

A Comparison of Ectoparasite Infestation by Chigger Mite Larvae (Acarina: Trombiculidae) on Resident and Migratory Birds in Chiapas, Mexico Illustrating a Rapid Visual Assessment Protocol¹

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Abstract

This study presents a protocol developed to rapidly assess ectoparasite prevalence and intensity. Using this protocol during a mist-netting project in two different coffee agroecosystems in Chiapas, Mexico, data were collected on ectoparasitic chigger mite larvae (Acarina: Trombiculidae) found on resident and migratory birds. Surprisingly high infestation rates were found for some long-distance migrants, as high as 73 percent for Swainson's Thrush (*Catharus ustulatus*), while many species remained uninfested. During the study, 17 of 26 species of long distance migrants and 24 of 44 resident species had at least one infested individual. Total prevalence averaged 0.18, with 0.16 for migrants and 0.23 for residents. The mite score protocol provided a useful relative measure of infestation intensity. Mean infestation intensities and abundances are reported for 70 species captured and opportunistically inspected during the course of this study. While this study does not directly link survival with infestation by ectoparasites, variation in infestation intensity among individuals could help explain differences in condition when birds arrive on the breeding range. Further study is merited on the ecology of ectoparasites, including the geographic distribution and degree to which human landscape management contributes to infestation. Constant effort mist-net monitoring stations could provide important data toward this effort by routinely collecting ectoparasite information.

Introduction

Temperate Neotropical birds that migrate long distances to tropical habitats, face a range of hazards that reduce survival. One such hazard is parasitism. Internal and external parasites may reduce survival during migration and leave birds in poor condition upon arrival on the breeding or wintering grounds. Despite potentially

grave consequences, little is known about the distribution and abundance of ectoparasite infestation in birds, especially in the tropics. However, over 2500 species from 40 families of mites (Acarina) are known to parasitize birds (Proctor and Owen 2000). Constant effort mist-net programs may provide an opportunity to gather information on ectoparasites. For such an effort to be compatible with on-going mist-net monitoring programs, rapid assessment methods need to be developed that complement data already collected without adding significantly to the processing time of each bird.

Chigger mites (Trombiculidae) are one parasitic group that may be difficult to sample using conventional methods. Chigger mites are parasitic only in their larval stage, when they are firmly anchored in difficult to reach areas behind the wings and legs. While in the successive nymphal and adult stages they are free moving and predominantly predatory on the eggs and young instars of small arthropods (Baker et al. 1956). Chigger mite larvae typically remain attached to their host for 3-4 days but some species can remain attached on their host as long as 30 days (Wharton and Fuller 1952, Clayton and Walther 1997).

A number of methods have been developed that use destructive sampling to collect ectoparasites for accurate counts (Walther and Clayton 1997). There are also non-destructive methods, such as dusting, that are less accurate but allow resampling of individual birds over time (Fowler and Cohen 1983, Bear 1995, Walther and Clayton 1997). These methods require specialized equipment, chemicals, and increased processing time per bird. They also poorly sample parasites that anchor themselves to the host (Walther and Clayton 1997). A simpler and more efficient approach would be more appropriate and likely to be implemented by routine monitoring programs, especially those that rely on volunteers. Visual inspections are straightforward and work well for longitudinal studies of ectoparasite dynamics (Clayton and Walther 1997), but counting individual mites can be time-consuming and tedious.

This study presents a protocol to assess infestation intensity of birds by a visually obvious ectoparasite with minimal extra time requirements for handling individual birds captured in mist nets. This relative

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measure is tested against actual ectoparasite abundance levels on infested individuals from visual counts. This study then uses the relative mite ranking scores to compare infestation differences between Neotropical resident and migratory birds.

Study Area and Methods

This study was conducted in the Soconusco region of Chiapas, Mexico. The Sierra Madre de Chiapas mountain range east of Tapachula is just north of the Guatemala border near the Pacific coast. Coffee is grown in this region at altitudes from 300 m to 1500 m. During January 9-25, 2001 and January 28 - February 4, 2002, mist netting was conducted at 1000 m elevation in two coffee agroecosystems of Finca Irlanda. These coffee agroecosystems use diverse shade with several *Inga* species and *Alchornia latifolia* the most abundant trees in the shade canopy (Martinez and Peters 1996). One agroecosystem contains greater canopy cover and a higher species richness and abundance of shade trees with additional native forest trees planted by the landowner. While differing in management intensity, both these agroecosystems would be classified as commercial polyculture using the “gestalt” system described by Moguel and Toledo (1999).

Resident birds were banded during winter 2001, 25 nets were run (198 m total) for 3 consecutive days in each plot. In winter 2002, 12 nets were used (96 m) for 2 consecutive days. Nets were opened at dawn (~ 6 am) and closed at 11 am each day. Tail feathers of migratory birds and resident hummingbirds were clipped to identify recaptured individuals. Weight, fat level, molt, and other standard banding measurements were taken for each bird captured (Ralph et al. 1993). While checking for body molt and fat, each bird was scored using a mite infestation ranking protocol (table 1). This study focused on red chigger mite larvae (Acarina: Trombiculidae). The ranking protocol (scored from 0-4) was designed to provide a rapid assessment of the relative abundance of mites on infested individuals. The general procedure is as follows. Each bird caught was visual inspected while checking for body molt by blowing feathers aside to examine the skin surface. This inspection included focal areas where mites seem to colonize, in particular along feather tracts behind the legs and wings (Figs. 1a and 1b). A single location refers to a general body area, such as behind one leg, behind a single wing, or the lower belly (common areas for chigger mites). A colony is a single grouping of mites. Individual mite larvae are visible as bumps within a grouping. During Winter 2002, after each bird was scored using the ranking protocol, individual mite larvae were counted. Mite scores from field assistants

were verified until their rankings were consistent with the protocol.

Table 1— Ranking protocol for Mite Score (MS). The following ranking system is an attempt to cover the variation from no mites to high infestation. While most possibilities are covered, there are likely to be birds with unusual infestations that are difficult to categorize. In these cases, judgment should be used to provide a relative scoring for the bird. If time permits, additional notes should be made with counts of individual mites. Each bird caught is visual inspected while checking for body molt by blowing feathers aside to examine the skin surface. This inspection should include focal areas where mites regularly colonize, in particular behind the legs and wings. A single location refers to a general body area, such as behind one leg, behind a single wing, or the lower belly (common areas for chigger mite larvae). A colony is a single grouping of mite larvae. Individual mite larvae are visible as bumps within a grouping (see Figure 1b).

Mite Score	Description
0	Absence of mites (none observed).
1	One small colony (<5 mites) in one location.
2	One large colony (>5 mites) or several colonies in one location. Two locations with mites, including from both locations with small colonies to both with large colonies but no heavy infestation.
3	Two locations with large colonies, at least one with heavy infestation (multiple colonies including one large). Three locations with small or large colonies.
4	Four or more locations with mites. Three locations with heavy infestation (multiple colonies including one large).

Statistical Analysis

In this account, prevalence refers to the proportion of individuals infested by at least one mite, mean abundance is the average number of mites recorded across all individuals examined, and mean intensity is the average number of mites recorded across all infested individuals (Margolis et al. 1982, Duffy and Campos De Duffy 1986, Pruett-Jones and Pruett-Jones 1991, Bush et al. 1997). Difference in prevalence was evaluated using contingency table χ^2 tests. Differences in mean abundance and intensity were tested using unpaired t-tests. Multiple tests conducted for species with greater than five captures per year used Bonferroni correction to determine α -values (Manly 2001). Statistical analyses were conducted with StatView (v5.0.1, SAS Institute, Inc).

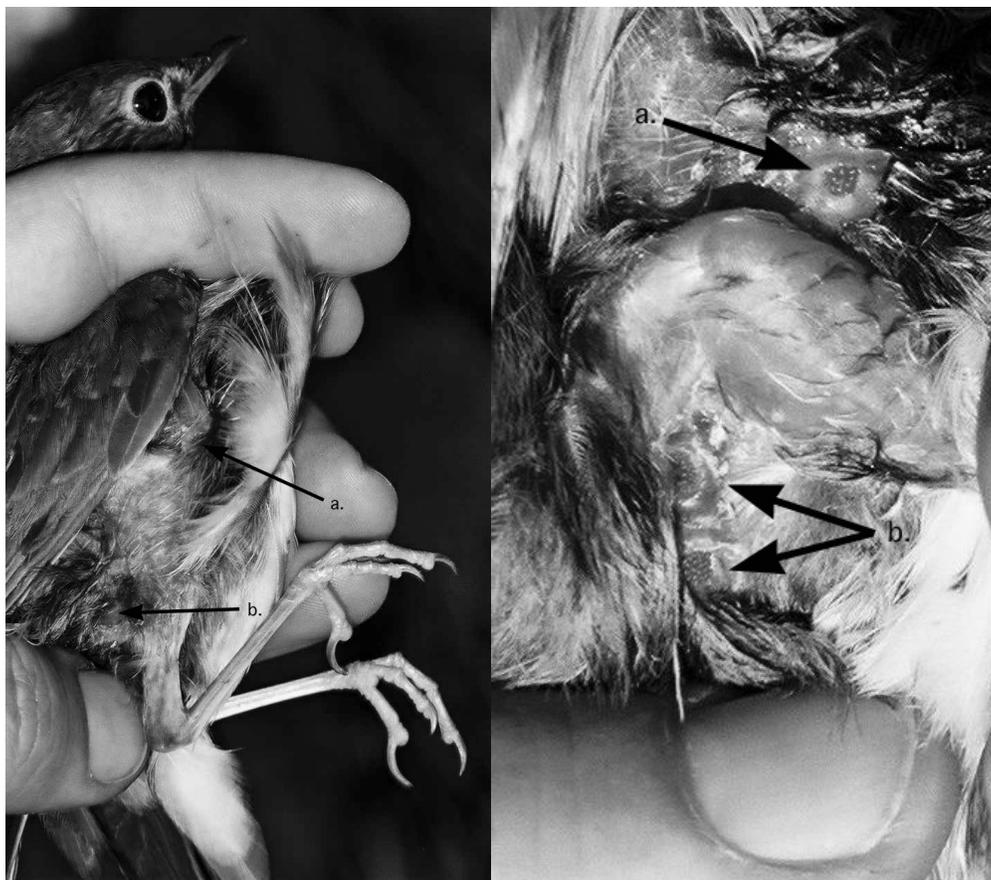


Figure 1—Swainson's Thrush (*Catharus ustulatus*) with chigger mite larvae. Two areas of infestation are shown (a and b) along feather tracts on either side of the right leg. Location b is a common location for these larvae behind each leg. In the close-up to the left, location a is a large colony with 9 individual mites while location b is a heavy infestation with 2 large colonies. Based on similar infestation on its opposite side, this bird received a mite score of 4.

Results

In total, 24 of 42 resident species and 16 of 26 migratory species had at least one captured individual with mites (*Appendix 1*). Mite score ranking system separated mite larvae abundance into significantly different categories ($F_{3,71} = 28.44$, $P < 0.0001$, *fig. 2*). Mite score was also significantly associated with actual mite larvae abundance using Pearson correlation ($N = 76$, $r = 0.723$, $P < 0.0001$). When present, mite-larvae abundance ranged from 1 to 164 individuals with a mean intensity of 21.8 with standard error of 3.37. Mite scores for birds with actual counts of mites (used in correlation above) had a mean intensity of 2.17 and standard error of 0.12. Based on this significant correlation, I use mite scores in place of actual abundance levels to evaluate mean intensity and mean abundance.

There was significantly higher prevalence in individuals from resident species than migrants, 0.23 and 0.16 respectively ($\chi^2 = 7.1$, $P = 0.008$). However, when analyzed by year, there was only a significant difference

in prevalence for 2001 (residents: 0.17, migrants 0.10, $\chi^2 = 6.9$, $P = 0.009$) not 2002 (residents: 0.38, migrants: 0.5, $\chi^2 = 2.2$, $P = 0.14$). Interestingly, there was no significant difference between residents and migrants in mean intensity or mean abundance in either year (*table 2*). Between-year comparisons for mean abundance were significantly different for both migrants and residents, while mean intensity was only different for migrants (*table 2*).

Swainson's Thrush had the highest infestation prevalence for migrant species with >5 captures at 0.73. For the Swainson's Thrush, the distribution of mite scores was significantly different between years (*fig. 3*, $\chi^2 = 29.1$, $P < 0.0001$, $df = 4$). This corresponds with significant differences in mean abundance and mean intensity between years. Swainson's Thrush mite score mean abundance was 1.2 for 2001 and 2.8 for 2002, a significant difference of 1.6 (Mann-Whitney U test, $P < 0.0001$). Swainson's Thrush mite score mean intensity was 1.9 for 2001 and 2.9 for 2002 (Mann-Whitney U test, $P < 0.0001$).

Table 2— Mean abundance and mean intensity mite scores for long distance migrants and resident birds each season with differences between years and migratory status. Mann-Whitney U test (MW) used to test for significance. Significant differences shown in bold.

Mean abundance	Winter 2001	Winter 2002	Difference
Migrants	0.16	1.07	0.91, MW, P < 0.0001
Residents	0.33	0.87	0.53, MW, P = 0.004
Difference	0.17, MW, P = 0.13	0.21, MW, P = 0.24	
Mean intensity	Winter 2001	Winter 2002	Difference
Migrants	1.64	2.15	0.51, MW, P = 0.02
Residents	1.94	2.24	0.31, MW, P = 0.33
Difference	0.3, MW, P = 0.15	0.09, t = 0.36, P = 0.75	

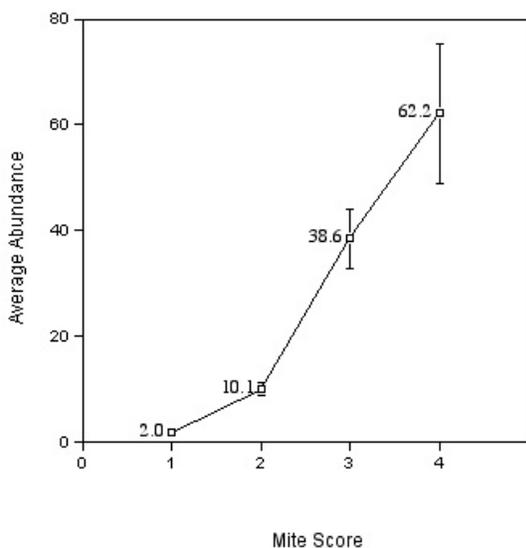


Figure 2— Ranking system reflects actual abundance of chigger mite larvae. The mite scores separated into significantly different categories ($F = 28.44$, $P < 0.0001$). Each mite score is labeled with the average number of mite larvae and standard error bars.

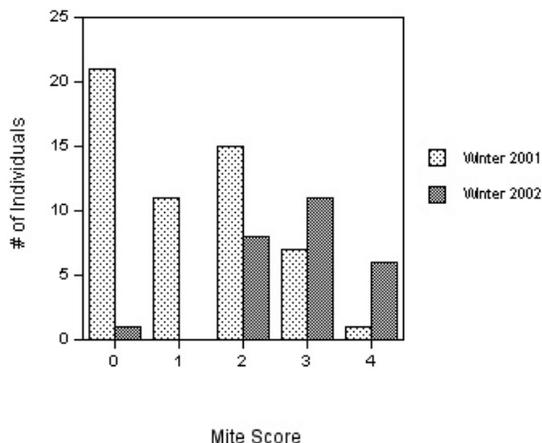


Figure 3— Mite score distribution for Swainson's Thrush (*Catharus ustulatus*) comparing Winter 2001 and Winter 2002. The distribution of mite scores was significantly different between years ($\chi^2 = 29.1$, $P < 0.0001$, $df = 4$).

Individual mites were collected and identified as larvae from the chigger mite family (Acarina: Trombiculidae) at the University of Michigan Museum of Zoology (B. O'Conner, pers. comm.). Voucher specimens have been stored in the museum entomology collection.

Discussion

In Chiapas, Mexico, ectoparasitic chigger mites (*Acarina: Trombiculidae*) affect a wide range of resident and migratory species and for many species there is a high and Winter 2002. The distribution of mite scores was prevalence of infestation (*Appendix 1*). This study opportunistically took data on chigger mite larvae during the course of a mist-netting project using a mite score ranking protocol. The mite score ranking protocol provides a rapid assessment of chigger mite infestation that can be readily incorporated into constant effort mist-net programs. The scoring process takes about the same time per bird as estimating body molt or fat level. Combining the mite scoring with normal body molt or fat level procedures can be done with minimal additional processing time. Mite scores were significantly correlated with actual mite abundance indicating that the ranking system provides a good estimate of infestation intensity (*fig. 2*).

At higher mite ranking scores, there is greater variability in actual abundance, due to chigger mite phenology and the relatively short duration that each larvae is on the host. Some birds that received higher ranking scores but with relatively low abundance had extensive scarring indicating that larvae had recently detached from their host, thus individual birds that have experienced high infestation levels may maintain the extent of infestation (i.e., the number of areas on each bird containing mites), even as mite abundance drops off. Thus, the ranking system may mask some of the variation in actual mite abundance. Nonetheless, the ranking scores provide a good relative measure of infestation intensity.

Useful characteristics that can be used to rank infestation are extent (i.e., proportion of body affected by ectoparasites) and localized intensity. I designed the protocol to evaluate the extent of infestation, then adjust for the intensity of infestation in each area (see *table 1*). Consequently, there is some margin of error when a bird is infested with multiple small clusters in different places or has a few large clusters in only a few locations. The most frequent location for infestation was behind the thighs, where occasionally large colonies (or multiple clusters merged together) were not matched by infestation in other locations, such as behind the wings. Another approach might be to count clusters. However, there is considerable variation in cluster size and cluster can grow and merge together as the larvae move into prime feeding areas. A method that counted clusters would also need to compensate for this variation.

Research on parasites usually requires specialized equipment and time consuming methods that may not be easily used by routine monitoring programs (Clayton and Walther 1997). Exact counts usually require sacrificing the host (Clayton and Drown 2001). Among non-lethal methods compared to sample chewing lice on Pigeons, dust-ruffling was the most effective and chemical fumigation was moderately effective, while visual counts sampled a low proportion of the actual lice on each bird (~10 percent, Clayton and Drown 2001). Nonetheless, visual counts were well correlated with actual lice abundance, performing as well or better than the chemical fumigation method (Clayton and Drown 2001). Lemke and Collison (1985) had similar results with northern fowl mites on laying hens.

Chigger mite larvae are fairly conspicuous once they have attached to the host and become engorged (personal observation). Their bright red color distinguishes them from surrounding skin and feathers quite readily. Though a comparison of sample methods has yet to be done for this ectoparasite, the difficulty in obtaining precise counts is not detectability, but rather adequate processing time to count individual mites within clusters on birds with heavy infestations. The mite score protocol presented here provides a straightforward approach to reducing processing time for each bird.

Simple and rapid methods can provide useful coarse data on the geographic distribution and prevalence of parasites across bird host species. This protocol should be useful for other ectoparasites that cluster in visible locations and can be adapted depending on clustering patterns. The high score could be adjusted to reflect the number of locations infested when individuals have high levels of infestation.

During winter, resident species had overall higher prevalence than migratory species overwintering on the

study area (*Appendix 1*). However when analyzed by year, only 2001 was significantly different. During the 2002 field season, which began slightly later than 2001, the climate was much hotter and dryer and the flowering period of the main overstory tree, *Inga* sp., had passed (personal observation). Consequently, many of the birds that forage in the overstory were absent or only present in small numbers. In particular, there was only one capture of the normally abundant Tennessee Warbler compared to 205 the previous year. Resident and migratory birds had higher prevalence the second year (*table 2*). Chigger mites are usually associated with the soil, which may lead to a greater susceptibility for birds that forage or spend time near the ground. Literak et al. (2002) found that birds with a higher prevalence of trombiculid larvae (>20 percent) were members of ground or near ground foraging guilds. The stronger effect of dryer conditions on the overstory foraging birds, especially among migrants, may have reduced the difference in mite prevalence between migrants and residents the second year of the study, 2002.

Unlike the temperate zone where only one or two generations of chiggers occur each year, chiggers reproduce year round in the tropics (Wharton and Fuller 1952). Consequently, resident species susceptible to chiggers maintain an ectoparasite load year round. On the other hand, migratory species probably accumulate larvae over time after arrival on the wintering grounds until reaching an equilibrium level based on the rate of larvae attachment and detachment following engorgement. This is supported by the significantly higher mean intensity during the second year than the first for migrants. This difference was mostly due to the dramatic difference between years for Swainson's Thrush (*table 2*). This difference may be due to the slightly later sampling in 2002 reflecting the build up of infested individuals with more time or may also reflect more favorable conditions for chigger mite reproduction and host location. Swainson's Thrushes traveling south in the fall captured at United States and Canadian constant effort banding stations do not have chigger mite infestations (Dietsch unpubl. data). A longitudinal study across the wintering season would help determine how this ectoparasite affects migrants each year on their wintering grounds.

Conclusions

Further study is merited on the ecology of ectoparasites, including the geographic distribution and degree to which human landscape management contributes to infestation. There are about 1600 species of chigger mite (Trombiculidae and Leeuwenhoekiiidae) and they have a cosmopolitan distribution (Wharton and Fuller 1952, Vercammen-Grandjean 1968). Some species

have been identified as vectors for one serious human disease, scrub typhus (*Rickettsia tsutsugamushi* Ogata), and a number of wildlife diseases (Wharton and Fuller 1952, Proctor and Owens 2000). Given that migratory birds can travel considerable distances in the time necessary for larvae to engorge themselves and detach, monitoring programs for ectoparasites may be important for recognizing the spread and causes of emerging diseases. The protocol presented here can be readily adopted by ongoing constant effort mist-net programs to begin collecting these data.

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Chigger Mite Protocol - Dietsch

Appendix 1— Prevalence, mean abundance and mean intensity listed by species for each season. The number of individuals scored for each species per season is n. The number of species with at least one infested individual is totaled for migrants and residents below each column.

Scientific name	English name	Winter 2001			Winter 2002			Total			
		N	Prevalence	Mean abundance	Mean intensity	N	Prevalence	Mean abundance	Mean intensity	N	Prevalence
<i>Archilochus colubris</i>	Ruby-throated Hummingbird	24	0.00	0.00						24	0.00
<i>Empidonax minimus</i>	Least Flycatcher	14	0.29	0.29	1.00	5	0.60	1.00	1.67	19	0.37
<i>Vireo gilvus</i>	Warbling Vireo	3	0.00	0.00						3	0.00
<i>Vireo solitarius</i>	Blue-headed Vireo	6	0.17	0.17	1.00					6	0.17
<i>Polioptila caerulea</i>	Blue-gray Gnatcatcher	3	0.00	0.00						3	0.00
<i>Catharus ustulatus</i>	Swainson's Thrush	55	0.62	1.20	1.94	26	0.96	2.81	2.92	81	0.73
<i>Catharus mustelinus</i>	Wood Thrush					1	1.00	2.00	2.00	1	1.00
<i>Vermivora pinus</i>	Blue-winged Warbler	1	0.00	0.00						1	0.00
<i>Vermivora peregrina</i>	Tennessee Warbler	205	0.00	0.01	2.00	1	0.00	0.00		206	0.00
<i>Vermivora ruficapilla</i>	Nashville Warbler	83	0.01	0.01	1.00	13	0.08	0.08	1.00	96	0.02
<i>Dendroica pensylvanica</i>	Chestnut-sided Warbler	5	0.00	0.00						5	0.00
<i>Dendroica magnolia</i>	Magnolia Warbler	14	0.00	0.00		6	0.50	0.50	1.00	20	0.15
<i>Dendroica virens</i>	Black-throated Green Warbler	9	0.00	0.00						9	0.00
<i>Mniotilta varia</i>	Black-and-White Warbler	13	0.08	0.08	1.00	4	0.25	0.25	1.00	17	0.12
<i>Helmitheros vermivorus</i>	Worm-eating Warbler	8	0.13	0.13	1.00	2	0.50	1.00	2.00	10	0.20
<i>Seiurus aurocapillus</i>	Ovenbird	13	0.08	0.08	1.00	8	0.13	0.13	1.00	21	0.10
<i>Seiurus motacilla</i>	Louisiana Waterthrush					1	1.00	1.00	1.00	1	1.00
<i>Oporornis formosus</i>	Kentucky Warbler					1	0.00	0.00		1	0.00
<i>Oporornis tolmiei</i>	MacGillivray's Warbler	3	0.33	0.33	1.00					3	0.33
<i>Wilsonia citrina</i>	Hooded Warbler	1	0.00	0.00		2	0.00	0.00		3	0.00
<i>Wilsonia pusilla</i>	Wilson's Warbler	38	0.11	0.11	1.00	9	0.33	0.44	1.33	47	0.15
<i>Icteria virens</i>	Yellow-breasted Chat	2	0.50	1.00	2.00	1	1.00	2.00	2.00	3	0.67
<i>Piranga ludoviciana</i>	Western Tanager	5	0.00	0.00						5	0.00
<i>Pheucticus ludovicianus</i>	Rose-breasted Grosbeak	20	0.00	0.00		12	0.42	0.42	1.00	32	0.16
<i>Passerina cyanea</i>	Indigo Bunting	13	0.23	0.23	1.00	2	0.50	0.50	1.00	15	0.27
<i>Passerina ciris</i>	Painted Bunting	1	0.00	0.00						1	0.00
Migrant Totals/Averages		539	0.10	0.16	1.64	94	0.50	1.07	2.15	633	0.16
		13 of 23 species				14 of 16 species				17 of 26 species	

Chigger Mite Protocol - Dietsch

Appendix 1— continued.

Scientific name	English name	Winter 2001			Winter 2002			Total	
		N	Prevalence	Mean abundance intensity	N	Prevalence	Mean abundance intensity	N	Prevalence
<i>Leptotila verreauxi</i>	White-tipped Dove	3	0.33	0.67	2.00			3	0.33
<i>Campylopterus hemileucurus</i>	Violet Sobering	3	0.00	0.00		2	0.00	5	0.00
<i>Abeillia abeillei</i>	Emerald-chinned Hummingbird	2	0.00	0.00				2	0.00
<i>Amazilia candida</i>	White-bellied Emerald	22	0.00	0.00				22	0.00
<i>Amazilia cyamura</i>	Blue-tailed Hummingbird	42	0.00	0.00		13	0.08	55	0.02
<i>Amazilia rutila</i>	Cinnamon Hummingbird	3	0.00	0.00				3	0.00
<i>Athys ellioti</i>	Wine-throated Hummingbird	1	0.00	0.00				1	0.00
<i>Momotus momota</i>	Blue-crowned Motmot	2	0.50	1.00	2.00			2	0.50
<i>Synallaxis erythrothorax</i>	Rufous-breasted Spinetail	2	0.00	0.00				2	0.00
<i>Dendrocincla homocroa</i>	Ruddy Woodcreeper					1	0.00	1	0.00
<i>Grallaria guatemalensis</i>	Scaled Antpitta					1	1.00	1	1.00
<i>Myiopagis viridicata</i>	Greenish Elaenia	1	0.00	0.00				1	0.00
<i>Mionectes oleagineus</i>	Ochre-bellied Flycatcher	4	0.00	0.00		6	0.00	10	0.00
<i>Zimmerius vilissimus</i>	Paltry Tyrannulet	1	0.00	0.00				1	0.00
<i>Oncostoma cinereigulare</i>	Northern Bentbill	1	1.00	2.00	2.00			1	1.00
<i>Rhynchochylus brevirostris</i>	Eye-ringed Flatbill	1	0.00	0.00		1	1.00	2	0.50
<i>Tolmomyias sulphureseens</i>	Yellow-olive Flycatcher	4	0.25	0.25	1.00	2	0.50	6	0.33
<i>Contopus pertinax</i>	Greater Pewee	2	0.00	0.00				2	0.00
<i>Empidonax flavescens</i>	Yellowish Flycatcher					2	1.00	2	1.00
<i>Myiarchus tuberculifer</i>	Dusky-capped Flycatcher	4	0.00	0.00				4	0.00
<i>Chiroxiphia linearis</i>	Long-tailed Manakin					2	0.00	2	0.00
<i>Hylophilus decurtatus</i>	Lesser Greenlet	4	0.00	0.00				4	0.00
<i>Thryothorus maculipectus</i>	Spot-breasted Wren	2	1.00	2.00	2.00			2	1.00
<i>Thryothorus rufalbus</i>	Rufous-and-White Wren	4	0.75	2.25	3.00	4	1.00	8	0.88
<i>Thryothorus pleurostictus</i>	Banded Wren	1	0.00	0.00				1	0.00
<i>Thryothorus modestus</i>	Plain Wren	5	0.40	0.80	2.00	2	1.00	7	0.57
<i>Troglodytes aedon</i>	House Wren	10	0.80	1.60	2.00			10	0.80
<i>Henicorhina leucosticta</i>	White-breasted Wood-Wren					1	1.00	1	1.00

Appendix 1— continued.

Scientific name	English name	Winter 2001				Winter 2002				Total	
		N	Prevalence	Mean abundance	Mean intensity	N	Prevalence	Mean abundance	Mean intensity		
<i>Catharus aurantiirostris</i>	Orange-billed Nighthawk	4	1.00	2.25	2.25	3	0.67	1.67	2.50	7	0.86
<i>Turdus assimilis</i>	White-throated Robin	11	0.27	0.45	1.67	7	1.00	2.86	2.86	7	1.00
<i>Turdus grayi</i>	Clay-colored Robin	3	0.33	0.33	1.00	6	0.33	0.33	1.00	17	0.29
<i>Myioborus miniatus</i>	Slate-throated Redstart	3	0.33	0.33	1.00	3	0.33	0.33	1.00	3	0.33
<i>Basileuterus lachrymosa</i>	Fan-tailed Warbler	1	0.00	0.00	0.00	3	0.33	0.33	1.00	4	0.25
<i>Basileuterus culicivorus</i>	Golden-crowned Warbler	23	0.09	0.13	1.50	7	0.14	0.14	1.00	30	0.10
<i>Basileuterus rufifrons</i>	Rufous-capped Warbler	1	0.00	0.00	0.00	5	0.00	0.00	0.00	6	0.00
<i>Habia rubica</i>	Red-crowned Ant-Tanager	5	0.20	0.20	1.00	1	0.00	0.00	0.00	5	0.20
<i>Piranga leucoptera</i>	White-winged Tanager	6	0.17	0.17	1.00	1	0.00	0.00	0.00	1	0.00
<i>Euphonia hirundinacea</i>	Yellow-throated Euphonia	1	0.00	0.00	0.00	1	0.00	0.00	0.00	6	0.17
<i>Cyanerpes cyaneus</i>	Red-legged Honeycreeper	3	0.00	0.00	0.00	1	1.00	1.00	1.00	4	0.25
<i>Diglossa baritula montana</i>	Cinnamon-bellied Flowerpiercer	182	0.17	0.33	1.94	75	0.39	0.87	2.24	257	0.23
<i>Melospiza bicarua</i>	Prevost's Ground-Sparrow	721	0.12	0.20	1.75	169	0.45	0.98	2.18	890	0.18
<i>Melospiza leucotis</i>	White-eared Ground-Sparrow										
Resident Total/Average		14 of 33 species				15 of 23 species				24 of 44 species	
Grand Total/Average											