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BREEDING STATUS OF THE GRAY VIREO ON THE BAJA CALIFORNIA PENINSULA

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ABSTRACT—Most of the breeding range of the Gray Vireo (*Vireo vicinior*) lies within the southwestern United States, where the population is sparse, patchy, and declining. But the species also breeds in Baja California, Mexico, where its status has not been assessed. To rectify this, in 2021 and 2022 we surveyed four mountain ranges where the Gray Vireo is known or might be expected. In the northernmost, the Sierra Juárez, we located 43 territories—an abundance strikingly greater than just across the border in Upper California. Territories were in both treeless chaparral dominated by chamise (*Adenostoma fasciculatum*) and redshank (*A. sparsifolium*), and in the extensive pinyon woodland. In the Sierra San Pedro Mártir, all 71 territories located were in *Adenostoma*-dominated chaparral. Extrapolation of the densities observed in these two ranges over the extent of suitable habitat implies the population of the Gray Vireo in Baja California should be over 10,000 individuals. Confirmed by audio recording, one sighting from the Sierra de Ulloa overlooking Ensenada suggests a still wider distribution in Baja California. Isolated stands of chaparral grow south of the Gray Vireo's previously reported breeding range, on the Sierra La Asamblea. But our reconnaissance of it revealed no Gray Vireos. Survey of the Sierra San Francisco in the center of the peninsula, 3–9 April, revealed only 3 Gray Vireos, all in winter habitat containing *Bursera microphylla*. Therefore two molting specimens collected in the Sierra San Francisco in October 1997 imply that some individuals molt in the winter range, not a southward extension of the breeding range. Despite Baja California representing only a small part of the Gray Vireo's breeding range spatially, it contributes disproportionately to the species' population and therefore conservation.

RESUMEN—La mayor parte del ámbito de la distribución reproductiva del Vireo

Gris (*Vireo vicinior*) se encuentra en el suroeste de los Estados Unidos, donde la población es escasa, en parches aislados y en declive. No obstante, la especie también anida en Baja California, México, donde no se ha evaluado su estado reproductivo. Para rectificar lo anterior, en 2021 y 2022 estudiamos cuatro sierras donde se conoce o se podría distribuir *V. vicinior*. En la sierra más septentrional, la Sierra Juárez, localizamos 43 territorios, una abundancia sorprendentemente mayor que al otro lado de la frontera internacional en Alta California. Los territorios estaban tanto en el chaparral sin árboles, dominado por chamizo (*Adenostoma fasciculatum*) y chamizo colorado (*A. sparsifolium*), como en el extenso bosque de pinos piñoneros. En la Sierra San Pedro Mártir, todos los 71 territorios ubicados ocurrieron en chaparral dominado por *Adenostoma*. La extrapolación de las densidades observadas en estas dos regiones hacia la extensión del hábitat adecuado implica que la población de *V. vicinior* en Baja California debería ser superior a 10,000 individuos. Un avistamiento confirmado por grabación de audio en la Sierra de Ulloa cerca de la ciudad de Ensenada sugiere una distribución aún más amplia en Baja California. Al sur del área de reproducción de *V. vicinior* reportada anteriormente, se encuentran parches aislados de chaparral en la Sierra La Asamblea. No obstante, nuestro muestreo allí no reveló ningún individuo. Nuestro estudio de la Sierra San Francisco, Baja California Sur, en el centro de la península, del 3 al 9 de abril, reveló solo tres individuos de *V. vicinior*, todos en un hábitat invernal que contiene el árbol *Bursera microphylla*, cuyo fruto constituye su principal alimento durante el invierno. El único espécimen recolectado no estaba en condición reproductiva y tenía mucha grasa corporal, condición que indicaría que estuviera listo para la migración. Por tanto, concluimos que *V. vicinior* se encuentra en la Sierra San Francisco solo como un visitante invernal, y el hecho de que dos especímenes recolectados en octubre de 1997 estuverian mudando implica que algunos individuos mudan después de llegar a su distribución invernal. A pesar de que Baja California representa espacialmente solo una pequeña parte del área de reproducción del *V. vicinior*, el Estado contribuye de manera desproporcionada a la población de la especie y, por ende, a su conservación.

The great majority of the breeding range of the Gray Vireo lies within the southwestern United States, with just a small proportion in Mexico (Barlow et al. 1999). The species nests in both pinyon–juniper woodland and chaparral. The breeding population tends to be sparse and patchy throughout its range, and in California it has declined steeply, to the point of extirpation from many sites the species occupied in the early 1900s (Unitt 2008, Hargrove and Unitt 2017). The Gray Vireo is a short-distance migrant, wintering mostly in northwestern Mexico in desert and thorn scrub containing the elephant tree *Bursera microphylla* (Bates 1992). It is a fairly common winter visitor in Baja California Sur but in the U.S. at that season it is rare. For example, in California wintering of the Gray Vireo is localized to one stand of *Bursera microphylla* (Unitt 2000).

The Gray Vireo also breeds in northern Baja California, but its status there has not yet been assessed. Birders' sightings back to the 1990s entered in www.eBird.org suggest a breeding population scattered widely across the region from at least the Sierra Juárez to the Sierra San Pedro Mártir, but they give little idea of its size or density. Lyman Belding was the first to report the Gray Vireo from northern Baja California, in the mid-1880s (Bryant 1889). Though he noted it at various places around the Sierra Juárez, the summary was "not many seen." In June 1927, Laurence Huey, May Canfield, and Sam Harter found the Gray Vireo common just west of Ojos Negros and collected 8 specimens now in the San Diego Natural History Museum (SDNHM; Huey

1928). Wilbur (1987) reported it common in the "piñon-chaparral areas of the Sierra Juárez" over two days in April 1979. The first specific records for the Sierra San Pedro Mártir are Wilbur's from two locations, Rancho San José or Meling at the west base of the mountains and Rancho El Parral on the southeast side. There are very few other published records for the Gray Vireo in Baja California during the breeding season.

The Gray Vireo's nesting habitat in southern California is primarily chaparral in which chamise (*Adenostoma fasciculatum*) is pervasive (Hargrove and Unitt 2017). South of the Sierra San Pedro Mártir, pinyon–juniper woodland and chamise-dominated chaparral extend south at higher elevations at least as far as the Sierra La Asamblea (~29.3° N). A team of botanists visited the Sierra La Asamblea in 2004 and reported 87 taxa of plants representing disjunct populations of more northern species, most of them typical of chaparral, including 38 new range extensions, among them chamise (Bullock et al. 2008). This is beyond the Gray Vireo's known breeding range, but the area is little explored by ornithologists. Even the middle elevations of the Sierra La Asamblea had not been visited by an ornithologist until June 2016 (Ruiz-Campos et al. 2018). Therefore, we hypothesized that these mountains could also reveal range extensions for chaparral birds, including the Gray Vireo.

Even farther south, in the Sierra San Francisco (27.59° N, 113.02° W), on 16 October 1997 Unitt collected two Gray Vireos of several seen (SDNHM 51125, UABC 1471). The Sierra San Francisco is within the Gray Vireo's known winter range, but both of these specimens were in heavy molt, one replacing flight feathers as well as body feathers. Voelker (2000) reported that the Gray Vireo molts only in its breeding range after breeding but before departure for the winter range. In our studies of the breeding biology of the Gray Vireo in San Diego County, we too saw the birds molting in the late summer before their departure in migration (Hargrove and Unitt 2017). Therefore we inferred that the Sierra San Francisco might support a nesting population or even be an area of year-round residency. The highest elevations of the Sierra San Francisco have a heavily grazed scrub that resembles chaparral in structure if not in species. In addition, there are stands of fairly large oaks, though many fewer than decades earlier (Francisco Arce pers. comm.).

Given this evidence, to better understand the Gray Vireo's status as a breeding bird in Baja California, in 2021 and 2022 we investigated these four mountain ranges: the Sierra Juárez, the Sierra San Pedro Mártir, the Sierra La Asamblea, and the Sierra San Francisco (Figure 1).

METHODS

Over the two years of our study, Hargrove, Unitt, Gaona-Melo, and Marrón completed four surveys, each approximately one week long (Table 1). In the Sierra San Francisco, we were also joined by Ruiz-Campos and Gonzalo de León-Girón. Except in the Sierra Juárez, mammalogists Scott Tremor, Jorge Valdez-Villavicensio, Aldo Guevara-Carrizales, Alan Harper, and/or Jonathan Alonso Villareal-Fletes were with us but worked independently. In each mountain range, we slowly drove or hiked on as many roads and trails as we could within accessible areas of chaparral and pinyon–juniper woodland, attempting to encompass the full elevational range of these habitats.

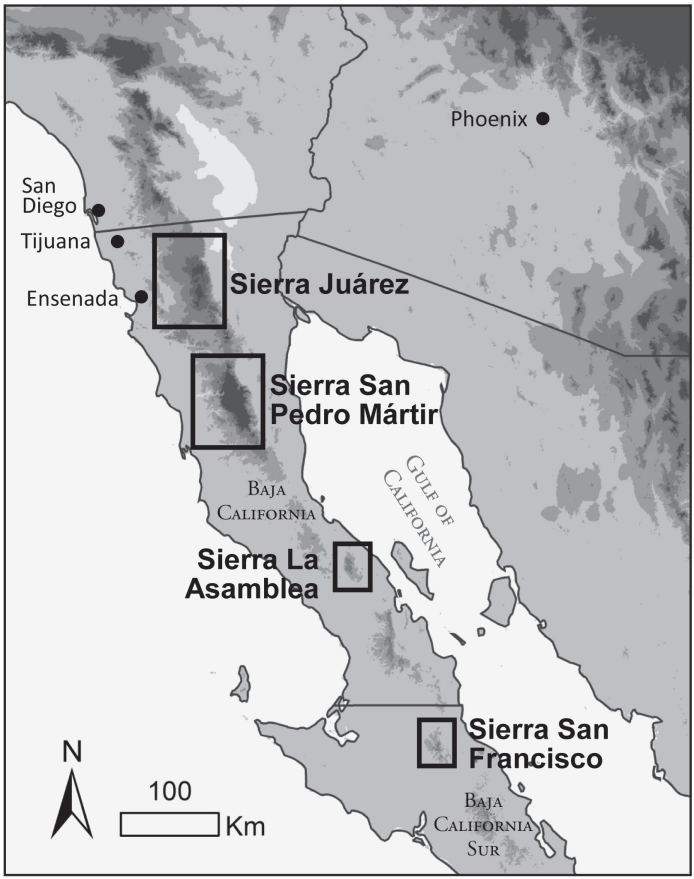

Figure 1. Peninsula of Baja California and locations of four mountain ranges targeted for Gray Vireo surveys, 2021–2022.

We most often worked in teams of two. Within each stretch of approximately 500 m where we did not detect a Gray Vireo, we broadcasted a recording of its song. Where Gray Vireos were detected, we observed the birds up to approximately 30 minutes to search for nesting, look for adjacent territories, and

Table 1 Dates and Elevation Ranges of Surveys for the Gray Vireo in Four Mountain Ranges of the Baja California Peninsula

Mountain range	Dates surveyed	Elevation range surveyed	Maximum peak
Sierra Juárez	1–5 Jun 2021	900–1740 m	1980 m
Sierra San Pedro Mártir	30 May–3 Jun 2022	420–2320 m	3096 m
Sierra La Asamblea	19–25 Apr 2021	950–1475 m	1661 m
Sierra San Francisco	3–9 Apr 2022	980–1530 m	1590 m

map approximate territory locations. We considered a singing bird or pair to represent one territory. In the Sierra La Asamblea and Sierra San Francisco, we also mist-netted birds generally, and in all areas we recorded all birds seen or heard (Appendix). We comment on the avifauna of the Sierra La Asamblea because it has been rarely visited by ornithologists.

Coverage areas were limited by accessibility as well as time. In the Sierra Juárez we spent 3 days in pinyon woodland mixed to varying degrees with chaparral to the east and north of Laguna Hanson and a day and a half in essentially treeless chaparral west and southwest of Laguna Hanson. Along multiple scattered sections of roads, our area of coverage extended from near the west base of the mountains 12 km east of Ojos Negros (31.92°, 116.14°) northeast to 2 km south of La Rumorosa (32.50° N, 116.06° W), thus 14 km south of the international border.

In the Sierra San Pedro Mártir we covered the west slope, walking the entire length of the road between the entrance to Parque Nacional Sierra de San Pedro Mártir and Rancho Meling, from elevation 2320 m down to 695 m, plus many side roads and trails. West of Rancho Meling, by intermittent spot checks, we covered the road north to Rancho El Coyote as well as the main road west down to an elevation of 420 m at 30.961° N, 115.853° W, below which the vegetation transitions from chaparral to desert scrub. Thus our survey of the Sierra San Pedro Mártir encompassed the entire elevational spread of chaparral, from that dominated by manzanita (*Arctostaphylos peninsularis*) and mixed with Jeffrey pine (*Pinus jeffreyi*) and other conifers at the upper end to patches of chamise amid open habitats at the lower end. In addition. on 5 April 2022 Gaona-Melo visited Rancho El Potrero (30.918° N, 115.644° W, elevation 900 m), 11 km southeast of Rancho Meling.

In the Sierra La Asamblea we mule-packed from the southeast base up to a campsite at 29.3008° N, 114.0702° W, elevation 1320 m, and spent a week in stands of chaparral and pinyon, hiking up to 1475 m and up to 6.75 km from the camp. With the time and resources available to us, however, we could not reach the largest stands of pinyons near the highest peak (1661 m), 7.5 km north of our base camp.

In the Sierra San Francisco, we spent 3 days on the north-facing slopes of the highest ridge, the Sierra Agua Verde, which overlooks the village of San Francisco de la Sierra to the north. We climbed practically to the summit at 27.5758° N, 113.0290° W, elevation ~1590 m, and also searched the mesa east of the summit. Over two additional days we also searched some lower canyons and in desert scrub both east and west of San Francisco de la Sierra.

We plotted on maps the approximate areas that were covered by our surveys, including the full extent over which we could reasonably expect to detect a singing bird. For each Gray Vireo territory, we plotted a territory centroid as the approximate average location where we observed a singing male or pair, and we estimated minimum territory density for each area by counting the number of territories found within the full extent of the area surveyed. As another index of density, we also calculated the mean nearest-neighbor distance between each plotted territory centroid. To coarsely extrapolate possible population sizes, we used two GIS layers, a digital elevation model with 1-km resolution (USGS 2018) and a habitat-classification model (INEGI 2018). The habitat model closely matched our observations, distinguishing

between chaparral and more open or disturbed areas at lower elevations, and the border between chaparral and coniferous woodland at higher elevations, but it did not distinguish between coniferous woodland dominated by pinyon vs. other pines. For each mountain range with Gray Vireo territories, we calculated the total area that was within both the elevation range and habitat types where we detected Gray Vireos.

RESULTS

We located a total of 139 Gray Vireos, representing at least 114 breeding territories, and confirmed 6 instances of nesting, described below for each mountain range. Breeding territories were found only in the two northernmost mountain ranges, the sierras Juárez and San Pedro Mártir, only within habitats classified as either chaparral or coniferous woodland, and between the elevations of 765 and 1685 m. This zone thus excluded lower-elevation chaparral and excluded the transition into coniferous woodland above the pinyon belt. Despite the Sierra San Pedro Mártir being a much higher mountain range as well as lying farther south, we found the Gray Vireo there in a zone of elevation substantially lower than in the Sierra Juárez (Figure 2). We

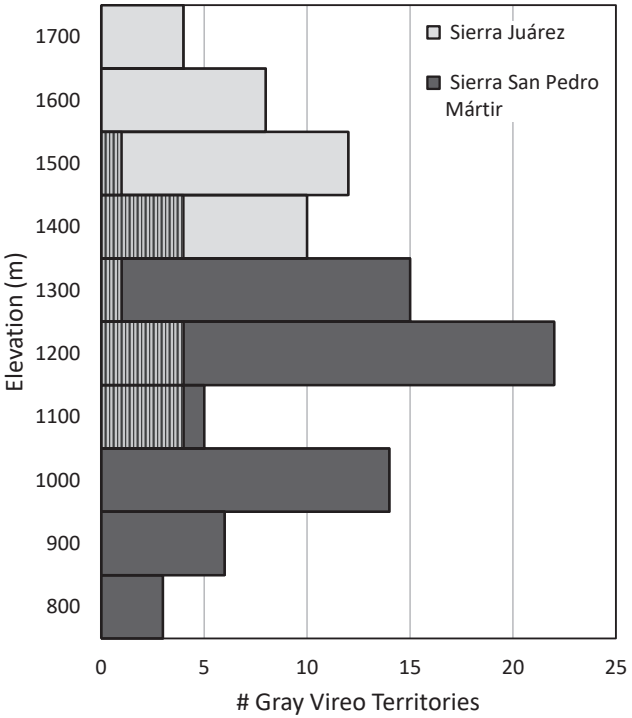

Figure 2. Elevational distribution of Gray Vireo territories at Sierra Juárez (2021) and Sierra San Pedro Mártir (2022). Striped bars indicate overlap.

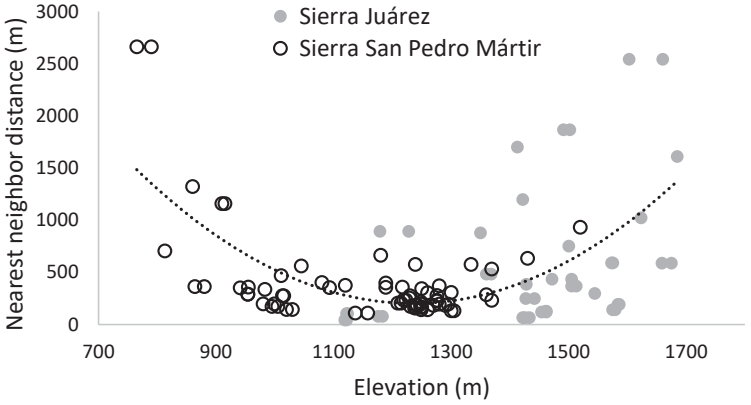

FIGURE 3. Nearest-neighbor distances of Gray Vireo territories in the Sierra Juárez (2021) and Sierra San Pedro Mártir (2022).

located >90% of territories by hearing spontaneous singing rather than by the bird's responding to play of a recording. The maximum nearest-neighbor distance was 2.7 km. On the basis of nearest-neighbor distance, territory density appeared greatest at middle elevations (Figure 3). The mean nearest-neighbor distance in the Sierra San Pedro Mártir (402 m ± 55 SE) was lower than in the Sierra Juárez (598 m ± 101 m SE), but by a t test the difference was of marginal significance ($t = 1.85$, df = 111, $p = 0.07$).

Sierra Juárez

We located 43 territories in disjunct patches between elevations 1120 and 1685 m (Figure 4). Three days in the extensive pinyons north and east of Laguna Hanson yielded 18 territories, whereas two days south and west of Laguna Hanson in treeless chaparral dominated by chamise and redshank (*A. sparsifolium*) yielded 25 territories. In the area where we found the densest population in treeless chaparral, we located at least 17 territories within 8 km^2 (Figure 5). From the digital elevation model and habitat mapping by INEGI (2018), between 1120 and 1685 m and within chaparral or coniferous woodland, we estimated that there are approximately 2500 km^2 of suitable habitat in the Sierra Juárez between latitudes 32.50° and 31.63° N. Of this we covered approximately 42 km^2 for an average minimum density of ~1 territory per square kilometer. Provided that the 2500 km^2 are occupied at the same average density, extrapolation suggests the number of territories in the Sierra Juárez is at least ~2000. We located three nests, one on 1 June with two eggs at height of ~1.1 m in a chamise (Figure 6), one on 3 June with three eggs at height of ~1.2 m in a pinyon, and one nearly complete but still under construction on 5 June at height of 1.8 m in a *Ceanothus perplexans*. The first nest was within a burned area that had regrown 6 years after a fire but just a few meters from mature chaparral, and the pair's territory encompassed both mature and regrowing chaparral.

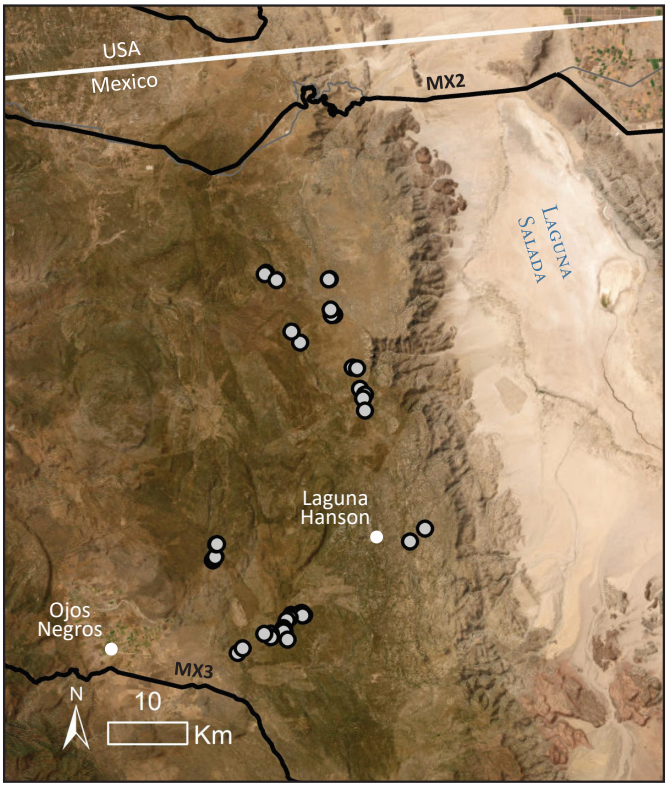

FIGURE 4. Locations of Gray Vireo territories, Sierra Juárez, 2021.

Sierra San Pedro Mártir

During our survey from 30 May to 3 June 2022, we located 70 territories over ~3.5 days at elevations from 765 to 1520 m (Figure 7), all in chaparral dominated by chamise and redshank, although a few territories also had pinyons. In addition, near Rancho El Potrero at 30.9523° N, 115.6597° W, elevation 1245 m, Gaona-Melo noted one additional Gray Vireo on 5 April 2022. Above 1520 m we spent ~1.5 days searching at elevations up to 2320 m at the forest edge, in both chamise-dominated chaparral and patches of chamise mixed with manzanita, yet in that zone we found not a single Gray Vireo. Below 1520 m the density increased abruptly. In one area of about 5 km^2 between 1200 and 1400 m elevation (Figure 8) we encountered 39 territories—a density between 4 and 5 times as great as the most we observed in the Sierra Juárez. We found Gray Vireos in small patches of chamise as low as 765 m, where the chaparral was becoming more dominated by the chaparral ash (*Fraxinus parryi*) and small-leaved rose (*Rosa minutifolia*). From the digital elevation model and habitat mapping by INEGI (2018), between

FIGURE 5. Habitat with greatest density of the Gray Vireo, dominated by chamise and redshank, Sierra Juárez, 2021.

Photo by Tonatiuh Gaona-Melo

FIGURE 6. Gray Vireo nest, Sierra Juárez, 1 June 2021.

Photo by Gerardo Marrón

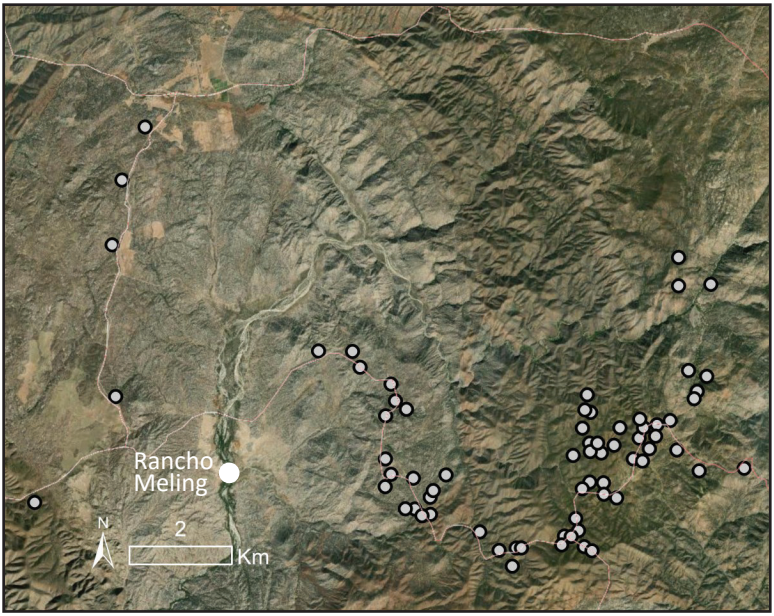

FIGURE 7. Locations of Gray Vireo territories, Sierra San Pedro Mártir, 2022.

FIGURE 8. Habitat with greatest density, dominated by chamise, Sierra San Pedro Mártir, 2022.

Photo by Tonatiuh Gaona-Melo

765 and 1520 m and within chaparral or coniferous woodland, we estimated that there are approximately 1500 km^2 of suitable habitat on the west slope of the Sierra San Pedro Mártir between latitudes 31.25° and 30.42° N. Of this we covered approximately 18 km^2 for an average minimum density of ~4 territories per square kilometer. Provided that 1500 km^2 are occupied at the same average density, extrapolation suggests the number of territories in the Sierra San Pedro Mártir is at least ~4000.

In the Sierra San Pedro Mártir our observations of reproductive activity were all on 1 June, of two pairs carrying nest material and one pair accompanied by three fledglings.

Sierra La Asamblea

Here we located no Gray Vireos. Even more disappointingly, we encountered no southward range extensions of any full species. Among birds the only possible range extension was the dark southern California/northern Baja California subspecies of the California Scrub-Jay, *Aphelocoma californica obscura*. The one specimen collected (UABC 2172), a one-year-old female, was in very worn plumage, but in the shade of gray on both the back and the flanks it matches specimens of *obscura* from northwestern Baja California more closely than the paler subspecies *A. c. hypoleuca* from the southern part of the peninsula. But in his description of *A. c. cactophila* from the central peninsula, Huey (1942) mentioned that it was slightly darker than *hypoleuca*, thus trending toward *obscura*, and this is borne out in the specimens on which *cactophila* was based, including six collected just ~12 km southwest of our specimen (SDNHM). The only other species seen that might have represented a southward extension of a breeding range was the Black-chinned Sparrow (*Spizella atrogularis*), but the birds seen (up to 10 per day) were not singing, and the one specimen collected, a female, was in nonbreeding condition. Indeed, the fauna of the higher elevations of the Sierra La Asamblea represented only a reduced subset of that widespread in central Baja California. For example, on the morning of 23 April 2021, around the summit of the peak at 29.300° N, 114.060° W, elevation 1460 m, and on the nearby pinyon-clad north-facing slope, almost the only birds noted were the Blue-gray Gnatcatcher (*Polioptila caerulea*) and Bewick's Wren (*Thryomanes bewickii*).

Sierra San Francisco

Our search of the higher elevations yielded no Gray Vireos. At lower elevations in scrub with the elephant tree *Bursera microphylla*, however, we located three individuals (Figure 9). On 8 April 2022 we collected one of these, and dissection confirmed it was a late winter visitor preparing to depart in spring migration: it was fat, and its testes were small (UABC 2210).

DISCUSSION

The abundance of the Gray Vireo that we found in the sierras Juárez and San Pedro Mártir of Baja California is strikingly greater than just across the border in southern Upper California. There, territory density had been estimated to range from 2 to 6 territories per km^2, but since 1997–2001 when the supporting data were recorded, the population has dropped substantially

FIGURE 9. Wintering Gray Vireo near San Francisco de la Sierra, 9 April 2022.

Photo by Gerardo Marrón

(Hargrove and Unitt 2014). Unitt (2004) estimated the population in all of San Diego County, 1997–2001, as "in the low hundreds," but by 2012–2013 it had declined or disappeared at many points where it was present 12–15 years earlier (Hargrove and Unitt 2017). Our surveys from 2008 to 2014 revealed no Gray Vireos at sites in the San Jacinto Mountains where Grinnell and Swarth (1913) found them fairly common in 1908, and only two in the Santa Rosa Mountains. In the sierras Juárez and San Pedro Mártir 2021–2022, we observed densities between 2 and 8 territories per km^2. These territories were patchily distributed, however, so at the scale of total suitable habitat covered, estimated minimum density was between 1 and 4 territories per km^2. Accessible areas surveyed represent only a small fraction of all similar habitat. If the densities observed in these two ranges can be extrapolated over the extent of similar habitat within them, we estimate the population of the Gray Vireo in Baja California to be over 10,000 individuals. We could see vast areas of similar habitat that we did not or could not reach. The Gray Vireo appears to be distributed patchily throughout its breeding range, absent from much apparently suitable habitat, but easily detectable over large distances (Schlossberg 2006). Thus care must be taken in any projection of the total population.

In the sierras Juárez and San Pedro Mártir as in San Diego County (Hargrove and Unitt 2017), the Gray Vireo occupies chaparral, often of uniform height and density, showing no evidence of a preference for pinyon-dominated habitat. In the Sierra San Pedro Mártir, though we found none at elevations above 1520 m, the Gray Vireo has been reported as high as 2500 m via eBird. Nevertheless, our results imply that the species strongly prefers the middle elevations where the two species of *Adenostoma* dominate. Unexpectedly, the Gray Vireo's elevation range appeared shifted to lower elevations in the Sierra San Pedro Mártir, despite those mountains being taller and farther south than the Sierra Juárez, and the population size and density also appeared greater.

Despite a peak population density at middle elevations, lower elevations near the Sierra Juárez might profitably be searched as well. The elevation of the site just west of Ojos Negros where Huey, Canfield, and Harter collected Gray Vireos in 1927 is 700 m (Huey 1928). On 9 May 2021, at 31.9267° N, 116.5432° W, at 600 m elevation in chaparral near a relict stand of knobcone pine (*Pinus attenuata*) on the Sierra de Ulloa, a ridge overlooking the city of Ensenada, Gaona-Melo audio-recorded one Gray Vireo. Therefore, we suggest that the hills between the Sierra de Ulloa and Ojos Negros as a priority for further surveys. The Gray Vireo's breeding range in Baja California could be even wider than the two ranges that make up the peninsula's northern backbone. Scattered reports to eBird suggest the distribution could be continuous between the Sierra Juárez and Sierra San Pedro Mártir, straddling Mexico Highway 3, from which a broader survey is also possible and desirable. We only surveyed the western slope of the Sierra San Pedro Mártir and did not include the eastern slope in our population estimate. But there is at least a narrow zone of potentially suitable habitat on the steeper eastern side, Wilbur's (1987) report from Rancho El Parral (30.488° N, 115.117° N) is on the east slope, and the southern limit of the breeding range remains uncertain.

Griffing Bancroft supposedly collected a set of Gray Vireo eggs near the coast, on a hillside at El Rosario (30.059° N, 115.725° W), on 19 April 1924 (Western Foundation of Vertebrate Zoology 73118). Only the data card for this set can now be found in the Western Foundation, however, and the card says the identification was by the eggs. Eggs of the Gray and Bell's (*V. bellii*) vireos are nearly identical (René Corado pers. comm.). F. L. Hancock supposedly collected a Gray Vireo at El Rosario, now in California State University, Long Beach, on 13 April 1954. Photos of the specimen (CSULB 938), however, kindly sent to us by Kelly Hood, show it to be a Bell's Vireo. More recently, birders have reported from El Rosario repeatedly without noting the Gray Vireo, though most of this attention has been in fall; visits in spring or summer have been few (https://ebird.org/barchart?r=L461031&yr=all&m=).

In spite of our negative result for the Gray Vireo in the Sierra La Asamblea, the northern part of this range, still unvisited by a vertebrate zoologist, merits study. This is likely to require an ascent by a route different from ours from the southeast, or transport by helicopter. The loose rubble covering much of the ground renders it treacherous even for mules, yet they were the means by which Bullock et al. (2008) accomplished their botanical survey of that area. Another isolated mountain range whose vertebrates are unsurveyed is the Sierra de la Libertad, which lies between the Sierra La Asamblea and Sierra San Francisco and reaches a maximum elevation of about 1805 m. The botanical survey of the Sierra de la Libertad (Wehncke et al. 2012) reached a maximum elevation of 1040 m, finding laurel sumac (*Malosma laurina*), holly-leaf cherry (*Prunus ilicifolia*), and shrub live oak (*Quercus turbinella*) but not chamise or redshank.

Migration and Molt

Around La Paz in Baja California Sur, Marrón has seen wintering Gray Vireos as late as 17 April, and reports via eBird extend as late as 29 April, so the 9 April date of our specimen from the Sierra San Francisco is not exceptional for a winter visitor. In 2022, after leaving the Sierra San Francisco, we

surveyed Rancho Ancón, ~25 km southeast of La Paz, from 11 to 14 April, still finding one or two Gray Vireos per day. The lack of reproductive behavior or physiology in the few Gray Vireos we encountered in the Sierra San Francisco in early April 2022 leads us to discount the idea that the Gray Vireo could be resident so far south. Instead, the two molting specimens collected in October 1997 demonstrate that at least some first-year birds molt after arrival in the winter range, a previously unknown aspect of the Gray Vireo's biology.

The migration of other species of vireos, the Warbling (*V. gilvus*) and Cassin's (*V. cassinii*), largely skirts the Gulf of California rather than crossing it. So we might expect the much shorter migration of the Gray Vireo to follow the same pattern. Birds breeding on the peninsula may be expected to migrate within it rather than crossing the gulf to mainland Mexico—a hypothesis to be tested.

Cross-Border Comparison

The inference that the invasion of the Brown-headed Cowbird (*Molothrus ater*) in the first half of the 1900s precipitated Upper California's population collapse seems inescapable (Unitt 2008). But in northern Baja California the vireo has undoubtedly been exposed to the cowbird for over a century—even Belding collected three cowbirds at the site of Rancho Meling from 16 April to 1 May in 1882 (specimens now in the U.S. National Museum of Natural History). In the Sierra San Pedro Mártir we saw a pair of Blue-gray Gnatcatchers with a fledgling cowbird. A difference between the two sides of the border in the incidence of cowbird parasitism is possible, but that factor alone probably does not account for the difference in the Gray Vireo's status. In northern Baja California, average annual rainfall decreases from north to south, and the greater aridity may disfavor the cowbird, even though cattle are pervasive.

Our study of the Gray Vireo's nest success in San Diego County in 2012 and 2013 revealed that in that area the leading cause of nest failure is predation of eggs by the California Scrub-Jay (Hargrove and Unitt 2017). Possibly, the decreasing prevalence of oaks with decreasing latitude in Baja California disfavors the Scrub Jay, decreasing the pressure on the Gray Vireo. Possibly different patterns of land use north of the border favor the jay by comparison with those south of the border.

In Mexico, the Gray Vireo may face different kinds of threats than it does in the U.S. In the best habitat in the Sierra San Pedro Mártir we found the chaparral criss-crossed by bulldozed trails, some made so recently that the leaves on the crushed shrubs were still green. Nevertheless, it is clear that the Gray Vireo is faring far better in Baja California than in Upper California. The factors responsible for the decline north of the border may be less onerous to the south, or possibly they have not been at work as long.

The two sides of the border differ in their pattern of wildfires, but the reasons for the difference have been much debated by fire ecologists (e.g., Minnich 1983, Keeley et al. 1999). The pattern of more frequent but smaller fires (patches or mosaics) in Baja California may be better for the Gray Vireo, even though it uses more mature chaparral. During our surveys of the sierras Juárez and San Pedro Mártir we saw ample areas where large fires had burned in Gray Vireo habitat. In our study in San Diego County (Hargrove and Unitt 2018) we found the Gray Vireo's response to fire to be negative,

but our sample size was very low. The Gray Vireo's fire ecology needs further study, as does how postfire recovery of chaparral may differ on either side of the border. Our finding a nest in the Sierra Juárez in a chamise that reached a height of at least 1.5 m just 6 years after a fire suggests the Gray Vireo may tolerate fire if it does not lead to habitat conversion.

The history of the Gray Vireo's population in Baja California is unknowable, and its current trend is unclear. But our survey of the southwestern extremity of the species' breeding range revealed a population much larger than expected. Thus despite Baja California representing only a small part of the Gray Vireo's spatial breeding range, it contributes disproportionately to the species' population and therefore conservation. Any understanding of the species' biology will be incomplete without consideration of its biology in the sierras Juárez and San Pedro Mártir. Furthermore, the importance of these mountain ranges to the Gray Vireo's demography heightens the importance of the peninsula in context of the winter range as well.

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APPENDIX. List of all bird species detected at four mountain ranges in the Baja California Peninsula (SJ, Sierra Juárez; SSPM, Sierra San Pedro Mártir; SLA, Sierra La Asamblea; SSF, Sierra San Francisco). Numbers indicate maximum seen per day per biologist.

English name	Species	SJ	SSPM	SLA	SSF
Mallard	*Anas platyrhynchos*	74			
Mountain Quail	*Oreortyx pictus*	6	56		
California Quail	*Callipepla californica*	39	31	245[a]	20
Least Grebe	*Tachybaptus dominicus*				1[a, b]
Rock Pigeon	*Columba livia*	1			
Eurasian Collared Dove	*Streptopelia decaocto*	1			
Common Ground-Dove	*Columbina passerina*			2	
White-winged Dove	*Zenaida asiatica*			24	20
Mourning Dove	*Zenaida macroura*	17	6	2	20
Greater Roadrunner	*Geococcyx californianus*	1	1	1	
Common Poorwill	*Phalaenoptilus nuttallii*	1		1	1
White-throated Swift	*Aeronautes saxatalis*	8	5	4	8
Anna's Hummingbird	*Calypte anna*	3	5		3
Costa's Hummingbird	*Calypte costae*	10	10	3	15
Xantus's Hummingbird	*Basilinna xantusii*				6
Rufous Hummingbird	*Selasphorus rufus*			1[a]	
Killdeer	*Charadrius vociferus*	3			
Great Egret	*Ardea alba*	1			
Green Heron	*Butorides virescens*	1			
California Condor	*Gymnogyps californianus*		1		
Turkey Vulture	*Cathartes aura*	5	5	12	11
Northern Harrier	*Circus hudsonius*				1
Cooper's Hawk	*Accipiter cooperii*	1	1	1	1
Zone-tailed Hawk	*Buteo albonotatus*		3	2	1
Red-tailed Hawk	*Buteo jamaicensis*	3	4	4	2
Barn Owl	*Tyto alba*	1			
Western Screech-Owl	*Megascops kennicottii*	1		1	
Great Horned Owl	*Bubo virginianus*	1	1	2	1
Northern Saw-whet Owl	*Aegolius acadicus*		2		
Acorn Woodpecker	*Melanerpes formicivorus*	5	2		
Gila Woodpecker	*Melanerpes uropygialis*				6[a]
Williamson's Sapsucker	*Sphyrapicus thryroideus*		1		
Nuttall's Woodpecker	*Dryobates nuttallii*	2	2		
Ladder-backed Woodpecker	*Dryobates scalaris*	2	1	4	4
Hairy Woodpecker	*Dryobates villosus*	4	3		
Northern Flicker	*Colaptes auratus*	5	5		
Gilded Flicker	*Colaptes chrysoides*			3	
American Kestrel	*Falco sparverius*	1		1	
Peregrine Falcon	*Falco peregrinus*	1			
Prairie Falcon	*Falco mexicanus*		1		
Ash-throated Flycatcher	*Myiarchus cinerascens*	12	11	8[a]	17
Western Kingbird	*Tyrannus verticalis*	6	2		
Olive-sided Flycatcher	*Contopus cooperi*	2	2		
Western Wood-Pewee	*Contopus sordidulus*	3	7		
Gray Flycatcher	*Empidonax wrightii*				2
Western Flycatcher	*Empidonax difficilis*	4	8	5[a]	4
Black Phoebe	*Sayornis nigricans*	1			2

(*continued*)

English name	Species	SJ	SSPM	SLA	SSF
Say's Phoebe	*Sayornis saya*	1	2	1	
Gray Vireo	*Vireo vicinior*	17	32		3[a]
Hutton's Vireo	*Vireo huttoni*	3	3		
Cassin's Vireo	*Vireo cassinii*		2	1[a]	1
Warbling Vireo	*Vireo gilvus*		4	3[a]	1
Loggerhead Shrike	*Lanius ludovicianus*		2	2	
Pinyon Jay	*Gymnorhinus cyanocephalus*	46	6		
California Scrub-Jay	*Aphelocoma californica*	19	10	6[a]	
Common Raven	*Corvus corax*	5	4	3	2
Verdin	*Auriparus flaviceps*	2		3	25
Mountain Chickadee	*Poecile gambeli*	11	16		
Oak Titmouse	*Baeolophus inornatus*	8	8		
Horned Lark	*Eremophila alpestris*	9	8		
Violet-green Swallow	*Tachycineta thalassina*	8	16	3	
N. Rough-winged Swallow	*Stelgidopteryx serripennis*				1
Purple Martin	*Progne subis*	5	2		
Cliff Swallow	*Petrochelidon pyrrhonota*	14			
Bushtit	*Psaltriparus minimus*	38	38		
Wrentit	*Chamaea fasciata*	7	27		
Ruby-crowned Kinglet	*Corthylio calendula*			3	1
Phainopepla	*Phainopepla nitens*	2	13	4	16
White-breasted Nuthatch	*Sitta carolinensis*	2	2		
Pygmy Nuthatch	*Sitta pygmaea*	9	20		
Blue-gray Gnatcatcher	*Polioptila caerulea*	5	25	16	30[a]
California Gnatcatcher	*Polioptila californica*		3	5	2
Rock Wren	*Salpinctes obsoletus*	4	7	2[a]	2
Canyon Wren	*Catherpes mexicanus*	1	1	1	3
Cactus Wren	*Campylorhynchus brunneicapillus*	1	1	7[a]	10
Bewick's Wren	*Thryomanes bewickii*	14	12	10	2
House Wren	*Troglodytes aedon*	3	11	2	
Gray Thrasher	*Toxostoma cinereum*			5	4
California Thrasher	*Toxostoma redivivum*	4	5		
Northern Mockingbird	*Mimus polyglottos*		1	3	3
European Starling	*Sturnus vulgaris*	11			
Western Bluebird	*Sialia mexicana*	30	12		
Hermit Thrush	*Catharus guttatus*			2[a]	2
American Robin	*Turdus migratorius*	6			
House Sparrow	*Passer domesticus*	3			8
House Finch	*Haemorhous mexicanus*	40	16	5[a]	13[a]
Cassin's Finch	*Haemorhous cassinii*		3		
Red Crossbill	*Loxia curvirostra*		2		
Pine Siskin	*Spinus pinus*	1	5		
Lesser Goldfinch	*Spinus psaltria*	3	16	5	6
Lawrence's Goldfinch	*Spinus lawrencei*	3	6		
Black-throated Sparrow	*Amphispiza bilineata*	4	3	22[a]	17
Lark Sparrow	*Chondestes grammacus*	1			
Chipping Sparrow	*Spizella passerina*			3	8
Black-chinned Sparrow	*Spizella atrogularis*	14	6	6[a]	1
Brewer's Sparrow	*Spizella breweri*			8	6

(*continued*)

APPENDIX (*continued*).

English name	Species	SJ	SSPM	SLA	SSF
Fox Sparrow	*Passerella iliaca*		3		
Dark-eyed Junco	*Junco hyemalis*	5	10		3
White-crowned Sparrow	*Zonotrichia leucophrys*			7[a]	40
Bell's Sparrow	*Artemisiospiza belli*	9	6		
Lincoln's Sparrow	*Melospiza lincolnii*			1	
California Towhee	*Melozone crissalis*	4	13	10	21
Rufous-crowned Sparrow	*Aimophila ruficeps*		7		5[a]
Green-tailed Towhee	*Pipilo chlorurus*			7[a]	
Spotted Towhee	*Pipilo maculatus*	10	21		
Western Meadowlark	*Sturnella neglecta*		1		
Hooded Oriole	*Icterus cucullatus*		2	8[a]	15[a]
Bullock's Oriole	*Icterus bullockii*	2			
Scott's Oriole	*Icterus parisorum*	4	9	5	3
Red-winged Blackbird	*Agelaius phoeniceus*	10			
Brown-headed Cowbird	*Molothrus ater*	2	2		
Brewer's Blackbird	*Euphagus cyanocephalus*	10			
Black-and-white Warbler	*Mniotilta varia*				1
Orange-crowned Warbler	*Leiothlypis celata*			5	1
Yellow Warbler	*Setophaga petechia*	1	1		
Yellow-rumped Warbler	*Setophaga coronata*			1	2
Black-throated Gray Warbler	*Setophaga nigrescens*	7	8	1[a]	4[a]
Townsend's Warbler	*Setophaga townsendi*			2[a]	1
Hermit Warbler	*Setophaga occidentalis*			2[a]	
Wilson's Warbler	*Cardellina pusilla*			6[a]	
Western Tanager	*Piranga ludoviciana*			1	
Northern Cardinal	*Cardinalis cardinalis*				5
Pyrrhuloxia	*Cardinalis sinuatus*				1
Black-headed Grosbeak	*Pheucticus melanocephalus*	5	12	3	1
Lazuli Bunting	*Passerina amoena*			1	

[a]Specimen(s) collected, deposited at the Universidad Autónoma de Baja California, Ensenada.

[b]See Ruiz-Campos et al. (2023) for details.