CHAPTER 7 SMALL MAMMAL DISTRIBUTION, ABUNDANCE AND HABITAT USE

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INTRODUCTION

Small mammals are an integral component of most ecosystems. In the Northwest the regional distribution of small mammals has been described by Ingles (1965) and Maser et al. (1981). Within unmanaged (e.g., old growth) Douglas-fir forests, small mammals were described in Aubry et al. (1991) by numerous biologists. Mammals in second growth forests under differing cutting practices and intensity of landscaping and development were described by (Stofel 1993). Local small mammal species and distributions in urban parks varying in size of approximately four to 400 ha within urbanizing areas were described by (Gavareski 1976).

The distribution and abundance of small mammals, similar to that of macroinvertebrates, amphibians and birds may be indicators of the environmental health of wetlands. They also exhibit the ability to shape wetlands through their influence on soil, water and plants. Several species such as Trowbridge's shrew, marsh shrew, shrew-mole, western red-backed vole and creeping vole (See Table 7-1 for scientific names) are endemic to the Pacific Northwest (Corn and Bury 1991) and could be expected at pristine wetlands. Our objective in this chapter is to present the relative distribution and abundance of small mammals across the wetlands we studied. We also examine wetland conditions such as size, hydrology and vegetation complexity to gain insight into habitat characteristics important for maintaining diversity and unique species.

METHODS

We used pitfall and Sherman trap captures during autumn (mid-October to mid-November) as indicators of small mammal distributions. We installed traps along two 250-meter transects on opposite sides of each wetland. A combination of 10 pitfalls and 25 Sherman traps at 10 meter intervals was used without drift fences. To minimize the ejection of pitfalls due to hydrostatic pressure, transects were located above winter high-water levels. Pitfalls locations and trap installation procedures are described elsewhere (Richter 1995). Pitfalls were operated for a total of 14, mostly consecutive, days and Shermans for total of six days (alternating between wetlands for three consecutive days). We closed and removed traps vandalized or disturbed by dogs, cats, raccoons and other mammals and continued trapping after several days, when predators were no longer expected at traps. At wetlands in which trap nights were less than attempted (because of ongoing disturbance), captures were adjusted by calculating rates on available traps which was assumed to have been the total number set less one half the number of traps unavailable (Sherman's closed with no captures or treadle stuck; pitfall disturbed by dogs or wildlife), and extrapolated to the full monitoring period (Nelson and Clark 1973) and specifically noted within our discussion. We also relocated traps that became permanently flooded during our study to higher ground where possible. We used wood stakes to mark the beginning and end of transacts and blue flagging to distinguish the trap sites.

All small mammals were identified to species. Deer mice and forest deer mice were distinguished from each other by tail lengths in which adults with tails exceeding 96 mm were identified as deer mice as opposed to forest deer mice with tails less than or equal to 96 mm. Additionally, we aged all deer mice species as adults and subadults (coarse-brown versus soft-gray pelage and weight), sexed and marked by cutting the "pencil-hairs" from the tip of tails, allowing us to determine recaptures and hence rough indexes of abundances for this taxa. The high mortality of shrews in pitfall traps also enabled us to use their capture data in population estimations since recapture rate was low.

We compared the number of National Wetlands Inventory (NWI) (Cowardin et al. 1979) vegetation associations with the diversity of mammal communities. We looked at wetland size and land use, including degree of urbanization and amount forest land within 1000 meters of the wetland. Quantification of these habitat and landscape characteristics are described in the amphibian and bird chapters (five and six) of this report.

RESULTS

We captured a total of 21 small mammal species, 19 of which are native within the wetlands censused (Table 7-1), excluding Norway rat and black rat. The range of species diversity among wetlands varied widely from a low of just one species in ELW1, Norway rat, to a high of 13 species (70% of observed native species) in LCR93 (Figure 7-1).

Table 7-1. Small mammals captured and observed in palustrine wetlands of the Puget Sound Basin.

Common Name	Scientific Name	Ames Lake 3	Bellevue 3I	Big Bear Creek24	East Lake Sammamish 39	East Lake Sammamish 61	East Lake Washington 1	Forbes Creek 1	Harris Creek13	Jenkin's Creek 28	Lower Cedar River 93	Lower Puget Sound 9	Middle Green Rivers 36	North Fork Issaquah Creek 12	Patterson Creek 12	Raging River 5	Snoqualmie River 24	Soos Creek 4	Soos Creek 84	Tuck Creek 13
Black Rat	*Rattus rattus*		●									●		●						
Bushy-tailed Woodrat	*Neotoma cinerea*											●								
Creeping vole	*Microtus oregoni*	●	●	●	●	●		●	●		●		●	●	●	●		●		●
Deer Mouse	*Peromyscus maniculatus*	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●
Douglas Squirrel	*Tamiasciurus douglasii*								●				●							
Ermine	*Mustela erminea*								●		●		●							
Forest Deer mouse	*Peromyscus oreas*	●	●	●	●	●			●	●	●	●	●	●	●	●	●	●	●	●
Long-tailed Vole	*Microtus longicaudus*			●							●	●		●						
Marsh Shrew	*Sorex bendirei*			●					●		●		●			●			●	●
Masked Shrew	*Sorex cinereus*										●									
Montane Shrew	*Sorex monticolus*				●	●			●		●	●	●		●	●			●	
Northern Flying Squirrel	*Glaucomys sabrinus*			●																
Norway Rat	*Rattus norvegicus*						●													
Pacific Jumping Mouse	*Zapus trinotatus*		●	●												●				
Shrew-mole	*Neurotricus gibbsii*			●					●		●		●		●	●	●			●
Southern Red-backed Vole	*Clethryonomys gapperi*		●		●						●								●	
Townsend's Chipmunk	*Eutamias townsendii*			●	●				●		●								●	●
Townsend's Vole	*Microtus townsendii*				●	●						●			●			●		
Trowbridge's Shrew	*Sorex trowbridgei*	●	●	●	●	●			●	●	●	●	●	●	●	●	●	●	●	●
Vagrant Shrew	*Sorex vagrans*	●	●	●	●	●		●	●		●	●	●	●	●	●		●	●	●
Water Shrew	*Sorex palustris*																			●

Sites severely altered by urbanization, and harboring minimal populations of native species, include ELW1 and FC1. Surprisingly, B3I, a small wetland almost totally surrounded by urbanization and containing black rats had seven native mammal species. Several wetlands were visited by free ranging dogs (BBC24), unidentified animals (most likely dogs, opossum, raccoon (LPS9), and bear and cougar (RR5), whose activities disrupted our trapping program.

Small mammal richness ranged widely between study years, shown for native species in Figure 7-2. For example, LCR93, which had the highest number of species over the whole study, had at least ten native species the first year, 1988, yet only five native species were collected or observed in 1993 and 1995. At another wetland, HC13, we identified eight, nine and seven species respectively in 1988, 1989 and 1995, yet in 1993, only three species were captured.

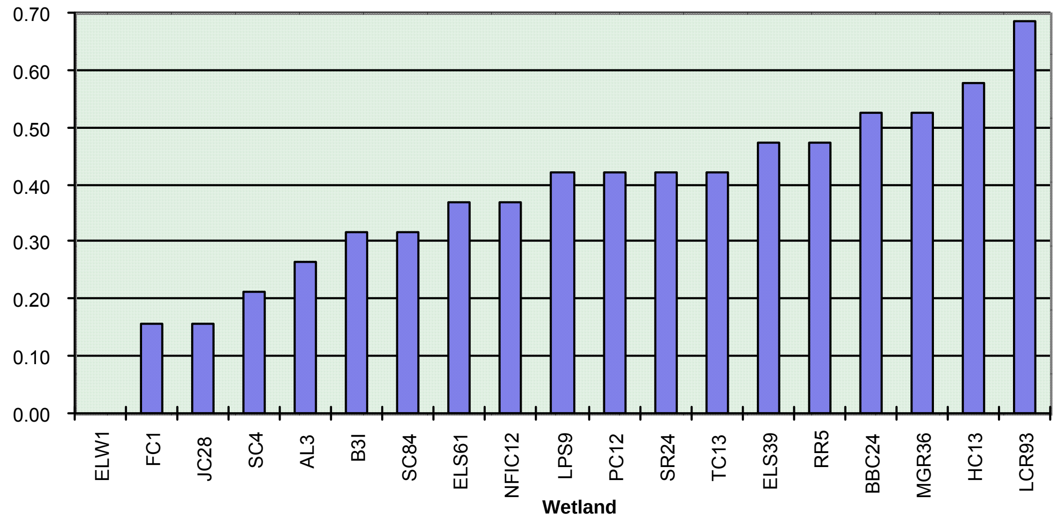

Figure 7-1. Proportional native species richness among 19 palustrine wetlands of the Puget Sound Region.

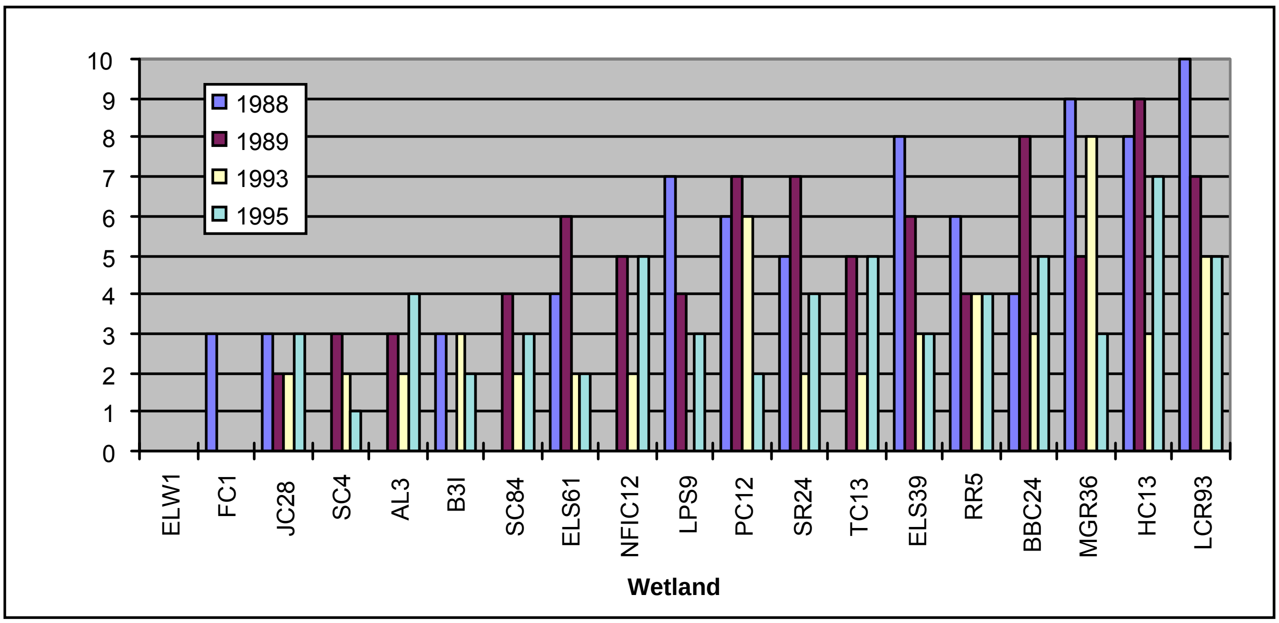

Figure 7-2. Native small mammal richness from 1988 to 1995 in study wetlands.

The abundance of deer mice and shrews varied widely between wetlands and between years. Table of capture rates of species by wetland and by year are available in Appendix Table 7-1. The deer mouse was by far the most abundant mammal captured in all years over all wetlands (Figure 7-3). The Montane shrew and forest deer mouse were the next most abundant and were captured in substantially fewer numbers than the deer mouse. The rarest capture was of the masked shrew, a fairly uncommon species in this area. The most unusual capture was that of the northern flying squirrel, traditionally an arboreal species and consequently unlikely to be captured in traps on the ground.

Wetland size, by itself, was not found to be significant to mammal richness or abundance (measured as number of captures per 100 trap nights). This result was expected for abundance, however, we expected mammal richness to be strongly related to wetland size, since intuitively, one would expect larger wetlands to have more niches and habitat opportunities. But wetland size was not by itself a major factor and neither were the number of NWI habitat classes. However, the total area of adjacent development was found to be weakly correlated with mammal richness ($R = 0.4$, $p = 0.09$). Though adjacent development was a factor, more critical to highly diverse mammal communities was the percent of forest land immediately adjacent to the wetland within 500 to 1000 meters ($R \geq 0.55$, $p \geq 0.02$) (Figure 7-4). Forest land included all deciduous and coniferous forest and also included lands with single family dwellings within forested parcels. We found that wetlands were more likely to have diverse mammal communities if a substantial part of the adjacent land was not cleared and was retained in forest land.

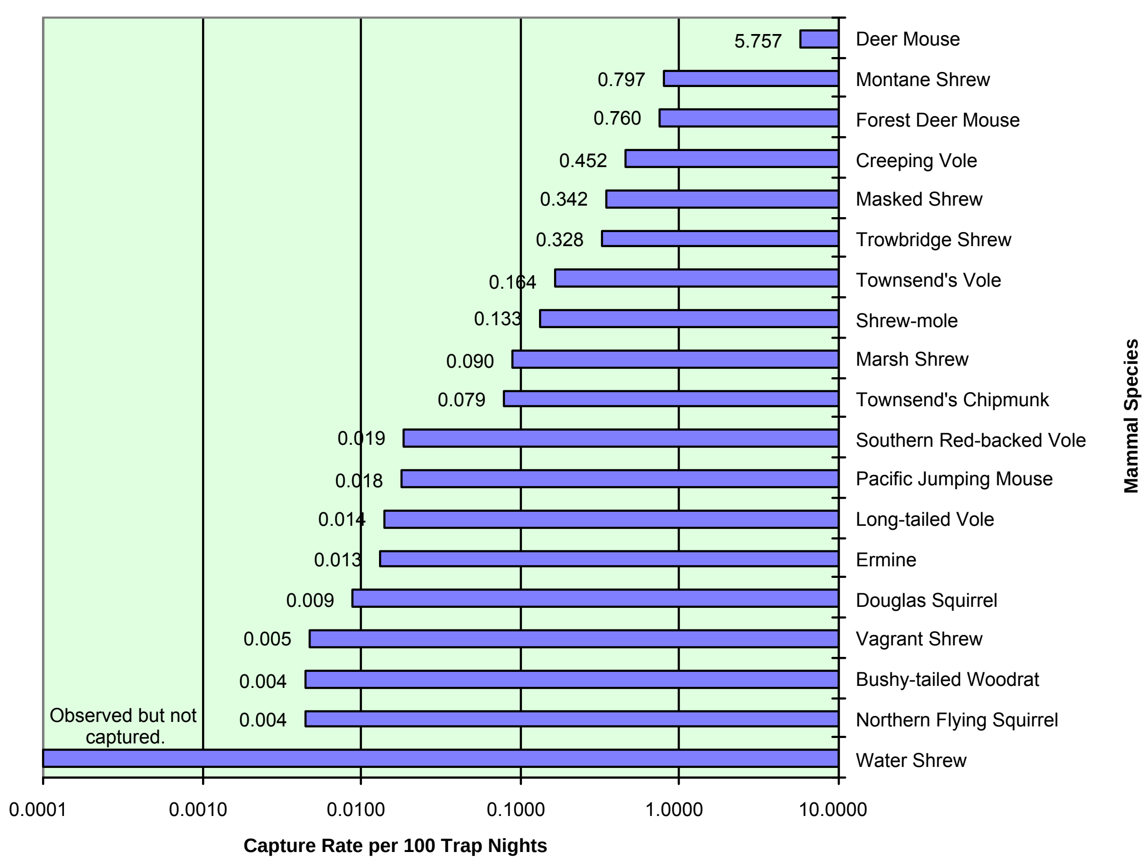

Figure 7-3. Capture rates of small mammals.

Large woody debris in the wetland buffer was also found to be a factor related to diversity. Small mammal richness was found to be associated with the combined factors of wetland size, adjacent land use and the relative quantity of large woody debris within the wetland buffer (Svendsen and Richter in prep.) (Figure 7-5).

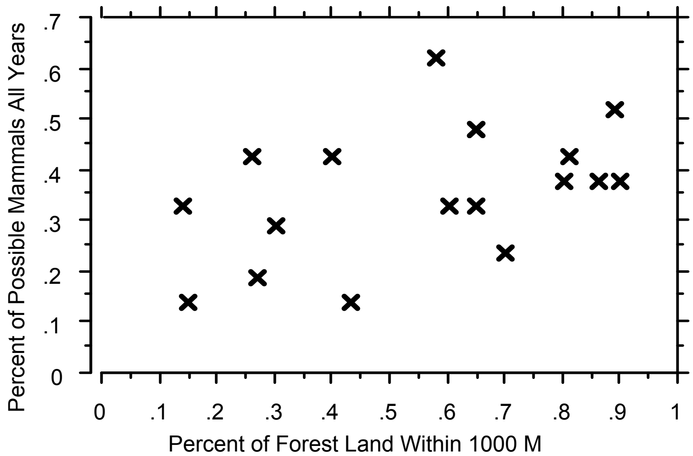

Figure 7-3. Relationship between small mammal diversity and forest land within 1000 meters of wetland.

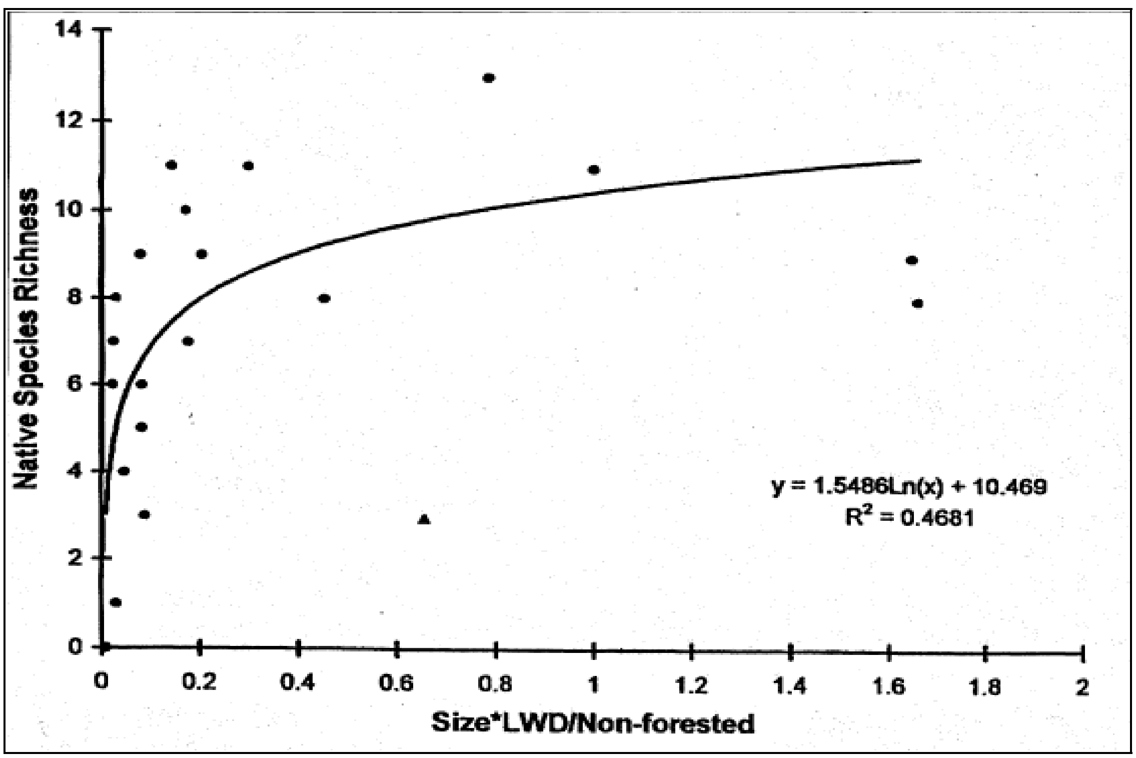

Figure 7-5. Relationship between small mammal species richness and habitat variables including wetland size, land use cover and large woody debris.

DISCUSSION

This study shows that the small mammal communities of wetlands are among the most diverse communities of mammals in the Puget Sound Basin. We captured 22 species (19 native), significantly more than in second-growth forests (Stofel 1993) and urban parks (Gavareski (1976). Because Northern flying squirrels, Douglas squirrels ermine, chipmunk and shrew moles are not well sampled by either pitfalls or Shermans, their true distribution and abundance remains unknown. We captured rats and mice (Muridae), which surprisingly Gavareski (1976) did not capture during her studies of urban parks. On the other hand, we did not capture or observe other non-native species of urban areas including Eastern-cottontail, (Sylvilagus floridanus), Fox squirrel (Sciurus niger) and Eastern gray squirrel (S. carolinensis).

Because of their numbers, deer mice most likely play important roles in trophic dynamics of palustrine wetlands. They appear to inhabit wetlands both in average years as well as in severe years, whereas other small mammals were not consistently captured.

Norway rats may be more damaging to native mammals than black rats in that wetlands with Norway rats appear to displace native species. This presumably happened in ELW1 and another wetland in a heavily urbanized landscape of Snohomish County studied by Svendsen and Richter (In press).

Perhaps one of the more significant findings is the importance of forest land and its consequent habitat component of large woody debris within the wetland buffer. Earlier statistical models that included the presence of vegetation structure (number of vegetation layers e.g., herb, shrub and tree cover), as well as the presence of development and its associated human and animal impacts (e.g., rats, cats and dogs) did not show the strong relationship that forest land and the presence large-woody debris exhibited. Consequently, this result suggests that a certain amount of development can occur and non-native mammals can be tolerated if enough forest land remains available for cover, food, shelter and microclimatic relief. Forest land can provide continuous production of large logs and tree stumps that provide habitat over time. These findings also point out the value of conserving and maintaining large woody debris in wetlands and wetland buffers to increase opportunities for small mammal habitat.

REFERENCES

Aubry, K. B., M. H. Brookes, (eds.). 1991. Wildlife and Vegetation of Unmanaged Douglas-fir Forests. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, OR, USA.

Corn, P. S., and R. B. Bury. 1991. Small mammal communities in the Oregon Coast Range. Pages 241-254. In K. B. Aubry and M. H. Brookes, (eds). Wildlife and Vegetation of Unmanaged Douglas-Fir Forests. U.S. Forest Service Pacific Northwest Research Station, Portland, OR, USA.

Cowardin, L. M., V. Carter, F. C. Goulet, and E. T. LaRoe. 1979. Classification of wetlands and deepwater habitat of the United States. U. S. Fish and Wildlife Service, Washington D.C., USA.

Gavareski, C. A. 1976. Relation of park size and vegetation to urban bird populations in Seattle, Washington. Condor 78:375-382.

Ingles, L. G. 1965. Mammals of the Pacific States. Stanford University Press, Stanford, CA, USA.

Maser, C., B. R. Mate, J. F. Franklin, and C. T. Dyrness. 1981. Natural History of Oregon Coast Mammals. Pages 496. U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station.

Nelson, L., Jr. And F.W. Clark. 1973. Correction for sprung traps in catch/effort calculations of trapping results. J. Mammal. 54:295-298.

Stofel, J. L. 1993. Evaluating wildlife responses to alternative silvicultural practices. Pages 126. University of Washington, Seattle, Washington, USA.

Svendsen, C. R., and K. R. Richter. In prep.. Small mammals in a restored urban wetland in response to biotic and landscape characteristics. Presented at Ecological Summit 96, Copenhagen, Denmark and to be published in Ecological Engineering).

Appendix Table 7-1. Pitfall capture rates of small mammals by wetland, species and year of capture.

Code	CLGA		EUTO			GLSA	MILO		
Species	Clethryonomys gapperi		Eutamias townsendii			Glaucomys grapperi	Microtus longicaudus		
Common Name	Southern Red-backed Vole		Townsend's Chipmunk			Northern Flying Squirrel	Long-tailed Vole		
Number of Captures per 100 Trap Nights									
SITE_ID	1988	1993	1988	1989	1995	1989	1988	1993	1995
AL3									
B3I	0.36								
BBC24						0.34		0.72	
ELS39	0.36		0.33	0.33	1.33				
ELS61									
ELW1									
FC1									
HC13				1.00					
JC28									
LCR93	0.33		2.33	0.67			0.36		
LPS9							0.33		
MGR36									
NFIC12									0.36
PC12									
RR5									
SC4									
SC84									
SR24		0.36		0.33					
TC13					0.33				

Code	MIOR				MITO				MUER	
Species	Microtus oregoni				Microtus townsendii				Mustela erminea	
Common Name	Creeping Vole				Townsend's Vole				Ermine	
Number of Captures per 100 Trap Nights										
SITE_ID	1988	1989	1993	1995	1988	1989	1993	1995	1988	1989
AL3				0.33						
B3I			0.36							
BBC24	1.37	1.01		2.15						
ELS39	5.95	1.00			7.24	2.07	0.36			
ELS61	1.36	0.33				0.33				
ELW1										
FC1	10.29									
HC13	4.02	0.67							0.33	
JC28										
LCR93	0.69			0.71						0.33
LPS9					1.05					
MGR36	6.90	0.69	0.36						0.33	
NFIC12		0.71		1.07						
PC12	1.71	1.33			1.69	1.33				
RR5	2.42									
SC4										
SC84		0.36				0.36				
SR24										
TC13		1.02								

Appendix Table 7-1. Pitfall capture rates of small mammals by wetland, species and year of capture.

Code	NECI	NEGI			PEMA			
Species	Neotoma cinerea	Neurotricus gibbsii			Peromyscus maniculatus			
Common Name	Bushy-tailed Woodrat	Shrew-mole			Deer Mouse			
Number of Captures per 100 Trap Nights								
SITE_ID	1989	1988	1989	1993	1988	1989	1993	1995
AL3						15.98	4.29	2.00
B3I					0.67		0.71	3.33
BBC24					3.70	14.48	0.72	13.01
ELS39					9.69	16.69	0.71	11.33
ELS61					8.00	12.38		2.02
ELW1								
FC1					8.67			
HC13			0.71		12.38	20.00	0.36	3.36
JC28					15.69	11.33	0.36	9.02
LCR93			0.36		32.40	7.33	2.86	8.67
LPS9	0.69				32.24	23.38		23.02
MGR36		0.36		0.36	7.79	14.74	4.64	9.05
NFIC12						9.64	0.36	2.33
PC12				1.07	3.69	11.05	5.00	9.02
RR5				3.21	8.42	10.11	1.79	4.05
SC4				0.36		14.76	0.36	23.00
SC84						73.50		16.33
SR24					1.67	19.02		2.00
TC13						0.67	1.43	3.38

Code	PEOR				RARA			SOBE		
Species	Peromyscus oreas				Rattus rattus			Sorax bendirei		
Common Name	Forest Deer Mouse				Black Rat			Marsh Shrew		
Number of Captures per 100 Trap Nights					1988	1989	1995	1988	1989	1993
SITE_ID	1988	1989	1993	1995						
AL3		1.67		3.33	1.33					
B3I				2.00					0.36	
BBC24	0.34	4.37		1.68						
ELS39				1.33						
ELS61	1.00	0.67		0.33						
ELW1										
FC1								0.71	0.36	
HC13	7.00	7.33		0.69						
JC28	6.33	1.00		0.67				0.71	1.07	
LCR93	5.36	2.67	0.36	0.67			1.67			
LPS9	1.33	0.33							0.36	1.43
MGR36	2.00	2.67	0.36	0.67						
NFIC12				0.67						
PC12		1.33	0.36	2.67				0.71		
RR5	1.68	1.34		0.34						
SC4		0.33								
SC84		6.02	0.36	1.67					0.36	
SR24	1.00	2.33		0.33					0.36	
TC13		0.33								

Appendix Table 7-1. Pitfall capture rates of small mammals by wetland, species and year of capture.

Code	SOCI	SOMO				SOTR			
Species	Sorex cinereus	Sorex monticolus				Sorex trowbridgei			
Common Name	Masked Shrew	Montane Shrew				Trowbridge Shrew			
Number of Captures per 100 Trap Nights									
SITE_ID	1988	1988	1989	1993	1995	1988	1989	1993	1995
AL3								1.79	1.07
B3I								1.79	
BBC24						0.69	2.13	3.21	1.79
ELS39		1.38	1.38			0.36		0.36	
ELS61			2.79			1.05		0.71	
ELW1									
FC1									
HC13		0.36	1.79	0.36	1.79	0.71	0.36	0.71	1.07
JC28						0.67		1.07	0.36
LCR93	0.36	1.07		0.36		1.07	1.79	3.93	0.36
LPS9		0.69				2.45	2.76		0.36
MGR36		1.07		1.43		1.02	1.07	1.79	2.86
NFIC12			0.69				1.05	0.36	0.36
PC12		2.79	2.83	0.36		0.69	3.19	2.86	
RR5		0.34				3.21	1.05	2.14	
SC4							0.36		
SC84									0.71
SR24		0.36	0.71		0.36	0.71	3.21	2.14	1.43
TC13							0.36	0.71	1.79

Code	SOVA				TADO		ZATR	
Species	Sorax vagrans				Tamiasciurus douglasii		Zapus trinotatus	
Common Name	Vagrant Shrew				Douglas Squirrel		Pacific Jumping Mouse	
Number of Captures per 100 Trap Nights								
SITE_ID	1988	1989	1993	1995	1988	1995	1989	1995
AL3		2.12						
B3I	0.36							
BBC24		0.72					0.69	
ELS39	2.12	0.69						
ELS61		0.33	0.36					
ELW1								
FC1	0.33							
HC13	0.36	0.36		0.69		0.33		
JC28								
LCR93			0.36	0.33				
LPS9	1.40			0.71				
MGR36	0.69		1.43		0.33			
NFIC12		0.36						
PC12	1.07	1.76	2.14					
RR5		0.34	0.71					0.67
SC4								
SC84			0.36					
SR24	0.36	3.19						
TC13				1.07				