STATUS REPORT AND BIOLOGICAL REVIEW OF THE GRAY VIREO IN NEW MEXICO

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Executive Summary

We compiled available published and unpublished records of Gray Vireos in the state of New Mexico and produced an overview of the distribution, status, and biology of the species in the state. We identified 49 population sites in 20 of New Mexico's 33 counties and estimated a maximum number of documented territories at 418. The largest known concentrations in the state are located in the Guadalupe Mountains (92 territories), Manzanita Mountains (60), Navajo Dam area (44), Caja del Rio area (25), and the Quebradas area (25); smaller but significant concentrations (10 to 17 territories) are in the Organ Mountains, San Andres NWR, the La Plata area, the Ladron Mountains, the Counselor area, near Glenwood, and in the vicinity of Zuni. There is little evidence of increasing or decreasing trends for the Gray Vireo in New Mexico, although BBS data suggest that declines may be occurring in the northern part of the state. Gray Vireos breed in pinyon pine-Utah juniper woodlands, oneseed juniper savannas, mixed juniper-oak woodlands, and desert riparian communities. Gray Vireos typically nest in juniper trees, although other tree and shrub species are used. The breeding phenology of Gray Vireos in New Mexico progresses from nest construction from late April through late June, through the start of incubation from early May through mid-July, hatching from mid-May through late July, and fledging from late May through early August. Breeding success is low in the state (usually ≤33%), in large part due to abandonment following brood-parasitism by the Brown-headed Cowbird. Parasitism rates are usually more than 50%, ranging 0-71%. Threats to the species include habitat loss (clearing of pinyon-juniper woodlands), disturbance from construction and development, habitat alteration from livestock grazing, and Brown-headed Cowbird brood-parasitism. We make six recommendations for management of the species in New Mexico, and we provide a survey protocol for clearance-type inventories.

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Introduction

The Gray Vireo (*Vireo vicinior*) (Figure 1) inhabits mid-elevation shrublands and pinyon (*Pinus* spp.)-juniper (*Juniperus* spp.) woodlands in the southwestern United States and northwestern Mexico (Barlow et al. 1999). The species' range, population size, habitats, and breeding biology are poorly documented, partly because it breeds in hot and remote locations not frequently visited by birdwatchers and ornithologists (Barlow et al. 1999, Schlossberg 2006). This lack of information, along with its small population size and threats such as habitat loss, has landed the Gray Vireo on several lists of sensitive species, including the list of threatened species for the state of New Mexico (NMDGF 2004), the United States Fish and Wildlife Service's national list of Birds of Conservation Concern (USFWS 2002), and the Partners in Flight Watchlist (Rich et al. 2004).

Figure 1. Gray Vireo photographed by Steve W. Cox on 16 August 2003 on Kirtland Air Force Base near Albuquerque, New Mexico.

Gray Vireos appear patchily distributed throughout their range (Barlow et al. 1999). Many areas of suitable habitat in New Mexico appear unoccupied (Mehlhop and DeBruin 1994; Schwarz 1996; DeLong and Cox 2004, 2005; Hawks Aloft 2006). For example, Schwarz (1996) indicated that despite frequent searches for the species on the Cibola National Forest, only two populations had been discovered. In addition, the species appears to have vacated some historically occupied areas, such as the Apache Hills in Hidalgo County and, apparently, areas in northeastern New Mexico, although searches for the species in such areas are rarely undertaken. It is unclear why the species is scarce, especially in light of the widespread occurrence of pinyon-juniper woodlands within the Gray Vireo's range. If the species has not been overlooked in many areas, or confused with the similar Plumbeous Vireo (*V. plumbeus*), then either the species must be selecting uncommon vegetation components within pinyon-juniper woodlands or there are demographic constraints restricting the species to small, isolated sub-populations.

Our knowledge of Gray Vireos in New Mexico spans some 125 years, beginning with specimens collected in the 1870s and 1880s, and continuing through the statewide summaries of Bailey (1928), Ligon (1961), and Hubbard (1970, 1978). The species was listed as threatened by the New Mexico Department of Game and Fish in 1983, partly because of the small population size and the apparent loss of some populations. Through the 1980s, no large-scale surveys or studies were conducted in New Mexico specifically targeting the species. By the early 1990s, however, agencies and organizations began survey and monitoring projects specifically for Gray Vireos. These efforts have indicated the species may be more common in New Mexico than once thought, with recent work documenting additional populations of the species, and ongoing survey efforts indicating that some populations are larger than was once thought (NMDGF 2004). In this review and status report, we summarize available published and unpublished records of Gray Vireos in New Mexico to develop a statewide overview of the species. We address the distribution, habitat, population size, nesting phenology, reproduction, population change, threats, and management recommendations for the Gray Vireo in New Mexico.

Methods

Information on Gray Vireos from throughout New Mexico was compiled from published records, contractor and agency reports, written and personal communications, Breeding Bird Survey (BBS) data, personal observations, museum records, nest card data, records from *Audubon Field Notes/American Birds* (1948 to present), records from *New Mexico Ornithological Society Field Notes* (1962 to present), and information in the New Mexico Ornithological Society Archives. No information collected after 2005 was included. The goal was to create as complete a distributional record as possible for the state. Information was entered into a database containing locations of sightings and nest sites, along with any useful information such as habitat, elevation, or reproduction. Four levels of organization were used: site, cluster, territory, and nest. Information from all sources was entered into the relevant level. If no information was available other than that a bird was seen in an area, the organization level was left blank. Because we were interested only in the breeding distribution and biology of the species, we excluded all records (few in number) of the species that occurred outside of the late-April through August breeding season. This database is available from the authors and from the New Mexico Department of Game and Fish (Endangered Species Program).

Site-level fields.—Many sources contained only site-level information, such as "five birds were seen in the Navajo Dam area." In such cases we entered data only in the site-level field for that year and site. Otherwise, data on nests and territories were pooled to provide site-level information, with interpretation needed in some cases to evaluate whether multiple reports at a place represented the same or multiple birds or territories. Sites represent populations of birds that appeared to be separated from other populations.

Cluster-level fields.—In some cases, multiple birds were reported as heard from a single location, such as "five singing males were seen in Reese Canyon." In cases such as this, we entered a cluster field and indicated the minimum number of birds and territories in the cluster.

The difference between a cluster and a site is clusters have multiple territories evident at a single reported point, whereas sites cover multiple locations.

Territory-level fields.—Some reports indicated the locations of singing males. These locations were entered as territories.

Nest-level fields.—Where nests were found and precise coordinates were provided for the location of the nest, the information was entered along with any observations on nesting substrate, timing, or productivity.

Mapping.—Locations for sites, clusters, territories, and nests were compiled in several ways. First, locations may have been marked in the field using a Global Positioning System (GPS) receiver and reported with UTM or latitude and longitude coordinates. In these cases, we imported or typed in the coordinates using the program Terrain Navigator version 6.04 produced by Maptech, Inc. Second, locations may have been marked on a map, using either traditional orienteering methods or a GPS receiver. In these cases, the maps provided were compared with electronic copies of USGS 7.5-minute quadrangles and points were placed on the electronic maps to match the provided locations. Coordinates for these were then obtained from the electronic map. Third, narrative descriptions of the locations were provided, and best-guess estimates of these locations were placed on the electronic map, allowing us to acquire approximate coordinates for these locations. Locations for sites were exported as decimal degree latitude/longitude points, averaged to obtain a site centroid, and the locations were plotted on a map of the state of New Mexico using a Geographical Information System (GIS) program.

Population size estimates.—The variation in information available for each record or source complicated our efforts to determine the number of birds found at each population site. To reconcile information from these varying sources, we counted the number of unique bird-locations found at each site for all years. We did not include any birds specifically noted as nestlings or fledglings, although in some cases these may have been reported along with adult birds without being specifically identified as such. Each time a bird was found at a clearly new point, it could be added to the total, but the bird would not be added to the total if we did not have information showing that the bird-location was distinct from other locations already provided for that site. This approach risked underestimating the population at a site because in some cases a singing male found at a site may belong to one of many existing territories, but the bird is reported only as a singing male. Even if several different people reported a singing male at a particular site for a particular year, without information suggesting that the birds were different they were not added to the total beyond the first entry. We assumed that all singing birds were males holding territories.

Gray Vireos were reported as pairs, singing males, family groups, or just simply birds. We felt it was necessary to report both a lower and an upper minimum to alleviate some of this disparity in available information. The reporting variation made it difficult to get a consistent sense of what was being tallied for each site. In some cases nine birds at a site might be four pairs and a floater, or it might be nine singing males where the actual number of birds present was 18. Thus, we sorted through the records and added mates whenever possible to bring the

estimates up to what a fully paired set of territories would represent population-wise. Halving the upper minimum provided our estimate of the minimum number of territories present at the site.

Precise location data were not provided with most records. Therefore, we simply counted up the maximum number of unique sightings for each site. As a fictional example, imagine that in 1990 four birds were found just north of Glenwood, and in 1991, five birds, one of which was a singing male, were found just south of Glenwood. We would report the lower minimum number for this site as nine birds. But because one of the birds was reported as a singing male, then we report the upper minimum as 10, having added a bird to account for the singing male's potential mate, although it is possible that a mate was one of the other eight reported birds.

Multiple years of intensive surveys have been undertaken at some sites, work which provided precise locations for many observations. At those sites, all the points were electronically mapped onto USGS 7.5-minute quadrangles, and with locations overlaid from multiple years, it was possible to identify areas that appeared to represent individual territories found in multiple years. The minimum number of territories for a site could be determined by counting from the map the clusters of sightings and nests, allowing many locations to be subsumed into single territories based on proximity, but also capturing the many territories that were not found each year. Generally speaking, points within 200 m of each other were considered to represent single territories, unless the presence of nests spaced less than 200 m apart was indicated by the reporting source. This method gives us the number of territories that have been found historically at a site but does not necessarily reflect current population sizes. Where possible, we doubled the maximum number of territories found using this method to provide the upper maximum number of birds that we used in place of the above-described method (assuming that each territory represented two adult birds).

Territory density estimates.—The density of territories was determined by drawing a polygon around groups of territories at a site and dividing the minimum number of territories inside the polygon by the area of the polygon. We drew polygons only for areas that appeared to have been surveyed completely; thus, we estimated territory density only for intensively surveyed sites. The limit of the surveys themselves determined the location of the polygons. Territories that were not in well-surveyed areas were not included in the density estimate.

Nesting phenology.—Estimates of when Gray Vireos breed were derived in two ways. First, laying, hatching, and fledging dates were estimated or observed by the reporting source. In these cases, we used the provided dates. Second, observations of Gray Vireos incubating or feeding nestlings were made. In these cases, we estimated laying, hatching, or fledging dates by calculating the median date between successive observations across nesting stage and then subtracting or adding 14 days to get to the appropriate date (incubation and nestling stages are about 14 days each; Barlow et al. 1999). For example, from an observation of incubation on 30 May and an observation of nestlings on 1 June we could estimate a hatching date of 31 May, a laying date of 17 May, and a fledging date of 14 June. These dates are estimates only, but as the chances of underestimating the dates should be equivalent to the chances of overestimating the

dates, we feel that these dates provide an unbiased estimate of the mean and range of nesting stages for this species.

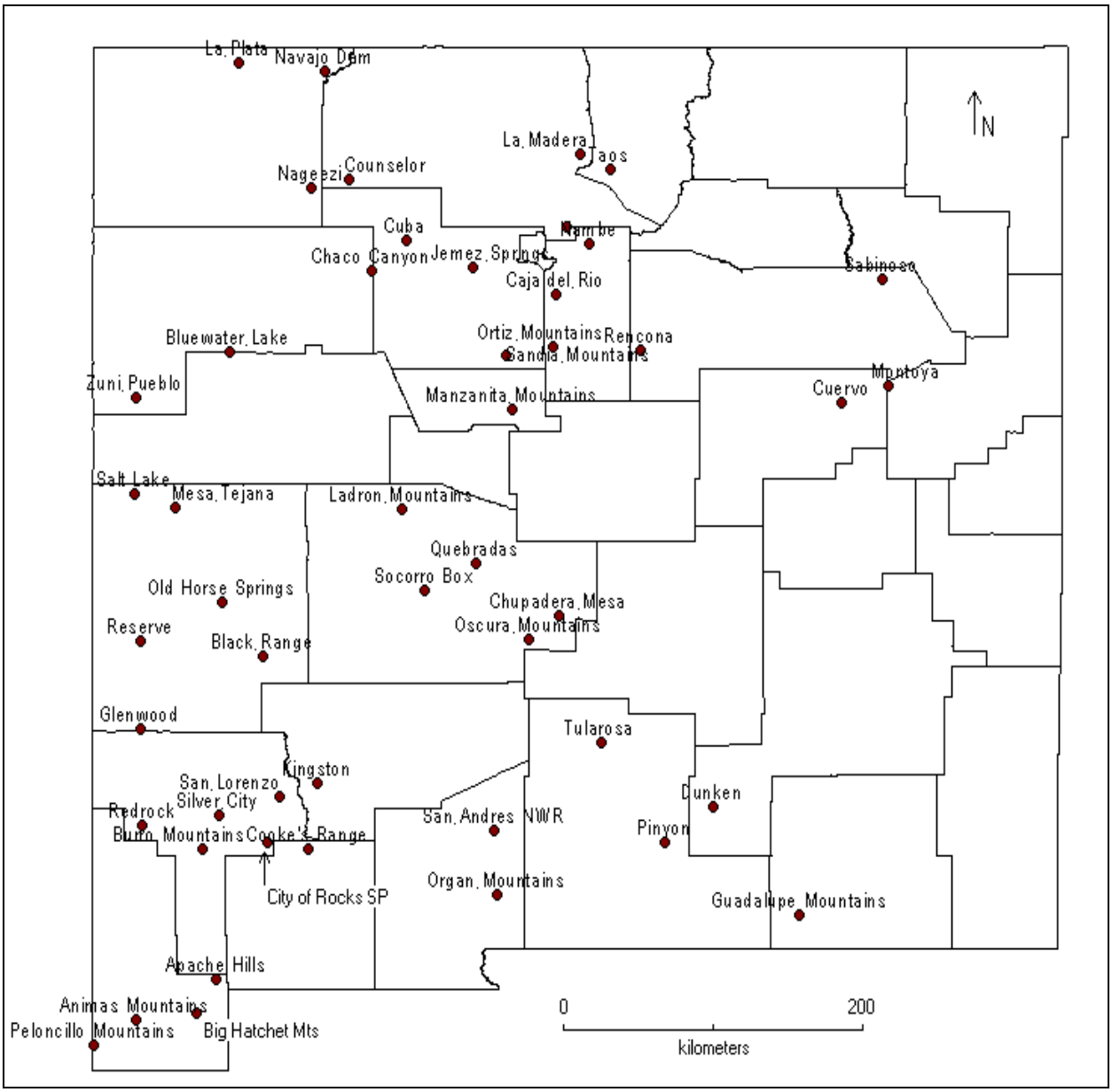

Figure 2. Location of 48 Gray Vireo population sites in New Mexico. The points were determined by averaging the Gray Vireo locations within each known site. Site names refer to the general location of the detections (see Appendix A).

Results and Discussion

Distribution.—We created a map of documented population sites of the Gray Vireo in New Mexico (Figure 2). Data from BBS indicate three major centers of distribution in the state (the Colorado Plateau/Farmington/Navajo Dam area, the Gila area, and the southern Guadalupe Mountains), corresponding fairly well to our findings. However, the distribution derived from BBS data excludes several populations along the Rio Grande corridor in central New Mexico, where there are few BBS routes. Although there are many locations where the species has been found in New Mexico, the largest documented populations are located in the Guadalupe Mountains, Manzanita Mountains, Navajo Dam area, Caja del Rio area, and the Quebradas area; smaller but significant concentrations are in the Organ Mountains, San Andres NWR, the La Plata area, the Ladron Mountains, the Counselor area, near Glenwood, and in the vicinity of Zuni (Figure 2, Table 1). All of the larger population sites have had some form of systematic inventory for either birds in general or specifically for Gray Vireos. Hence, it is possible that other large populations will be found when additional systematic survey work is conducted.

Population size.—The estimated Gray Vireo population for New Mexico currently is a lower minimum of 549 birds and a upper minimum of 827 birds (Table 1). These values are based on actual reports of Gray Vireos and not an attempt to extrapolate the population size of the whole state based on Gray Vireo densities in suitable habitat. If we divide the upper minimum by two (and rounding up for odd-numbered population sizes) we get an upper estimate of the number of territories documented in the state of 418.

We identified 49 population sites. A site was distinguished from other sites when some spatial separation of the locations in neighboring sites was apparent, but we do not mean to imply that population sites are truly isolated from other sites in any way. In some cases, the gaps between sites resulted from real gaps in habitat and in other cases from an absence of survey efforts in the area between sites. In one case, Navajo Dam, two population sites were designated to indicate that there were records in both Rio Arriba County (east of Navajo Lake) and in San Juan County (west of Navajo Lake), but only one point was mapped for the Navajo Dam records (Figure 2, Table 1). A description of each population site is provided in Appendix A.

The population sites varied widely in area and the number of documented territories they contain, from a minimum of one to 92 (Table 1). Some of the variation presumably is derived from the range of survey effort undertaken at the different sites. Of the sites that have actually been searched for Gray Vireos, and excluding sites where Gray Vireos were simply detected along with other birds, then the range is 3-92. There are only 12 sites that have 10 or more territories, indicating that most of the populations are quite small. Much of the survey effort has been concentrated in areas where Gray Vireos were already known to occur, so there is likely a positive feedback process occurring whereby known numbers increase over time as additional effort is put forth in those locations. Areas with few or no birds are not revisited as often and the number of documented territories therefore remains small at those sites. Density of populations in New Mexico ranged from 0.2 to 0.9 birds per 40 hectares (Table 2). Because few sites have had intensive inventories, this range is based on values from only five sites.

Table 1. List of 48 identified Gray Vireo population sites in New Mexico by county, with lower and upper minimum population size estimates and territory number estimate. Site names indicate the general area of the sightings (see Appendix A). Sites marked with an asterisk (*) are those where we estimated the upper minimum using the territory-counting method. Note that the Navajo Dam population is split out by county here but not counted or mapped as two sites.

County	*Site*	*Lower minimum number of birds*	*Upper minimum number of birds*	*Max number of territories*
Bernalillo	Manzanita Mountains*	58	120	60
Catron	Glenwood	12	22	11
	Railroad Canyon	1	2	1
	Old Horse Springs	1	2	1
	Mesa Tejana	2	2	1
	Salt Lake	4	6	3
	Reserve	1	2	1
Chaves	Dunken	2	4	2
Dona Ana	Organ Mountains	18	33	17
	San Andres Nat'l Wild. Refuge*	15	32	16
Eddy	Guadalupe Mountains	181	183	92
Grant	City of Rocks State Park	1	1	1
	San Lorenzo	2	4	2
	Burro Mountains	4	8	4
	Redrock	1	2	1
	Silver City	4	8	4
Guadalupe	Cuervo	1	2	1
Hidalgo	Animas Mountains	2	2	1
	Apache Hills	4	4	2
	Big Hatchet Mountains	1	2	1
	Peloncillo Mountains	4	4	2
Luna	Cooke's Range	5	10	5
McKinley	Bluewater Lake	2	2	1
	Zuni Pueblo	10	20	10
Otero	Piñon	5	10	5
	Tularosa	1	1	1
Quay	Montoya	4	4	2

County	*Site*	*Lower minimum number of birds*	*Upper minimum number of birds*	*Max number of territories*
Rio Arriba	Navajo Dam	26	42	21
	La Madera	1	1	1
	Espanola	2	4	2
San Juan	Navajo Dam	30	46	23
	Chaco Canyon	2	4	2
	Counselor	12	24	12
	La Plata	21	31	16
	Nageezi	2	6	3
San Miguel	Rencona	2	4	2
	Sabinoso	1	2	1
Sandoval	Sandia Mountains	3	4	2
	Cuba	3	3	2
	Jemez Springs	2	2	1
Santa Fe	Nambe	1	1	1
	Ortiz Mountains	2	4	2
	Caja del Rio*	22	50	25
Sierra	Kingston	4	8	4
Socorro	Chupadera Mesa	1	2	1
	Quebradas*	23	50	25
	Socorro Box	4	4	2
	Ladron Mountains*	30	32	16
	Oscura Mountains	7	7	4
Taos	Taos	2	4	2
Total		**549**	**827**	**418**

Table 2. Gray Vireo populations in New Mexico with sufficient data to determine minimum number of territories and territory density. Only territories in areas with actual area searches for birds are included. Gray Vireos found in areas incompletely surveyed are not included in these density estimates.

Site	*Minimum # of territories*	*Territories/ hectares used in density estimate*	*Territory density (#/40 ha)*	*Source*
Manzanita Mountains	60	60/2794	0.9	Cox in litt. 2006; Mehlhop and DeBruin 1994; Moore et al. 2004, 2005; Schwarz 1996
Caja del Rio	25	16/935	0.7	Arbetan and Muldavin 2003, 2004, 2005; Arbetan et al. 2002; DeBruin 1996; DeLong and Cox 2005; DeLong and Jewell 2005; Cox in litt. 2006
Quebradas	25	4/538	0.3	Cox 2001, 2002, 2003; DeLong and Cox 2004, 2005
Socorro Box	2	2/518	0.2	Cox 2003, DeLong and Cox 2004
Ladron Mountains	16	8/468	0.7	Cox 2001, 2002, 2003; DeLong and Cox 2004, 2005
Range			**0.2-0.9**	

Habitat.—Gray Vireos use three general habitats in New Mexico. In the northern and northwestern parts of the state, the species uses pinyon pine-Utah juniper (*J. osteosperma*) stands at 5,800-7,200 ft. In the central and western part of the state, Gray Vireos typically use oneseed juniper (*J. monosperma*) savannas at 5,500-7,000 ft. However, in west-central New Mexico, Gray Vireos may occasionally be found in juniper savanna above 7,200 ft. In the southern and southeastern parts of the state, the species uses mixed juniper-oak (*Quercus* spp.) woodlands and desert riparian communities at 4,300-6,600 ft. Gray Vireo habitat usually contains a mixture of open savannas and slightly more closed-canopy woodland areas, with a wide variety of understory shrubs and grasses, and the terrain is often characterized by rocky slopes, arroyos, or steep hillsides (Schwarz 1991, 1995, 1996; Reeves 1999; DeLong and Cox 2004, 2005; Moore et al. 2004, 2005). A series of photographs depicting Gray Vireo habitat in New Mexico is presented in Appendix B.

Little information is available regarding breeding habitat selection within the general habitat types mentioned above. Territories are often found in small basins, near steep hills, or near arroyos, but the birds may use flat areas as well (Schwarz 1991, 1995, 1996; Reeves 1999; Moore et al. 2004; DeLong and Cox 2005). On the Colorado Plateau in northern Arizona and southern Utah, the species preferred areas dominated by juniper over areas dominated by pinyon pine, and lower elevations within the study area were preferred (Schlossberg 2006). This result corresponds well to the observation that as pinyon-juniper savanna-woodland grades into taller pine woodlands the Gray Vireo is replaced by the Plumbeous Vireo (Barlow et al. 1999). In New Mexico, DeLong and Cox (2005) found that Gray Vireo nest sites had a slightly higher

density of oneseed junipers than randomly-selected sites that were surveyed and found unoccupied (1.7 versus 0.6 trees per 100 m^2, respectively). Hence, habitat quality may be related to juniper density, with both too low and too high a density being avoided by Gray Vireos (Moore et al. 2004, DeLong and Cox 2005, Schlossberg 2006). On the Colorado Plateau, areas with some shrub were preferred, especially as the prevalence of sagebrush (*Artemisia tridentata*) increased (Schlossberg 2006). In central New Mexico, a wide range of shrub densities and species was observed, but there was no relationship between Gray Vireo presence and any shrub variable (DeLong and Cox 2005). We have found no studies investigating how grass cover relates to habitat quality or selection for the Gray Vireo, but Schwarz (1995, 1996) suggested that grazed areas with low grass cover may be avoided. There is no information available on breeding habitat selection in the desert riparian areas of southeastern New Mexico.

In the central and northern parts of the state, nests are placed primarily in juniper trees (Arbetan et al. 2002; Arbetan and Muldavin 2003, 2004, 2005; DeLong and Cox 2004, 2005; Moore et al. 2004, 2005). In other parts of the state, other trees and shrubs also may be used as nest substrates, including pinyon pine, alligator juniper (*J. deppeana*), Utah juniper, netleaf hackberry (*Celtis laevigata*), littleleaf sumac (*Rhus microphylla*), and oaks (Table 3). Nests are placed on the outside of the nest tree, anywhere from fairly low off of the ground (within 1 m of the ground) to nearly the highest points in the top of the tree (Figures 3 and 4).

Table 3. Frequency of nest-substrate observations for 80 Gray Vireo nests located in New Mexico. The predominance of oneseed juniper as a nest substrate reflects the large amount of nest searching and monitoring conducted in three population sites in central New Mexico (Caja del Rio, Manzanita Mountains, and Ladron Mountains).

Common Name	***Scientific Name***	**#**	***Source***
Alligator juniper	*Juniperus deppeana*	1	Hawks Aloft 2006
Oneseed juniper	*Juniperus monosperma*	57	Schwarz 1991, in litt. 1995; Mehlhop and DeBruin 1994; Arbetan and Muldavin 2003, 2004; DeLong and Cox 2004, 2005; Moore et al. 2004, 2005; NMOSFN 17:9,22
Utah juniper	*Juniperus osteosperma*	1	Reeves 1997
Unidentified juniper	*Juniperus* sp.	9	Hawks Aloft 2006
Pinyon pine	*Pinus edulis*	2	Hawks Aloft 2006
Littleleaf sumac	*Rhus microphylla*	1	Weisenberger in litt. 1997
Netleaf hackberry	*Celtis laevigata*	1	Weisenberger in litt. 1994
Unidentified oak	*Quercus* sp.	8	Hawks Aloft 2006, S. West, personal communication

Figure 3. Gray Vireo on nest in the Southern Guadalupe Mountains population site. Photograph by Mike Stake, 21 May 2005.

Figure 4. Gray Vireo incubating eggs in the Ladron Mountains site. Photograph by John P. DeLong, 1 June 2005.

Phenology.—Schwarz (1997) indicated that arrival of Gray Vireos occurs in late April-early May and departure sometime in August. Based on our collated records, Gray Vireo breeding phenology progressed from nest construction in late April through late June, through the start of incubation from early May through mid-July, hatching from mid-May through late July, and fledging from late May through early August (Table 4). Unfortunately, most observers did not report whether the nests observed were first, second, or third nesting attempts, and this complicates our understanding of the breeding phenology. DeLong and Cox (2005) reported multiple nesting attempts for several territories in central New Mexico, indicating that first nesting attempts were in May, with post-failure re-nesting occurring in June for most territories. On the other hand, Schwarz (1995) suggested that the Gray Vireo may delay nesting to coincide with the rainy season, and observations of Gray Vireos in the dry spring of 2006 suggest that delayed nesting may indeed occur (JPD personal observation). Hence, June or July nesting attempts may be either re-nesting attempts after initial failures or delayed nesting. However, there have been no reports of double-brooding in New Mexico, so late nesting attempts are not likely to be second broods. Ehrlich et al. (1988), however, indicated that the species may have two broods.

Table 4. Early, median, and late dates for nesting stages of Gray Vireo in New Mexico, compiled from 32 nesting records for which all or partial information was available.

Nesting stage	***Early***	***Median***	***Late***
Construction	26 April	19 May	28 June
Start of incubation	5 May	27 May	11 July
Hatching	16 May	14 June	24 July
Fledging	31 May	27 June	6 August

Reproduction.—The nesting ecology of the Gray Vireo is poorly known. Few efforts have been made to document nesting behavior, timing, or ecology for the species, but some recent efforts are providing new information on productivity for New Mexico.

We compiled observations of 87 nesting attempts for New Mexico. For 38 nests which were examined during incubation, the average number of eggs present was 2.8 (± 1.1 SD). For 44 nests which were examined during the nestling phase, the average number of nestlings was 1.5 (± 1.5 SD). For 39 nests, the average number of young fledged was 1.1 (± 1.4 SD). The number of young fledged per territory ranged from 0.7 to 3.0 across studies (Table 5). Egg and nestling loss appears to occur throughout the nesting cycle. Little information regarding nest predators is available, but Barlow et al. (1999) suggested that Western Scrub-Jays (*Aphelocoma californica*), Mexican Jays (*A. ultramarina*), Scott's Orioles (*Icterus parisorum*), Northern Mockingbirds (*Minimus polyglottos*), Loggerhead Shrikes (*Lanius ludovicianus*), snakes, and various small mammals are all possible predators of Gray Vireos. Predation by these species may account for egg or nestling loss.

Nest abandonment appears common, with at least 38 of 87 (43.7 %) nests being abandoned. In contrast, only 7 (8 %) nests were known to have been destroyed. Nesting success (fledgling at least one young Gray Vireo) for studies ranged from 25 to 100% (Table 5). Most studies found nesting success in th 25-50% range (Table 5). As early as the 1940s, Hanna (1944) observed that nests of Gray Vireos often "come to some unhappy end," so it is not surprising that we found such low productivity for Gray Vireos in New Mexico.

Table 5. Demography of Gray Vireos in New Mexico, showing the number of nests monitored, percent of successful territories, the number of young fledged per territory, and estimate Brown-headed Cowbird (BHCO) brood-parasitism rate. Methods vary by study, and therefore results are not necessarily comparable among studies. In addition, because we report only data for monitored nests, some of these reported rates may be low. For example, Gray Vireos were observed to fledge young BHCOs in the Ladron Mountains in 2004, but the nests in those territories were not found and therefore were not included in this summary.

Population	***# of nesting attempts monitored***	***% successful territories***	***# fledged per territory***	***BHCO brood-parasitism rate***	***Source***
Manzanita Mountains	16	-	-	57	Moore et al. 2005
Guadalupe Mountains	19	32	0.7	71	Hawks Aloft 2006
Caja del Rio	3	≤33	-	67	DeLong and Cox 2005
Quebradas	4	25	0.8	24	DeLong and Cox 2004
	3	33	1.0	25	DeLong and Cox 2005
Socorro Box	2	50	-	50	DeLong and Cox 2004
Ladron Mountains	4	100	2.5	0	DeLong and Cox 2004
	14	25	0.9	43	DeLong and Cox 2005
Total/Range	66	25-100	0.7-3.0	0-71	

Population change.—The Gray Vireo is poorly monitored by long-term surveys such as the BBS. Rich et al. (2004) considered the population trend estimates from BBS data "imprecise." For New Mexico, the Gray Vireo has been detected on only 12 BBS routes (two of these routes have a shared section as one route replaced the other), usually in very low numbers. Nonetheless, BBS trend estimates may help us assess population stability. The following information was part of an analysis for the years 1966-2005 prepared by Sauer et al. (2005). For

New Mexico, the trend was -3.3% (P = 0.87, N = 6). For the entire species range, the trend was 1.6% (P = 0.46, N = 41). For the period 1980-2005, the New Mexico trend was considerably more negative, at -21.0% (P = 0.31, N = 6), and the range-wide trend also was negative at -1.9% (P = 0.57, N = 38). The map of trends (Figure 5) indicates that increases may be occurring in Arizona and southern Utah, southern New Mexico, and west Texas, whereas decreases may be occurring in an area extending from northern New Mexico through Colorado and up into northeastern Utah and in the easternmost part of the species range in Texas. Given the low numbers of birds detected per route, these trends should be viewed with considerable caution. Because BBS routes do not adequately provide long-term population trend data for Gray Vireos, alternative monitoring programs should be implemented.

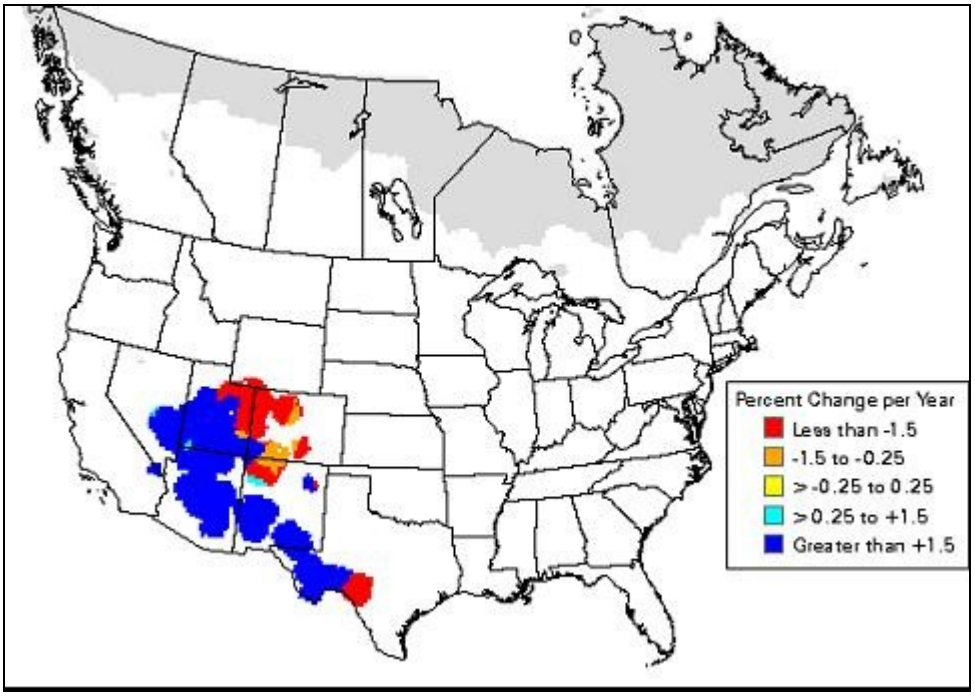

Figure 5. BBS trends for the Gray Vireo, showing stable or increasing trends in the western part of its range and decreasing trends from northern New Mexico through northeastern Utah and northwestern Colorado. Map from Sauer et al. (2005).

Another potential source of information on population stability are observations of birds in popular birding locales around the state. Some locations are visited often by birders to find certain species for annual or county bird lists. Although such observations do not qualify as monitoring, the species has occurred consistently at some sites for decades, suggesting that at least some local populations are persisting through time (Table 6).

Table 6. Gray Vireo persistence at localities frequently visited by birders.

Location	*County*	*# years detected*	*First Report*	*Most recent Report*
Aguirre Springs	Dona Ana	7	1985	2005
Big Canyon	Eddy	6	1939	1997
Glenwood	Catron	7	1978	2001
Guadalupe Canyon	Hidalgo	11	1962	2003
Redrock	Grant	4	1876	2000
Sitting Bull Falls	Eddy	3	1963	2000
Slaughter Canyon	Eddy	10	1966	2004
Socorro Box	Socorro	5	1995	2004
Zuni	McKinley	19	1979	2004

Threats.—Threats to landbird populations in North America are widespread and in general include loss of habitat, fragmentation and degradation of remaining habitat, and increases in mortality factors not directly related to habitat change (Rich et al. 2004). Gray Vireos in New Mexico may be impacted by all of these threats.

In many pinyon-juniper areas of the western United States, juniper savanna is cleared to increase forage for livestock (Gottfried and Severson 1994, Barlow et al. 1999). Clearing of juniper savanna is continuing in some areas of New Mexico where the Gray Vireo occurs. Since Gray Vireos in New Mexico depend on a range of woodland types in pinyon-juniper habitat, removal of trees has the potential to negatively impact Gray Vireos. In a Colorado study, areas cleared of pinyon-juniper had few tree-dependent species compared with uncleared areas (O'Meara et al. 1981). Although the Gray Vireo apparently was not present in the study area, it seems likely that it also would vacate an area that loses its woodland cover. In some areas, tree cutting for firewood also may cause Gray Vireo habitat loss (Reeves 1997*a*, Barlow et al. 1999). Biomass energy projects that harvest pinyon and juniper trees for feedstock (e.g., PNM 2006) have the potential to alter large areas of Gray Vireo habitat.

Fire suppression in grassland-forest ecotones may have increased potential habitat for the Gray Vireo by allowing the spread of juniper savanna into grassland areas (Moore et al. 2004). Indeed, in some areas Gray Vireos now occur in places that were formerly mapped as non-woodland by the makers of the USGS quadrangle maps (personal observation). However, fire suppression also may increase the densities of pinyon and juniper trees (Baker and Shinneman 2004), possibly making many areas unsuitable for Gray Vireos. Whether these changes have canceled each other out or whether Gray Vireo habitat has increased or decreased as a result of fire suppression is unknown.

Although little information is available, disturbance may be a threat to Gray Vireo populations (Barlow et al. 1999). In northwestern New Mexico, the species is found nesting near oil and gas wells, which have the potential to disturb nesting birds (Reeves 1997*a*,*b*). Schwarz (1997) observed that in the Sandia and Manzanita mountains, the species is not found near urban development, suggesting that Gray Vireos may abandon areas with construction activities or

increased human presence. However, to our knowledge, actual abandonment of territories after a disturbance has not been documented.

Grazing causes changes in vegetation structure that may have beneficial or negative effects on landbirds (Bock et al. 1993). We found no studies investigating the direct effects of grazing on Gray Vireos, but Schwarz (1995) observed that the only two areas the species is known to occur in the Sandia and Manzanita mountains area are ungrazed. Other large populations in the state, such as in Carlsbad Caverns National Park and San Andres National Wildlife Refuge, also do not have grazing. In contrast, areas such as the Ladron Mountains and Quebradas have extensive grazing.

The Brown-headed Cowbird is a native North American passerine bird that lays its eggs in the nests of other bird species, causing the host birds to raise cowbird chicks in addition to, or instead of, their own chicks (Robinson et al. 1995). Many species of songbirds are targeted as hosts by cowbirds. Some vireos, such as the Black-capped Vireo (*V. atricapilla*) and the Bell's Vireo (*V. bellii*), are parasitized to the extent that population declines result (Robinson et al. 1995). Typically, Gray Vireos abandon their nests after they are parasitized, but they also may build replacement floors in the nest and renest in the same structure (Ehrlich et al. 1988). Gray Vireos also may show decoy aggressive behavior and build decoy nests to avoid predators and brood-parasitism (Schwarz 1991, Mehlhop and DeBruin 1994).

Gray Vireos in New Mexico are a regular Brown-headed Cowbird host (Schwarz 1991, 1995, 1996; Mehlhop and DeBruin 1994; DeLong and Cox 2004, 2005; Hawks Aloft 2006). Four studies that investigated cowbird parasitism of Gray Vireos in New Mexico found rates ranging from 0 to 71% per study, but most observations indicated parasitism rates of 24 to 71% (Table 5). Of the 29 nests we compiled which were parasitized by Brown-headed Cowbirds (including only nests with eggs actually found in the nest), 3 (14%) raised cowbird chicks, 22 (76%) abandoned their nests, and one had an unknown outcome. Three additional pairs, all in the Southern Guadalupe Mountains, fledged their own young despite being parasitized (Hawks Aloft 2006). Sequential parasitism of replacement nests in some territories has led to season-long nesting failure for some pairs (DeLong and Cox 2005).

The upper part of the observed range of parasitism for Gray Vireos in New Mexico is similar to the parasitism rates of highly imperiled species for which brood-parasitism appears to be one cause of the imperilment (Robinson et al. 1995). Although Brown-headed Cowbird brood-parasitism has been identified as a possible cause of declines in Gray Vireo populations in California and Arizona (DeSante and George 1994), it is unclear whether brood-parasitism is having population-level consequences in New Mexico. The impact of brood-parasitism on Gray Vireos in New Mexico should be investigated further.

Management recommendations.—Based on the information we have compiled in this overview of the Gray Vireo in New Mexico, we make the following six recommendations:

1. Gray Vireos are more common in New Mexico than once thought, but the species is still relatively rare and faces several potentially serious threats, particularly cowbird brood-

parasitism and habitat loss. We believe the listing of the species as threatened in New Mexico is justified.

2. Require inventories of the species prior to removal of trees in pinyon-juniper habitat, and avoid cutting any trees in known Gray Vireo breeding territories. Established territories may be stable and not move from year to year (Moore et al. 2004), so protection of occupied sites may be a key component for protecting the species.

3. Determine the optimum juniper and pinyon density for the species and tailor woodland clearing or restoration projects towards those densities.

4. Improve monitoring of the species through annual inventory and monitoring of targeted populations.

5. Investigate the effects of Brown-headed Cowbird brood-parasitism on the productivity and site-selection of the Gray Vireo.

6. Investigate the effects of grazing on the productivity and site-selection of the Gray Vireo.

Literature Cited

Arbetan, P., K. Johnson, and E. Muldavin. 2002. Report of faunal surveys for the Gray Vireo and Black-tailed and Gunnison's Prairie Dog at the New Mexico Army National Guard Camel Tracks Training Site. Unpublished report to the New Mexico Army National Guard Environmental Office by the New Mexico Natural Heritage Program. NMNHP Report: 02-GTR 222.

Arbetan, P., and E. Muldavin. 2003. Report of bird surveys at New Mexico Army National Guard Training Areas – Camel Tracks, Roswell Weekend, Happy Valley. Unpublished report to the New Mexico Army National Guard Environmental Office by the New Mexico Natural Heritage Program. NMNHP Report: 02-GTR 259.

Arbetan, P., and E. Muldavin. 2004. Report of bird surveys at the New Mexico Army National Guard Camel Tracks Training Area – 2003. Unpublished report to the New Mexico Army National Guard Environmental Office by the New Mexico Natural Heritage Program. NHNM Report: 02-GTR-260.

Arbetan, P., and E. Muldavin. 2005. Report of Gray Vireo surveys and monitoring at the New Mexico Army National Guard Camel Tracks Training Area – 2004. NHNM Report: 04-GTR-277.

Bailey, F. M. 1928. The birds of New Mexico. New Mexico Department of Game and Fish, Santa Fe, New Mexico. 807 pages.

Baker, W. L., and D. J. Shinneman. 2004. Fire and restoration of pinon-juniper woodlands in the western United States: a review. Forest Ecology and Management 189:1-21.

Barlow, J.C., S.N. Leckie, and C.T. Baril. 1999. Gray Vireo (*Vireo vicinior*). The Birds of North America. No. 477. A. Poole and F. Gill, eds. Philadelphia: The Birds of North America, Inc.

Bock, C. E., V. A. Saab, T. D. Rich, and D. S. Dobkin. 1993. Effects of livestock grazing on Neotropical migratory landbirds in western North America. Pages 296-309 in D. M. Finch and P. W. Stangel, editors. Status and management of Neotropical migratory birds. U.S.D.A. Forest Service, General Technical Report RM-229.

Cox, N. S. 2001. Initial Year 2001 Report for Gray Vireo Surveys within the Socorro Resource Area. Unpublished report to the Bureau of Land Management by SORA. 12 pages plus appendices.

Cox, N. S. 2002. Annual Report for Gray Vireo (*Vireo vicinior*) Surveys within the Socorro Resource Area. Unpublished report to the Bureau of Land Management by SORA. 10 pages plus appendix.

Cox, N. S. 2003. Annual Report for Gray Vireo (*Vireo vicinior*) Surveys within the Socorro Resource Area. Unpublished report to the Bureau of Land Management by SORA. 10 pages.

DeBruin, E. A. 1996. Biological assessment of expanded Camel Tracks Training Site: year II. Unpublished report to the New Mexico Army National Guard Environmental Office by the New Mexico Natural Heritage Program.

DeLong, J. P., and N. S. Cox. 2004. 2004 Gray Vireo surveys in the Socorro Resource Area, central New Mexico. Unpublished report to the Bureau of Land Management by SORA and Eagle Environmental, Inc. 16 pages.

DeLong, J. P., and N. S. Cox. 2005. Nesting ecology of Gray Vireos in central New Mexico: 2005 results. Unpublished report to the Bureau of Land Management and New Mexico Department of Game and Fish by SORA and Eagle Environmental, Inc. 16 pages.

DeLong, J. P., and J. V. Jewell. 2005. Cerrito Pelado Scoria Mine Gray Vireo survey and wildlife inventory report. Unpublished report to Metric Corporation by Eagle Environmental, Inc. 6 pages.

DeSante, D. F., and T. L. George. 1994. Population trends in the landbirds of western North America. Studies in Avian Biology 15:173-190.

Ehrlich, P. R., D. S. Dobkin, and D. Wheye. 1988. The birder's handbook. Simon and Shuster, Inc., New York. Xxx + 785 pp.

Gottfried, G. J., and K. E. Severson. 1994. Managing pinyon-juniper woodlands. Rangelands 16:234-236.

Hanna, W. C. 1944. The Gray Vireo as a victim of the cowbird. Condor 46:244.

Hawks Aloft, Inc. 2006. Gray Vireo population monitoring in southeast New Mexico. Unpublished report to New Mexico Department of Game and Fish, Share with Wildlife Program. 26 pages.

Hubbard, J. P. 1970. Check-list of the birds of New Mexico. New Mexico Ornithological Society. Publication 3. 108 pages.

Hubbard, J. P. 1978. Revised check-list of the birds of New Mexico. New Mexico Ornithological Society. Publication 6. 110 pages.

Ligon, J. S.. 1961. New Mexico birds and where to find them. University of New Mexico Press, Albuquerque, New Mexico. 360 pages.

Mehlhop, P., and DeBruin, E. A. 1994. Surveys for rare plants and animals on Kirtland Air Force Base, New Mexico and adjacent lands under its management. Part of an unpublished progress report to Kirtland Air Force Base by New Mexico Natural Heritage Program. 7 pages.

Moore, W. L., R. D. Frei, C. A. Riebe, R. L. Klundt, and D. Stites. 2004. Kirtland Air Force Base field surveying report for Mountain Plover and Gray Vireo populations. Unpublished report to Kirtland Air Force Base by LopezGarcia Group. 49 pages.

Moore, W. L., R. D. Frei, R. L. Klundt, and D. Stites. 2005. Final surveying report for Mountain Plover and Gray Vireo populations at Kirtland Air Force Base. Unpublished report to Kirtland Air Force Base by LopezGarcia Group. 76 pages.

New Mexico Department of Game and Fish. 2004. Threatened and endangered species of New Mexico, 2004 biennial review. New Mexico Department of Game and Fish, Santa Fe, New Mexico. 112 pages.

O'Meara, T. E., J. B. Haufler, L. H. Stelter, and J. G. Nagy. 1981. Nongame wildlife responses to chaining of pinyon-juniper woodlands. Journal of Wildlife Management 45:381-389.

Public Service Company of New Mexico (PNM). 2006. New Mexico's first biomass plant. Available from http://www.pnm.com/news/2006/073106_biomass.htm.

Reeves, T. 1997*a*. Gray Vireo nesting survey in San Juan and Rio Arriba counties, New Mexico. Unpublished report to Bureau of Land Management. 23 pages.

Reeves, T. 1997*b*. Gray Vireo (*Vireo vicinior* Coues) nesting in San Juan County, New Mexico. New Mexico Ornithological Society Bulletin 25(4):89-95.

Reeves, T. 1999. Gray Vireo distribution survey on BLM Farmington District lands in McKinley, Rio Arriba, San Juan counties, New Mexico: 1999 results and final report on three-year study. Unpublished report to Bureau of Land Management. 73 pages.

Rich, T. D., C. J. Beardmore, H. Berlanga, P. J. Blancher, M. S. W. Bradstreet, G. S. Butcher, D. W. Demarest, E. H. Dunn, W. C. Hunter, E. E. Iñigo-Elias, J. A. Kennedy, A. M. Martell, A. O. Panjabi, D. N. Pashley, K. V. Rosenberg, C. M. Rustay, J. S. Wendt, T. C. Will. 2004. Partners in Flight North American Landbird Conservation Plan. Cornell Lab of Ornithology. Ithaca, NY. Available from http://www.pwrc.usgs.gov/pif/cont_plan.

Robinson, S. K., S. I. Rothstein, M. C. Brittingham, L. J. Petit, and J. A. Grzybowski. 1995. Ecology and behavior of cowbirds and their impact on host populations. Pages 428-460 *in* Ecology and Management of Neotropical Migratory Birds, T. E. Martin and D. M. Finch, eds. Oxford University Press, Oxford.

Sauer, J. R., J. E. Hines, and J. Fallon. 2005. The North American Breeding Bird Survey, Results and Analysis 1966 - 2005. Version 6.2.2006. USGS Patuxent Wildlife Research Center, Laurel, MD.

Schlossberg, S. 2006. Abundance and habitat preferences of Gray Vireos (*Vireo vicinior*) on the Colorado Plateau. Auk 123:33-44.

Schwarz, H. 1991. Gray Vireo survey in the Sandias. Unpublished report for the Cibola National Forest. 7 pages.

Schwarz, H. 1995. Cibola National Forest breeding bird survey report for 1995. Unpublished report to Cibola National Forest. 47 pages.

Schwarz, H. 1996. Cibola National Forest breeding bird survey report for 1996. Unpublished report to Cibola National Forest. 61 pages.

Schwarz, H. 1997. Cibola National Forest breeding bird survey report for 1997. Unpublished report to Cibola National Forest. 69 pages.

Sibley, D. A. 2000. National Audubon Society the Sibley guide to birds. Alfred A. Knopf, New York. 544 pages.

U.S. Department of Agriculture, Natural Resources Conservation Service. 2006. Plants database. Available from http://plants.usda.gov/index.html.

U.S. Fish and Wildlife Service. 2002. Birds of conservation concern 2002. U.S. Fish and Wildlife Service, Division of Migratory Birds, Arlington, VA.

West, S. 2005. Inventory of high elevation breeding birds at Carlsbad Caverns National Park. Unpublished report to Carlsbad Caverns National Park. 79 pages.

Appendix A. Location of 48 identified population sites, arranged by county.

Bernalillo
Manzanita Mountains.—Western foothills of the Manzanita Mountains, including Coyote Springs Canyon and south to Isleta Pueblo, primarily on Kirtland AFB.

Catron
Glenwood.—Canyons in the vicinities of Glenwood and Pleasanton, including Whitewater Canyon, Harve Gulch, Shelton Canyon, South Dugway Canyon, and Frisco Hot Springs.
Railroad Canyon.—Railroad Canyon in the Indian Peaks area, south of Pelonia Mountain.
Old Horse Springs.—Horse Springs BBS.
Mesa Tejana.—Near Mesa Tejana.
Reserve.—Vicinity of Reserve.

Chavez
Dunken.—South of Dunken.

Dona Ana
Organ Mountains.—Aguirre Springs plus Filmore, Soledad, Rucker, and Long Canyons.
San Andres NWR.—San Andres Mountains, including Cox Canyon, Ropes Springs Canyon, San Andres Canyon, and Ash Spring.

Eddy
Guadalupe Mountains.—Primarily the southern Guadalupe Mountains, including Carlsbad Caverns National Park, Sitting Bull Falls, the vicinity of Queen, and including Last Chance, Walnut, Slaughter, Dark, and Big Canyons.

Grant
City of Rocks State Park.—Park in southwestern Grant County.
San Lorenzo.—West slope of Black Range on Emory Pass BBS.
Burro Mountains.—Burro Mountains and White Signal vicinities.
Redrock.—Vicinity of Redrock on lower Gila River.
Silver City.—Vicinities of Silver City and Tyrone, including Lone Mountain.

Guadalupe
Cuervo.—Near Cuervo, probably along Cuervo Mesa.

Hidalgo
Animas Mountains.—Lower Indian Creek Canyon area.
Apache Hills.—Apache Hills southeast of Hachita.
Big Hatchet Mountains.—Big Hatchet Mountains south of Hachita.
Peloncillo Mountains.—Guadalupe and Skeleton canyons.

Luna
Cooke's Range.—Foothills on the east side of Cooke's Peak.

McKinley
Bluewater Lake.—Cottonwood Gulch area in the Zuni Mountains.

Zuni Pueblo.—Hills and canyons around the town of Zuni, including Chaema and Mullen canyons.

Otero
Piñon.—Piñon BBS near Piñon.
Tularosa.—Northeast of Tularosa along Tularosa Creek.

Quay
Montoya.—Pajarito Creek northwest of Montoya.

Rio Arriba
Navajo Dam.—East side of Navajo Lake, including Gobernador Canyon.
La Madera.—Hills near La Madera.
Espanola.—West of Santa Clara.

San Juan
Navajo Dam.—Canyons and mesas west of Navajo Lake, including Mesa Mountains and Pump Canyon to the northwest.
Chaco Canyon.—Chaco Mesa.
Counselor.—Counselor BBS.
La Plata.—Vicinities of Farmington and Aztec, including La Plata BBS and Farmington BBS.
Nageezi.—Nageezi BBS.

San Miguel
Rencona.—Pecos BBS on Rowe Mesa near Rencona.
Sabinoso.—Sabinoso BBS near Montoya Point.

Sandoval
Sandia Mountains.—North end of the Sandia Mountains, including the Bernalillo Watershed Withdrawal Area.
Cuba.—About 12 miles southwest of Cuba.
Jemez Springs.—Canyon slopes west of Jemez Springs.

Santa Fe
Nambe.—Northeast of Nambe.
Ortiz Mountains.—Near Madrid, including the La Cienega BBS.
Caja del Rio.—Camel Tracks area, Tetilla Peak, and Diablo Canyon areas south and west of Santa Fe.

Sierra
Kingston.—East slope of Black Range on Emory Pass BBS.

Socorro
Chupadera Mesa.—Chupadera Mesa in eastern Socorro County.
Quebradas.—Broken hills and gulches in the Sierra Larga area east of Escondida.
Socorro Box.—Hills and canyons south of the Socorro Box, southwest of Socorro.
Ladron Mountains.—Western foothills of the Ladron Mountains, including Saladito Mesa.
Oscura Mountains.—Eastern slopes of the Oscura Mountains, on White Sands Missile Range.

Taos
Taos.—Along the Rio Grande Gorge and the Comanche Rim, west of Taos.

Appendix B. Photographs showing Gray Vireo breeding habitat from a selection of population sites in New Mexico, ordered from north to south. See Figure 2 for the location of population sites.

Navajo Dam.—Photo by Tim Reeves, 16 June 1998.

Caja del Rio.—Photo by John P. DeLong, 13 August 2005.

Ladron Mountains.—Photo by John P. DeLong, 12 August 2005.

Quebradas.—Photo by John P. DeLong, 11 August 2005.

Socorro Box.—Photo by John P. DeLong, 16 June 2004.

Chupadera Mesa.—Photo by Nancy S. Cox, 23 April 2006.

San Lorenzo.—Photo by John P. DeLong, 6 June 2006.

San Andres NWR.—Photo by Mara Weisenberger, 15 June 2004

Guadalupe Mountains.—Photo by Mike Stake, 23 June 2005

Guadalupe Mountains.—Photo by Steve West, 20 June 2003.

Appendix C. Protocol for surveying for Gray Vireos in New Mexico

Introduction

The Gray Vireo (*Vireo vicinior*) is listed as threatened by the state of New Mexico (NMDGF 2004). Because of the threatened status, potential effects on the species by activities on federal or state land often need to be assessed prior to beginning work. Activities that remove habitat or cause disturbance have the potential to negatively affect breeding Gray Vireos. Activities such as juniper cutting, prescribed fire, road building, housing development, or oil and gas exploration should not be conducted until the project site has been surveyed for Gray Vireos.

Despite increasing efforts in recent years to document populations of Gray Vireos in New Mexico, a field survey protocol has not been available to assist field workers in locating the species. Developing a uniform approach to conducting Gray Vireo surveys will increase confidence in the outcomes of those surveys and enable a better assessment of the status of the species. We reviewed several vireo-survey methods from agency and contractor reports for the state of New Mexico (DeLong and Cox 2004, 2005; Moore et al. 2004, 2005; Schwarz 1991) to develop the following survey recommendations. This protocol is a recommendation only, and no special permits are required for noninvasive surveying of Gray Vireos in New Mexico.

Survey Recommendations

Identification.—The Gray Vireo is a smallish, non-descript passerine (Barlow et al. 1999, Sibley 2000). The bird is light gray with brownish wings and faint wing-bars, and has a relatively long tail for a vireo. Gray Vireos are thought to do more tail-flicking behavior than other vireos. Gray Vireos resemble the Plumbeous Vireo (*V. plumbeus*) but have a thin white eye ring and a faint white wing bar rather than the prominent white spectacles and bold white wing bars of the Plumbeous Vireo. The two vireos may occur in the same areas but the Plumbeous Vireo typically occurs at higher elevations where densities of pinyon and ponderosa pine are higher than in areas typically used by the Gray Vireo (Barlow et al. 1999, DeLong and Cox 2005, Hawks Aloft 2006, Schwarz 1996). The songs of the two species are similar, but the Gray's is sweeter and faster with shorter phrases, and the Plumbeous' is slower, burrier, and has more pauses between phrases (Barlow et al. 1999, Sibley 2000).

Habitats to survey.—The Gray Vireo uses three main types of habitats in New Mexico. In the northern part of the state and on the Colorado Plateau, the species uses pinyon pine-Utah juniper (*J. osteosperma*) stands 5,800-7,200 ft in elevation. In the central and western part of the state, Gray Vireos typically use oneseed juniper (*J. monosperma*) savannas 5,500-7,000 feet in elevation. In the southern and southeastern parts of the state, the species uses mixed juniper-oak woodlands and desert riparian communities 4,300-6,600 feet in elevation. Any project site that falls into these habitat types and elevations should be surveyed for Gray Vireos prior to conducting project or management activities.

W*hen to survey*.—The species arrives on breeding areas in New Mexico in late April in the south and early May in the north. Surveys can begin early May in the south and in the central part of the state, and by mid-May in the north. Surveys can be conducted through July, but the most reliable period is May and June. Some pairs may be hard to detect later in the breeding season because they may have failed in their nesting attempts and abandoned their territories by July (DeLong and Cox 2005).

Time of day.—Gray Vireos may sing all day, but during the hottest parts of the breeding season they may be considerably more quiet after noon. Thus, the best time to survey for this species is between dawn and noon.

How many times to survey.—Ideally, one set of surveys should be conducted during May. If vireos are found, then the surveys may be considered complete. However, if no Gray Vireos are detected, then a second set of surveys should be conducted in mid-late June. This recommendation derives from our observation that in dry years Gray Vireos may delay nesting and be fairly difficult to detect. A second set of surveys increases the chances that a population would be detected if surveys were conducted during a time when vireos were not particularly vocal.

Survey methodology.—

1.Tape-playback surveys should be conducted. Purely listening surveys can allow detection of Gray Vireos (Hawks Aloft 2006, Schwarz 1991, West 2005), but tape-playback surveys may locate as many as twice the number of territories (G. Giroir, personal communication cited in Moore et al. 2004).[1] In addition, although Gray Vireos are known for being vociferous, they may be quiet for considerable periods of time during the day (JPD personal observation). The quiet periods may be long enough for a passive listener to conclude the species was not present in a spot and move on (JPD personal observation, Moore et al. 2004). In addition, after the arrival and courtship portion of the breeding season, the birds may be less vocal and therefore harder to detect without the use of tape-playback methods. Therefore, when clearance-type surveys are required for pre-project activities, tape-playback methods should be used.

2.The standard song of the Gray Vireo should be played from points spaced 200-300 m apart, depending on habitat quality, topography, and locations of other Gray Vireos. The closest spacing of Gray Vireo territories (territory center to territory center) in New Mexico is about 200-300 m, suggesting that point-spacing of 200-300 m will allow detection of most territories. In addition, Gray Vireos may respond to the tape-playback calls from distances of 100 m or more (Moore et al. 2004, JPD personal observation), indicating that broadcast stations may effectively locate birds within about 150 m or so of the station.

3.Each survey stop should begin with a listening period of 1-2 minutes, followed by 20-30 seconds of broadcast, another 1-2 minutes of listening, 20-30 seconds of broadcast, and end with 1-2 minutes of listening. Longer listening times after broadcasting may be helpful at times. The direction of broadcasting should rotate 360 degrees during the survey.

Data collection.—The following information should be recorded for each Gray Vireo survey:

- Site name, county, and distance and direction from nearest town
- date
- start and stop time
- observer's full name
- weather [wind-speed, temperature, cloud cover, precipitation]
- habitat type

[1] The question of whether the use of tape-playback methods causes undo disturbance is currently unanswered. There are no studies to demonstrate a negative effect of tape-playback surveys on the Gray Vireo, and the currently available data suggest that sites surveyed without the use of tape-playback experience similar levels of nest success as sites surveyed with tape-playback methods.

- location of each point surveyed whether Gray Vireos were detected or not (UTM or lat/longs of each point should be determined with a GPS receiver if possible), along with county and approximate distance to nearest town.
- number of Gray Vireos heard or seen
- age and sex of individuals seen (e.g., 2 adults with 1 fledgling)
- exact location of birds seen (preferably using a GPS receiver)
- if exact location cannot be obtained, the distance and direction of the bird from the survey point should be recorded
- presence of Brown-headed Cowbirds and cattle at each point
- habitat of survey area, including observations of habitat manipulations (cutting, burning, or development) at each point