The effect of riparian zones in structuring small mammal communities in the southern Appalachians

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Abstract

Riparian zones have been shown to be important in structuring vertebrate communities and in maintaining biodiversity. We examined the role of riparian zones in structuring small mammal communities ‘in a southern Appalachian watershed at Coweeta Hydrological Laboratory, Macon County, North Carolina. We established pitfall and live-trap grids in three replicates each of seeps, first-order,, second-order, and third-order stream riparian zones. We established upland non-riparian controls for each replicate at a distance greater than 100 m from the respective riparian zones. These sites, were distributed over northern hardwood, cove hardwood, moderate oak, and xeric-oak-pine cover types along an elevational gradient from 678 to 1,592 m. We found no significant differences in the composition of small mammal communities, between riparian and non-riparian zones at these sites. Patterns of species richness, diversity, and evenness for both pitfall surveys and live trapping estimators were similar for riparian and non-riparian areas. Within-stream order comparisons yielded similar results; no differences were found, between riparian and non-riparian sites for seeps, second-order, or third-order streams. The only exception was in first-order stream comparisons where *Blarina brevicauda* was found ‘to be more abundant in non-riparian sites. The lack of significant differences between riparian arid non-riparian sites in small mammal parameters examined would appear to be associated with the general lack of structural and vegetative distinction between riparian and non-riparian zones in the southein Appalachians.

1. Introduction

The role of riparian habitats in structuring terrestrial vertebrate communities is poorly known. However, there is an increasing focus on riparian habitats (often referred to as streamside or riparian zones) and their role in maintaining biological diversity, particularly’in view of conflicting use demands (e.g., Johnson and Jones, 1977; Sands, 1977; Thomas et al., ‘1979;

Knopf et al., 1988; Newton et al.; 1996). Much of the available literature relating to,riparian zones has focused largelyon birds in arid regions of the southwestern United States, especially floodplainsand low gradient streams (Austin, 1970; Carothers, et al., 1974; Gaines, 1974; Stamp, 1978; Stauffer and Best, 1980; Knopf, 1985; Knopf et al., 1988; Dickson et al., 1995). In most of these studies, riparian zones have been shown to enhance avian species diversity, and important to the breeding and feeding ecology of a number of species.

The influence of riparian zones on small mammals has been less well documented. However, as in birds, much of the work has focused on arid regions of the western United States (Boeer and Schmidly, 1977; Thomas et al.; 1979; Szaro and Belfit, 1987) or in managed pine plantation ecosystems in the Southeast (Dickson and Williamson, 1988; Thurmond and Miller, 1994) where vegetational cover and microhabitat features between riparian zones and non-riparian zones differ dramatically. Similarly, studies in the Pacific Northwest (Doyle, 1990) indicate riparian zones have higher species richness and abundance of small mammals compared to adjacent uplands. However, other studies suggest patterns of small mammal richness and abundance, as well as community composition, between riparian and non-riparian zones may differ across elevational and vegetational gradients (Olson and Knopf, 3988; Simons et al.; 1990; Laerm et al., in press).

The southern Appalachian Mountains are characterized by the highest annual precipitation in the eastern United States, which, produces and maintains water flow through a complex network of perennial streams (SAMAB, 1996). These streams and associated riparian vegetation zones are a significant componant of the landscape. Despite the significant area that riparian zones constitute in the southern Appalachians, only a few published accounts. of mammal faunas associated with riparian systems are available (Paul and Quay, 1963; Whitaker et al., 1975). There have been no studies of the role of riparian zones in structuring small mammal communities in the region, nor are there studies which compare patterns of species richness and abundance between riparian zones and surrounding non-riparian upland habitat. .

As part of wide ranging surveys of small mammals in the southern Appalachians, we examined the role of high elevation riparian zones in structuring small mammal communities. We contrasted the composition of small mammal communities in riparian versus non-riparian zones, and examined the effect of elevation, stream order, and habitat differences on these communities.

2. Methods

This study was conducted at U.S. Department of Agriculture Forest Service Coweeta Hydrological Laboratory, Macon, County, North Carolina (latitude 350 03' N, longitude 830 25' W). Coweeta Laboratory encompasses two drainage basins (Coweeta Creek and Dryman Fork Creek) which range in elevation from 678 to 1,592 m, located in the Nantahala National Forest, Blue

Ridge Physiographic Province. Our study was conducted in the 1,626 ha Coweeta Creek Basin. Coweeta has a marine, humid, temperate climate and receives 152 mm monthly average of rain. A number of primary vegetative associations are present at Coweeta. Northern Hardwood communities are typical of higher elevations (usually above 1'220 m) and north-facing slopes. These are dominated by yellow birch (*Betula alleghaniensis* Britton), black birch (B. *lenta* L.), yellow buckeye (*Aesculus flava* Solander), northern red oak (Quercus *rubra* L.), American beech (*Fagus grandifolia* Ehrh.), striped maple (*Acer pennsylvanicum* L.), and mountain maple *(A. spicatum* L.). Rosebay rhododendron *(Rhododendron maximum* L.) is a common midstory associate. Cove Hardwood associations occur from approximately 610 to almost 1220 m and are characteristic of moist, north-facing slopes and sheltered ravines. They are dominated by yellow poplar *(Lin'odendron tulipifera* L.), yellow buckeye, basswood (*Tilia heterophylla* L.), black cherry (*Prunus serotina* Ehrh.), northern red oak, and white oak *(Quercus alba* L.). Cove hardwood communities are noted for their rich herbaceous understory, but a well developed ericaceous midstory is rarely present. Mixed oak-hickory communities occur at all elevations in the basin. These are dominated by northern red oak, white oak, black oak *(Q. velutina* Lam.), hickories (*Carya* spp.), and blackgum (*Nyssa sylvatica* Marshall). They often include a midstory shrub layer dominated by American chestnut *(Casfanea dentata* (Marshall)), magnolia (Magnolia spp.), and rosebay rhododendron on the more mesic sites or mountain laurel (*Kalmia latifolia* L.) on the more moderate to xeric sites. Moderate to xeric oak-pine communities are present on xeric ridgetops and south-facing slopes, particularly at low and mid elevations. These stands are dominated by chestnut oak *(Q. prinus* L.), scarlet oak *(Q. coccinea* Muenchh.), sourwood (*Oxydendrum arboreum* (L.)), and blackgum with white pine (*Pinus sfrobus* L.), pitch pine (*P. rigida* Miller), and/or Virginia pine (*P. virginiana* Miller), depending upon moisture, aspect, and elevation. Thick growths..of mountain laurel, greenbrier (*Smilax* spp.), and blueberries *(Vaccinium* spp.) are usually present. Riparian zones occur throughout the Coweeta Basin. These vary in their vegetative associations, depending largely on elevation, aspect 'and structure of surrounding vegetative cover. Most are dominated by white pine eastern hemlock (Tsuga canadensis (L.)) with a rosebay rhododendron shrub layer. However, other canopy dominants in many riparian zones differ little from surrounding communities. See Swank and Crossley (1988) for discussion,, of physiography, hydrology, and vegetative communities of Coweeta Hydrological Laboratory.

We established trapping grids along a riparian gradient (the treatments) and in adjacent uplands (the controls). Twelve replicated riparian trapping grids were equally distributed among seeps, first-order, second-order, and third-order streams sites. Twelve upland control grids were located a minimum of 100 m from the respectively paired riparian grids. Trapping grids were also replicated among- vegetative communities along a topoedaphic gradient and included northern hardwood, cove hardwood, mesic oak-hickory, and oak-pine communities. Each trapping grid consisted of a 60 x 60 m (0.36

ha) grid with 49 trapping stations on 10 meter centers. The riparian treatment grids were centered in the respective riparian zones. While riparian zones are often poorly defined in southern Appalachian forests (there is no sharp demarcation between the riparian zone and surrounding habitat), we felt that 30 meters on each side of the riparian system (seep or various order-stream) 'was an adequate distance to observevestream effects, if present, particularly since we also tested for distance '(see below); Each trapping station on each grid included a small (6.5x55x16.5 cm). Sherman live trap and a 0.91 l plastic pitfall cup with 0: 15 l preservative. Live trapping with Sherman traps was conducted from 15-20 August, 1996. Both pitfall and live trapping were used to optimize opportunities for estimation of abundance of. both the soricid and rodent communities, respectively (Ford et al., 1994, 1997; Handley and Varn, 1994; Kirkland and Sheppard, 1994). Pitfall traps were open for 14 days between 29 September and 12 October, 1996. Live trapped mammals were individually marked with numbered ear tags, and their body mass, sex, and reproductive condition recorded.

We conducted point vegetative sampling to determine basal area and vertical height. of herbaceous vegetative structure as well as volume of coarse woody: debris and volumb of rock at each site., Values obtained from five randomly selected points were averaged for each site: A 10x prism. and Robel pole were used to estimate basal area and' vertical vegetative structure, respectively. Reported values for basal area (square meters per hectare) is mean value per site; reported values of vertical structure is mean value per site of height of herbaceous cover in decimeters. Volume of coarse woody debris (based on length and diameter measurements) and volume of rock (length, breadth, height above ground) > 2.5 cm was calculated based on measurements taken in randomly placed one meter sampling squares.

Abundance estimates obtained from rodent live trap, mark-recapture studies were determined for the three most abundant rodents captured, southern fed-backed vole (*Clethrionomys gapperi*), deer mouse (*Peromyscus maniculatus*), and white-footed mouse (*P. leucopus*), using the program CAPTURE (White et al., '1982). Abundances are reported in terms of individuals per 0.36 ha. Comparisons of shrew pitfall capture results were made based on their relative abundance. Reported values are based upon numbers recovered per 100 trap night effort. Shannon's diversity index and Pielou's measure of evenness were used in all analyses (Pielou, 1966). Data were normalized using log transformation. We tested for differences between the riparian zones and non-riparian (control) zones using a t-test. We tested for differences among stream qrders and habitat types within the riparian zones and within the' non-riparian zones using an ANOVA and Duncan's Multiple Range Test. We also tested for significant correlations between all dependent variables and elevation, stream order, and habitat as well as distance from the stream (seep). For all tests significance was accepted at $p \leq 0.05$.

3. Results

A total of 16,464 pitfall trap nights and 5,580 live trap nights were recorded, evenly distributed among 24 sites (12 riparian and 12 non-riparian). Mean values for structural habitat and vegetative variables and capture results for riparian and non riparian sites are shown in tables 1 and 2. We recovered five species of shrews including the masked shrew (***Sorex cinereus*** Kerr), smoky shrew (S. ***fumeus*** Miller), pygmy shrew (S. ***hoyi*** Baird), water shrew (S. palustris Richardson), and northern short-tailed shrew (***Blarina brevicauda*** (Say)), and six species of 'rodents including the deer mouse *(Peromyscus* ***maniculatus*** **Wagner),** white-footed mouse (***P. leucopus*** Rafinesque), golden mouse (***Ochrotomys nuttalli*** (Harlan)), Capper's red-backed, vole (***Clethrionomys gapperi*** **(Vigors)),** pine vole (***Microtus pinetorum*** **(LeConte)),** and woodland jumping mouse *(ffapaeozapus* ***insignis*** (Miller)). Of the rodents, only three species (***P.*** *maniculafus,* ***P.*** *leucopus* and ***Clethrionomys*)** were captured in sufficient numbers to permit utilization of the program CAPTURE in determination of abundance estimates.

No significant differences for vegetative or structural features were observed between riparian and non-riparian sites. In comparisons of the variables associated with pitfall. trapping (total pitfall captures, pitfall **richness,** pitfall diversity, pitfall evenness, and the abundance per 100 trap nights **of the** five species of shrews recovered) we'observed significant differences between the riparian and non-riparian sites for only two variables (Tables 1 and 2).

Table 1. A comparison of the mean values of habitat **and** capture variables of six riparian (three seeps and three first order streams) and six non-riparian sites at Coweeta Hydrological Laboratory, Macon County, North Carolina. Pitfall captures based on numbers per 100 trap nights. Values for rodents based on abundance estimates per 0.36 ha. R = riparian; C = control. Significant values at **P<0.05** indicated by **(*)**.

		Seeps		1st order stream	
	R/C	mean	std. en-.	mean	std. err.
Habitat variables					
Volume coarse woody debris	R	37.38	20.41	152.36'	55.67
	C	**49.15**	8.28	81.54	21.15
Volume rock	R	59.18	32.60	**930.06**	930.06
	C	17.11	17.11	116.64	1.93
Basal area	R	110.00	5.77	146.66	10.72
	C	142.22	14.57	116.64	1.93
Vertical height herbaceous	R	**1.77**	0.88	10.20	2.72
	C	0.89	0.11	2.88	1.47
Pitfall variables					
Total pitfall captures	R	4.62	1.53	4.18	1.14
	C	5.27	0.32	5.00	0.83

Pitfall richness	R	6.00	1.00	6.33	0.33
	C	6.50	0.50	6.50	0.50
Pitfall diversity	R	1.07	0.11	1.58*	0.08
	C	1.48	0.09	1.47*	0.09
Pitfall evenness	R	0.60	0.00	0.85	0.04
	C	0.87	0.00	0.88	0.03
Sorex cinereus	R	3.23	0.93	1.56	0.50
	C	3.13	0.80	2.14	0.63
Sorex fumeus	R	0.39	0.26	0.97	0.51
	C	0.20	0.13	0.63	0.24
Sorex hoyi	R	0.01	0.01	0.05	0.05
	C	0.00	0.00	0.00	0.00
Blarina brevicauda	R	0.51	0.25’	0.49*	0.13
	C	0.64	0.26	1.02*	0.15
Peromyscus maniculatus	R	0.15	0.15	0.29	0.22
	C	0.63	0.32	0.44	0.08
Peromyscus leucopus	R	0.00	-0.00	0.10	0.05
	C	0.05	0.05	0.10	0.10
Ochrotomys nuttalli	R	0.00	0.00	0.00	0.00
	C	0.00	0.00	0.00	0.00
Microtus pinetorum	R	0.10	0.05	0.19	0.10
	C	0.40	0.12’	0.00	0.00
Clethrionomys gapperi	R	0.15	0.08	0.53	0.17
	C	0.11	0.05	0.68	0.05
Live trapping variables					
Live richness	R	2.67	0.33	2.67	0.33
	C	2.67	0.33	3.00	0.00
Live diversity	R	0.65	0.19	0.72	0.09
	C	0.72	0.13	0.92	0.08
Live evenness	R	0.64	0.12	0.77	0.10
	C	0.72	0.13	0.84	0.07
Peromyscus maniculatus	R	10.66	8.69	17.77	8.25
	C	12.00	7.77	20.66	‘4.17
Peromyscus leucopus	R	8.00	2.31	7.66	6.69
	C	9.33	3.18	7.66	3.48
Clethrionomys gapperi	R	5.00	4.51	12.33	4.63
	C	3.67	3.18	10.66	3.93
Total rodent density	R	23.67	11.17	37.66	7.44
	C	25.00	10.50	39.00	4.16

Table 2. A comparison of the mean values of habitat and capture variables of six riparian (three second order streams and three third order streams) and six non-riparian sites at Coweeta Hydrological Laboratory, Macon County, North Carolina. Pitfall captures based on numbers per 100 trap nights. Values for rodents based on abundance estimates per 0.36 ha. R = riparian, C = control. Significant values at $P<0.05$ indicated by (*).

		2nd order stream		3rd order stream	
	R/C	mean	std. err.	mean	std. err.
Habitat variables					
Volume coarse woody debris	R	103.17	32.74	196.70	167.08
	C	167.90	91.76	59.29	52.05
Volume rock	R	1196.00	1196.00	122.30	122.30
	C	5.00	4.81	2.68	2.68
Basal area	R	86.88	36.64	4444	31.15
	C	100.00	47.85	55.99	30.99
Vertical height herbaceous	R	6.88	2.05	2.22	1.35
	C	4.11	2.28	4.10	2.12
Pitfall variables					
Total pitfall captures	R	4.91	1.01	3.45	0.89
	C	4.66	1.08	3.69	0.19
Pitfall richness	R	4.33	0.33	4.33	0.88
	C	5.33	0.03	5.00	1.15
Pitfall diversity	R	1.05	0.03	1.11	0.08
	C	1.63	0.10	0.97	0.27
Pitfall evenness	R	0.72	0.05	0.79	0.07
	C	0.81	0.07	0.60	0.09
Sofex *cinereus*	R	2.72	0.34	1.85	0.42
	C	1.89	0.86	2.53	0.27
Sofex *fumeus*	R	1.17	0.66	0.92	0.35
	C	1.02	0.30	0.44	0.22
Sorex hoyi	R	0.05	0.05	0.00	0.00
	C	0.05	0.05	0.00	0.00
Blarina brevicauda	R	0.68	0.40	0.29	0.22
	C	1.22	0.05	0.29	0.14
Pefomyscus maniculatus	R	0.10	0.10	0.00	0.00
	C	0.19	0.01	0.05	0.05
Peromyscus leucopus	R	0.00	0.00	0.05	0.05
	C	0.00	0.00	0.15	0.08
Ochrotomys nuttalli	R	0.00	0.00	0.10	0.10
	C	0.00	0.00	0.05	0.05
Microtus pinetorum	R	0.05	0.05	0.10	0.10
	C	0.10	0.05	0.15	0.08

Clethrionomys gapperi	R	0.15	0.15	0.15	0.08
	c	0.24	0.17	0.05	0.05
Live trapping variables					
Live richness	R	3.00	0.00	3.00	0.00
	C	3.00	0.00	3.00	0.00
Live diversity	R	0.93.	0.10	0.85	0.12
	C	0.90	0.08	0.98	0.04
Live evenness	R	0.85	0.08	0.78	0.11
	C	0.82	0.07	0.89	0.04
Peromyscus maniculatus	R	15.00	5.13	16.00	8.54
	c	18.00	7.81	19.33	3.17
Peromyscus leucopus	R	8.00	4.73	9.33	4.91
	C	9.33	3.52	19.66	6.96
Clethrionomys gapperi	R	8.62	7.77	12.66	6.39
	C	9.33	3.71	4.66	2.26
Total rodent density	R	39.00	56.29	38.00	9.71
	C	36.67	7.31	43.66	9.17

Significantly ($p = 0.0377$) more *Blarina brevicauda* were recovered in pitfalls in the non-riparian site of first-order streams. Also, pitfall richness was significantly higher ($p = 0.0029$) in non-riparian first-order stream sites. No significant differences were observed between ‘riparian and non-riparian sites in seeps, second-order, or third-order streams. In comparisons between stream orders in the riparian areas, only pitfall diversity differed significantly ($p = 0.0049$), being higher in first-order streams compared to others stream orders. No significant differences were observed between non-riparian sites in matchings consistent with those of the various stream orders. No differences were observed in comparisons between habitat types associated with the riparian sites. However, in comparisons between habitat types associated with’ the non-riparian sites, *Sorex cinereus* was significantly ($p = 0.0435$) more abundant in cove hardwood communities compared to other Cover types.

In comparisons of the variables associated with live trapping ‘(species richness, species diversity, species evenness, and densities of the three rodent species), no significant differences were ‘observed in pairings of riparian versus, non-riparian areas or in comparisons of stream orders. No differences were observed in comparisons between habitat types associated with the riparian sites or non-riparian sites.

A number of significant correlation’s were related to elevation. As expected, rank, of stream order ($r^2 = -0.9308$, $p = 0.0001$) was strongly negatively correlated with elevation, since seeps and first-order streams at -our sites were associate9 with high elevation areas. Also, as expected, habitat type ($r^2 = 0.6361$, $p = 0.0001$) was correlated with elevation. Basal area was positively associated with elevation ($r^2 = 0.5568$, $p = 0.0047$). Pitfall richness

(r^2 = 0.5848, p = 0.0043) and pitfall diversity (r^2 = 0.4703, p = 0.0272) were correlated with elevation. No species were found to be significantly correlated with elevation. None of the species were found to exhibit significant differences in abundance with distance to the stream.

Several variables were correlated. with stream order. These include basal area (r^2 = -0.5741, p = 0.0034) pitfall richness (r^2 = -0.5202, p = 0.0131), and pitfall diversity (r^2 = -0.4517, p = 0.0348).

Rank of stream order (r^2 = -0.5388, p = 0.0066), vertical structure (r^2 = -0.4726, p = 0.0197), total pitfall abundance (r^2 = 0.4080, p = 0.0478), abundance of S. *cinereus* (r^2 = 0.4356, p = 0.0337) were correlated' with habitat, and. total density (r^2 = -0.3984, p = 0.0538) approached significance with habitat.

There were a number of significant correlations with habitat structure (volume of coarse woody debris and volume of rocks) and vegetation (basal area). Volume of coarse woody debris was correlated only with live trap evenness (f-2 = 0.5135, p = 0.0103), and volume of rocks was correlated with abundance of *Sorex fumeus* (r^2 = 0.7513, p = 0.0001). Total pitfall abundance (r^2 = 0.5295, p = 0.0078) *Blarina brevicauda* (r^2 = 0.4419, p = 0.0306), pitfall evenness (r^2 = 0.4364, p = 0.0423), pitfall diversity (r^2 = 0.5424; p = 0.0091), and total rodent density (r^2 = -0.4888, p = 0.00154) were significantly correlated with basal area, and pitfall richness approached significance (r^2 = 0.4110, p = 0.0574). No significant correlations were observed for vertical structure.

4. Discussion

With the exception of *Blarina brevicauda* and pitfall richness we 'found no significant, differences in the composition of small mammal. communities between riparian zones and non-riparian zones at our southern Appalachian sites. Patterns of species diversity and evenness for both pitfall surveys and live trapping estimators were similar for riparian and non-riparian areas. Within stream-order comparisons yielded similar results; no differences were found between riparian and non-riparian zones for seeps, second-order, or third-order streams. Reasons for the few exceptions are not apparent.

We report here on additional observation of small mammals in the Coweeta Basin. We collected a single water shrew, *Sorex palustris*, in a live trap in a seep during our study. We did not include it in our live trapping analysis. However, prior to the surveys reported upon here, we collected six specimens of the water shrew, *Sorex palustris*, from four-additional sites at Coweeta. All of these captures were associated with riparian zones, and all but one were captured in snap traps. In over 10,000 live trap nights and 64,000 pitfall trap nights recorded at Coweeta to date, we recovered only two water shrews in pitfalls or live traps (one in each). However, our snap trapping capture rate of 0.87 individuals per.1 00 TN effort at. these sites suggest that *S. palustris* may be more widespread and possibly more abundant in the southern Appalachian riparian zones than previously believed or reflected in our, pitfall or iive trapping data: All of our specimens were collected immediately in seeps and first order streams in northern hardwood, cove hardwood; or white pine-hemlock communities characterized by abundant cover (overhangs, rocks, roots, logs, and crevices) between 800 and 1525 m elevation (see Laerm et at:, 1995; Laerm et al., in press).. We also note the collection of three woodland jumping mice, *Napaeozapus insignis* Miller. Two were taken in a non-riparian zone and one in a riparian zone. The differences were not significant.

The lack of differences between riparian and non-rip&an sites in small mammal parameters examined would appear to be associated with the general Jack of structural and vegetative distinction between riparian and non-riparian sites in mid to high. elevations in the southern Appalachians. For example, in those regions where faunal differences occur between riparian and non-riparian zones, <particularly. in the arid southwest, the riparian zone stands in marked contrast to surrounding uplands in terms of moisture, vegetative 'diversity, and structural complexity (Boeer and Schmidly, 1977; Johnson et al., 1977; Cross 1 985; Knopf et al.., 1988; Olson and Knopf, 1988). Similarly, uplands associated with managed monocultural pine plantations of the. Southeast stand also in contrast to often mature, more structurally complex and vegetatively diverse deciduous forests in riparian zones, which provide nesting sites, food, and cover for numerous species (Dickson and Huntley,1987). Riparian zones in more mesic areas such as the Pacific Northwest, do not contrast as sharply to non-riparian uplands as do those of the arid Southwest, yet several studies" have shown significant differences in vegetative .and structural associates of riparian versus non-riparian zones, which in turn lead to higher mammalian species richness and diversity within the riparian zones (Cross, 1985; Doyle, 1990; McComb et al.,, 1993).

The southern Appalachians Mountains are characterized by the highest annual precipitation in the eastern United States, which produces and maintains water flow through a complex network of perennial streams (SAMAB, 1996). Correspondingly, these streams and associated riparian vegetation zones are a significant componant of the landscape. For example, at the Coweeta Hydrological Laboratory, riparian zones constitute approximately 8.2% of the surface area of the 1626 ha Coweeta Basin {value calculated from data provided by Wallace, 1988). 'Often in seeps and many first order streams, exclusive of the herbaceous layer, little difference in canopy and shrub composition is encountered between the 'riparian zone and adjacent uplands. Riparian zones in other first order streams and usually through. higher order streams, typically support higher concentrations of white pine, eastern hemlock, and a rosebay rhododendron shrub layer in the immediate riparian zone. However, these are highly variable through the landscape, and these components will occur away from the immediate influence of a riparian zone.

The fact that we also found, in general, no significant differences in comparisons between habitat associations ranging from higher elevation and mesic northern hardwood and cove hardwood cover types on the one end of a topoedaphic gradient to lower elevation and more moderate oak-pine cover type on the other, indicates no sharp contrasts in small mammal communities across vegetational communities in the Coweeta Basin. However, we need note that our sites did not include the most xeric of oak-pine communities at Coweeta, nor did our survey include higher (fourth through sixth) order streams associated with broad flat valleys and generally in agriculture, pasture, or old-field succession. Perhaps where disturbance extremes exist between riparian areas and surrounding areas we would have found differences.

Few differences in the small mammal community with respect to elevation are apparent from our data. While total pitfall richness and total pitfall diversity were significantly correlated with elevation, no individual species exhibit significant correlations with elevation over the range examined here. Higher pitfall richness and diversity occurred at higher elevations, but there was no concordant higher level of pitfall diversity and richness in the upper elevation vegetative cover types (northern hardwoods and cove hardwoods). These observations contrast those of Gentry et al. (1968) who previously conducted studies on the effect of elevation and forest manipulation on relative abundance of small mammals at Coweeta. They reported a trend for increasing abundance with higher elevation. However, the results of that study are somewhat compromised by the fact that individuals of several species of known voucher materials were misidentified.

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