Section 6 (Texas Traditional) Report Review

Attachment to letter dated: JAN 12 2007

Project Title: Ecology, Habitat Use, Threats, & Geographic Distribution of the Black-capped Vireo (*Vireo atricapilla*) on the Winter Range

Final or Interim Report? FINAL

Grant #: E-33

Reviewer Station: Arlington ESFO

Lead station was contacted and concurs with the following comments:
__Yes __No _X_ Not applicable (reviewer is from lead station)

Interim Report (check one):	**Final Report (check one):**
__ is acceptable as is	___ is acceptable as is
__ is acceptable as is, but comments below need to be addressed in the next report	___ is acceptable, but needs minor revision (see comments below)
__ needs revision (see comments below)	_X_ needs major revision (see comments below)

Comments:

Overall, the report is well written and presents a clear understanding of the results of the study. We look forward to the inclusion of the comments below and the stable isotope analysis in the next version.

- While the report notes the major habitat types used by vireos on the winter range (thorn forest, cloud forest, etc.), we would appreciate a more detailed description of the habitats used by vireos. For example, a table that includes all of the information collected from the vegetation plots at sites where black-capped vireos were located.
- Please include a detailed map of the black-capped vireo locations within the study area.
- If collected, we would appreciate general descriptions of the conditions of the habitat at surveyed sites (even if anecdotal), with respect to habitat fragmentation and/or patchiness.
- The Approach section states that the report addresses threats of predation and competition. However, we can find no further mention of these threats in the Results section of the report.
- According to the original proposal for this project, satellite imagery was to "be used to assess threats to habitat at the landscape scale." Was this portion of the study completed? If so, please submit the information in the next version.

FINAL REPORT

As Required by

THE ENDANGERED SPECIES PROGRAM

TEXAS

Grant No. E-33

Endangered and Threatened Species Conservation

Ecology, Habitat Use, Threats and Geographic Distribution of Black-capped Vireo (*Vireo atricapillus)* in Winter Range

Prepared by: Robert Powell and R. Douglas Slack

Robert Cook
Executive Director

Matt Wagner
Program Director, Wildlife Diversity

Mike Berger
Division Director, Wildlife

19 September 2006

FINAL REPORT

State: Texas **Grant Number:** E-33

Grant Title: Ecology, Habitat Use, Threats and Geographic Distribution of Black-capped Vireo (*Vireo atricapillus)* in the Winter Range

Reporting Period: September 1, 2002 through August 31, 2006

Grant Objectives:

1) To describe the geographic distribution and habitat use of Black-capped Vireos in the Western/Central states of Mexico.
2) Determine guild structure and flock composition of species of birds associated with foraging Black-capped Vireos.
3) Identify threats to local wintering populations including habitat loss, urbanization, competition, predation, and direct human induced mortality.
4) Initiate studies of the linkages between populations on the wintering grounds with those in breeding areas.

Accomplishments:

See Attachment A.

Significant Deviations:

- Task 4, stable isotope investigation of linkage between wintering grounds and breeding grounds, has been hampered by delays in analyzing samples. Principal investigator pledges to provide results of analyses when they become available (see Attachment A, p. 19, "Significant Deviations").

Location:

Mexican States of Jalisco, Oaxaca, Nayarit, Sinaloa, and Colima.

Cost: Financiao Status Report was not available at time of report.

Prepared by: Craig Farquhar **Date:** September 19, 2006

Approved by: Neil E. Carter **Date:** November 14, 2006
Federal Aid Coordinator

ATTACHMENT A

See Adobe Acrobat .pdf file, titled ‘Attachment_A_E33.’

Ecology, Habitat Use, Threats, & Geographic Distribution of the Black-capped Vireo (*Vireo atricapilla*) on the Winter Range

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Section 6 Grant No. E-33
Final Report

Interagency Cooperation Contract No. 111166

31 August 2006

Principal Investigators:
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Overview

The purpose of this Final Report is to provide results from field investigations conducted during the winters of 2002/2003 and 2003/2004 concerning the wintering ecology of the black-capped vireo (*Vireo atricapilla;* BCVI) in the western states of Mexico. While in Mexico, intensive surveying for BCVI and habitat sampling were conducted and mist nets were utilized to capture individual BCVI for use in stable isotope analyses. This report is an overview of the efforts that were undertaken during that time span and since.

Introduction

The BCVI is a migratory songbird known to breed in isolated areas of Oklahoma and portions of central and southwestern Texas and Coahuila, Nuevo Leon, and Tamaulipas states in Mexico (Wilkins et al. 2006). This species was federally listed as Endangered in 1987, due primarily to threats on the breeding range, including habitat loss from development, habitat loss due to grazing, and nest parasitism by brown-headed cowbirds (*Molothrus ater*) (Ratzlaff 1987). In its breeding range, the natural history, habitat use, and population biology of the BCVI has received considerable attention (Graber 1961, Marshall et al. 1985, U.S. Fish and Wildlife Service 1991, Grzybowski 1995, Wilkins et al. 2006).

Much less is known about this species in its non-breeding (winter) range, and this knowledge gap is cited as one of the top research priorities in both the Black-capped Vireo Recovery Plan (U.S. Fish and Wildlife Service 1991) and the Black-capped Vireo Population and Habitat Viability Assessment Report (U.S. Fish and Wildlife Service 1996). The known geographic extent of the non-breeding range consists of an elongated and patchily distributed area along the Pacific slopes of Mexico's Sierra Madre

Occidental. Across much of this winter range, location records are sparse, but Mexican states containing areas of documented occurrence (from North to South) include Sonora, Sinaloa, Durango, Nayarit, Jalisco, Colima, Michoacan, Guerrero, and Oaxaca (Graber 1957, Graber 1961, Marshall et al. 1985, Binford 1989, Hutto 1992, Howell and Webb 1995, Russell and Morrison 1996, Howell 1999).

Portions of the BCVIs winter range (parts of Nayarit and Sinaloa states) have been investigated to a limited extent during two previous visits (Graber 1957, Marshall et al. 1985). Graber (1957, 1961) found BCVIs using both arid scrub in southern Sinaloa and mesic secondary growth in coastal Nayarit, while Marshall et al. (1985) only found vireos in the higher, more arid thorn forest slopes. These previous studies were primarily qualitative in nature and limited in scope, duration, and geographic coverage. Nevertheless, they suggest that some geographic variation may occur in habitat use on the wintering grounds, which is not surprising considering that geographic variation in BCVI habitat use has also been documented on the breeding grounds (Grzybowski et al.1994). Quantitative research of habitat use and vegetative characteristics will be valuable in understanding how BCVIs select habitat during the nonbreeding season.

The majority of the non-breeding records are concentrated in Sinaloa and Nayarit and this has been described as the center of the wintering grounds (Graber 1961). However, Sinaloa and Nayarit were the states most heavily surveyed during previous studies, so it is premature to assume they represent the true heart of the winter range. More efforts at finding BCVIs in other portions of the described wintering range are necessary before making such a claim.

While understanding the wintering distribution of the BCVI is important, it is equally important to begin to examine the relationship between wintering sites and breeding locations. In order to understand how the biology of a species is influenced by

the interactions of events on both the breeding and nonbreeding grounds, it is necessary to track populations or individuals between different phases of the life cycle. A promising approach that avoids many of the drawbacks of conventional tracking techniques involves stable isotope analysis of bird feathers (Hobson and Wassenaar 1999). Stable isotope signatures in animal tissues reflect those of local food webs, which in turn can vary spatially based on several biogeochemical processes, including temperature gradients, altitude, season, and distance inland from the coast (e.g., Peterson and Fry 1987, Tieszen and Boutton 1988). For example, stable hydrogen (H) isotope ratios in precipitation show a latitudinal gradient in North America that is reflected in plants and subsequently animals that consume the plants (Hobson 1999, Meehan et al. 2004). Therefore, linkages between deuterium (δD, an isotope of H) levels in local food webs and those in animals that feed at the same locations can be used to track migratory animals.

Many species of migratory songbirds grow feathers on or close to their breeding grounds before fall migration. Feathers are metabolically inert and so maintain an isotopic record reflecting the location where the tissue was synthesized (Mizutani et al. 1990). Therefore, a feather collected on the wintering grounds would reflect the isotopic record during the previous breeding season (period of growth), allowing researchers to effectively link these two areas (e.g., Hobson and Clark 1992, Chamberlain et al. 1997, Hobson and Wassenaar 1997, Wassenaar and Hobson 2000, Hobson et al. 2001, Hobson and Wassenaar 2001, Rubinstein et al. 2002). Caution has been urged with interpretation of stable isotopic patterns because altitude and distance from the coast may sometimes confound the results (Ziegler 1988, Graves et al. 2002), but research in western Mexico found that continental and altitudinal effects were not large enough to obscure the latitudinal pattern (Kelly et al. 2002).

While hydrogen can provide a good indicator of latitude, other isotopes, such as those of carbon and nitrogen, can provide further resolution to regions of occurrence along these bands of latitude (Hobson 1999, Hobson et al. 1999). Plants differ in their isotopic signatures due to differences in photosynthetic pathway (e.g., C_3 vs. C_4 plants), nitrogen fixation process, soil moisture condition, and exposure to nitrogen fertilizers (Rundel et al. 1989, Alisauskas and Hobson 1993). Carbon ($\delta^{13}C$ relative to ($\delta^{12}C$) isotope values have shown a southwest to northeast gradient in North America and their values decrease with increasing latitude and altitude, reflecting the combined effect of changing temperature and pressure (Stuiver and Braziunas 1987, Korner et al. 1991, Hobson et al. 1999). Nitrogen ($\delta^{15}N$ relative to $\delta^{14}N$) isotope ratios should reveal similar patterns, and when combined with $\delta^{13}C$, should be able to reveal patterns to a greater extent than that afforded by just one ratio alone (Hobson 1991, Hobson 1993, Thompson and Furness 1995).

Other aspects of wintering ecology of the black-capped vireo that are missing from the scientific literature include information on threats, interspecific associations with other birds, space use, and food resource use and partitioning among congenerics. The identification of threats to habitat availability, such as continued clearing of shrubland for agricultural purposes, has important implications for the conservation of the species. An examination of interspecific associations with other birds while roosting or foraging (e.g., mixed species flocks) can be helpful in understanding habitat selection and can possibly serve as a predictive tool for wintering habitat selection (i.e., Mikusinski et al. 2001). Space use, including territorial defense or aggregations with other birds in mixed species flocks, can also play an important role in terms of habitat selection because competition is involved.

Objectives

Overall goals for this project are to (1) describe the geographic distribution and habitat use of BCVI's in the western states of Mexico; (2) determine guild structure and flock composition of species of birds associated with foraging BCVI's; (3) identify threats to local wintering populations; (4) initiate studies of the linkages between populations on the wintering grounds with those in breeding areas. Specific objectives include: locating contemporary wintering ground locations for BCVI's; recording age, sex, geographic coordinates and altitude for vireo locations; recording vegetative and habitat features, as well as ecological and behavioral features at vireo locations; and to conduct stable isotope analysis of bird feathers collected on the wintering grounds.

Study Area

Much of the region in which BCVIs can be found in the nonbreeding season can be classified into one of four major habitat types: tropical deciduous forest, thornforest, cloud forest, or pine-oak-fir forest (Rzedowski 1983, Hutto 1992). Geographically, these habitats extend from the northwestern state of Sonora down through the southern state of Oaxaca and form a narrow strip between the Pacific coast and the peaks of the Sierra Madre Occidental. Site visits, avian surveys and habitat sampling were conducted in the states of Sinaloa, Durango, Nayarit, Jalisco, Colima, Michoacan, Guerrero, and Oaxaca during the winter months (November-March) for two consecutive years (2002-2003 and 2003-2004).

Approach

(1) Distribution and Habitat Use

Global Positioning System (GPS) units were used to record exact coordinates and elevation of initial observations of all BCVIs by age and sex. Age and sex were

determined (to the extent that it is possible) based on molt patterns, skull pneumaticization, and plumage (Pyle 1997).

At sites where BCVIs were located, habitat variables were measured within an 11.3m radius plot (0.04 ha) centered around each vireo location, at 3 microhabitat locations (each centered 35m from the vireo point and 120 degrees from each other), and at 3 random locations along the survey transect at each vireo site. Vegetation sampling procedures were modified from the BBIRD protocol (Martin et al. 1997), which itself is a modification of the James and Shugart (1970) method and involves habitat measurements taken at both 5m and 11.3m radius circular plots. Variables measured included aspect, slope, visual obscurity, canopy cover, ground cover, number of tree species within plot, shrub density, mean tree diameter at breast height (DBH), mean tree distance, tree density, and mean tree height within the plot.

Winter habitat use was evaluated using a logistic regression model by comparing local habitat characteristics at BCVI plots against random plots. Prior to model building, all model variables were evaluated using univariate logistic regression. Variables with a $P \leq 0.25$ were entered into an initial multivariate logistic model (Hosmer and Lemeshow 2000). Highly correlated (>0.5) variables were eliminated and the final model was then run and evaluated using best subsets from Akaike's information criterion (AIC; Burnham and Anderson 1998).

(2) Guild structure and flock composition

We attempted to assess the associations between BCVIs and multispecific flocks with bird censuses conducted using a fixed-radius point count method that was developed in western Mexico for across-habitat comparisons (Hutto et al. 1986). The intent was to identify flock members to species and quantitatively assess flock activities and composition. We also tried to assess foraging behaviors (Remsen and Robinson 1990) of

BCVIs, determine whether they foraged individually or with associated flock members, and assess evidence of competition or territoriality.

(3) Threats to wintering populations

We addressed threats to habitat and survivorship of overwintering black-capped vireos based on observations conducted along the geographic transect. Data includes extent of human habitat alteration (clearing, fragmentation, urbanization, agriculture, roadways, etc.) and their proximity to observed vireos, as well as the threats of predation, competition, or direct human induced mortality.

(4) Linkages between breeding and wintering populations

All feathers collected in the field will be analyzed at the Colorado Plateau Stable Isotope Laboratory (CPSIL) in Flagstaff, Arizona. In addition to the feathers we collected personally, we have obtained wintering season vireo feathers from museum collections to increase the overall sample size and geographic coverage of our analysis. In addition to feathers collected from the wintering grounds, we also obtained BCVI feathers from across a geographic gradient of the breeding range (including the Wichita Mountains in Oklahoma, Fort Hood in central Texas, and sites in Coahuila, Mexico) that will be analyzed for comparisons of isotopic ratios between breeding season feathers and nonbreeding season feathers.

Prior to isotopic analysis, all feathers were gently cleaned of any surface contamination using a detergent solution and soaked in a 2:1 chloroform/methanol mixture to remove lipids (Hobson and Welch 1992), and then dried in an oven at approximately 50º C for 48 hours. Segments were clipped from the vanes of each feather near the tip, encapsulated in either silver (δD isotopes) or tin ($\delta^{13}C$ and $\delta^{15}N$ isotopes) capsules, and then weighed (approximately 0.35 mg for δD and 0.90 mg for $\delta^{13}C$ /$\delta^{15}N$) to the nearest ± 0.001 mg. The CPSIL will then analyze all samples via high-

temperature pyrolysis using Finnegan Delta continuous flow isotope mass spectrometers that have been calibrated for specific isotopes (R. Doucett, pers. comm.). We will develop a least squares regression model that predicts breeding latitude (breeding origins) of wintering vireos based on mean δD, $\delta^{13}C$ and $\delta^{15}N$ values in their feathers.

Results

(1) General Results

Field surveys were conducted between the dates of 5 February 2003 and 10 April 2003 and between 7 December 2003 and 19 March 2004. A total of 1,017 person-hours were spent surveying for BCVI in winter 2002/2003 and a total of 1,297 person-hours in winter 2003/2004. Surveys were conducted at a total of 41 sites, 24 of which were visited during winter 2002/2003 and 36 of which were visited in 2003/2004. These 41 sites included 9 sites in the state of Sinaloa, 1 in Durango and Sinaloa, 7 in Nayarit, 5 in Jalisco, 6 in Colima, 2 in Michoacan, 4 in Guerrero, and 7 in Oaxaca (see Table 3 for a list of sites). The inconsistent number of survey sites in each state reflects our ability to find sites suitable for surveying in many areas.

(2) Distribution and Habitat Use

A total of 63 BCVI (n=13 in 2002/2003 and n=50 in 2003/2004) were identified on the wintering grounds in Mexico during the two years of investigation (Tables 1 and 2). The distribution of these individual birds included 1 in Durango, 20 in Sinaloa, 28 in Nayarit, 2 in Jalisco, 12 in Colima, and none from Michoacan, Guerrero, or Oaxaca. These included 35 male birds, 16 females, and 12 for which sex determination was difficult (may have been females, but could have been young males). While age and sex could not be adequately determined for some of these birds, from the perspective of looking at sexual segregation, it is useful to lump the females and the unknowns together

to compare their distribution against that of the adult males. In doing so, for the northern 3 states (Durango, Sinaloa, Nayarit), 63% (31 of 49) of the birds were identified as adult males, while for the 2 more southern states (Jalisco and Colima), only 29% (4 of 14) were adult males. The mean elevation for all BCVI was 627m (2,057 ft) and elevation ranged from sea level to 1,462m (4,797 ft).

Based on logistic regression analyses, BCVI winter habitat use was best predicted by lower values of canopy cover, and by higher slopes and shrub density (Figure 1). The model correctly predicted 87.6% of the data with a pseudo (Nagelkerke) r^2 of 0.66, and a -2 log likelihood of 74.27 (Hosmer-Lemeshow goodness of fit test, $\chi^2 = 19.05$, $df = 7$, $P = 0.008$; likelihood ratio $\chi^2 = 90.80$, $df = 7$, $P < 0.001$).

(3) Guild structure and flock composition

Several logistical difficulties made it difficult to address associations of BCVIs with flocks, document foraging behavior, or determine guild structure. First, no BCVIs were ever found using the point-count method. Black-capped vireos are difficult to locate on the wintering grounds due to their quiet, secretive behavior and use of shrubby substrates where many other species are being more vocal. For similar reasons, it was extremely difficult, once a BCVI had been located, to follow the bird for more than a few seconds before losing sight of the bird. This complicated all attempts to document foraging behavior, determine guild structure, or assess associations within a flock.

After initiation of this project, we realized that these types of objectives would be best achieved in a study that focuses on one, or a small number, of permanent field sites, where more long-term focus on select individuals could be made. Unfortunately, that type of approach conflicted with other objectives of this study that required travel between multiple field sites across a large geographic area, such as the stable isotope work and determination of geographic range. We chose to focus on the use of multiple

sites, which meant that each site was visited for short durations and we therefore were unable to acquire useful data on guild structure and flock composition.

With that said, we did try to assess whether or not BCVI were foraging in the presence or absence of flocks. Out of 72 observed BCVI over 3 years of study (including a pilot season), 13 (18%) BCVIs were found foraging solitarily, 15 (21%) were foraging within a flock, and the remaining 44 (61%) we could not adequately determine. In the latter cases, they appeared to be foraging alone although there were other birds foraging nearby as well. It was just too difficult to assess the nature of the relationship between the activities of the BCVI and the other birds, primarily because of our inability to follow the movements of the BCVI for long enough time intervals. Furthermore, it is quite possible that the BCVI that appeared to be in a flock (n=15) were actually foraging alone while a flock happened to be passing through the area. As we have said above, finding an answer to this question would require much more time at a limited number of sites than what we were able to afford because of our other responsibilities. Foraging behavior of wintering BCVI was characterized as secretive, quiet, and not very social. For this reason, it is our belief that in most cases, BCVI were likely foraging solitarily with little affinity for flocks, although this is only conjecture.

When they were seen foraging in what appeared to be a flock, BCVI were found in flocks composed of anywhere between 3 and 14 other species. The 3 species most commonly associated with flocks in which BCVI were present were the warbling vireo (*Vireo gilvus*), which was present 53% (n=8) of the time, and the blue-gray gnatcatcher (*Polioptila caerulea*) and Nashville warbler (*Vermivora ruficapilla*), both of which were present 47% (n=7) of the time. Other commonly occurring flock associates included the hooded oriole (*Icterus cucullatus*), which was present 33% (n=5) of the time, the plumbeous vireo (*Vireo plumbeous*), golden vireo (*Vireo hypochryseus*), black-throated

grey warbler (*Dendroica nigrescens*), and varied bunting (*Passerina versicolor*), all of which were present 27% of the time (n=4), and the squirrel cuckoo (*Piaya cayana*), broad-billed hummingbird (*Cyanthus latirostris*), Bell's vireo (*Vireo bellii*), blue mockingbird (*Melanotis caerulescens*), Wilson's warbler (*Wilsonia pusilla*), streak-backed oriole (*Icterus pustulatus*), and rusty-crowned ground sparrow (*Melozone kieneri*), all of which were present 20% of the time (n=3).

Other flock associates infrequently identified as present included the West Mexican chachalaca (*Ortalis poliocephala*), mourning dove (*Zenaida macroura*), cinnamon hummingbird (*Amazilia rutila*), black-chinned hummingbird (*Archilochus alexandri*), golden-cheeked woodpecker (*Centurus chrysogenys*), northern beardless tyrannulet (*Camptostoma imberbe*), western flycatcher (*Empidonax difficilis*), dusky-capped flycatcher (*Myiarchus tuberculifer*), thick-billed kingbird (*Tyrannus crassirostris*), masked tityra (*Tityra semifasciata*), dwarf vireo (*Vireo nelsoni*), Cassin's vireo (*Vireo cassinii*), red-eyed vireo (*Vireo olivaceus*), black-throated magpie-jay (*Calocitta colliei*), Sinaloa wren (*Thryothorus sinaloa*), black-capped gnatcatcher (*Polioptila nigriceps*), orange crowned warbler (*Vermivora celata*), Lucy's warbler (*Vermivora luciae*), magnolia warbler (*Dendroica magnolia*), black-and-white warbler (*Mniotilta varia*), painted redstart (*Myioborus pictus*), slate-throated redstart (*Myioborus miniatus*), rufous-capped warbler (*Basileuterus rufifrons*), red breasted chat (*Granatellus venustus*), western tanager (*Piranga ludoviciana*), stripe-headed sparrow (*Aimophila ruficauda*), grayish saltator (*Saltator coerulescens*), yellow grosbeak (*Pheucticus chrysopeplus*), black-headed grosbeak (*Pheucticus melanocephalus*), blue bunting (*Cyanocompsa parellina*), and scrub euphonia (*Euphonia affinis*). Other species might have been present as well that were harder to find due to their detectability.

For all of these species identified as flock associates, the same caveat described above for the BCVI applies as well. These species were present, but without more intensive efforts, it is premature to assume that they were all active participants within a flock. It is quite likely that many of them were foraging alone as a flock was passing through the area, similar to what we have suggested for the BCVI. We must also urge some further caution in interpretation of the flock associates data. For the species that are most commonly associated with BCVI in the above list, it is difficult to say if the BCVI have any particular affinity to these species since many of them (e.g., blue-grey gnatcatcher, Nashville warbler, Wilson's warbler) were amongst the most commonly found species across the surveyed range.

(4) Threats to wintering populations

Another aspect of this study that was difficult to adequately address was the assessment of threats to wintering populations of BCVI. We certainly made notes of continuing or impending threats to local populations or habitats when such threats were witnessed, but these records can only document a snapshot in time. In other words, this information is anecdotal in nature and cannot provide a sufficient picture of what the true nature of the threat is to the species. A more useful approach to answering that question might involve a GIS study that examines land use or land cover change through time. Table 3 lists records of possible threats to sites that we surveyed for BCVI on the wintering grounds in Mexico. Across the range of sites that we visited, the most common observed threat was clearing of brush for grazing (primarily cattle) or other agricultural purposes. This form of clearing was localized in its nature, primarily undertaken by small-scale farmers on family plots, and was often accompanied by some clearing for firewood as well. Small controlled burns were often used as well as a means of clearing unwanted brush. It should be kept in mind that these types of small-scale management

practices by local farmers are not necessarily a threat to the BCVI. For many avian species that typically use more mature vegetation, this continued clearing may be a problem, but the BCVI may prefer early successional habitat types created by such disturbance.

Few areas surveyed seemed threatened by development pressures, although our survey sites were typically located away from larger human population centers. It is possible that in those areas, development pressures are a more serious threat. We documented no evidence of any direct threat to BCVI from hunters, collectors, or from the bird trade. In parts of Mexico, the illegal capture and selling as pets of wild birds either along roadsides or in urban markets is a formidable problem for which little has been done. We visited many bird markets and never found a single BCVI. More typically, colorful birds such as great kiskadees (*Pitangus sulphuratus*), green jays (*Cyanocorax yncas*), or male painted buntings (*Passerina ciris*) were the subject of such trade.

(5) Linkages between breeding and wintering populations

In total, we have sent the CPSIL feathers from 144 BCVI (typically one tail feather and 2-3 breast feathers from each bird), of which 64 are from the wintering grounds and 80 from the breeding grounds (Table 4). Wintering grounds feathers include those we collected from 26 birds in Mexico in 2003 and 2004, as well as those from 38 birds that were loaned to us by various research museums and collections. Breeding grounds feathers include those from 46 birds collected at Fort Hood in Bell and Coryell Counties, Texas, 20 birds collected at Fort Sill in Comanche County, Oklahoma, and 14 birds from breeding sites in Coahuila Mexico that were also loaned to us by various institutions.

While the feathers were sent to the CPSIL in June for analysis, none of them have been analyzed as of this time, as there have been various and numerous setbacks in this aspect of the study. Considerable amounts of time (from last fall through early this spring) were lost in negotiations with certain museums due to permitting concerns related to such loans. The CPSIL also had considerable delays in their normal turnaround time due to some equipment difficulties at their lab. Furthermore, once they received the feathers, they had difficulties with extracting enough material from some of the museum feathers, so they moved other clients' samples ahead of ours in the processing queue. As a result, the CPSIL informed us that they would not be able to begin the processing until early September. We have actively requested additional feathers from all museums to allow the CPSIL to more easily extract enough material to complete all analyses. At this time, half of the museums have granted additional feather samples and we are awaiting word from the others. We expect to hear back soon and will promptly ship all new feathers to the CPSIL to add to the existing material, so that they can proceed in a timely fashion with the analysis sometime in early to mid-September. We should have the results from those analyses within a few weeks of that, and should be able to complete our analysis of this aspect of the study in October.

Discussion

It is clear from our results on distribution that BCVI tend to be more readily found in the northern Mexican states compared to states further south. The more northern states of Sinaloa, Durango and Nayarit contained 78% (49 out of 63) of the documented BCVI found during this research. The other 22% were located in the western central states of Jalisco and Colima, while the southernmost states of Michoacan, Guerrero, and Oaxaca produced no BCVI during this effort. This is not to say that there are no BCVI in those

southern states, but rather that they are not as abundant further south and more difficult to locate. It should be reiterated that we had a difficult time locating suitable survey sites in many areas along the southern coast, especially in Michoacan and Guerrero. These areas are quite poor and, as a result, have few access roads off of the main highways. Oftentimes, our survey sites were selected based on recommendations of other researchers or birdwatchers. In the southern states, recommended sites were few as a result of political instability (related to drugs and insurgent groups) and a greater distrust of outsiders by the locals. We therefore were more restricted to areas in which we felt relatively safe.

Our results are largely consistent with findings of Graber (1957), who suggested that Sinaloa and Nayarit represent the heart of the wintering distribution. We did not survey in Sonora at all (there has only been 1 documented occurrence of BCVI in Sonora), and did not find any BCVI in more northern parts of Sinaloa state. Since we did find a relatively high number of BCVI in Colima, we suggest that the wintering distribution is predominately located between Sinaloa and Colima.

Surprisingly, we found few BCVI in Jalisco state, which falls within this range and to the north of Colima. The state of Jalisco is where the majority of all blue agave (*Agave* spp.) used in the production of tequila is harvested. Due to a boom in tequila consumption around the world over the past 20 years, intensive cultivation of now occurs on approximately 80,000 hectares of land in Jalisco (Valenzuela-Zapata and Nabhan 2004). The widespread clearing necessary for such cultivation in Jalisco has clearly altered the landscape and has likely led to the destruction of many areas formerly suitable for wintering BCVI.

An interesting result from this research pertains to the differences in distributions found between the sexes. A sex-biased winter distribution for a migratory species occurs

when the sexes migrate different distances. This situation can be considered an example of differential migration, which describes any difference in timing of migration or distance migrated among distinguishable classes (such as age or sex) of a population (Terrill and Able 1988). Strong evidence of differential migration has been reported in 53 species (Cristol et al. 1999), and recent research in Mexico has shown evidence from an additional 9 species (Komar et al. 2005). While in some cases we were unable to differentiate between females and young males, it can be assumed that since none of those birds were adult males, they were subordinates. In the northern portions of the wintering range, where BCVI were found much more readily, we found 31 adult males compared to only 18 subordinates, while further south, in Jalisco and Colima, we found 10 subordinates to only 4 adult males.

There are two nonmutually exclusive hypotheses that may explain such a result. First, the dominance hypothesis states that dominant individuals occupy winter habitat that confers optimal survival, forcing subordinates to migrate farther (Gauthreaux 1978, Ketterson and Nolan 1976, Ketterson and Nolan 1979). Second, the arrival-time hypothesis is based on the assumption that wintering closer to the breeding grounds allows an advantage in intrasexual competition for resources for breeding (Myers 1981). There is, however, little evidence demonstrating a strong relationship between migration distance and arrival time (Cristol et al. 1999). The implications of latitudinal segregation are that this could lead to different annual survival rates between the sexes or possibly evolution of different habitat preferences (Komar et al. 2004), both of which could influence management strategies for an endangered species such as the BCVI.

We found that BCVI winter habitat use was best predicted by lower values of canopy cover, and by higher slopes and shrub density. These results are not surprising, considering that the species is commonly associated with dense scrub with an open

canopy cover. While BCVI were not typically found in dense stands of trees, they also passed up areas with few trees in favor of sites with canopy coverage of between 60-75%. We frequently found BCVI using scrubby vegetation on steep, inaccessible slopes in canyons that are common throughout the wintering range of the species. Vegetation in these canyons remains relatively undisturbed from alteration due to clearing, grazing, agriculture, or development because of its rugged inaccessibility. It is possible that BCVI, and other birds, frequently use such areas for that very reason.

In general, it appears that BCVI are much more of a generalist species in their habitat use on the wintering grounds than they are during the breeding season. The tight ecological requirements they need for nesting are more relaxed during the nonbreeding season, as we have found wintering BCVI in habitat types ranging from thorn forest and arid scrub to semi-deciduous forest and even pine oak forests at higher altitudes. Usually, however, we found BCVI in what would be described as either thorn scrub or thorn forest.

Our inability to locate wintering BCVI using point-count surveys is similar to a finding from the work of Hutto (1992), who only located one BCVI during 1,649 point-count points distributed across 36 west Mexican sites similar to ours. This demonstrates the difficulties with detecting such a secretive species during the nonbreeding season.

Related to their shy behavior, BCVI did not appear to favor the social benefits of participating in winter flocks. In fact, only 21% of BCVI that we found were foraging within a flock, and we cannot be certain that those individuals were flock participants. It would take a more committed effort to assess their propensity towards social aggregations, but our viewpoint is that BCVI prefer to forage solitarily on the wintering grounds.

Our assessment of threats to the BCVI on the wintering grounds did not reveal anything concrete that could be considered a serious problem for the species. As was mentioned earlier, to truly assess the threat to the species across its wintering range would require a more in-depth GIS-based approach. We did mention the possibility of large-scale clearing in the state of Jalisco due to the booming tequila industry. For most areas that we visited across the range, the most common form of land use change was small-scale clearing by local ranchers and farmers, and we cannot adequately determine whether this is even a threat or not for the BCVI.

Significant Deviations

As was mentioned above, the feathers have not been analyzed yet for stable isotope signatures. We do, however, expect that this will be completed in the near future so that we can then interpret the patterns as they relate to migratory connectivity between breeding and wintering sites. As soon as that has been completed, we will update this report to reflect new insights.

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Table 1. Locations of Black-capped Vireos Found in Mexico in Winter 2002-2003

Bird #	Feathers Collected	Coordinates (N)	Coordinates (W)	Sex	Date Found	Altitude (m)	State	Location
2003BCVI1	Yes	23 24.512	105 55.957	M	2/6/2003	600	SIN	Panuco, Durango Hwy
2003BCVI2	No	23 26.713	106 19.592	M	2/8/2003	212	SIN	La Noria, Mazatlan
2003BCVI3	No	23 20.758	106 26.589	M	2/17/2003	41	SIN	Mazatlan
2003BCVI4	Yes	23 26.812	106 19.540	F	2/25/2003	233	SIN	La Noria, Mazatlan
2003BCVI5	No	21 34.850	105 14.420	F	3/1/2003	8	NAY	Singayta, San Blas
2003BCVI6	No	21 31.150	104 58.315	M	3/5/2003	1057	NAY	Cerro de San Juan
2003BCVI7	No	21 31.110	104 58.326	M	3/5/2003	1045	NAY	Cerro de San Juan
2003BCVI8	No	21 21.265	104 33.627	M	3/10/2003	780	NAY	Santa Maria del Oro
2003BCVI9	Yes	21 22.752	104 33.759	M	3/11/2003	793	NAY	Santa Maria del Oro
2003BCVI10	No	21 22.752	104 33.759	F	3/11/2003	793	NAY	Santa Maria del Oro
2003BCVI11	Yes	21 22.681	104 33.724	F	3/11/2003	755	NAY	Santa Maria del Oro
2003BCVI12	No	19 20.407	104 44.311	F	3/22/2003	496	JAL	Barranca el Choncho
2003BCVI13	Yes	19 25.943	103 42.114	M	3/29/2003	1390	COL	San Francisco

Sex: M- Male
F- Female
U- Unknown

Table 2. Locations of black-capped vireos found in Mexico in winter 2003-2004.

Bird #	Feathers Collected	Coordinates (N)	Coordinates (W)	Sex	Date Found	Altitude (m)	State	Location
2004BCVI1	Yes	23 24.433	105 56.123	M	12/8/2003	633	SIN	Copala
2004BCVI2	No	23 24.502	105 55.954	M	12/8/2003	611	SIN	Copala
2004BCVI3	No	23 23.381	105 56.222	F	12/9/2003	547	SIN	Copala
2004BCVI4	Yes	23 23.381	105 56.222	F	12/10/2003	541	SIN	Copala
2004BCVI5	No	23 23.288	105 56.124	F	12/11/2003	560	SIN	Copala
2004BCVI6	No	23 26.039	106 19.965	M	12/13/2003	184	SIN	La Noria, Mazatlan
2004BCVI7	No	23 26.039	106 19.965	F	12/14/2003	184	SIN	La Noria, Mazatlan
2004BCVI8	No	23 26.039	106 19.965	M	12/14/2003	184	SIN	La Noria, Mazatlan
2004BCVI9	Yes	24 23.785	106 36.698	M	12/16/2003	376	SIN	Cosala
2004BCVI10	No	24 24.433	105 56.123	M	12/16/2003	633	SIN	Cosala
2004BCVI11	Yes	24 24.433	105 56.123	M	12/16/2003	633	SIN	Cosala
2004BCVI12	No	24 24.487	105 58.232	M	12/16/2003	633	SIN	Cosala
2004BCVI13	Yes	24 24.208	106 36.233	F	12/17/2003	353	DUR	Cosala
2004BCVI14	No	24 24.208	106 36.233	M	12/17/2003	360	SIN	Cosala
2004BCVI15	No	24 23.664	106 19.235	M	12/18/2003	424	SIN	Cosala
2004BCVI16	No	23 27.710	106 19.466	M	12/24/2003	183	SIN	La Noria, Mazatlan
2004BCVI17	Yes	23 27.707	106 19.463	M	1/6/2004	159	SIN	La Noria, Mazatlan
2004BCVI18	Yes	19 09.321	104 30.256	M	1/8/2004	-11	NAY	San Blas
2004BCVI19	No	19 08.356	104 27.383	F	1/9/2004	324	NAY	San Blas
2004BCVI20	Yes	19 09.352	104 30.161	F	1/10/2004	217	NAY	La Bajada, San Blas
2004BCVI21	Yes	19 25.889	103 41.902	M	1/15/2004	322	NAY	La Bajada, San Blas
2004BCVI22	Yes	19 26.589	103 42.844	M	1/16/2004	25	NAY	La Bajada, San Blas
2004BCVI23	Yes	21 31.034	104 58.352	M	1/20/2004	1079	NAY	Cerro de San Juan
2004BCVI24	No	21 31.121	104 58.335	M	1/20/2004	1049	NAY	Cerro de San Juan
2004BCVI25	No	21 30.819	104 58.213	M	1/22/2004	1099	NAY	Cerro de San Juan
2004BCVI26	No	21 30.649	104 58.213	M	1/22/2004	1174	NAY	Cerro de San Juan
2004BCVI27	No	20 50.595	105 27.142	M	1/23/2004	8	NAY	Sayulita
2004BCVI28	Yes	21 22.752	104 33.759	U	1/28/2004	792	NAY	Santa Maria del Oro
2004BCVI29	No	21 22.644	104 33.588	M	1/28/2004	813	NAY	Santa Maria del Oro
2004BCVI30	No	21 22.232	104 33.598	U	1/28/2004	735	NAY	Santa Maria del Oro

Bird #	Feathers Collected	Coordinates (N)	Coordinates (W)	Sex	Date Found	Altitude (m)	State	Location
2004BCVI31	No	21 22.082	104 33.604	U	1/28/2004	731	NAY	Santa Maria del Oro
2004BCVI32	No	21 22.695	104 33.928	U	1/29/2004	785	NAY	Santa Maria del Oro
2004BCVI33	Yes	21 22.659	104 33.661	M	1/29/2004	794	NAY	Santa Maria del Oro
2004BCVI34	No	21 22.506	104 33.499	U	1/30/2004	714	NAY	Santa Maria del Oro
2004BCVI35	Yes	21 22.810	104 33.853	M	1/31/2004	696	NAY	Santa Maria del Oro
2004BCVI36	Yes	21 22.806	104 33.075	M	1/31/2004	741	NAY	Santa Maria del Oro
2004BCVI37	Yes	21 21.918	104 34.832	U	2/2/2004	708	NAY	Santa Maria del Oro
2004BCVI38	No	21 21.609	104 34.489	U	2/5/2004	745	NAY	Santa Maria del Oro
2004BCVI39	Yes	19 09.321	104 30.256	M	2/10/2004	113	COL	Playa de Oro
2004BCVI40	No	19 20.347	104 44.487	U	2/12/2004	373	JAL	Barranca el Choncho
2004BCVI41	Yes	19 08.356	104 27.383	U	2/13/2004	286	COL	Microondas el Toro
2004BCVI42	Yes	19 09.352	104 30.161	U	2/15/2004	107	COL	Playa de Oro
2004BCVI43	No	19 09.137	104 30.419	U	2/15/2004	159	COL	Playa de Oro
2004BCVI44	No	19 26.010	103 41.978	U	2/18/2004	1437	COL	San Francisco
2004BCVI45	No	19 25.832	103 42.217	F	2/18/2004	1358	COL	San Francisco
2004BCVI46	No	19 25.884	103 41.889	U	2/19/2004	1462	COL	San Francisco
2004BCVI47	Yes	19 25.889	103 41.902	M	2/20/2004	1429	COL	San Francisco
2004BCVI48	No	19 26.309	103 42.642	F	2/21/2004	1276	COL	San Francisco
2004BCVI49	Yes	19 26.589	103 42.844	M	2/24/2004	1196	COL	San Francisco
2004BCVI50	No	19 26.010	103 41.978	M	2/24/2004	1437	COL	La Maria Road

Sex: M- Male
F- Female
U- Unknown

Table 3. Potential threats identified at Mexican sites surveyed for black-capped vireos.

Site Name	State	# of BCVI	Assessment of Threats
La Noria Road, Mazatlan	SIN	6	Local clearing for cattle grazing, firewood
Cerro El Elephante, Durango Hwy	SIN	0	Area being cleared for a toll highway
Durango Highway	SIN	0	Local clearing for cattle grazing, firewood
Panuco Road, Durango Hwy	SIN	3	Local clearing for agriculture, grazing
Copala, Durango Hwy	SIN	3	Local clearing for cattle grazing, firewood
Mazatlan (SIN 5-03)	SIN	1	Local clearing for cattle grazing, firewood
La Noria road to Santa Fe (Mazatlan)	SIN	1	Local clearing for firewood, some grazing
Cosala	SIN/DUR	7	Protected area, few people, minimal apparent risk of threats
Imala	SIN	0	Local clearing for agriculture, grazing
El Fuerte	SIN	0	Local clearing for agriculture, grazing
Singayta, San Blas	NAY	3	Hurricane damage, associated clearing, some ecological protection
La Bajada, San Blas	NAY	3	Hurricane damage, few people, clearing for firewood
El Cora	NAY	0	Local clearing for agriculture, grazing, firewood
Cerro de San Juan	NAY	6	Local clearing for grazing and firewood, some ecological protection
Laguna Santa Maria del Oro	NAY	14	Increasing development pressures around lake
Pig farm trail, Santa Maria del Oro	NAY	1	Some cattle grazing
Sayulita, road to Punta de Mita	NAY	1	Potential for increased clearing for development
Barranca el Choncho	JAL	2	Local clearing for grazing and firewood
Puerto los Mazos, Sierra de Manantlan	JAL	0	Protected area, some grazing, few people, minimal risk
Rancho el Mojo, Sierra de Manantlan	JAL	0	Protected area, some grazing, few people, minimal risk
Microondas San Francisco, Autlan	JAL	0	Relatively unused area alongside road to microwave tower
Tequila volcano, Tequila	JAL	0	Some disturbance from campers, relatively pristine area
Playa de Oro Road	COL	3	Relatively unused area, some grazing
Microondas el Toro Road	COL	1	Relatively unused area alongside road to microwave tower
Finca de San Antonio, Colima	COL	7	Some clearing for firewood; relatively unused area
Laguna La Madria, Colima	COL	0	Relatively minimal risk; some foot traffic
La Maria Road, Colima	COL	1	Localized cattle grazing and clearing
Volcan de Fuego, Colima	COL	0	Relatively inaccessible, occassional volcano damage, minimal risk
coastal Michoacan, Playa las Brisas	MIC	0	Cattle grazing
Michoacan, Playa Azul	MIC	0	Local clearing for grazing, firewood

Site Name	State	# of BCVI	Assessment of Threats
Microondas road, Zihuatanejo	GUE	0	Relatively unused area alongside road to microwave tower
Ixtapa	GUE	0	Pressures from development
Sierra de Atoyac	GUE	0	Relatively unpopulated area, minimal risk for birds
Acapulco, Guerrero, Pie de la Cuerta	GUE	0	Cattle grazing
Puerto Escondido	OAX	0	Some local clearing for grazing, firewood
Puerto Escondido, km 32 inland, Rte. 135	OAX	0	Some local clearing for grazing, firewood
Puerto Escondido, Hwy 131	OAX	0	Some local clearing for grazing, firewood
Puerta Angel/ Zipolite	OAX	0	Minimal clearing; some clearing
La Soledad, Sierra de Mihuatlan	OAX	0	Minimal clearing; relatively unpopulated area
Monte Alban	OAX	0	Protected area (archaeological ruins)
Teotitlan del Valle, Oaxaca	OAX	0	Some local clearing for grazing, firewood

Table 4. Information about black-capped vireo feathers used for stable isotope analysis.

Number	State[1]	Season[2]	Date[3]	Sex[4]	Age[5]	Location[6]	ID #[7]	Feather Type[8]		Provider[9]
								Breast	Tail	
1	COA	breeding	4/19/1910	M	1st yr.	Sabinas	MVZ 107441	Yes	No	MVZ
2	COA	breeding	4/23/1953	M	1st yr.	Sierra del Carmen	MVZ 129897	Yes	No	MVZ
3	COA	breeding	4/26/1953	M	1st yr.	Sierra del Carmen	MVZ 129900	Yes	No	MVZ
4	COA	breeding	4/24/1953	M	U. ad.	Sierra del Carmen	MVZ 129899	Yes	No	MVZ
5	COA	breeding	4/27/1953	F	U. ad.	Sierra del Carmen	MVZ 129901	Yes	No	MVZ
6	COA	breeding	4/23/1953	F	U. ad.	Sierra del Carmen	MVZ 129898	Yes	No	MVZ
7	COA	breeding	5/8/1954	M	Adult	Sierra Padilla	KU 31493	Yes	No	KMNH
8	COA	breeding	5/9/1954	M	1st yr.	Sierra Padilla	KU 31494	Yes	No	KMNH
9	COA	breeding	7/3/1952	M	Adult	Sierra del Pino	KU 32099	Yes	No	KMNH
10	COA	breeding	7/3/1952	M	Adult	Sierra del Pino	KU 32100	Yes	No	KMNH
11	COA	breeding	4/2/1910	UNK	UNK	Sabinas	AMNH 758855	Yes	No	AMNH
12	COA	breeding	6/18/1956	M	UNK	Ocampo	FMNH 292520	Yes	No	FMNH
13	COA	breeding	6/18/1956	F	UNK	Ocampo	FMNH 292521	Yes	No	FMNH
14	COA	breeding	6/17/1956	M	UNK	Ocampo	FMNH 292522	Yes	No	FMNH
15	UNK	wintering	2/26/1904	UNK	UNK	Coquimatlan	AMNH 806362	Yes	No	AMNH
16	COL	wintering	2/8/1959	F	Adult	La Medialuna	DMNH 026089	Yes	No	DMNH
17	COL	wintering	10/27/1957	UNK	Adult	Manzanillo	MVZ 136245	Yes	No	MVZ
18	COL	wintering	2/10/2004	M	UNK	Playa de Oro	#2131-94023	Yes	Yes	R. Powell
19	COL	wintering	2/13/2004	UNK	UNK	Microondas el Toro	#2131-94024	Yes	Yes	R. Powell
20	COL	wintering	2/15/2004	UNK	UNK	Playa de Oro	#2131-94025	Yes	Yes	R. Powell
21	COL	wintering	2/20/2004	M	UNK	La Maria	#2131-94026	Yes	Yes	R. Powell
22	COL	wintering	2/24/2004	M	UNK	La Maria	#2131-94027	Yes	Yes	R. Powell
23	DUR	wintering	10/21/1937	F	UNK	Rancho Guasimal	Moore19967	Yes	No	MC
24	DUR	wintering	11/13/1937	M	UNK	Rancho Guasimal	Moore19965	Yes	No	MC
25	DUR	wintering	11/21/1937	M	UNK	Tamazula	Moore19966	Yes	No	MC
26	DUR	wintering	12/10/1937	M	UNK	Tamazula	Moore19968	Yes	No	MC
27	GUE	wintering	1888	F	young?	Rincon	BMNH1891.11.3.284	Yes	No	BMNH
28	JAL	wintering	1/12/1891	M	Adult		AMNH 505141	Yes	No	AMNH
29	JAL	wintering	2/19/1952	F	UNK	Sapotillo	Moore53216	Yes	No	MC
30	JAL	wintering	2/21/1952	F	UNK	Sapotillo	Moore53217	Yes	No	MC
31	JAL	wintering	12/3/1956	M	Adult	Suchitlan, El Refugio	DMNH 026088	Yes	No	DMNH
32	JAL	wintering	3/24/2003	F	UNK	Barranca el Choncho	#2131-94005	Yes	Yes	R. Powell

Number	State[1]	Season[2]	Date[3]	Sex[4]	Age[5]	Location[6]	ID #[7]	Feather Type[8]		Provider[9]
								Breast	Tail	
33	MIC	wintering	1/1/1953	F	UNK	Tiquichio	Moore54911	Yes	No	MC
34	NAY	wintering	8/27/1938	F	UNK	Tepic	Moore22062	Yes	No	MC
35	NAY	wintering	3/15/1941	F	UNK	Chacala	Moore28284	Yes	No	MC
36	NAY	wintering	3/19/1948	M	UNK	San Blas	Moore47914	Yes	No	MC
37	NAY	wintering	11/4/1957	M	Adult	San Blas	DMNH 026091	Yes	No	DMNH
38	NAY	wintering	11/28/1952	M	immature	Las Varas	DMNH 026079	Yes	No	DMNH
39	NAY	wintering	11/25/1952	F	immature	Las Varas	DMNH 026080	Yes	No	DMNH
40	NAY	wintering	11/16/1952	M	immature	Las Varas	DMNH 026081	Yes	No	DMNH
41	NAY	wintering	10/8/1955	M	Adult	Tepic	DMNH 026083	Yes	No	DMNH
42	NAY	wintering	10/10/1957	M	Adult	San Blas	DMNH 026086	Yes	No	DMNH
43	NAY	wintering	11/30/1952	M	Adult	Compostela	DMNH 026087	Yes	No	DMNH
44	NAY	wintering	12/28/1955	F	UNK	Las Varas	FMNH 292513	Yes	No	FMNH
45	NAY	wintering	12/29/1955	M	UNK	Las Varas	FMNH 292515	Yes	No	FMNH
46	NAY	wintering	3/11/2003	M	UNK	St. Maria del Oro	#2131-94004	Yes	Yes	R. Powell
47	NAY	wintering	3/1/2003	F	UNK	Singayta	#2131-94002	Yes	Yes	R. Powell
48	NAY	wintering	3/6/2003	M	UNK	Cerro de San Juan	#2131-94003	Yes	Yes	R. Powell
49	NAY	wintering	1/8/2004	M	UNK	Singayta	#2131-94013	Yes	Yes	R. Powell
50	NAY	wintering	1/12/2004	M	UNK	La Bajada, San Blas	#2131-94014	Yes	Yes	R. Powell
51	NAY	wintering	1/15/2004	M	UNK	La Bajada, San Blas	#2131-94015	Yes	Yes	R. Powell
52	NAY	wintering	1/16/2004	M	UNK	Singayta	#2131-94016	Yes	Yes	R. Powell
53	NAY	wintering	1/20/2004	M	UNK	Cerro de San Juan	#2131-94017	Yes	Yes	R. Powell
54	NAY	wintering	1/29/2004	UNK	UNK	Santa Maria del Oro	#2131-94018	Yes	Yes	R. Powell
55	NAY	wintering	1/30/2004	M	UNK	Santa Maria del Oro	#2131-94019	Yes	Yes	R. Powell
56	NAY	wintering	1/31/2004	M	UNK	Santa Maria del Oro	#2131-94020	Yes	Yes	R. Powell
57	NAY	wintering	1/31/2004	M	UNK	Santa Maria del Oro	#2131-94021	Yes	Yes	R. Powell
58	NAY	wintering	2/1/2004	M	UNK	Santa Maria del Oro	#2131-94022	Yes	Yes	R. Powell
59	OAX	wintering	12/8/1963	F	Adult	San Gabriel Mixtepec	DMNH 026085	Yes	No	DMNH
60	OAX	wintering	12/11/1963	F	Adult	San Gabriel Mixtepec	DMNH 026090	Yes	No	DMNH
61	SIN	wintering	2/1868	F	1st winter	Mazatlan	USNM 55046	Yes	No	NMNH
62	SIN	wintering	12/18/1933	M	UNK	Rosario	Moore7164	Yes	No	MC
63	SIN	wintering	1/6/1934	M	UNK	Rosario	Moore7165	Yes	No	MC
64	SIN	wintering	2/26/1935	M	UNK	Rosario	Moore13000	Yes	No	MC

Number	State[1]	Season[2]	Date[3]	Sex[4]	Age[5]	Location[6]	ID #[7]	Feather Type[8]		Provider[9]
								Breast	Tail	
65	SIN	wintering	2/9/1935	M	UNK	Chele	Moore12827	Yes	No	MC
66	SIN	wintering	2/15/1935	M	UNK	Chele	Moore12826	Yes	No	MC
67	SIN	wintering	3/18/1937	F	UNK	San Ignacio	Moore18175	Yes	No	MC
68	SIN	wintering	3/20/1937	M	UNK	San Ignacio	Moore17928	Yes	No	MC
69	SIN	wintering	2/21/1938	M	UNK	Iguana	Moore20260	Yes	No	MC
70	SIN	wintering	4/12/1972	F	Adult	Palmito	DMNH 023057	Yes	No	DMNH
71	SIN	wintering	12/21/1955	M	UNK	Concordia	FMNH 292514	Yes	No	FMNH
72	SIN	wintering	2/21/2003	UNK	UNK	Mazatlan	#2131-94001	Yes	Yes	R. Powell
73	SIN	wintering	12/8/2003	M	UNK	Panuco Rd.	#2131-94006	Yes	Yes	R. Powell
74	SIN	wintering	12/10/2003	F	UNK	Copala	#2131-94008	Yes	Yes	R. Powell
75	SIN	wintering	12/16/2003	F	UNK	Cosola	#2131-94009	Yes	Yes	R. Powell
76	SIN	wintering	12/16/2003	F	UNK	Cosola	#2131-94010	Yes	Yes	R. Powell
77	SIN	wintering	12/17/2003	M	UNK	Cosola	#2131-94011	Yes	Yes	R. Powell
78	SIN	wintering	1/6/2004	F	UNK	La Noria, Mazatlan	#2131-94012	Yes	Yes	R. Powell
79	OKL	breeding	7/4/2003	F	SY	Fort Sill	#1870-55761	No	Yes	J. Grzybowski
80	OKL	breeding	7/4/2003	M	SY	Fort Sill	#2320-49954	No	Yes	J. Grzybowski
81	OKL	breeding	7/8/2003	M	ASY	Fort Sill	#2320-49955	No	Yes	J. Grzybowski
82	OKL	breeding	7/11/2003	F	SY	Fort Sill	#2320-49959	No	Yes	J. Grzybowski
83	OKL	breeding	7/11/2003	M	SY	Fort Sill	#2320-49960	No	Yes	J. Grzybowski
84	OKL	breeding	7/11/2003	M	SY	Fort Sill	#2320-49962	No	Yes	J. Grzybowski
85	OKL	breeding	7/16/2003	M	SY	Fort Sill	#2320-49963	No	Yes	J. Grzybowski
86	OKL	breeding	7/16/2003	M	ASY	Fort Sill	#2320-49964	No	Yes	J. Grzybowski
87	OKL	breeding	7/18/2003	M	ASY	Fort Sill	#2320-49968	No	Yes	J. Grzybowski
88	OKL	breeding	7/18/2003	F	ASY	Fort Sill	#2320-49969	No	Yes	J. Grzybowski
89	OKL	breeding	7/20/2003	M	ASY	Fort Sill	#2320-49970	No	Yes	J. Grzybowski
90	OKL	breeding	7/20/2003	F	SY	Fort Sill	#2320-49971	No	Yes	J. Grzybowski
91	OKL	breeding	7/21/2003	F	ASY	Fort Sill	#2320-49973	No	Yes	J. Grzybowski
92	OKL	breeding	7/21/2003	F	ASY	Fort Sill	#2320-49976	No	Yes	J. Grzybowski
93	OKL	breeding	7/21/2003	M	ASY	Fort Sill	#2320-49977	No	Yes	J. Grzybowski
94	OKL	breeding	7/22/2003	M	HY	Fort Sill	#2320-49978	No	Yes	J. Grzybowski
95	OKL	breeding	7/22/2003	F	HY	Fort Sill	#2320-49979	No	Yes	J. Grzybowski
96	OKL	breeding	7/22/2003	M	SY	Fort Sill	#2320-49980	No	Yes	J. Grzybowski

Number	State[1]	Season[2]	Date[3]	Sex[4]	Age[5]	Location[6]	ID #[7]	Feather Type[8]		Provider[9]
								Breast	Tail	
97	OKL	breeding	7/7/2003	M	SY	Fort Sill	#2320-50151	No	Yes	J. Grzybowski
98	OKL	breeding	7/20/2003	F	ASY	Fort Sill	#2320-50157	No	Yes	J. Grzybowski
99	TEX	breeding	4/23/2003	M	ASY	Ft. Hood	#820-07153	No	Yes	D. Cimprich
100	TEX	breeding	7/15/2003	M	A4Y	Ft. Hood	#1780-18752	No	Yes	D. Cimprich
101	TEX	breeding	5/13/2003	M	SY	Ft. Hood	#2270-36998	No	Yes	D. Cimprich
102	TEX	breeding	5/13/2003	M	TY	Ft. Hood	#2270-36926	No	Yes	D. Cimprich
103	TEX	breeding	7/10/2003	M	ASY	Ft. Hood	#2340-14325	No	Yes	D. Cimprich
104	TEX	breeding	5/27/2003	M	SY	Ft. Hood	#2270-37179	No	Yes	D. Cimprich
105	TEX	breeding	5/7/2003	M	SY	Ft. Hood	#820-07196	No	Yes	D. Cimprich
106	TEX	breeding	4/28/2003	M	SY	Ft. Hood	#2270-36958	No	Yes	D. Cimprich
107	TEX	breeding	4/29/2003	M	ASY	Ft. Hood	#2270-36987	No	Yes	D. Cimprich
108	TEX	breeding	4/29/2003	M	AHY	Ft. Hood	#820-07155	No	Yes	D. Cimprich
109	TEX	breeding	4/24/2003	M	SY	Ft. Hood	#820-07170	No	Yes	D. Cimprich
110	TEX	breeding	4/22/2003	M	SY	Ft. Hood	#820-07175	No	Yes	D. Cimprich
111	TEX	breeding	4/21/2003	M	SY	Ft. Hood	#820-07129	No	Yes	D. Cimprich
112	TEX	breeding	4/21/2003	M	ASY	Ft. Hood	#820-07149	No	Yes	D. Cimprich
113	TEX	breeding	4/16/2003	M	SY	Ft. Hood	#820-07148	No	Yes	D. Cimprich
114	TEX	breeding	4/14/2003	M	ASY	Ft. Hood	#820-07147	No	Yes	D. Cimprich
115	TEX	breeding	4/26/2004	F	ASY	Ft. Hood	#2340-14391	No	Yes	D. Cimprich
116	TEX	breeding	6/25/2004	F	6Y	Ft. Hood	#1671-20418	No	Yes	D. Cimprich
117	TEX	breeding	5/6/2004	F	AHY	Ft. Hood	#2340-14538	No	Yes	D. Cimprich
118	TEX	breeding	4/25/2004	F	SY	Ft. Hood	#2340-14254	No	Yes	D. Cimprich
119	TEX	breeding	4/25/2004	F	SY	Ft. Hood	#2340-14255	No	Yes	D. Cimprich
120	TEX	breeding	5/5/2004	F	SY	Ft. Hood	#2340-14447	No	Yes	D. Cimprich
121	TEX	breeding	5/17/2004	F	SY	Ft. Hood	#2340-14616	No	Yes	D. Cimprich
122	TEX	breeding	6/16/2004	F	SY	Ft. Hood	#2340-14926	No	Yes	D. Cimprich
123	TEX	breeding	4/27/2004	F	SY	Ft. Hood	#2340-14370	No	Yes	D. Cimprich
124	TEX	breeding	4/27/2004	F	SY	Ft. Hood	#2340-14394	No	Yes	D. Cimprich
125	TEX	breeding	6/24/2004	F	SY	Ft. Hood	#2340-14946	No	Yes	D. Cimprich
126	TEX	breeding	5/17/2004	F	SY	Ft. Hood	#2340-14599	No	Yes	D. Cimprich
127	TEX	breeding	5/28/2004	F	SY	Ft. Hood	#2340-14771	No	Yes	D. Cimprich
128	TEX	breeding	6/1/2004	F	ASY	Ft. Hood	#2340-14685	No	Yes	D. Cimprich

Number	State[1]	Season[2]	Date[3]	Sex[4]	Age[5]	Location[6]	ID #[7]	Feather Type[8]		Provider[9]
								Breast	Tail	
129	TEX	breeding	4/25/2004	M	SY	Ft. Hood	#2340-14256	No	Yes	D. Cimprich
130	TEX	breeding	4/25/2004	F	SY	Ft. Hood	#2340-14257	No	Yes	D. Cimprich
131	TEX	breeding	4/7/2004	F	SY	Ft. Hood	#2340-14250	No	Yes	D. Cimprich
132	TEX	breeding	6/11/2004	M	SY	Ft. Hood	#2340-14861	No	Yes	D. Cimprich
133	TEX	breeding	?	M	SY	Ft. Hood	#2340-14838	No	Yes	D. Cimprich
134	TEX	breeding	4/27/2004	M	SY	Ft. Hood	#2340-14395	No	Yes	D. Cimprich
135	TEX	breeding	6/29/2004	M	SY	Ft. Hood	#2270-37007	No	Yes	D. Cimprich
136	TEX	breeding	7/2/2004	M	SY	Ft. Hood	#2340-14992	No	Yes	D. Cimprich
137	TEX	breeding	6/4/2004	M	SY	Ft. Hood	#2340-14914	No	Yes	D. Cimprich
138	TEX	breeding	5/24/2004	M	SY	Ft. Hood	#2340-14679	No	Yes	D. Cimprich
139	TEX	breeding	5/24/2004	M	SY	Ft. Hood	#2340-14680	No	Yes	D. Cimprich
140	TEX	breeding	4/29/2004	M	SY	Ft. Hood	#2340-14389	No	Yes	D. Cimprich
141	TEX	breeding	5/20/2004	M	SY	Ft. Hood	#2340-14491	No	Yes	D. Cimprich
142	TEX	breeding	6/17/2004	M	SY	Ft. Hood	#2340-14936	No	Yes	D. Cimprich
143	TEX	breeding	?	M	SY	Ft. Hood	#2340-14359	No	Yes	D. Cimprich
144	TEX	breeding	5/3/2004	M	SY	Ft. Hood	#2340-14534	No	Yes	D. Cimprich

[1] State abbreviations are: COA- Coahuila; UNK- Unknown; COL- Colima; DUR- Durango; GUE- Guerrero; JAL- Jalisco; MIC- Michoacan; NAY- Nayarit; OAX- Oaxaca; SIN- Sinaloa; OKL- Oklahoma; TEX- Texas

[2] Season indicates whether feathers are from the breeding grounds or wintering grounds

[3] Date indicates date specimen or feathers were collected

[4] Sex of bird; M- Male; F- Female; UNK- Unknown

[5] Age of bird

[6] General location or nearest town where birds/feathers were collected

[7] Provides the museum catalog number for museum specimens or the U.S. Fish and Wildlife Service band number for birds released after feather removal

[8] Indicates whether breast feathers or tail feathers were used in analyses

[9] MVZ- Museum of Vertebrate Zoology, Univ. California, Berkeley; KMNH- Univ. Kansas, Museum of Natural History; AMNH- American Museum of Natural History; FMNH- Field Museum; DMNH- Delaware Museum of Natural History; MC- Moore Collection, Occidental College; BMNH- British Museum of Natural History; NMNH- Smithsonian Institution National Museum of Natural History; R. Powell- collected in field for this study; J. Grzybowski- provided by Joe Grzybowski from Fort Sill, Oklahoma; D. Cimprich- provided by Dave Cimprich from The Nature Conservancy, Fort Hood

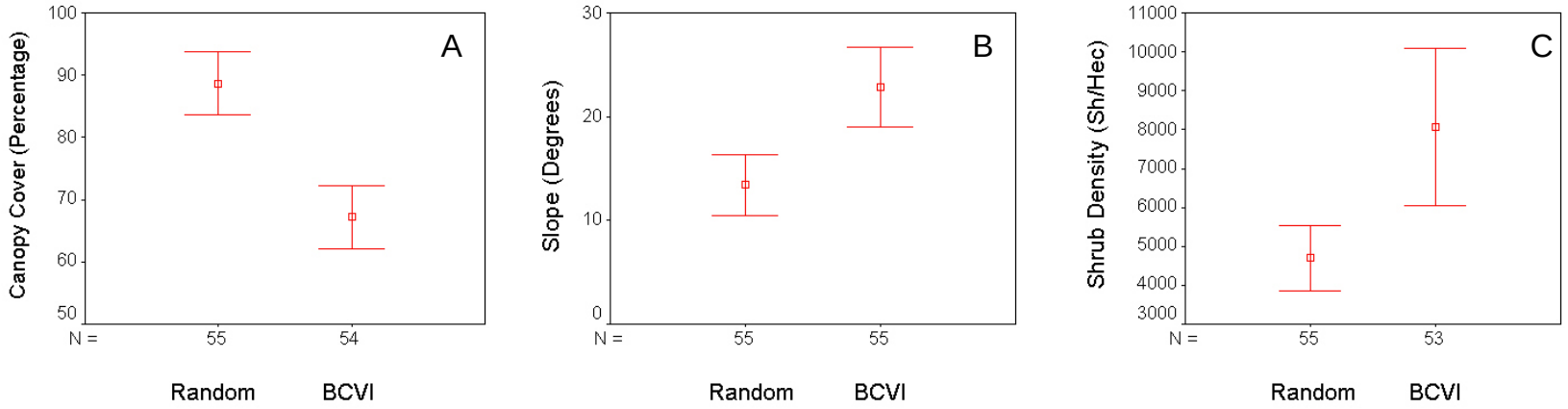

Figure 1. Means values of important habitat selection variables (Canopy Cover (Percentage) [A], Slope (Degrees) [B], and Shrub Density (Shrubs/Hectare) [C]) for black-capped vireos in Mexico, 2002-2004. Whiskers indicate a 95% confidence interval.