2024 DEER MICE AND VOLE MONITORING KAMLOOPS BC

EXECUTIVE SUMMARY

Prepared by Paige Skofteby
October 18th, 2024

Though petite in size, small mammals play a vital role in structure and function of ecosystems, with a particularly remarkable ability to drastically alter the vegetation and processes that occur within grassland habitats (Hale 2002). Despite their efforts not being easily visible to the human eye, small mammals provide habitat for various species of wildlife and vegetation by engineering specialized patches which improves landscape heterogeneity (Hale 2002). Their services extend further as seed dispersers, consumers of invertebrates, vegetation, seeds, and woody material, as well as important prey for several grassland predators (Hale 2002). The role they play as multi-trophic linkages in the grassland food web (Minor and Eichholz 2024) are particularly crucial for these ecosystems, since over 30% of species at risk in BC inhabit them (Hale 2002). Thus, understanding abundance patterns and distribution of small mammals in grasslands, which cover less than 1% of BC's land base (Hale 2002), can further our management efforts to protect a vast range of trophic level species and habitat.

Compared to other vertebrates, small mammals are often in abundance, have a smaller range within their populations (Larson, Adams & Haughland 2007) and are easily captured, making them relatively easy to study (Watson 2024). Although small mammals have been studied for over 60 years (Watson 2024), a deeper comprehension of the mechanisms causing population fluctuations on both small and large scales is still undetermined (Hale 2002). The complex dynamics between resource-consumer relationships can only further be understood by continuing long-term studies (Brown and Ernest 2002).

In Kamloops BC, a small mammal study across three sites has occurred annually since 1997. The key species being monitored are deer mice (*Peromyscus maniculatus*), meadow voles (*Microtus pennsylvanicus*) and montane vole (*Microtus montanus*) using mark-recapture techniques. While both vole species have population cycles, occurring every 2-5 years for the meadow vole and 3-4 years for montane vole, the deer mice populations don't show cycles, but rather inter-annual fluctuations (Watson 2024). For this report, the meadow vole and montane vole will be referred together as vole species. The objective of the study is to monitor deer mice and vole densities over time and assess the relationship between deer mice densities and monthly precipitation between March-September (Watson 2024)

Over the past 27 years, sampling grids have been assembled at three study sites within Kamloops by the NRSC 4040 Wildlife Management class at Thompson Rivers University. There is an optional fourth location that has been utilized in the past when the class has more participants. The sites are located in arid grasslands, dominated by bluebunch wheatgrass and big sagebrush, with ponderosa pines scattered along the habitat edges. The study runs on the third week of September and takes a total of 8 days to complete.

On each site, a 15m x 15m grid is measured out to create four parallel transect lines that are labelled A, B, C and D. Along each line, 15 Longworth traps are placed 15m apart, making a total of 60 traps per study site. A piece of flagging tape is placed in a visible location near each trap and labelled with a trap identification code that is created based on the line and trap number, beginning with A1 and ending at A15 for the first line. Traps are placed on flat ground to prevent rolling, and near covered areas if available, such as coarse woody debris or big sagebrush, to enhance capture probability. To avoid rainfall entry, a flat plastic board is strapped to the top and traps are positioned to face downhill. All traps are left locked open on the first night with no bait.

For the following three nights, traps remain locked out, but each is checked to ensure that it has not been tampered with. A seed mixture comprised of sunflower seeds and oats is placed in the trap tunnel and slightly outside of it, to establish trust and comfortability with the small mammals on site. After the three nights of pre-baiting are complete, the box of the traps is filled with cotton for warmth, a slice of apple for hydration and a handful of seed mixture, then set to capture on the fifth evening of the study. At 6:45am the next morning, all traps are checked for individuals captured. When an animal is capture, the trap is carefully disassembled and placed into a 5-gallon bucket to prevent escapement. One team member records information on the animal and what trap they were captured in, while another wearing proper PPE gently assesses the animal to identify the species and sex before attaching an ear-tag that contains an individualized coded. The animal is then placed into a plastic bag to obtain the weight before being released. Once the trap is check, it is locked open for the day, until later that evening when the entire site is reset for capture, repeating two more evenings of the study. Any individual with a coded ear-tag that trapped again one the remaining days is recorded as recaptured under whichever tap it was caught in.

To estimate the total population size of deer mice and voles amongst our study sites, we used a mark-recapture method, which requires capturing individuals, marking them with an identifiable code, releasing them and then resampling multiple times to establish population densities (Ransome 2024). Since there is three days of capturing done during this study, the K-sample capture-recapture model was used, which assumes the population is closed, meaning there are no births, deaths, immigration, or emigration occurring during the time of sampling and that no individuals will lose their identification marks, which are properly recorded (Ransome 2024). The average population densities of deer mice and voles from the 2024 captures are compiled and compared with the results of previous years findings to obtain an understanding of changes in population density within the sites. Figure 1 below shows high fluctuation on the average densities for both populations, however deer mice have substantially higher variation consistently throughout the years of this study.

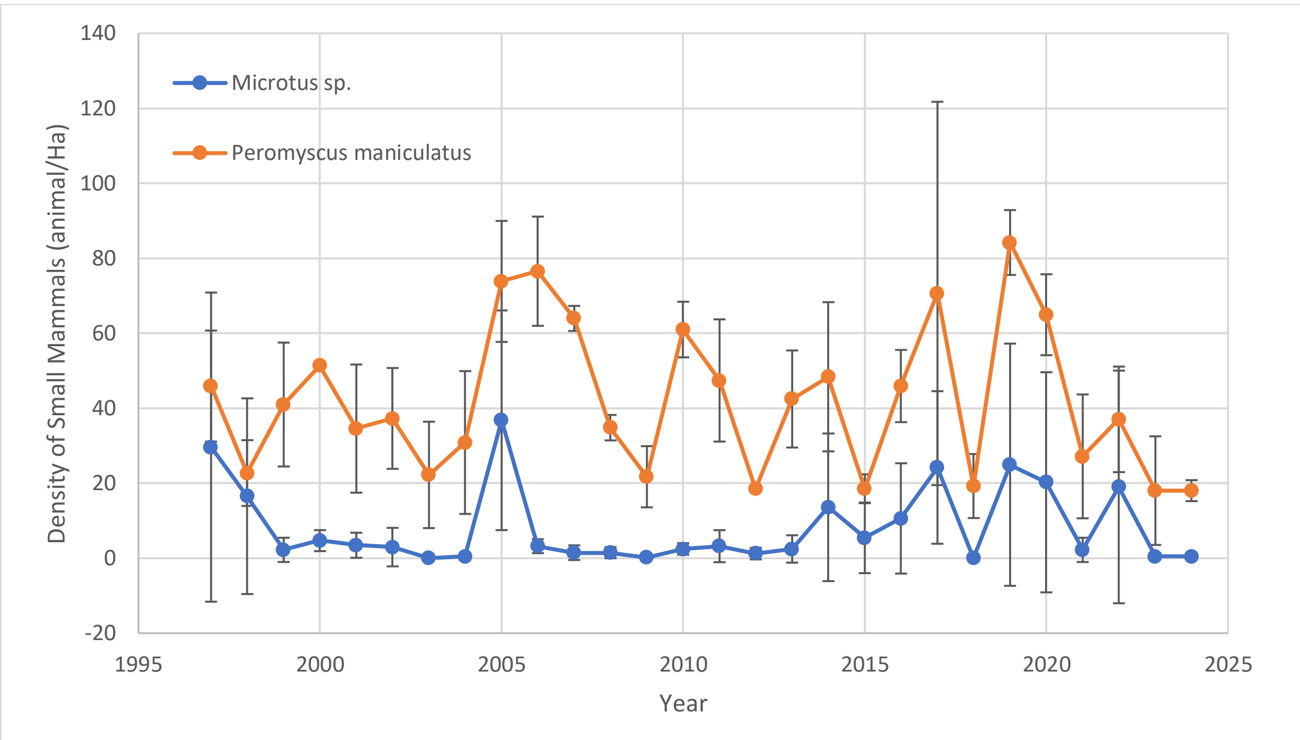

***Figure 1.* Average density of P. maniculatus and Microtus sp. between 1997-2024, amongst three grassland locations in Kamloops, BC.**

The average mean density for deer mice populations between 1997-2024 is 42.08, while the voles mean average density is 8. Although both deer mice and vole populations have had variability in their average densities over time, there are some areas of overlap between years with the highest and lowest densities, as seen in Table 1. Some of the highest densities for both species occured within the same four years. Additionally, the lowest densities for both species happened in the same three years, leading to the belief that the same pressure was put on both species cause the flux or decline in population sizes. Six years of the highest and lowest density years were listed in Table 1, due to only 1 vole capture occurring across all three sites in 2004, 2009, 2023 and 2024. In 2003 and 2019, not a single vole was captured at any time during the study period.

***Table 1.* Evaluating average density trends in deer mice and voles between 1997-2024 from three study sites in Kamloops, BC.**

	Deer Mice	Voles
Highest Densities	84.20 (2019)	37 (2005)
	76.54 (2006)	30 (1997)
	73.83 (2005)	25 (2019)
	70.62 (2017)	24 (2017)
	64.94 (2020)	20 (2020)
	63.95 (2007)	19 (2022)
Lowest Densities	18.02 (2024)	0 (2003)
	18.02 (2023)	0 (2019)
	18.52 (2015)	0 (2004)
	18.52 (2012)	0 (2009)
	19.26 (2018)	0 (2023)
	21.73 (2009)	0 (2024)

The Anderson-Darling test was used to check for normality when examining the relationship between monthly precipitation from March to September and average densities of deer mice over the duration of this study. Table 2 shows normal distribution for the monthly precipitation values in March, May and July, allowing a Pearson correlation test to be ran with those values. An indication of not normal distribution is found when a P-Value is <0.05, which occurred for April, June and August, meaning a Spearman correlation test was required.

***Table 2.* Results of Anderson-Darling (AD) normality test**

Variable	P-Value	AD
March Precipitation	0.122	0.575
April Precipitation	<0.005	1.914
May Precipitation	0.167	0.523
June Precipitation	<0.005	1.139
July Precipitation	0.346	0.396
August Precipitation	<0.005	1.215
Average Density of Deer Mice	**0.212**	**0.960**

The results of the correlations tests indicate that the relationship between monthly precipitation during those months and average deer mice density was not strong. As seen in Table 3 below, each month tested showed correlation values less than +/-0.250 and P-Values greater than 0.05, which implies that the relationship between the two variables was of little significance. Though still weak, March had the closest relationship between the two variables, which could be linked to increased amounts of spring rain and freshet, while June has the furthest separation.

Table 3. **Results of correlation between total monthly precipitation from March-September and average deer mice density from 1997-2024 using the Pearson correlation test and the Spearman (*) correlation test.**

Month	P-value	Correlation Value
March	0.312	0.167
April*	0.395	0.170
May	0.688	-0.081
June*	0.951	0.013
July	0.420	0.162
August*	0.793	0.052

The current findings from this long-term study show that deer mice have consistently had greater average densities, making them the dominant small mammal across all three sites. While our results do reflect those of Hale (2002), who titled deer mice as the dominant rodent in dry semi-arid grasslands, another study by Sullivan and Sullivan (2023) found that voles were competitively dominant in interactions between the two species. However, like our findings, both studies found the species coexisting on the sites. Deer mice are mainly insectivorous and granivorous, while voles are herbivorous, making food sources a less competitive issue within the grassland habitat (Sullivan and Sullivan 2023). Factors affecting population densities can vary greatly amongst sites, making the competitive success between species largely dependent on life histories, biological traits (Balciauskas and Balciauskene 2022) and fitness.

Both species have had oscillating average densities since 1997, which was visually seen in Figure 1, with signs of some overlapping trends of highest and lowest densities in Table 1. Although deer mice densities and precipitation had no sizeable relationship, winter rainfall has been suggested as possible causality for deer mice density fluxes (Sullivan and Sullivan 2023), broaden insight on the relationship between monthly precipitation for the entire year and average deer mice densities would be beneficial to have clearer determination on if the ecosystem is operating at a "bottom-up" pattern with inputs being transmitted up (Brown and Ernest 2002).

The effect of average monthly precipitation on primary production of vegetation diversity and richness (Sullivan and Sullivan 2023) could have a greater relationship with rates of predation or reduce availability of cover. Future research on these sites could focus on vegetation composition and average daily temperature to see a relationship between microclimates and thermoregulation of deer mice, as refuge sites are dire for reducing body water loss in the dry, hot environment (Hale 2002), especially with increasing drought. Another avenue for future research is litter accumulation rates and vole densities, to see if average temperatures or monthly precipitation rates is reducing cover availability from predators. More knowledge regarding the resources abundance for the rodent species to escape and maintain cover from predators can give us a better understanding on presence of “top-down” effects of carnivorous food chains (Brown and Ernest 2002).

To summarize, both species had varying populations sizes between each year, with deer mice densities being more prominent than vole densities across all three sites. Though no direct connection was made between highest and lowest density years, there is a close link between environmental pressures on these two species that could be seen in Figure 1. Identifying the biotic or abiotic sources that increase pressure to small mammal population densities can provide further insight on how to better manage our ecosystems (Minor and Eichholz 2024), which is why it is necessary to continue this long-term study.

Balciauskas L and Balciauskene L. 2022. Long-term changes in a small mammal community in a temperate zone meadow subject to seasonal floods and habitat transformation. *Integrative Zoology.* 17(3): 443-455

Brown JH and Ernest SK. 2002. Rain and Rodents: Complex Dynamics of Desert Consumers. *Bioscience*. 52(11): 979-987. (Brown and Ernest 2002)

Hales GS. 2011. SMALL MAMMAL COMMUNITIES IN TWO GRASSLAND ECOSYSTEMS IN BRITISH COLUMBIA, CANADA. [Master's thesis]. Kamloops, BC: Thompson Rivers University.

Larson KW, Adams IT, Haughland DL. 2007. Small mammal communities in a pyrogenic habitat mosaic. *International Journal of Wildland Fire.* 16: 728-740.

Minor AK and Eichholz MW. 2024. Vegetation diversity and structure influence small-mammal communities in native and restored northern mixed grasslands. *Journal of Wildlife Management.* 88(5).

Ransome, D. 2024. Estimating Abundance – Part 2. Presented at Thompson Rivers University.

Sullivan TP and Sullivan DS. 2023. Population Fluctuations of the Deer Mouse (Peromyscus maniculatus) in Old-Field and Bunchgrass-Sagebrush Habitats: The Role of Agricultural Setting and Optimum Habitat. *Ecologies.* 4(2): 406-425

Watson, S. 2024. NRSC 4040 Wildlife Management & Conservation I – Know Your Study Animal. Presented at Thompson Rivers University.