Small mammal monitoring at the landscape scale
Denali National Park and Preserve[†]

1998 Annual Report

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Executive summary

- For a second consecutive year, small mammal sampling was conducted in four watersheds in the vicinity of Park headquarters. This constitutes a seventh year of sampling in the Rock Creek watershed, in an effort to document patterns of inter- and intra-annual variation in small mammal abundance.

- The watersheds adjacent to Rock Creek were also sampled less intensively to assess whether dynamics in Rock Creek were representative of dynamics manifested in other geographically proximate locations.

- A total of 48,000 trap checks were conducted in the eastern study area, resulting in approximately 1700 small mammal captures.

- Population levels were uniformly low, relative to years of high abundance, across all plots.

- The greatest population size of 42 individuals/plot were detected at the end of the field season in the riparian habitat of Rock Creek. This is less than half the abundance seen in years of high abundance (e.g. 1995). Population sizes were approximately equal to abundance estimated on these plots during the 1997 field season.

- At these low population levels, there is no discernable ‘watershed’ effect; i.e., abundance measured in Rock Creek was similar to abundance measured in other watersheds surrounding it.

- For a fourth year, a three-day sampling event was also conducted at the west end of the Park, along the McKinley Bar trail. Abundance on the McKinley Bar plots was

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roughly half as large as abundance measured on the eastern plots at approximately the same time during the field season. This is also consistent with the findings of the 1997 field season when only three animals were captured on the McKinley Bar plots.

Introduction

As one element of the Denali National Park and Preserve Long-term Ecological Monitoring Program, the 1998 field season of small mammal sampling was virtually identical to the 1997 field efforts. Emphasis was placed on adding a seventh year to the small mammal monitoring in the Rock Creek watershed to further examine temporal patterns of abundance in this study area. Additional sampling in the surrounding watersheds continued the spatial expansion begun in 1997. This report will provide a brief overview of the estimates of small mammal abundance from 39 plot/occasion combinations sampled during the field season. The objective of this investigation was to

- Continue to document dynamics of small mammal populations in the Rock Creek watershed,
- determine whether the environment of the Rock Creek watershed is similar to surrounding watersheds such that demographic patterns detected there are representative of patterns in the surrounding watersheds.

Methods

Study plots were located in the Rock Creek watershed as in 1997, two riparian grids (RR1 and RR2) and two ridge grids (RF1 and RF2). Sampling also occurred in the watershed to the west of Rock Creek, the watershed west of that, and the Hines Creek watershed south of the Park road. Four plots (2 riparian grids and 2 ridge grids) were used in each watershed (Fig. 1). Four plots were also situated in the spruce forest adjacent to the McKinley Bar trail.

Sampling was conducted throughout the summer on these 20 study plots. Sherman livetraps were deployed on the plots for 4-day periods, beginning on Sunday evenings, and concluding on Thursday evenings. The schedule of visits to the watersheds attempted to correspond within logistical constraints to the 1997 schedule, and is summarized in Table 1.

Each sampling plot was approximately 0.8ha in area, and was laid out in a square configuration, except in circumstances where topography prevented, and an elongated rectangle was used. Field procedures followed methodology described by Furtsch (1995) and Rexstad (1996) in which traps were baited with sunflower seeds and bedding, and checked 3 times per day. Captured individuals were identified by sex and species, and weight and reproductive status was determined. Unmarked individuals were implanted with passive integrated transponder (PIT) tags, and released.

Data were error-checked in the field and PIT tag codes were verified against an inventory list to ensure integrity of the data collected. Abundance estimates were computed using closed population models of Otis et al. (1978) as incorporated in program CAPTURE (Rexstad and Burnham 1991). These models incorporate three potential sources of variation in individual capture probabilities: variation due to time (t), variation due to behavior (b), and variation due to individual heterogeneity (h). These sources of variation may operate singly, or in concert, giving rise to eight potential models of capture variability (no variation, t, b, h, tb, th, bh, tbh). A model selection algorithm tests for the presence of these sources of variation present in the capture data and produces abundance estimates based upon the most appropriate model for each data set. Notation used in this report designates models by the capital letter "M" subscripted by the source(s) of variation present in the model; M_0 is the model in which none of the three potential sources of variation is explicitly modeled. Abundance estimates are possible only when marked individuals are recaptured. In many instances this summer, there were no recaptures, in which case the estimated abundance is equal to the number of individuals captured.

Results

A total of 48,000 trap checks (10 sampling periods x 400 traps/site x 4 days/site x 3 checks/day) were conducted in the 4 study areas during the summer, yielding a total of 1719 captures, or approximately 1 capture for every 28 traps checked. Table 2 lists the numbers of captures by species.

The estimates of abundance for northern red-backed voles (*Clethrionomys rutilus*) and tundra and singing voles (*Microtus* spp.) are presented in Table 3.

In many instances, where the number of individuals captures <10, the abundance estimate is nearly identical to the number of individuals captured, which is unlikely to be true, but the amount of data available for abundance estimation was too small for the estimation routine to make a more reasonable approximation.

Visually, the abundance of animals across the study area and field season is shown in Fig 2a,b.

Discussion

1998 abundance levels for both *Clethrionomys* and *Microtus* populations appear to be some of the lowest measured in the past seven years in DNPP. The 1997 studies showed a severe reduction in abundance for *Clethrionomys*, while *Microtus* populations maintained a reasonable level, higher than that of *Clethrionomys* for the first time (Fig. 3-5). In 1998, however, both genera experienced extremely low population levels, with *Clethrionomys* abundance on our Rock Creek RF1 plot (that has continuously been sampled in an identical manner since 1992) remaining at the same level as in 1997, and the *Microtus* abundance falling to levels previously seen in 1994.

Oakley et al. (in prep.) have produced a model of small mammal population dynamics based on spring weather conditions. Warm, dry springs tend to produce large populations of *Clethrionomys*, whereas cool, damp springs produce suppressed population levels. The spring of 1998 was cool and damp, and therefore population levels were suppressed, although abundance was even lower than predicted by the model.

Regarding the objective of understanding the "representativeness" of the Rock Creek watershed, it appears in 1998 that the population trough experienced by *Clethrionomys* and *Microtus* was universal in all watersheds sampled. As was the case with observations in 1997, we still lack information from a year of high population abundance to discern whether this spatial concordance would be maintained during "good" years. With small sample sizes, the power of any statistical test to discriminate differences between abundance by watersheds is significantly impaired.

Continued sampling at this spatial scale needs to continue to determine if dynamics of small mammal populations are tracked across watersheds when a favorable year of high abundance occurs. Sampling should begin to take place in watersheds at a greater distance from Rock Creek to begin to appreciate the spatial concordance in small mammal dynamics.

Literature Cited

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Table 1: Complete sampling effort of locations, dates, and personnel in small mammal monitoring in 1998.

Watershed	Sampling periods	Personnel
Rock Creek	(1) 22-25 June	Leo W. Faro, Greg A. Clark, Eric A. Rexstad
	(2) 6-9 July	Leo W. Faro, Greg A. Clark
	(3) 20-23 July	Leo W. Faro, Greg A. Clark, Jane and Brett Busch-Mumford
	(4) 17-20 August	Leo W. Faro, Greg A. Clark
	(5) 31 August-3 September	Leo W. Faro, Greg A. Clark, Eric A. Rexstad, Edward M. Debevec
West of Rock Creek	(1) 29 June-2 July	Leo W. Faro, Greg A. Clark
	(2) 24-27 August	Leo W. Faro, Greg A. Clark
West of west of Rock Creek	(1) 27-30 July	Leo W. Faro, Greg A. Clark, Jane and Brett Busch-Mumford
Hines Creek	(1) 13-16 July	Leo W. Faro, Greg A. Clark, Jane and Brett Busch-Mumford
McKinley Bar	(1) 7-9 August	Leo W. Faro, Greg A. Clark, Eric A. Rexstad

Table 2: Number of capture events by species in 1998. Numbers are combined captures from 10 sampling periods in 5 watersheds.

Species	Number of captures
Clethrionomys rutilis	1147
Microtus oeconomus	277
Microtus miurus	70
Shrew	146
Boreal Chickadee	2
Gray Jay	25
Junco	21
Red Squirrel	13
White-crowned Sparrow	18

Table 3: 1998 abundance estimates for *Clethrionomys rutilis* and *Microtus* sp. on Rock Creek watershed plots.

		Clethrionomys						***Microtus***					
Plot	**Date**	**M_{t+1}[1]**	**Model[2]**	**N[3]**	**SE(N)[4]**	**LCI[5]**	**UCI[6]**	**M_{t+1}**	**Model**	**N**	**SE(N)**	**LCI**	**UCI**
Riparian 1	22-25 Jun	6	M(b)	8	4.97	6	37	0					
(RR1)	6-9 Jul	12	M(h)	15	2.40	12	23	0					
	20-23 Jul	13	M(h)	13	0.20	13	13	1					
	17-20 Aug	14	M(h)	22	5.38	16	40	1					
	31 Aug-3 Sep	20	M(h)	42	10.38	29	72	1	M(o)	1	0.19	1	1
Riparian 2	22-25 Jun	2	M(h)	3	1.93	2	13	19	M(bh)	41	46.01	20	298
(RR2)	6-9 Jul	3	M(o)	3	0.20	3	3	10	M(o)	10	0.71	10	10
	20-23 Jul	11	M(h)	12	2.80	11	29	11	M(o)	11	0.34	11	11
	17-20 Aug	16	M(o)	18	2.01	16	26	7	M(o)	7	0.08	7	7
	31 Aug-3 Sep	14	M(th)	20	5.03	15	39	10	M(h)	11	2.80	10	28
Ridge 1	22-25 Jun	7	M(o)	7	0.77	7	7	2	M(h)	4	2.47	2	15
(RF1)	6-9 Jul	4	M(o)	4	0.26	4	4	1	M(t) Chao	1	0.00	1	1
	20-23 Jul	12	M(bh)	17	9.46	12	68	8	M(o)	8	0.71	8	8
	17-20 Aug	10	M(o)	10	0.28	10	10	13	M(o)	13	0.45	13	13
	31 Aug-3 Sep	7	M(h)	9	2.49	7	20	4	M(h)	5	1.39	4	11
Ridge 2	22-25 Jun	4	M(o)	4	0.51	4	4	0					
(RF2)	6-9 Jul	9	M(o)	9	0.63	9	9	0					
	20-23 Jul	11	M(bh)	11	0.64	11	11	1	M(t) Chao	1	0.00	1	1
	17-20 Aug	18	M(h)	21	2.41	18	29	7	M(h)	7	3.04	7	7
	31 Aug-3 Sep	21	M(b)	26	6.78	21	58	6	M(h)	7	1.39	6	13

[1] Unique number of individuals captured on the plot during the sampling session
[2] Model selected as most appropriate for data set; see Otis et al. (1978) for model descriptions
[3] Estimated abundance
[4] Standard error of abundance estimate
[5] Lower 95% confidence bound
[6] Upper 95% confidence bound

Table 4. 1998 abundance estimates for *Clethrionomys* and *Microtus sp*. in watershed west of Rock Creek watershed.

		Clethrionomys						***Microtus***					
Plot	**Date**	**M_{t+1}**	**Model**	**N**	**SE(N)**	**LCI**	**UCI**	**M_{t+1}**	**Model**	**N**	**SE(N)**	**LCI**	**UCI**
Ridge 1	29 Jun-3 Jul	0						0					
(CF1)	24-27 Aug	4	M(o)	4	0.18	4	4	0					
Ridge 2	29 Jun-3 Jul	3	M(bh)	3	0.01	3	3	4	M(o)	8	5.32	4	32
(CF2)	24-27 Aug	14	M(o)	17	2.77	14	27	1	M(o)	1	0.02	1	1
Riparian 1	29 Jun-3 Jul	13	M(h)	17	4.26	13	35	2	M(o)	2	0.60	2	2
(CR1)	24-27 Aug	12	M(b)	13	2.25	12	25	9	M(h)	9	2.48	9	9
Riparian 2	29 Jun-3 Jul	2						4	M(h)	4	2.13	4	4
(CR2)	24-27 Aug	12	M(h)	16	4.23	12	33	0					

Table 5. 1998 abundance estimates for *Clethrionomys* and *Microtus sp*. in watershed west of the watershed west of Rock Creek, the Hines Creek watershed, and the plots along the McKinley Bar trail.

		Clethrionomys						***Microtus***					
Location	**Plot**	**M_{t+1}**	**Model**	**N**	**SE(N)**	**LCI**	**UCI**	**M_{t+1}**	**Model**	**N**	**SE(N)**	**LCI**	**UCI**
West of West	Riparian 1 (KR1)	10	M(bh)	13	5.00	10	38	1	M(o)	1	0.09	1	1
(27-30 Jul)	Riparian 2 (KR2)	11	M(o)	11	0.49	11	11	6	M(h)	7	1.40	6	13
	Ridge 1 (KF1)	13	M(o)	13	0.44	13	13	1	M(t) Chao	1	0.00	1	1
	Ridge 2 (KF2)	12	M(o)	12	0.69	12	12	0					
Hines Creek	Riparian 1 (HR1)	12	M(o)	12	0.54	12	12	0					
(13-16 Jul)	Riparian 2 (HR2)	5	M(o)	5	0.36	5	5	12	M(h)	40	11.24	25	71
	Ridge 1 (HF1)	11	M(b)	12	1.78	11	21	3	M(h)	5	1.97	3	13
	Ridge 2 (HF2)	4	M(o)	4	0.28	4	4	0					
McKinley Bar	Plot 1 (W1)	5	M(o)	6	1.54	5	13	1					
(7-9 Aug)	Plot 2 (W2)	3	M(o)	3	1.25	3	3	0					
	Plot 3 (W3)	9	M(h)	11	2.83	9	24	0					

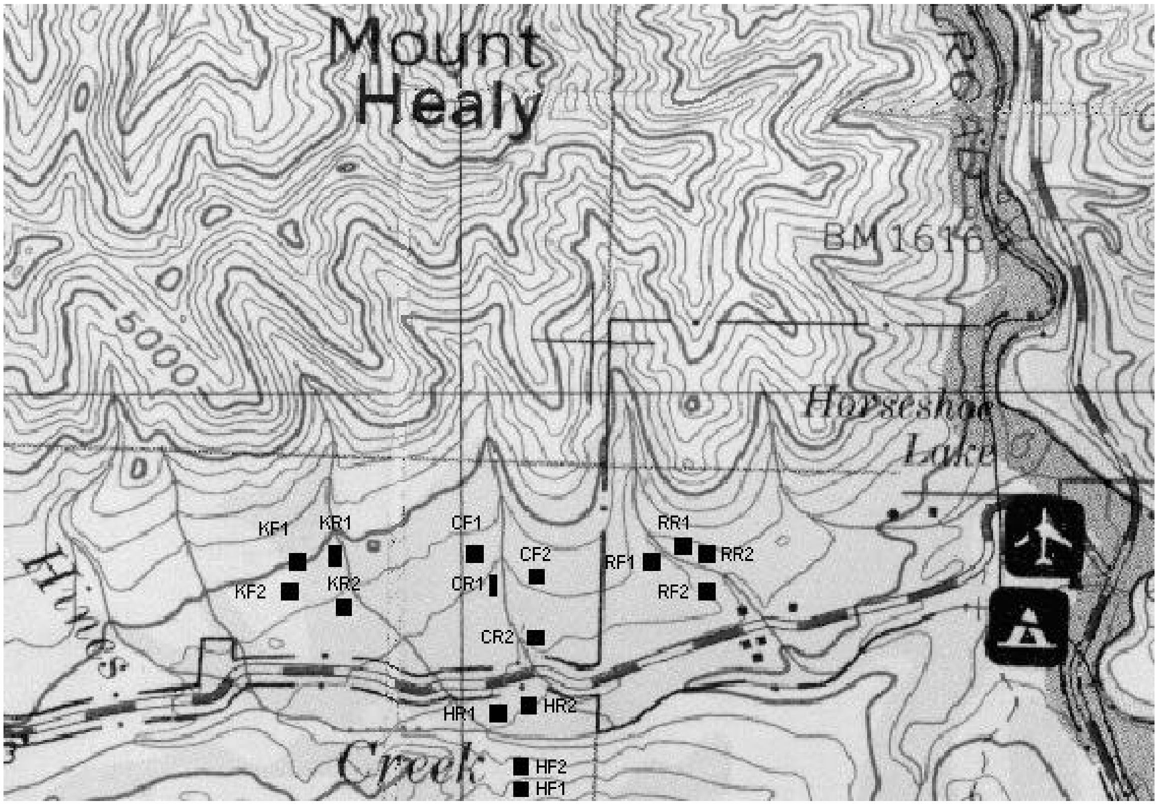

Figure 1a: Location of sampling plots in the Rock Creek watershed and surrounding area. With the current labeling scheme, the first letter identifies the watershed (R = Rock, C = West of Rock Creek, K = West of west of Rock Creek, H = Hines Creek) and the second letter specifies the habitat type of the plot (R = riparian, F = ridge).

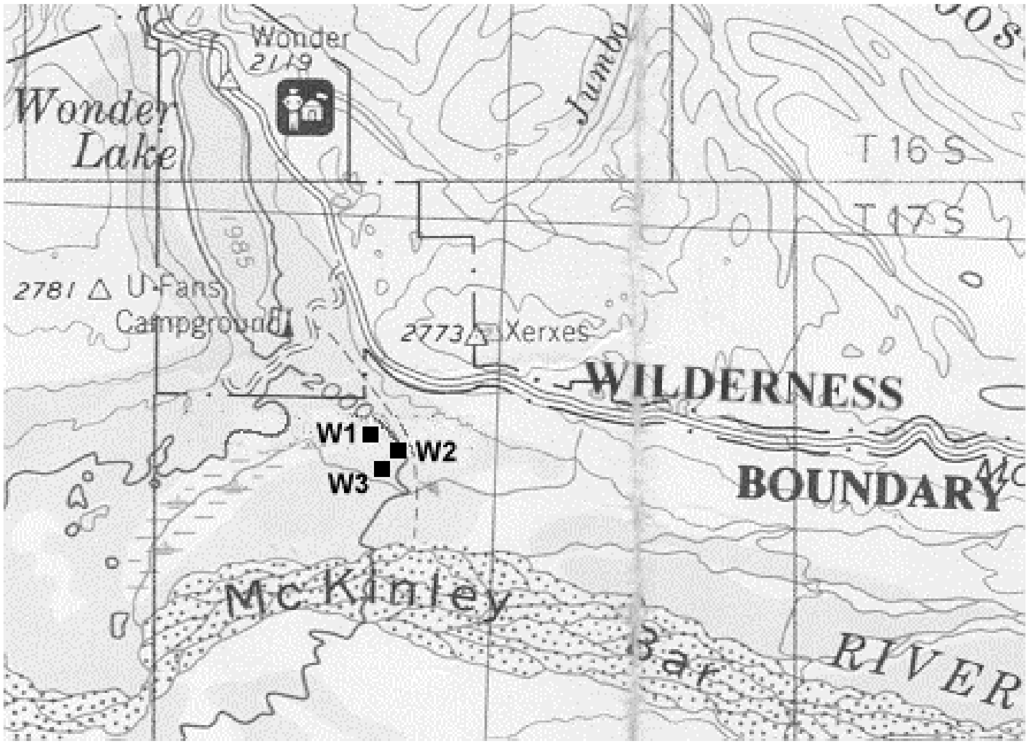

Figure 1b: Location of sampling plots along the McKinley Bar trail near Wonder Lake.

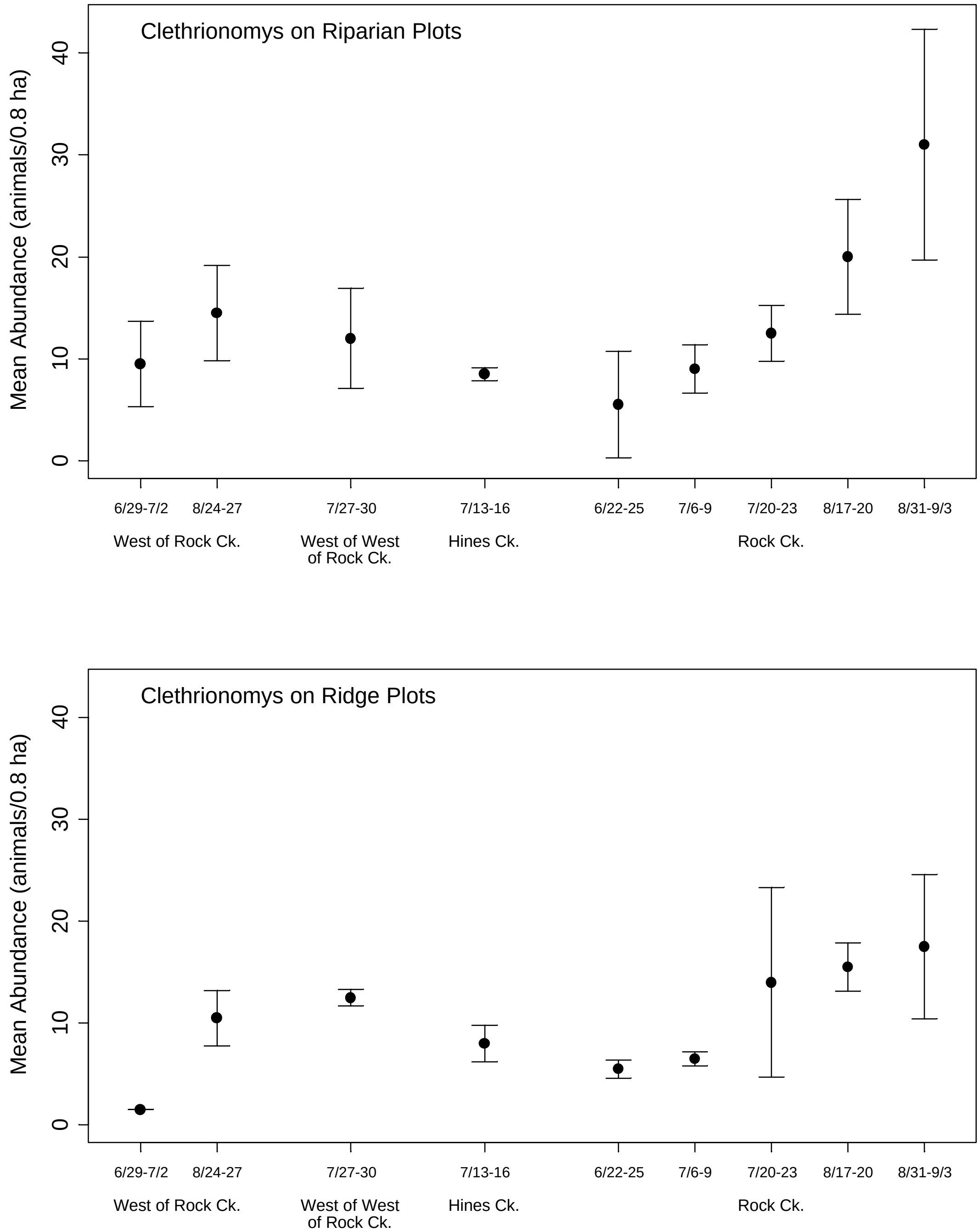

Figure 2a: 1998 abundance estimates for *Clethrionomys rutilis* by habitat type. Each point is the mean abundance for two replicate plots for each location and sampling session. Error bars represent 95% confidence intervals.

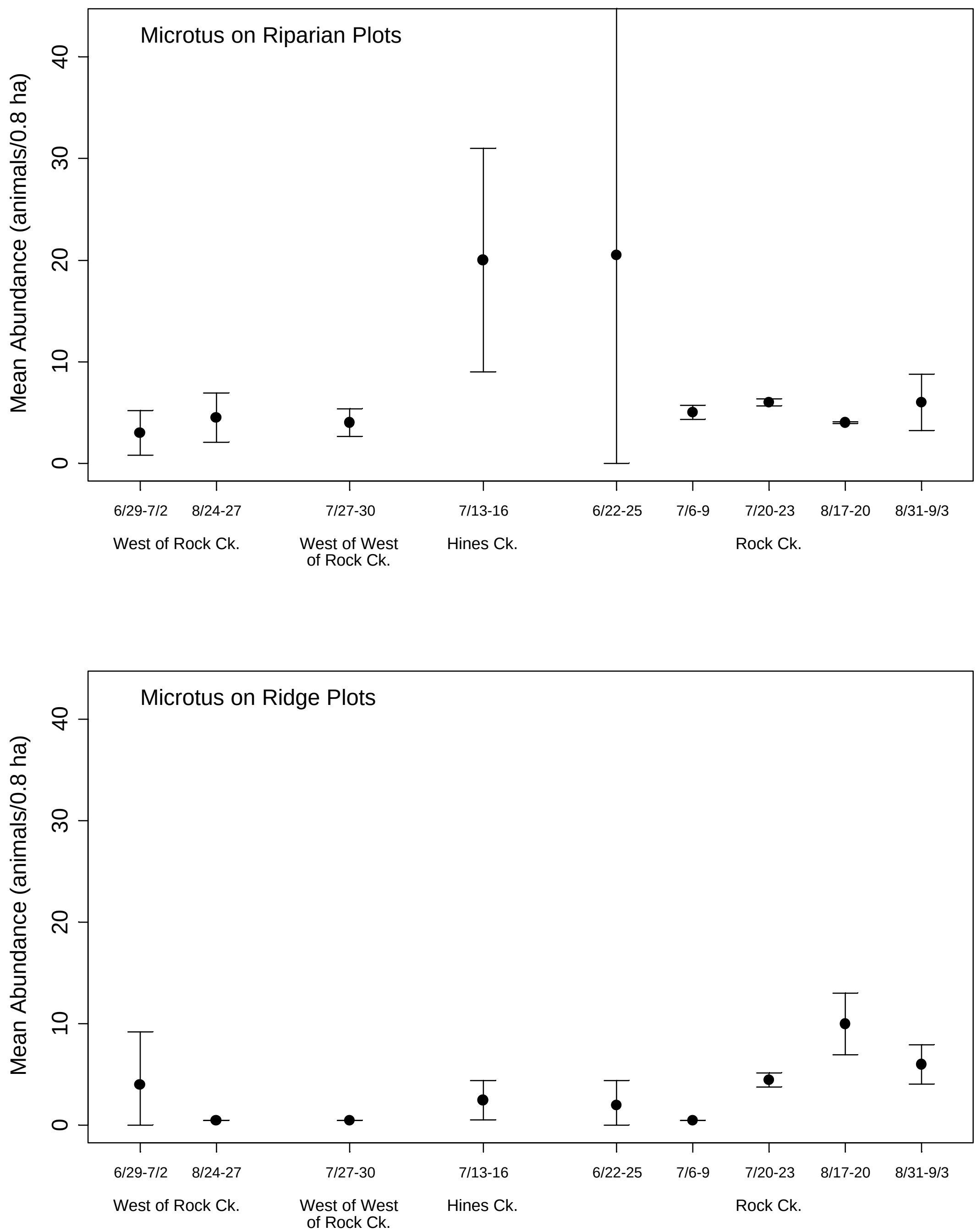

Figure 2b: 1998 abundance estimates for *Microtus* sp. by habitat type. Each point is the mean abundance for two replicate plots for each location and sampling session. Error bars represent 95% confidence intervals.

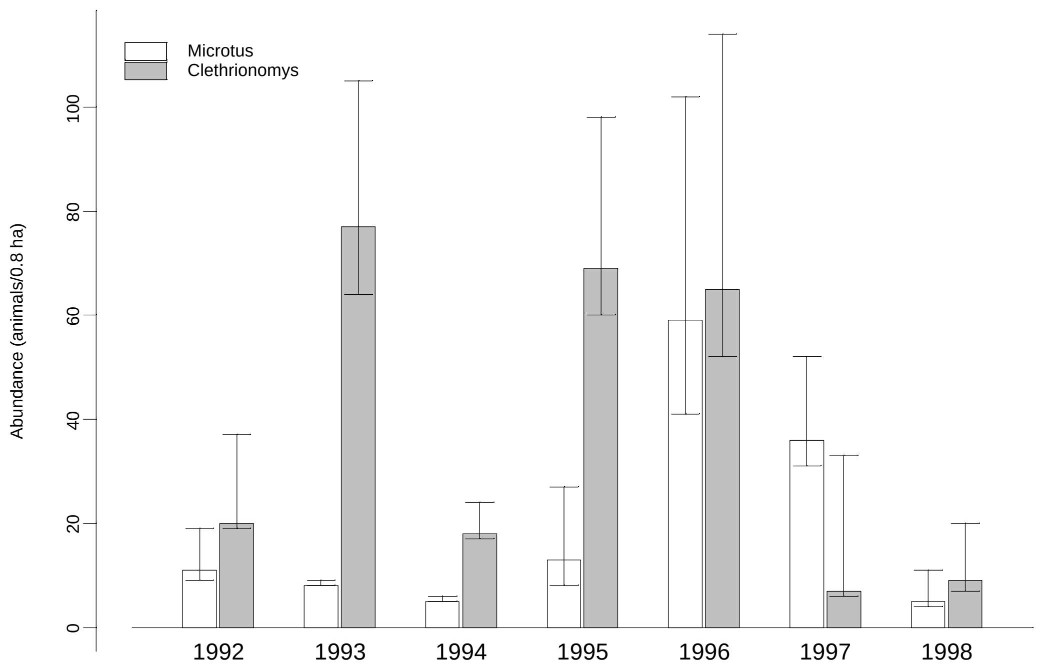

Figure 3: 1992 to 1998 abundance estimates for *Clethrionomys rutilis* and *Microtus* sp. in early September on plot RF1. Error bars represent 95% confidence intervals.