RELATIVE ABUNDANCE AND DIVERSITY OF SMALL MAMMALS ALONG STILL CREEK, BURNABY & VANCOUVER, BC

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ABSTRACT

Small mammal abundance and diversity was surveyed along the Still Creek corridor in Burnaby and Vancouver, British Columbia from September 2005 to April 2006. It is important to monitor biodiversity in urban centers because habitat alteration and fragmentation is having a significant negative impact on urban biodiversity. This study was conducted to assess differences in biodiversity among 3 types of corridor habitat: 2 small corridor widths (2-5 m) with high abundance of invasive plants, 2 wide corridors (200 – 300 m) with high proportion of native plants, and 2 corridors of intermediate widths (10 – 30 m) with a mixture of native and non-native vegetation. We also established baseline data to monitor trends for land management decisions.

We predicted small mammal abundance and diversity would be greatest in large riparian buffer zones dominated by native vegetation compared to narrow buffer widths (2 – 30 m) composed primarily of non-native plant species.

Small mammals were trapped during four sessions using Longworth and Tomahawk live traps from September 2005 to April 2006.

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1.0 Introduction

1.1 Significance of study

It is important to monitor biodiversity in cities because wildlife is under a greater threat of local extinction than in more remote wilderness areas. Most existing wildlife refuges are not big enough to prevent local extirpation of native species (Diamond, 1976). Eighty-nine percent of Canadians think biodiversity is a very important issue (Ransome, 2005). Many studies have concluded that large refuges of natural habitat are essential to minimize extinction rates and to ensure all species a chance of survival (Diamond, 1976). Patches of natural habitat within an urban area such as parks and riparian corridors are vital 'islands' of refuge. To facilitate movement of species between these islands, greenways or park corridors are essential to effectively maintain wildlife diversity in urban environments (Ransome, 2005). If society wishes to maintain biodiversity in their cities, they must maintain and enhance natural habitat within urban areas.

Still Creek is located in the Georgia Depression ecoprovince of British Columbia. This region has a total of 133 red-listed and 120 blue-listed species including 11 red-listed mammalian species (Species At Risk, 2006). The Georgia Depression ecoprovince is second only to the Southern Interior which has a total of 153 red-listed and 166 blue-listed species (Species At Risk, 2006). It is the largest tributary of the Brunette River watershed; it originates in Burnaby, flows through Vancouver where it loses most of its elevation, and then travels back into Burnaby where it eventually enters Burnaby Lake. Urban streams such as Still Creek provide pockets of habitat, surrounded by human

development. These areas are important to maintain biodiversity and species abundance in an urban setting. Human development has the tendency to disrupt vital wildlife habitat, such as riparian zones. Some portions of the Still Creek corridor remain intact and still provide critical habitat to urban wildlife. These areas also have high recreational value by providing opportunities for walking or wildlife viewing. Losing this critical and rare riparian corridor to development will diminish the biodiversity of the area.

1.2 Management of Still Creek

The Still Creek watershed has changed from the natural features including forests and swamps to the highly urbanized watershed of today (Nenninger et al., 1996). European immigrants began to populate the lower mainland of BC in the mid to late 19th century. These immigrants began to log old growth and clear the land in the watershed, giving way to agriculture. Residential development expanded as the 20th century began. To promote job creation industrial land was zoned following WWII (Nenninger et al., 1996), resulting in a prolonged commercial expansion which continues to this day.

Channel straightening, culverting, and removal of vegetation, as well as reduced cover permeability and water storage on the land base have resulted in extreme flow regimes (Nenninger et al., 1996). As a result, Still Creek is known for its flash floods, and also extremely low summer flows. This unnatural condition causes problems such as bank

erosion, down cutting, increased sediment load, and infilling during peak flow events. Low summer flows cause increased water temperatures and low dissolved oxygen levels.

The original structure of Still Creek has been lost due to culverting, channelization and straightening of the waterway. Many areas around the creek have been paved, causing increased water runoff and contaminants entering the watercourse.

Management issues related to Still Creek include flooding, environmental, recreation and urban expansion. There are a number of initiatives set forth to manage and monitor these concerns. Currently, BCIT is involved in a ten-year study monitoring different aspects of the Still Creek corridor. Purpose of this study is to measure trends in fish, birds, wildlife, wildlife habitat and invasive plant species. There are a number of initiatives currently in development, proposed or implemented in recent years including the Greater Vancouver Regional District Biodiversity Conservation Strategy. The scientific component of this strategy uses scientific information to define core habitats and critical elements of biodiversity (Greater Vancouver Regional District, 2005).

Quality of Still Creek's water has improved significantly from a time when combined sewage and storm water systems polluted the creek. This problem was fixed in the early 1990s and since then, fecal coliform levels have dropped from one million milligrams per litre to less than one thousand milligrams per litre (Angelo, pers. comm.). Still Creek has also been contaminated by industrial effluents and other harmful substances that have

washed into the watercourse. In the past, Still Creek had high levels of lead, but that problem has diminished with the banning of leaded gasoline (Angelo, pers. comm).

1.3 Significance of small mammals

Effects of human activity on the Still Creek corridor can be detected through small mammal inventories. Small mammals are important indicators of ecosystem health. Numerous ecological benefits accompany increased small mammal abundance. Some of these benefits include increased prey availability for reptiles, carnivores and raptors; increased dispersion of spores of fungi symbiotic with trees across the forest floor and higher consumption rates of invertebrate pests (Carey and Wilson, 2001). It is important to monitor indicators, such as small mammals, over time. This survey provides baseline data for an ongoing ten-year study of Still Creek. Small mammal communities must be monitored through time to enable the assessment of annual and long-term trends in population size and distribution. This is especially important for streams such as Still Creek which continue to be heavily impacted by human development.

1.4 Past studies on Still Creek

A biological survey of Still Creek was conducted in 2003/2004 (Sampson and Watson, 2004). The authors inventoried the riparian corridor for relative abundance of small mammals, birds and vegetation. They sampled 3 areas of the corridor: wide (up to 300 m) riparian buffer zone, medium (up to 100 m) and small (5 m). They found that Shannon-Wiener diversity index was highest in wide riparian buffer zone and lowest in the small riparian buffer zone. Species richness was also highest in the wide riparian

buffer zone and even between small and medium riparian buffer zones (Sampson and Watson, 2004).

We expanded on their study by characterizing native and non-native vegetation and how it influenced small mammal populations. We enhanced the study design of Sampson and Watson (2004) to include 6 study sites rather than 3.

The objective of this study was to determine relative abundance and diversity of small mammals along the Still Creek corridor in Burnaby, BC. We predicted that small mammal diversity and abundance would be greatest in wide riparian buffer zones dominated by native vegetation and lowest in small riparian buffer zones dominated by invasive plants.

2.0 Study Area

Still Creek headwaters are located in Central Park in Burnaby, B.C. From there, the creek flows southwest, under Boundary road into Vancouver. In Vancouver, Still Creek is heavily impacted with most of the section culverted and channelized. Still Creek is located in the Coastal Western Hemlock zone (Meidinger and Pojar, 1991). This zone receives high rainfall amounts totaling 1154.7 mm annually (BC Passport, 2006). Mean daily temperature for the region is 10.1° C (BC Passport, 2006). Dominant trees for this zone include western hemlock (*Tsuga heterophylla*), Douglas-fir (*Pseudotsuga menziesii*)

and western red cedar (*Thuja plicata*). Shrubs include vine maple (*Acer circinatum*), red huckleberry (*Vaccinium parvifolium*), salal (*Gaultheria shallon*), sword fern (*Polystichum munitum*), elderberry (*Sambucus racemosa*) and salmonberry (*Rubus spectabilis*).

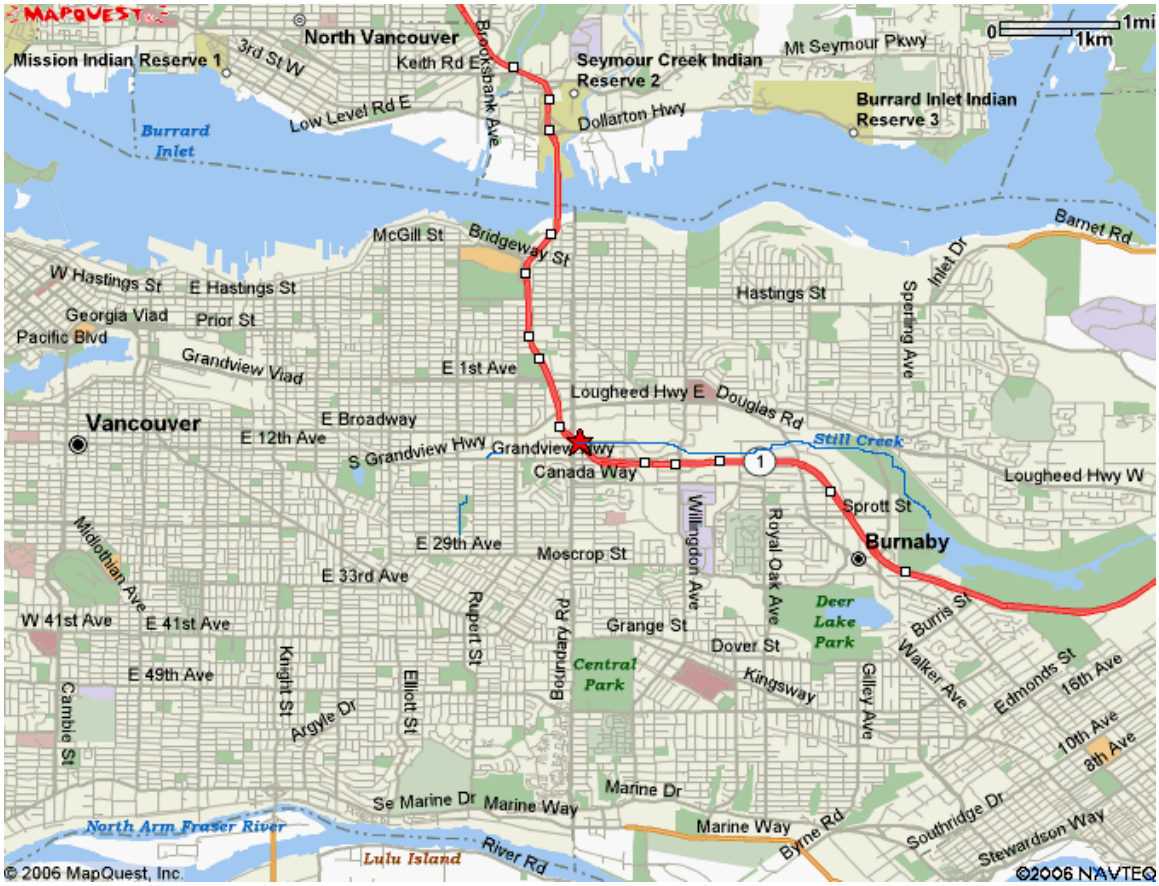

Figure 1. Map of Still Creek located in Burnaby and Vancouver, British Columbia. Adapted from Google Maps.

The Vancouver portion of Still Creek is mainly residential (Figure 1). The watercourse travels about 6.5 km from Central Park until it reaches 29th Avenue and Renfrew Street, in Vancouver. From there it flows north along Renfrew Street; the section through Renfrew Ravine and Renfrew Community Park are daylighted, but still channelized. Still

Creek begins to flow east when it reaches the Grandview Highway and crosses underneath Boundary Rd. a second time, back into Burnaby.

The section of Still Creek flowing through Burnaby (from Boundary Road to Burnaby Lake) is mainly unculverted. This is in compliance with the city of Burnaby's open watercourse policy. Unlike in Vancouver, the Burnaby portion of Still Creek flows mainly through industrial and commercial areas. There is little change in elevation through this portion of the watercourse and the area is prone to flooding. Size of the riparian buffer zone and composition of its plant communities vary extensively as the watercourse moves eastward through Burnaby. Still Creek enters Burnaby Lake Regional Park east of Holdom Avenue. At this point, the riparian lands both sides are wide (up to 300 m) and protected. The creek provides over 40% of the water for the Burnaby Lake system. Major tributaries entering Still Creek are Beecher Creek, Guichon Creek and Chubb Creek.

Six transects were placed along Still Creek in six different locations which reflected the three buffer widths and vegetation communities being studied. Two transects were placed in each of the three categories:

- Wide riparian buffer zone (200 m – 300 m) with primarily native vegetation
- Medium riparian buffer zone (10 m – 30 m) with evenly mixed native and non-native vegetation
- Small riparian buffer zone (2 m – 5 m) with primarily non-native vegetation

Transects A and B were narrow riparian buffer zones (2 m – 5 m) with primarily non-native vegetation including Himalayan blackberry (*Rubus discolor*), Japanese knotweed (*Polygonum cuspidatum*) and policeman's helmet (*Impatiens glandulifera*). Transect A ran along the south side of Still Creek between Douglas Rd. and Westminster Avenue. Access to this transect is from behind a local business. Transect B was near the 3700 block of Still Creek Avenue, east of Boundary Road. This transect was divided onto both sides of the creek due to space constraints.

Transects C and D were medium riparian buffer zones (10 m – 30 m) with evenly mixed native and non-native vegetation including *Impatiens glandulifera*, *Rubus discolor*, red alder (*Alnus rubra*) and Oregon-grape (*Mahiona nervosa*). Transect C was located on the south side of Still Creek, directly west of Willingdon Ave. This transect ran along the pedestrian trail and crosses a small tributary of Still Creek. Transect D was in Renfrew Ravine and was the only transect located in Vancouver. This transect was divided onto both sides of the creek and was located within Renfrew Ravine Community Park.

Transects E and F were wide riparian buffer zones (200 m – 300 m) with primarily native vegetation including *Rubus spectabilis*, red-osier dogwood (*Cornus stolonifera*) and Pacific crabapple (*Malus fusca*). Transect A was located on the south side of Still Creek, off old Sperling Road in Burnaby. This transect was within the boundaries of the Burnaby Lake conservation zone. Transect F ran along the hydro right-of-way between Westminster Ave. and Willingdon Ave.

3.0 Materials and Methods

Random transects were established in each of the six study areas. Access to transects was blazed using a machete for sections A, E and D due to the dense underbrush and impenetrable *Rubus discolor*. Each study site contained a mouse transect and squirrel transect each with a random starting point. Mouse transects contained 7 stations every 15 m along a bearing parallel to Still Creek. Two Longworth traps were placed at each station, covering a distance of 90 m. Squirrel transects ran on top of mouse transects and utilized some of the same stations. Tomahawk live traps were used for squirrel stations. Starting point for this line was set back ten meters from the starting point of the mouse line on the same bearing. Total transect was 110 m.

Transect B had four stations on the north side of the creek, and five on the south side. Transect D had four stations on the west side of the creek and five on the east side. This was necessary because there was insufficient room to fit all stations along one continuous transect.

Starting stations were marked with flagging tape. All Longworth traps were baited with whole oats and all Tomahawk traps were baited with sunflower seeds. Tomahawk traps contained a plastic container with coarse cotton which served as a nest box for the captured animal. All traps were pre-baited (locked open) for two weeks prior to trapping to allow the animals a chance to grow accustomed to entering traps for food. For transects B, C and D, empty tin cans were used to pre-bait instead of the Longworth

traps. This was done to reduce amount of time traps would sit outside and lower the risk of them being removed or tampered with by the public. Longworth traps were covered with a piece of cedar shingle to help conceal the trap and keep captured specimens, bait, and cotton dry. Tomahawk traps were covered with a sheet of clear plastic for the same reasons. Following the pre-baiting period, traps were set on afternoon of day one, checked on day two (one day trapping session) and then removed from all study sites. Dry gloves were used to handle all captured animals; mice and voles were placed in a large plastic pail, and squirrels and rats were forced into a secure mesh sac for handling (Figure 2).

Figure 2. Norway rat (*Rattus norvegicus*) in mesh sac caught in Transect D (medium corridor) November 12, 2005 (Cam Bennett photo).

Individually numbered ear tags were applied to each animal and individuals were weighted, identified to species, using Eder and Pattie (2001), location recorded, then released at point of capture.

Diversity of small mammals was estimated by calculating Simpson's and Shannon-Wiener diversity indices. These indices allow us to compare diversity across different populations. Simpson's index is inversely related to the probability that two individuals picked at random belong to the same species (Ransome, 2005). Shannon-Wiener function relates diversity to the difficulty of correctly predicting the species of the next individual collected (Ransome, 2005).

4.0 Results

In total we had four trap nights, one in November, January and two in March. Seven species of small mammals were trapped and identified in November (Table 1); while six species were trapped in January (Table 2).

Table 1. Mammal species trapped along Still Creek corridor Nov.12, 2005.

Species	**Small Corridor (2– 5 m)**		**Medium Corridor (10 – 30 m)**		**Wide Corridor (200 – 300 m)**		**Total**
	A	**B**	**C**	**D**	**E**	**F**	
Native							
Deer mouse *Peromyscus maniculatus*	1	0	0	0	5	3	**9**
Creeping vole *Microtus oregoni*	6	0	0	0	5	7	**18**
Douglas squirrel *Tamiasciurus douglasii*	0	0	0	1	0	0	**1**
Non-native							
Black rat *Rattus rattus*	0	0	2	0	1	0	**3**
Norway rat *Rattus norvegicus*	0	4	2	0	0	0	**6**
Eastern gray squirrel *Sciurus carolinensis*	0	0	0	2	0	0	**2**
House mouse *Mus musculus*	0	1	0	0	0	0	**1**
Transect Totals	**7**	**5**	**4**	**3**	**11**	**10**	**40**
Corridor Total	**12**		**7**		**21**		

Table 2. Mammal species trapped along Still Creek corridor Jan.22, 2006

Species	**Small Corridor (2– 5 m)**		**Medium Corridor (10 – 30 m)**		**Wide Corridor (200 – 300 m)**		**Total**
	A	**B**	**C**	**D**	**E**	**F**	
Native							
Deer mouse *Peromyscus maniculatus*	0	0	1	0	4	7	**12**
Creeping vole *Microtus oregoni*	0	0	1	0	0	3	**4**
Douglas squirrel *Tamiasciurus douglasii*	0	0	0	0	0	0	**0**
Non-native							
Black rat *Rattus rattus*	1	0	0	0	1	1	**3**
Norway rat *Rattus norvegicus*	0	2	0	2	0	0	**4**
Eastern gray squirrel *Sciurus carolinensis*	0	0	0	3	0	0	**3**
House mouse *Mus musculus*	0	1	0	0	0	0	**1**
Transect Totals	**1**	**3**	**2**	**5**	**5**	**11**	**27**
Corridor Total	**4**		**7**		**16**		

The trap night in early March yielded five species of small mammals (Table 3).

Table 3. Mammal species trapped along Still Creek corridor March 5, 2006

Species	**Small Corridor (2– 5 m)**		**Medium Corridor (10 – 30 m)**		**Wide Corridor (200 – 300 m)**		**Total**
	A	**B**	**C**	**D**	**E**	**F**	
Native							
Deer mouse *Peromyscus maniculatus*	0	0	0	0	2	6	**8**
Creeping vole *Microtus oregoni*	0	0	2	0	1	2	**5**
Douglas squirrel *Tamiasciurus douglasii*	0	0	0	0	0	0	**0**
Non-native							
Black rat *Rattus rattus*	0	0	1	1	0	0	**2**
Norway rat *Rattus norvegicus*	0	0	0	1	0	0	**1**
Eastern gray squirrel *Sciurus carolinensis*	0	0	0	0	0	0	**3**
House mouse *Mus musculus*	0	1	0	0	0	0	**1**
Transect Totals	**0**	**1**	**3**	**2**	**3**	**8**	**17**
Corridor Total	**1**		**5**		**11**		

The trap night in mid-March yielded 4 species of small mammals (Table 4).

Table 4. Mammal species trapped along Still Creek corridor March 12, 2006

Species	**Small Corridor (2– 5 m)**		**Medium Corridor (10 – 30 m)**		**Wide Corridor (200 – 300 m)**		**Total**
	A	**B**	**C**	**D**	**E**	**F**	
Native							
Deer mouse *Peromyscus maniculatus*	1	0	0	0	0	3	**4**
Creeping vole *Microtus oregoni*	0	0	0	0	1	1	**2**
Douglas' squirrel *Tamiasciurus douglasii*	0	0	0	0	0	0	**0**
Non-native							
Black rat *Rattus rattus*	0	0	2	0	0	0	**2**
Norway rat *Rattus norvegicus*	1	0	1	0	0	0	**2**
Eastern gray squirrel *Tamiasciurus carolinensis*	0	0	0	0	0	0	**0**
House mouse *Mus musculus*	0	0	0	0	0	0	**0**
Transect Totals	**2**	**0**	**3**	**0**	**1**	**4**	**10**
Corridor Total	**2**		**3**		**5**		

In total, we caught seven species of small mammals with the majority of native species caught in wide corridors (Table 5).

Table 5. Total species trapped along Still Creek corridor, Burnaby and Vancouver, B.C. November 2005 to March 2006.

Species	**Small Corridor (2– 5 m)**		**Medium Corridor (10 – 30 m)**		**Wide Corridor (200 – 300 m)**		**Total**
	A	**B**	**C**	**D**	**E**	**F**	
Native							
Deer mouse *Peromyscus maniculatus*	1	0	1	0	11	16	**29**
Creeping vole *Microtus oregoni*	6	0	3	0	6	12	**27**
Douglas squirrel *Tamiasciurus douglasii*	0	0	0	1	0	0	**1**
Non-native							
Black rat *Rattus rattus*	1	0	3	1	2	1	**8**
Norway rat *Rattus norvegicus*	0	6	2	3	0	0	**11**
Eastern gray squirrel *Sciurus carolinensis*	0	0	0	5	0	0	**5**
House mouse *Mus musculus*	0	3	0	0	0	0	**3**
Transect Totals	**8**	**9**	**9**	**10**	**19**	**29**	**84**
Corridor Total	**17**		**19**		**48**		

Incidental wildlife observations were also made along Still Creek (Table 5). There was also evidence of bank beavers along the creek including haul-out sites, downed trees with chewed off bark and beaver pathways.

Table 6. Incidental wildlife sightings along Still Creek corridor, Sep. 2005 – May 2006.

Species	**Small Corridor (2 – 5 m)**		**Medium Corridor (10 – 30 m)**		**Wide Corridor (200 – 300 m)**		**Total**
	A	**B**	**C**	**D**	**E**	**F**	
Native							
river otter			1				**1**
beaver	1						**1**
Transect Totals	**1**		**1**				
Corridor Total	**1**		**1**				**2**

Wide, native vegetation dominated riparian buffers had the greatest number of native small mammal individuals that were captured. Medium, mixed vegetation dominated riparian buffers had the greatest diversity in small mammal species (although mainly non-native species) as indicated by Simpson's diversity index. Shannon-Weiner diversity index also indicated diversity was greatest in medium buffer riparian widths (Figure 4). Non-native small mammals are more common in smaller riparian buffers with non-native plant communities.

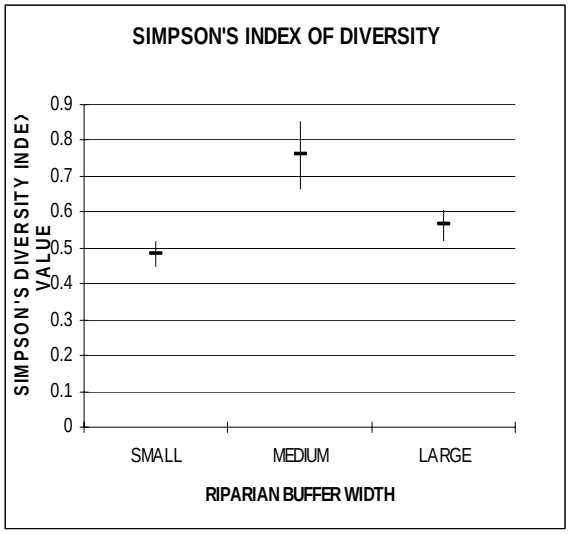

Figure 3. Simpson's index of diversity for small mammals.

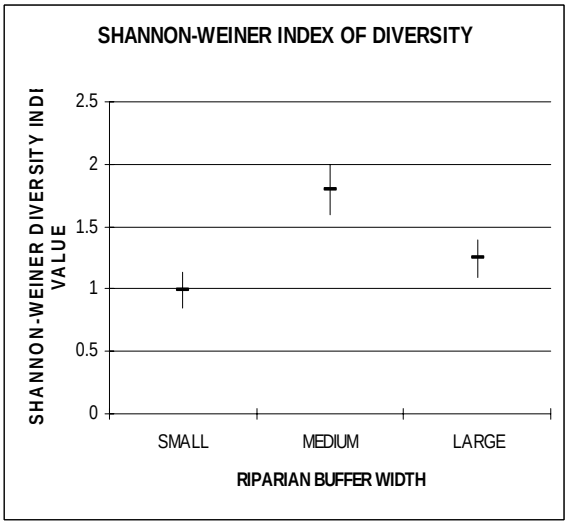

Figure 4. Shannon-Weiner index of diversity for small mammals.

5.0 Discussion

5.1 Small mammal habitat associations

Deer mice are common rodents found in various habitat types from grasslands to forests and they are habitat generalists (Eder and Pattie, 2001). Deer mice were captured in the majority of transects, with highest numbers being at large transects E and F. Deer mice were the most successful in these transects which represent wide riparian buffer width dominated with native shrubs. Deer mice were not detected in transects B and D, both of which are located adjacent to urban development.

Creeping voles prefer openings in moist coniferous forests as well as brushland but they are also habitat generalists (Eder and Pattie, 2001). Like deer mice, creeping voles had the greatest populations in transects E and F. These transects had greater proportions of grasses and shrubs which provide cover for voles. Vole populations will fluctuate from high to low concentrations on a regular cycle (Ransome, pers. comm). Our data suggests creeping vole populations along portions of Still Creek were in a downward trend during the study period: 18 voles were caught in November, 4 in January, 5 in early March and 2 in mid-March. A larger sample size and area would confirm this trend.

Norway and black rats were introduced to North America and are commonly found in or near human development (Eder and Pattie, 2001). Both rat species were most common in transects A, B, C, and D: the four transects that are closest to buildings.

Members of the Scuridae family were captured only in transect D. Eastern grey squirrels were introduced to the lower mainland of BC from eastern Canada. Transect D had the most large diameter trees suitable for squirrels. This transect was located in a park and there was some signs of supplemental feeding of seeds by local citizens. This could have an effect on squirrel abundance in this transect.

5.2 Riparian Width Associations

The two widest transects (E and F) had the greatest abundance of small mammals captured, 62 individuals between the two transects. By preserving a larger riparian area, small mammal diversity and abundance will be maintained. Larger riparian areas are also more resistant to invasive plant infestations.

The medium riparian width transects (C and D) had the highest small mammal species diversity. These are the only two transects with a trail system used by the public. These trails may or may not have an effect on the diversity of small mammals present.

There was little difference in the abundance of small mammals between the narrow and medium riparian widths. However, these two categories contained the vast majority of non-native species. The smaller size of the riparian buffer in these transects is due to road or building development. Non-native small mammals such as rats or house mice are better adapted to living in or near human development (Eder and Pattie, 2001) and therefore, more suited the medium and narrow buffer widths.

6.0 Recommendations

6.1 Future Surveys

Trap densities were appropriate for all transects. Trap sessions could be planned at regular intervals throughout the study period in order to better represent all seasons. Small mammal trapping could be expanded to include summer surveys that would target animals that hibernate in the winter such as chipmunks.

Care was taken to avoid flood zones when choosing the transect locations however, some traps were submerged during pre-baiting sessions. Still Creek is a flashy system and careful monitoring of trap locations should be undertaken. Land use changes throughout the study area may impact transect locations or possibly alter the flood impact zones.

Land use changes will also affect the framework of this study and therefore, they should be accounted for in future surveys.

6.2 Land Use Decisions

Transects E and F should not be developed for recreation, industry or any other development. Disturbing these areas will facilitate the spread of invasive plant and small mammal species. The abundance of deer mice and creeping voles in these transects shows that they are important habitat reserves for native small mammals in Burnaby.

Invasive plant and garbage removal from all transects will improve the overall health and appeal of the area. Businesses located along either side of the creek between Douglas Rd. and Westminster Ave. may be contributing to garbage loads in the creek as well as bank erosion. These businesses should be monitored for violations and encouraged to undertake stream restoration projects on the riparian land behind their businesses. Removal of invasive vegetation overhanging into the stream such as blackberry should be removed to help improve water flow and possibly lessen the impact of flooding.

Ongoing monitoring of Still Creek, invasive plant removal and habitat restoration are key to ensure the long-term health and overall sustainability of the Still Creek corridor.

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