of vireo nestlings means that they are less likely to survive in competition with a cowbird chick than the nestlings of even such a relatively small species as the Song Sparrow (Nice 1937). Finally, Bell's Vireo eggs are superficially rather similar to those of cowbirds in both color and pattern, if not in size.

Bell's Vireos do not appear to use all of the appropriate nesting habitat which remains along the Colorado. It is reasonable to conclude that the availability of nesting habitat is not solely responsible for limiting the population of Bell's Vireos along the river. A number of alternative limiting factors may be postulated, including cowbird parasitism, high mortality due to unspecified factors operating during migration, and high mortality on wintering areas in Mexico. Unfortunately, only the first of these factors is amenable both to testing and possible control.

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