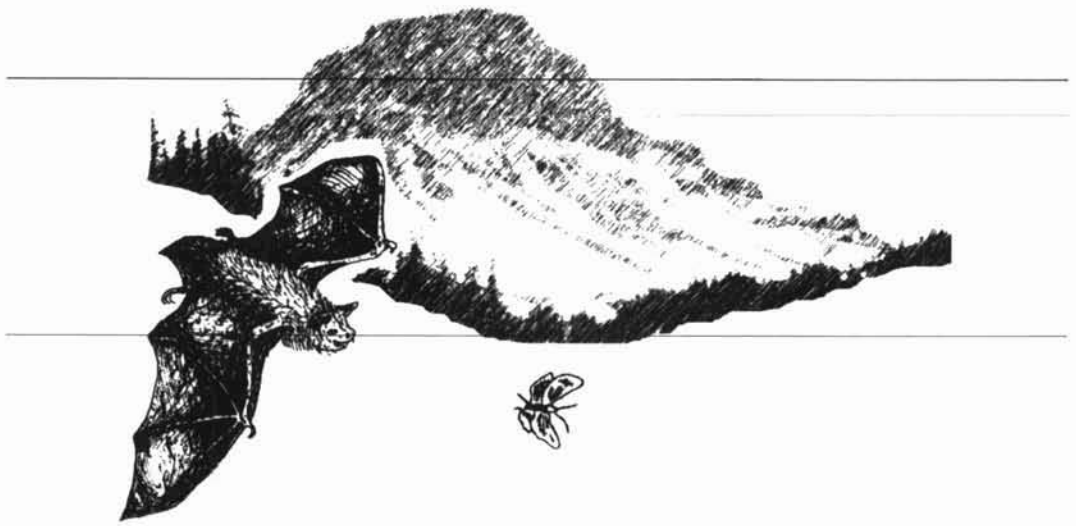
BAT SPECIES ABUNDANCE AND DISTRIBUTION, THE EFFECTS OF FOREST THINNING AND BURNING ON BAT FORAGING ACTIVITY, AND INCIDENCE OF WEST NILE INFECTION IN BATS AT HEIL VALLEY RANCH, 2004



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SUMMARY POINTS FOR 2004 FIELD SEASON

- A total of $15,500 was sequestered by the P.I. for HVR research in 2004
- 91 bats were captured and released across 60 net nights and 15 sites
- 1,606 unknown sonar calls was recorded across 82 detectors nights in 2004
- 90 hand-released calls were recorded for the call library
- Overall apparent decline in bat population numbers in 2004
- Species showing greatest decline was *Myotis lucifugus*
- Positive test of West Nile Virus infection in *Myotis lucifugus*
- Highest declines were in female and juvenile bats for *M. lucifugus* and *M. thysanodes*
- Apparent loss of *M. thysanodes* maternity roost in Geer Canyon
- New record of female, lactating *Corynorhinus townsendii*, an imperiled species
- Higher incidence and dispersion of female *Myotis volans* than recorded in previous years
- Sonar data from 2004 showed the presence of eight species foraging at HVR. However, a single species, *E. fuscus* composed 47% of all recorded calls
- Most active habitat type was meadow, followed by thinned, followed by burn, and forest
- Highest number of species recorded were in thinned habitats ($n = 8$)
- However, Thinned sites were lowest in species diversity when species evenness was taken into account. *E. fuscus* composed 84% of all recorded passes

Abstract: In 2004 we conducted research at Heil Valley Ranch (HVR) to measure 1) bat species abundance and distribution that was begun in 2002, 2) the effects of forest thinning on bat foraging patterns along with establishment of a call library for Colorado bats begun in 2003 and 3) to initiate a new study of the incidence of West Nile virus in bat populations at the Ranch. Results from 2003 added one species (*M. volans*) to the list of bats reproducing at HVR. In addition to replicating capture and release and sonar analysis of previous sites, we added seven new sites to the forest thinning survey, one of which was a burn plot from the Overland fire in fall 2003, two new water hole sites and three terrestrial netting sites for capture and release. Matching funds for the Forest Thinning study were secured from The North American Bat Conservation Partnership ($5K) and for the West Nile virus study from the UNC Research Scholarship fund ($2.5K).

Despite a very wet, rainy, windy and cool summer which frustrated our netting attempts, a total of 91 bats were captured across 29 nights (60 net nights) and 15 sites. Curiously, bats species that were rare (i.e. *Myotis volans*) in previous years were more abundant (n = 4) and captured across more sites ($n = 3$); where the most common species (*M. lucifugus*) were rarely captured ($n = 8$) in 2004. A highlight was the capture of two female, lactating Townsend's big-eared bats (*Corynorhinus townsendii*) at Ingersol Quarry in September. This is the first record of females of this imperiled species at HVR. Overall trend in species abundance and distribution was down in 2004. Species of highest loss were *M. lucifugus* and *M. thysanodes* which showed large declines in females and juveniles. A maternity colony of *M. thysanodes* in Geer Canyon that predictably visited our middle Geer Canyon netting site in 2003, was nonexistent.

Of the 22 individuals (10 *M. evotis*, 7 *M. lucifugus*; and 5 *M. thysanodes*) tested for West Nile virus, none showed measurable level of viremia in their saliva. Blood analysis, however, showed an adult male, *M. lucifugus* to have antibody inhibin to WNV infection.

INTRODUCTION

Part I: ***Tracking Species Abundance and Distribution:*** Because bats are difficult to catch and change their foraging patterns and areas seasonally, long-term studies of bat populations are required to ascertain presence and abundance of bat populations. In addition, because bats are susceptible to human disturbance, infectious diseases, and are responsive to climate variation, year-to-year patterns may shift and thus require long-term efforts to understand regional ecology, population dynamics and stability. In this third year of capture and release data collection, we begin to better understand ecological patterns of bats at Heil Valley Ranch (HVR), Boulder County, Colorado. Four components of the study of bats at HVR have evolved over the past three years.

Part 1: Species Presence/Abundance and Roost Site Presence: In 2002, we began mist netting bats at ephemeral and nonephemeral water holes throughout HVR. In addition, radio tagging of some lactating female individuals allowed for locating and mapping maternity roost sites as well as allowing outflight counts and emergence times of various colonies and species. These data are paramount in the management and conservation of bat species in the West. In 2004, we continued with mist netting efforts that contributed new information on species abundance and species presence at HVR.

Part 2: Forest Thinning Practices: Protecting critical foraging habitats for bats is of paramount importance because loss of critical foraging habitat can affect the stability and survivorship of bat populations, and several critical factors need be in balance. For insectivorous bats, foraging in less cluttered habitats is most energy efficient because obstacle avoidance is limited as they hunt. However, foraging in open areas has its own risks, such as predation from owls at night, or other raptors before darkness (Erickson and West, 2002).

Human impacts to foraging habitats usually come in the form of forest cutting and various other degradations. Clear-cutting practices have likely caused the loss of some bat populations, however, the overall effects will never truly be known. Studies in the West indicate bat activity is low where clear-cutting has occurred. Conversely, the less-severe practice of forest thinning may enhance bat foraging areas (Parker et al., 1996; Perdue and Steventon, 1996). In 2003, we began a study to understand the effects of forest thinning practices currently underway at HVR using set ¼ hectare plots in four habitat types. This study continued in 2004.

Part 3: Building a Sonar Call Library: In connection with the forest thinning study, we began in 2003 to build a sonar call library based upon calls expressed by hand-released, individuals of identified species. These calls are used to compare with unknowns recorded in each of the test plots for identification purposes. We continued to build the call library in 2004.

Part 4: Incidence of West Nile Virus in HVR Bat Populations: Insectivorous bats are the predominant foragers of night-flying insects, including adult mosquitoes (Gould 1955; Griffin et al. 1960; Findley, 1993; Altringham, 1996). In Colorado, myotis species consume mosquitoes in variable amounts (Adams, 2003). In Moffat County, *M. lucifugus* consumed 21% of their diet in flies, including mosquitoes with other myotis species consuming about 10% of their diet in flies (Freeman, 1984). Diets of bats, however, differ regionally. Adams (1993, 1997) found seasonal differences in consumption of Diptera by *M. lucifugus*, from 28% in spring to 38% in fall. If the consumption of mosquitoes by bats causes West Nile Virus (WNV) infections remains unknown. However, some bat species have tested positive for infection by WNV in New York (Marra et al., 2003). Because Boulder, Larimer, and Weld counties were the "hot-zone" for human cases of WNV infections, we initiated a study to document the incidence of WNV infection in *Myotis* species at HVR in 2004.

METHODS

Capture and Release: We continued mist netting bats at previously netted water holes and at previously unnetted locations throughout the park. In addition, forest netting occurred in sonar survey plots at times other than detector deployment censusing to corroborate analysis of unknown sonar data.

Bat Activity and Forest Thinning: As in 2003, Pettersson 240X time-expansion, sonar detectors interfaced with Sony tape recorders were position in ¼ hectare fixed plots in unthinned forest, recently thinned forest (2002), and open meadows. In addition, we sampled a burned site from the Overland fire event that occurred in October 2003. We added four detector units to the survey in 2004 allowing for censusing of two plots simultaneous. One-quarter hectare plots were established in each of the treatment groups and followed the protocol established in 2003. ***Null hypotheses:*** **H_0:** There are no significant differences in bat foraging activity as measured by sonar pass recordings between unthinned, human-thinned, montane meadow, and natural burned habitats (i.e. treatment plots). **H_1:** Bat species composition will not be significantly different between treatment plots.

Building a Call Library: We continued to construct the bat call library by recording sonar calls from hand-released individuals of known species.

***Blood Sampling for West Nile Virus*:** Bats were captured in mist nets and anaesthetized using Isoflurane. Approximately 30 µL of blood was drawn from an artery located in the interfemoral membrane by puncturing with a 25 gauge needle and collected in heparinized, glass capillary tubes (Lollar and Schmidt-French 2002; Kunz and Nagy 1988). Pressure was applied to the wound the researcher's index finger, until blood-loss ceased. Individuals were returned to capture sacs for 20 minutes to ensure that bleeding did not reoccur. Individuals were then

released. Blood samples were put on ice and later spun down using a Autocrit Ultra 2 micro-centrifuge and stabilized using Ambion, Ribopure blood kit. Samples were analyzed using a 1-step RT-PCR kit (Ambion) called Retroscript (Kauffman, et al., 2003).

***Null hypothesis*: H_0:** There will be no antibodies present for WNV in bats at HVR.

Viremia Testing: Oral swabs were taken from individuals in the field, stored in sealed plastic tubes and kept on ice. These samples were tested with Ambion Viremia Test Strip Indicators.

***Null hypothesis*: H_0:** There will be no viremia detected for WNV in the saliva of bats at HVR.

RESULTS

Matching funds for the Forest Thinning study were secured from The North American Bat Conservation Partnership ($5K) and for the West Nile virus study from the UNC Research Scholarship fund ($2.5K) and UNC Foundation for purchasing of an Autocrit microcentrifuge ($3K). Total funding for the 2004 season for bats at HVR was $15,500.

Capture Data: Despite a very wet, rainy, windy and cool summer which frustrated our netting attempts, a total of 91 bats were captured across 29 nights (60 net nights) and 15 sites (Table 1). Curiously, bats species that were rare (i.e. *Myotis volans*) in previous years were more abundant ($n = 4$) and captured across more sites ($n = 3$); where the most common species (*M. lucifugus*) were rarely captured ($n = 8$) in 2004. A highlight was the capture of two female, lactating Townsend's big-eared bats (*Corynorhinus townsendii*) at Ingersol Quarry in September. This is the first record of females of this imperiled species at HVR. See Discussion section concerning patterns across capture data gathered from 2001-2003.

Table 1. *Capture and release data from 2004, organized by capture site.*

Date	Location	Species	Sex	Age	Repro	Weight	Status
18-Jul	Burn 1	no captures					
19-Jul	Burn 1	no captures					
1-Aug	Forest 4	no captures					
12-Aug	Ingersol Quarry	M. evotis 001	male	A	S	5.1	bled/released
12-Aug	Ingersol Quarry	M. evotis 002	female	A	L	NW	bled/released
12-Aug	Ingersol Quarry	M. evotis 003	female	A	L	NW	bled/released
12-Aug	Ingersol Quarry	M. evotis 004	female	A	NLNP	NW	bled/released
29-Aug	Ingersol Quarry	M. evotis 007	male	A	S	6.1	bled/released
29-Aug	Ingersol Quarry	M. evotis 008	female	A	NLNP	6	bled/released
29-Aug	Ingersol Quarry	M. evotis 009	female	A	PL	6.8	bled/released
29-Aug	Ingersol Quarry	M. evotis 010	female	A	PL	6.1	bled/released
29-Aug	Ingersol Quarry	M. lucifugus 001	male	A	S	6.8	bled/released
11-Sep	Ingersol Quarry	M. lucifugus 002	male	A	S	6	bled/released
11-Sep	Ingersol Quarry	M. lucifugus 003	female	A	S	6.1	bled/released
11-Sep	Ingersol Quarry	M. lucifugus 004	male	A	S	6	bled/released
11-Sep	Ingersol Quarry	M. lucifugus 005	male	A	S	6	bled/released
11-Sep	Ingersol Quarry	M. lucifugus 006	male	A	S	6	bled/released
11-Sep	Ingersol Quarry	M. lucifugus 007	male	A	S	6	bled/released
12-Aug	Ingersol Quarry	M. thysanodes 003	female	A	L	7.1	bled/released
12-Aug	Ingersol Quarry	M. thysanodes 004	female	A	L	NW	bled/released
29-Aug	Ingersol Quarry	**C. townsendii**	female	A	L	13.5	released
29-Aug	Ingersol Quarry	**C. townsendii**	female	A	L	NW	released
29-Aug	Ingersol Quarry	E. fuscus	male	A	NS	16	released
29-Aug	Ingersol Quarry	E. fuscus	male	A	NS	16.5	released
11-Sep	Ingersol Quarry	E. fuscus	male	A	S	NW	released
11-Sep	Ingersol Quarry	E. fuscus	male	A	S	NW	released
10-Jul	Ingersol Quarry	M. ciliolabrum	male	A	NS	4.5	released
12-Aug	Ingersol Quarry	M. ciliolabrum	male	A	S	4.3	released
12-Aug	Ingersol Quarry	M. ciliolabrum	male	A	S	3.8	released
11-Sep	Ingersol Quarry	M. ciliolabrum	male	SA	NS	4.4	released
12-Aug	Ingersol Quarry	M. evotis	male	A	S	13.2	released
12-Aug	Ingersol Quarry	M. evotis	male	A	S	5.9	released
12-Aug	Ingersol Quarry	M. evotis	male	A	S	6.3	released
12-Aug	Ingersol Quarry	M. evotis	female	A	NLNP	5.8	released
12-Aug	Ingersol Quarry	M. evotis	male	A	S	6.3	released
12-Aug	Ingersol Quarry	M. evotis	male	A	S	6.3	released
12-Aug	Ingersol Quarry	M. evotis	male	A	S	5.2	released
12-Aug	Ingersol Quarry	M. evotis	female	A	L	7.8	released
29-Aug	Ingersol Quarry	M. evotis	male	A	S	5.9	released
29-Aug	Ingersol Quarry	M. evotis	male	A	S	6.9	released
29-Aug	Ingersol Quarry	M. evotis	male	A	S	7	released

29-Aug	Ingersol Quarry	M. evotis	male	A	S	6.1	released
29-Aug	Ingersol Quarry	M. evotis	female	A	L	7.3	released
29-Aug	Ingersol Quarry	M. evotis	female	J	NLNP	5	released
11-Sep	Ingersol Quarry	M. evotis	male	A	NS	6.6	released
11-Sep	Ingersol Quarry	M. evotis	male	A	NS	6.6	released
11-Sep	Ingersol Quarry	M. evotis	male	J	NS	6.1	released
11-Sep	Ingersol Quarry	M. evotis	male	A	NS	6.6	released
11-Sep	Ingersol Quarry	M. evotis	male	A	NS	8.5	released
11-Sep	Ingersol Quarry	M. evotis	male	A	NS	6.9	released
11-Sep	Ingersol Quarry	M. evotis	male	A	NS	6.5	released
11-Sep	Ingersol Quarry	M. evotis	male	A	NS	6.4	released
11-Sep	Ingersol Quarry	M. evotis	female	A	P	8.7	released
10-Jul	Ingersol Quarry	M. thysanodes	male	A	NS	6.5	released
10-Jul	Ingersol Quarry	M. thysanodes	male	A	NS	7.5	released
11-Sep	Ingersol Quarry	M. thysanodes	female	A	PL	7.9	released
18-Sep	Ingersol Quarry	no captures					
24-Aug	Lower Geer Canyon	M. evotis 005	female	A	L	NW	bled/released
24-Aug	Lower Geer Canyon	M. evotis 006	male	A	NS	NW	bled/released
24-Aug	Lower Geer Canyon	M. thysanodes 005	female	SA	NLNP	NW	bled/released
2-Jun	Lower Geer Canyon	no captures					
6-Sep	Lower Geer Canyon	no captures					
25-Jul	Meadow 3	no captures					
9-Jul	Middle Geer Canyon	M. thysanodes 002	female	A	L	9.3	bled/released
7-Jun	Middle Geer Canyon	M. volans	female	A	P	5.8	died
7-Jun	Middle Geer Canyon	M. thysanodes	female	A	P		escaped
7-Jun	Middle Geer Canyon	E. fuscus	male	A	S	17	released
7-Jun	Middle Geer Canyon	E. fuscus	male	A	NS	11	released
7-Jun	Middle Geer Canyon	E. fuscus	male	A	NS	12	released
7-Jun	Middle Geer Canyon	E. fuscus	male	A	NS	14.5	released
7-Jun	Middle Geer Canyon	E. fuscus	male	A	NS	12.6	released
7-Jun	Middle Geer Canyon	E. fuscus	male	A	NS	13.5	released
7-Jun	Middle Geer Canyon	E. fuscus	male	A	NS	15.6	released
8-Jul	Middle Geer Canyon	L. cinereus	male	A	NS	26	released
8-Jul	Middle Geer Canyon	L. cinereus	male	A	NS	27	released
8-Jul	Middle Geer Canyon	L. noctivagans	male	A	NS	10	released
9-Jul	Middle Geer Canyon	L. noctivagans	male	A	NS	11.5	released
7-Jun	Middle Geer Canyon	M. ciliolabrum	female	A	P	NW	released
8-Jul	Middle Geer Canyon	M. ciliolabrum	male	A	NS	4.4	released
24-Aug	Middle Geer Canyon	M. ciliolabrum	male	J	NS	6.1	released
8-Jul	Middle Geer Canyon	M. evotis	male	A	NS	5	released
7-Jun	Middle Geer Canyon	M. thysanodes	female	A	P	7.5	released
7-Jun	Middle Geer Canyon	M. thysanodes	female	A	P	5.8	released
8-Jul	Middle Geer Canyon	M. thysanodes	female	A	P	10.3	released
6-Jul	Plumely Canyon	no captures					

1-Jun	Quarry 2	E. fuscus	male	A	NS	12	released
1-Jun	Quarry 2	E. fuscus	male	A	NS	13.1	released
1-Jun	Quarry 2	E. fuscus	male	A	NS	15	released
1-Jun	Quarry 2	E. fuscus	male	A	NS	11.7	released
1-Jun	Quarry 2	E. fuscus	male	A	NS	15.5	released
1-Jun	Quarry 2	M. thysanodes	female	A	P	6.5	released
1-Jun	Quarry 2	M. volans	female	A	P	7	released
1-Jun	Quarry 2	M. volans	female	A	L	9.5	released
13-Aug	Quarry 3	no captures					
30-Jul	Road 1 & 2	no captures					
Aug-04	Roadside Geer Canyon	E. fuscus	female	A	PL	18	released
17-Jun	Thinned 2	no captures					
11-Aug	Thinned 2	no captures					
1-Sep	Thinned 2	no captures					
29-Jul	Thinned 3	M. thysanodes 001	female	A	L	6.5	bled/released
29-Jul	Thinned 3	M. thysanodes	male	A	NS	9.5	released
28-Jul	Thinned 3	no captures					
22-Jun	Upper Geer Canyon	E. fuscus	male	A	NS	15.4	released
22-Jun	Upper Geer Canyon	M. volans	female	A	P	NW	released
13-Jul	Upper Geer Canyon	no captures					
27-Jul	Upper Geer Canyon	no captures					

Sonar Survey Data: A total of 1,606 unknown sonar calls was recorded across 82 detectors nights in 2004. Of these, 17 sonar passes were recorded from the burn site, 19 from forested sites, 412 from thinned sites, 1,158 from meadows. Averaging across detectors nights for each plot gives 1.14 call detections per detector in the burn site ($n = 3$), 0.12 calls per detector in forested sites ($n = 5$), 25.75 calls per detector in thinned sites, and 96.5 call per detector in meadow sites.

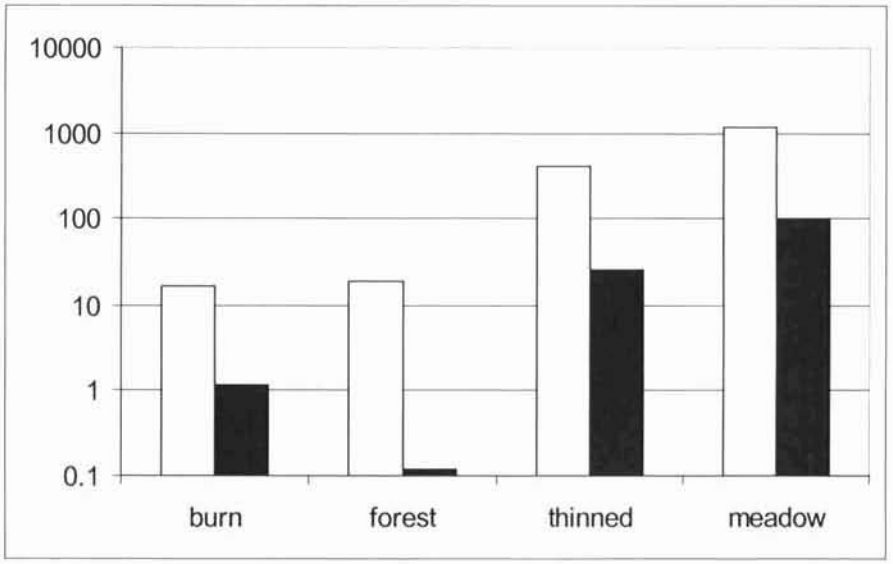

Figure 1. Pooled data from sonar analysis of plot types. Open bars indicate raw number of sonar passes, whereas filled bats are raw data adjusted for sampling effort in terms of number of sites of similar type censused in 2004 and number of detectors per site. Black bars indicate number of sonar passes detected per detector across samples.

Patterns on raw data (open bars) indicate that highest use by bats for foraging was in meadows, followed by thinned sites, burn sites, and lastly forested sites. However, when number of detectors is taken into account associated with number deployed per plot type (forest 6, al others 4) and number of times each plot type was censused in 2004, we see that the forest plots although a bit higher in raw data recorded, were drastically lower after calculating adjusted usage. The number of species detected using each plot type also varied.

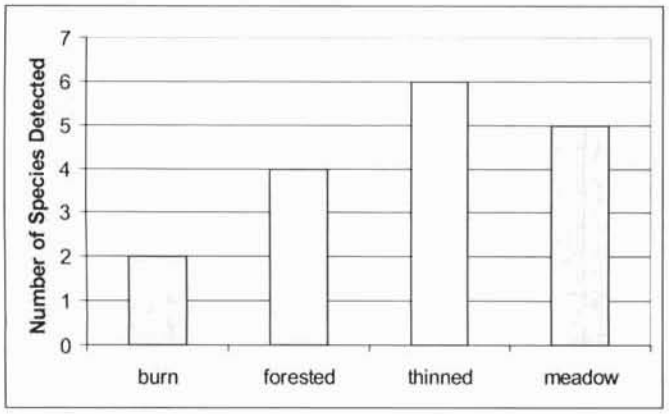

Figure 2. Number of species detected foraging in each plot type.

Thinned areas showed the highest species number detected, followed by meadows, forested and burn sites. However, the picture differs when looking at taxonomic diversity within each plot. *Myotis* species were most abundant in forested habitat; whereas *Eptesicus* dominated

Table 2. *Ratios of three taxa across plot types. Sums per plot types = 100%*

Taxon	**Burn**	**Forested**	**Thinned**	**Meadow**
Myotis	0.47	0.70	0.11	0.13
Eptesicus	0.13	0.30	0.85	0.55
Lasiurines	0.40	0	0.04	0.31

in thinned areas, and also in meadows, but to a lesser extent. Lasiurines (*Lasiurus cinereus* and *Lasionycteris noctivagans*) were recorded in highest frequency in the burn area, however, it is possible that they were flying above the burn area rather than through it. Table 3 shows tabular statistics of Diversity($H = - \Sigma p_i (\ln p_i)$, and Evenness ($J = H/Hmax$).

Table 3. *Diversity, measured using Shannon Index, and Evenness calculations across habitats relative to the distribution of* Myotis *spp.*, E. fuscus, *and Lasiurines.*

Habitat	**Diversity (*H*)**	**Evenness (*J*)**
Burn	0.97	0.89
Forested	0.6	0.87
Thinned	0.51	0.47
Meadow	0.95	0.87

Diversity was highest in the Burn and Meadow sites, with the least diversity using Thinned sites. Evenness was lowest in Thinned sites, where *E. fuscus* dominated (85%) the number of sonar calls gathered in those areas. The Burn and Forested areas, although low in number of detected calls, were high in diversity and species evenness.

West Nile Virus Data: Of the 22 individuals (10 *M. evotis*, 7 *M. lucifugus*; and 5 *M. thysanodes*) tested for West Nile virus, none showed measurable level of viremia in their saliva. Blood analysis for WNV antibodies showed one positive outcome. An adult, nonscrotal male *Myotis lucifugus* showed positive for WNV antibody inhibition indicating that it was at some point infected with WNV.

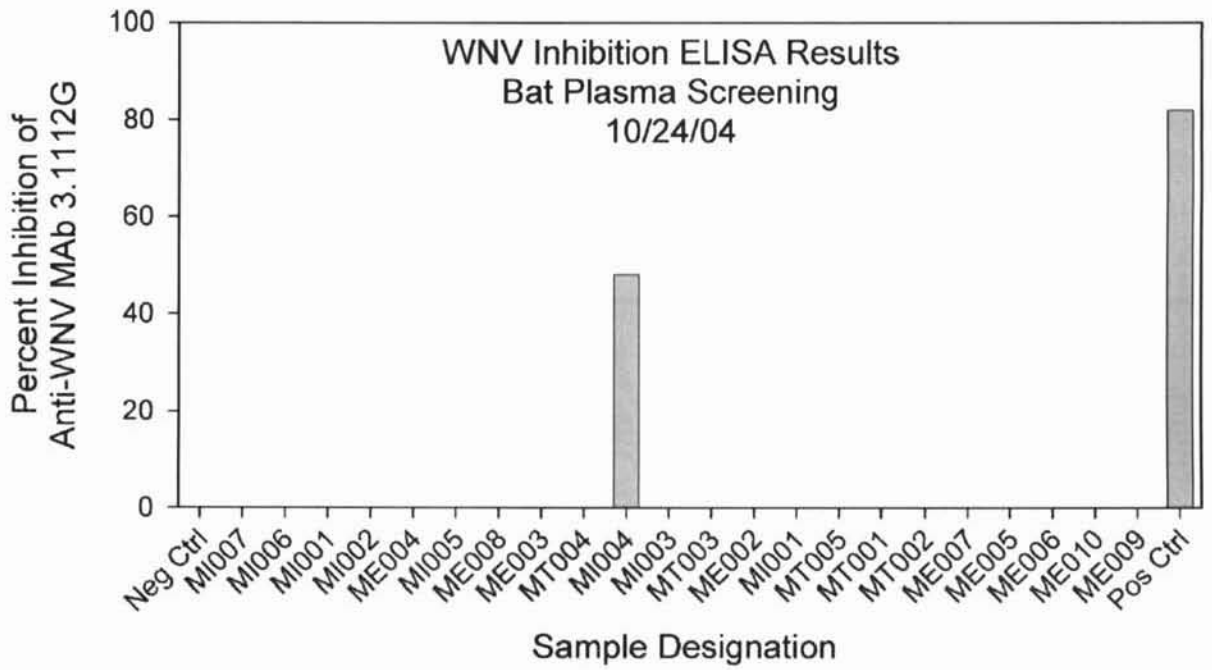

Figure 3. Results from ELISA test on blood samples for incidence of West Nile Virus inhibin response among three myotis species (MI = *Myotis lucifugus*, ME = *M. evotis*, Mt = *M. thysanodes*). One positive response was found to occur in an adult male *M. lucifugus* captured at Ingersol Quarry in September.

Thus, the null hypothesis that WNV infection would not be found in *Myotis* species was refuted. Tests for viremia excretion in saliva were negative and thus the null hypothesis for viremia was supported.

DISCUSSION

Despite the impression that bat population numbers on HVR in 2004 were depressed from previous years, we were able to capture more individuals than in previous years by netting more often and later into the field season (mid-September). Most telling was the drop in overall captures of *M. lucifugus* over the last three years, 23 in 2002, 14 in 2003, and 9 in 2004. In addition, whereas the ratio of females to males had been about equal (47% females in 2002, 50% females in 2003), in 2004 only one of eight (12.5%) were female (Table 2).

Table 4. *Comparative capture data across three years at HVR.*

Species	**2002**	**2003**	**2004**	**Total**
M. ciliolabrum	1 (♀)	7 (4♀, 3♂)	7 (1♀, 6♂)	15 (6♀, 9♂)
M. evotis	21 (6♀, 11♂)	15 (9♀, 6♂)	34 (9♀, 25♂)	70 (24♀, 42♂)
M. lucifugus	23 (12♀, 11♂)	14 (7♀, 7♂)	9 (1♀, 8♂)	46 (20♀, 26♂)
M. thysanodes	17 (13♀, 4♂)	22 (9♀, 11♂)	14 (11♀, 3♂)	53 (33♀, 18♂)
M. volans	0	1 (♀)	4 (♀)	5 (5♀, 0♂)
E. fuscus	7 (♂)	38 (♂)	18 (1♀, 17♂)	63 (1♀, 62♂)
L. cinereus	1 (♂)	0	2 (♂)	3 (0♀, 3♂)
L. noctivagans	1 (♂)	1 (♂)	2 (♂)	4 (0♀, 4♂)
C. townsendii	1 (♂)	0	2 (♀)	3 (2♀, 1♂)
Total	32♀, 36♂	30♀, 66♂	25♀, 63♂	

Overall capture of juvenile bats has decreased significantly at HVR from 29% of all captures in 2002, to 20% in 2003, to 4.6% in 2004. The species of highest decline in juvenile numbers was *M. thysanodes* that showed a high of 45.4% of all captures as juveniles in 2003.

This was higher than in 2002 (23.5%) because we found a new netting spot at Middle Geer Canyon where juveniles congregated presumably roosting in the maternity roost found proximate to the water hole. Netting at this spot in 2004 yielded only one of 14 captures as juvenile (7.1%). Indeed, the maternity roost found in Middle Geer Canyon in 2002 appeared empty or to contain only a few individuals in 2004 (Table 3).

Table 5. *Comparative age distributions per species across years at HVR.*

Species	**2002**	**2003**	**2004**
M. ciliolabrum	A(1) J(0)	A(3) J(2)	A(6) J(1)
M. evotis	A(8) J(9)	A(8) J(7)	A(32) J(2)
M. lucifugus	A(19) J(4)	A(14) J(0)	A(9) J(0)
M. thysanodes	A(13) J(4)	A (12) J(10)	A(13) J(1)
M. volans	A(1) J(0)	A(1) J(0)	A(4) J(0)
E. fuscus	A(5) J(2)	A(38) J(0)	A(18) J(0)
Total	**A(47) J(19)**	**A(76) J(19)**	**A(82) J(4)**

Sonar data from 2004 showed the presence of eight species however, a single species, *E. fuscus* composed 47% of all recorded calls. Although difficult at this point to draw conclusion for the apparent decline in bat population numbers at HVR, it is conceivable that WNV has culled bat populations in the area. Capture data collected on OSMP property in 2004 corroborated drops in population numbers, especially for *M. lucifugus*. For example, sampling over the past nine years at water holes on OSMP property showed high numbers of *M. lucifugus* that typically composed about 35% of all captures, on average 100 individuals captured per year. In 2004, we captured only a single male *M. lucifugus* on OSMP property. In addition, roost sites housing maternity colonies of *M. thysanodes* that we have been monitoring for at least five years were either unoccupied this year or housed only a fraction of individuals relative to colony

counts in past years.

Sonar sampling continued to show thinned areas heavily used by foraging bats. However, if a drop in *Myotis* species began in 2003 and continued into 2004, the bat assemblage at HVR is becoming skewed heavily towards open aerial foragers. The drop in numbers of myotis bats at HVR may be due to WNV infection, but could also be associated with the thinning of forest at HVR. In particular, thinning should be done with care relative to *M. thysanodes* and *M. evotis* both of which forage preferably in forested habitats. The fact that *M. evotis*, the most clutter adapted bat at HVR has not shown massive population declines and therefore the probability that forest thinning has thus affected *Myotis* populations is not immediately apparent. However, *M. evotis* does need a minimum critical area of thickly forested habitat to maintain population health. The minimum amount needed is not known. Further testing for WNV infection should be undertaken to better ascertain its affects on HVR bat populations.

FUTURE NEEDS

- Continue blood sampling for WNV
- Radio-tag female *C. townsendii* in order to locate roost site
- Continue sonar data collection from forest thinning operation
- Continue building sonar call library

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