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# Feeding Habits of the Eastern Woodrat (*Neotoma floridana*) in Southern Illinois

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## ABSTRACT

The eastern woodrat, a state-endangered species, is a generalist herbivore that depends on cached food during part of the year. We identified seasonal variation in the diet of woodrats at Pine Hills, Union County, Illinois, based on analysis of fecal pellets, and determined if they consumed forage in proportion to its availability in the habitat. Woodrats did not consume forage in proportion to availability for any season during 1995. Mast, primarily hickory nuts, comprised 61-67% of the diet each season, despite no mast available in the habitat during spring, and relatively little during summer. Few herbaceous species were eaten during any season; only Virginia creeper was identified in fecal samples throughout the year. Virginia creeper, spicebush, and sedge accounted for 79.4% of the identified herbaceous material consumed throughout the year, despite relatively low availability in the habitat. Resource caching decisions of woodrats depend on nutrient content and perishability. Woodrats appeared to ration cached resources so as not to be left with poor foods at the end of the cache-dependent period.

## INTRODUCTION

The eastern woodrat (*Neotoma floridana*) is currently a state-endangered species in Illinois (Herkert 1992). Southern Illinois represents the periphery of the species' range in the midwest, where it currently is known to occur at La Rue Pine Hills and Horseshoe Bluff in Union County, and Fountain Bluff and Little Grand Canyon in Jackson County (Monty et al. 1995). Historically, woodrats were more widely distributed throughout the state, with populations in Hardin, Monroe, and Randolph counties (Layne 1958, Parmalee 1959, Parmalee et al. 1961). Nawrot (1974) documented 24 sites of past woodrat occurrence throughout Shawnee National Forest in southern Illinois. Like the closely-related Allegheny woodrat (*N. magister*), eastern woodrat populations have declined throughout their geographic range (Woodrat Recovery Workshop 1993, Beans 1994). Several causative factors for these declines have been proposed, including weather, predation, reduced food supply, parasitism, and habitat fragmentation (Neal 1967, Nawrot 1974, Birch et al. 1994). The objective of this study was to identify seasonal variation in the diet of woodrats at Pine Hills, and determine if woodrats selected forage in proportion

to availability. Besides intrinsic interest, these data will be useful in habitat assessment if woodrats are reintroduced to formerly occupied sites in southern Illinois.

## MATERIALS AND METHODS

### Study Area

The Pine Hills area is composed of north-south oriented Devonian age Bailey limestone bluffs that extend 8.8 km and average 2.4 km above the flood plain (Baskett 1925, Weller and Ekblaw 1940). Swamp land borders the southern 8 km of the bluff. Woodrats occur along the south and west-facing bluffs located in T11S, R3W, sections 9, 12, 21, and 28. The principal overstory vegetation consists of several species of hickory (*Carya* sp.) and oak (*Quercus* sp.), with sweetgum (*Liquidambar styraciflua*) and Kentucky coffee tree (*Gymnocladus dioicus*) also present. Understory vegetation is dominated by poison ivy (*Toxicodendron radicans*), mayapple (*Podophyllum peltatum*), spring beauty (*Claytonia virginica*), and spleenwort (*Asplenium* sp.).

### Diet Analysis

Microhistological techniques were used to identify plant fragments in woodrat fecal material using plant epidermal features, including stomata, hairs, cell wall ornamentation, and the presence and position of silica cells. Fresh fecal pellets were collected from woodrats captured in Tomahawk wire mesh live traps (16.5 x 16.5 x 48 cm) set along the bluff where woodrat sign was evident, including stick nests, fecal droppings, feeding debris, and/or tracks. Traps were operated for 3 consecutive days every 3 or 4 weeks

Fecal samples were collected monthly from October 1994 through December 1995. The pellets were collected from cotton bedding material in each trap and/or the bag used to handle the woodrats. The animal's individual identification number, trap site location, and the date were recorded. Pellets from individual woodrats remained separate and were stored in sealed plastic bags until analyzed.

Microscope slides of fecal material were prepared as described by Middleton and Rojas (1994) and Scott and Dahl (1980). Chloral hydrate was used to clear pigments from the fecal material without damaging the plant epidermal characteristics (Middleton and Rojas 1994), and as the mounting medium.

Fecal samples were placed in a Wiley micro mill and ground through a 60 μm screen. The mill was cleaned after each sample was ground to avoid combining the samples. The ground material was placed in a 0.1 mm sieve and rinsed with water until the water ran clear. Each sample was ground and rinsed separately. Cleaned material was then placed in a petri dish to dry overnight. A small amount of processed fecal material was placed on a 75 x 25 mm plain microscope slide and boiled with two drops of Hertwig's clearing solution over an alcohol lamp. Two drops of Hoyer's mounting solution was added and the mixture was boiled again. While the slide was still hot, a cover slip (24 x 40 mm) was placed on it and sealed with clear fingernail polish. Plant epidermal fragments were recorded from 20 fields per slide at 125X magnification (Dial 1988).

**Plant Sampling**

Belt transects (5 x 9 m) were used to sample the plant community of Pine Hills. The 4.8 km lower Pine Hills road (#354) was divided into 0.16 km increments. Transects were placed from these points, perpendicular from the road to the bluff. Four transects were randomly chosen as permanent plots for the study. An additional random plot was chosen during each sampling period. These additional plots were sampled once during the study, with a different plot chosen each sampling period. All plants in the shrub layer, 50 cm to 5 m in height, and the herb layer, < 50 cm, were counted and identified, as well as mast and fruit from trees (Mueller-Dombois and Ellenberg 1974). Transects were sampled four times during the year, February (winter), April (spring), July (summer), and September (fall) of 1995. Within the transects, a total count of each species was recorded. A sample of leaves, stems, flowers, fruit and seeds was collected to make a reference collection of epidermal tissue. Reference slides were made in the same manner as the fecal slides.

## RESULTS

A total of 27 plant species was observed during habitat sampling. Only 2 species, plantain (*Plantago* sp.) and poison ivy, occurred throughout the year in the transects. Eight plant species were observed in the winter transect sample, 17 in the spring, 16 in summer, and 11 in fall (Table 1).

Fecal samples from 8 to 17 woodrats were analyzed each season. During the winter, eight plant species were identified from fecal samples. The woodrats relied heavily on mast (Table 2). The remainder of the diet was composed of herbaceous material: 15% sedge (*Carex* sp.), 8% Virginia creeper (*Parthenocissus quinquefolia*), 6% spicebush (*Lindera benzoin*), neither of which were found in winter transects (Table 1), and hickory leaves (1%). In the spring, the number of identified plant species consumed increased to 10. Woodrats again relied heavily on mast, all from cached material, as none was available in the habitat (Tables 1 and 2). Herbaceous material consisted solely of Virginia creeper (12%), spicebush leaves and berries (8%), mayapple (4%), jewell-weed (*Impatiens pallida*) (2%), and grape (*Vitis* sp.) (1%). The summer diet included seven identified plant species, again primarily cached mast. Virginia creeper (8%), hickory leaves (2%), and mayapple (1%) composed the herbaceous portion of the diet. Unidentified plant species made up 25% of the diet, the largest unknown percentage of any season. As in other seasons, most of the unidentified material was herbaceous. Nine plant species were found in the fall fecal sample. Mast composed most of the diet, with sedge (10%), hickory leaves (9%), spicebush (2%), Virginia creeper (2%), and mayapple (1%) the identifiable herbaceous portion.

Virginia creeper was the only plant identified in the diet all four seasons. It apparently was cached, as it did not occur in transects during winter and spring. Only seven herbaceous species were identified from fecal samples. Of these, three species (Virginia creeper, spicebush, and sedge) accounted for 79.4% of the identified herbaceous material consumed throughout the year. All three were relatively infrequent in the habitat (Table 1).

Although mast available in the habitat varied seasonally, the percentage of mast consumed by woodrats was relatively consistent throughout the year. Woodrats consumed

cached mast in spring and summer, when little or none was available in the habitat, and ate less mast than was available in fall and winter, caching the remainder.

## DISCUSSION

The eastern woodrat is a small, generalist herbivore that depends on cached food during winter, when access to other resources is limited. Resource caching decisions of woodrats depend on factors such as nutrient and energy content (Post 1993), and perishability (Reichman 1988). Like other cachers, woodrats should eat a diverse diet so as not to be left with poor foods prior to the end of the cache-dependent period (Reichman and Fay 1983). The woodrats at Pine Hills did appear to ration stored mast throughout the year. Mast comprised 61-67% of the diet each season, with little variation, despite no mast available in the habitat during spring, and relatively little during summer. The animals selected nuts over other food items, but were not selective in their choice of mast. Hickory was the most common mast in the Pine Hills area, and woodrats ate hickory nuts in proportion to their availability.

Woodrats are capable of adapting their feeding habits to local conditions and available plant material, but generally a few plant species make up the majority of the diet (Rainey 1956). During the spring and summer months, the animals utilized more herbaceous material, while it was available to them. Nonetheless, relatively few herbaceous species were utilized. In the fall, collecting of cache material began. Because it is much less perishable than herbaceous material (Reichman 1988), stored mast provided the primary food source during the winter and early spring months.

Translocations (reintroduction) of woodrats into formally occupied sites throughout the Shawnee National Forest is a possible management option to promote recovery of the species in Illinois. Among numerous considerations in any reintroduction effort (Griffith et al. 1989), potential food resources are a critical factor. A necessary aspect of successful establishment of woodrats in southern Illinois would appear to be sites with abundant mast resources. Secondarily, the presence of key herbaceous species, including Virginia creeper, spicebush, and sedge is recommended.

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Table 1. Seasonal percentage of 27 plant species found in transect counts at Pine Hills, Union County, Illinois, 1995. No value indicates the species was not found in any transect that season.

| | Percentage Occurrence | | | |
|---|---|---|---|---|
| Species | Winter | Spring | Summer | Fall |
| Acorns (*Quercus* sp.) | 28 | | 3 | 1 |
| Alumroot (*Heuchera parviflora*) | 9 | | | |
| Bedstraw (*Galium* sp.) | | 9 | 9 | 1 |
| Bellflower (*Campanula americana*) | | 6 | 5 | |
| Black Locust (*Robinia hispida*) | 15 | | | |
| Bloodroot (*Sanguinaria canadensis*) | | 1 | | |
| Catbrier (*Smilax* sp.) | | | 1 | 1 |
| Dutchman's Breeches (*Dicentra cucullaria*) | | 8 | | |
| Grape (*Vitis* sp.) | | 2 | 1 | |
| Hickory Leaves (*Carya* sp.) | | | 9 | 14 |
| Hickory Nuts (*Carya* sp.) | 13 | | 11 | 74 |
| Jewell-weed (*Impatiens pallida*) | | 6 | 9 | 1 |
| Kentucky Coffee Tree pods (*Gymnocladus dioicus*) | 18 | | | |
| Larkspur (*Delphinium tricorne*) | | 2 | | |
| Mayapple (*Podophyllum peltatum*) | | 11 | 13 | |
| Panic Grass (*Panicum* sp.) | | | 1 | |
| Plantain (*Plantago* sp.) | 9 | 2 | 1 | 1 |
| Poison Ivy (*Toxicodendron radicans*) | 5 | 1 | 24 | 3 |
| Sedge (*Carex* sp.) | 3 | | | |
| Sessile Trillium (*Trillium sessile*) | | 3 | | |
| Spicebush (*Lindera benzoin*) | | 1 | 1 | 1 |
| Spleenwort (*Asplenium* sp.) | | 19 | 2 | |
| Spring Beauty (*Claytonia virginica*) | | 22 | | |
| Sweet Clover (*Melilotus* sp.) | | 2 | | |
| Violet (*Viola* sp.) | | 4 | | |
| Virginia Creeper (*Parthenocissus quinquefolia*) | | | 9 | 2 |
| Wood Nettle (*Laportea canadensis*) | | 1 | 1 | 1 |

Table 2. Seasonal percentages of mast[a] vs. herbaceous food items available in the habitat, and percentages in woodrat (*Neotoma floridana*) diets (based on fecal samples), from Pine Hills, Union County, Illinois, 1995.

| Season | % Mast | | % Herbaceous | | % Unknown |
|---|---|---|---|---|---|
| | Available | In Diet | Available | In Diet | in Diet[b] |
| Winter | 74 | 67 | 26 | 30 | 3 |
| Spring | 0 | 61 | 100 | 27 | 12 |
| Summer | 14 | 64 | 86 | 11 | 25 |
| Fall | 74 | 65 | 26 | 24 | 11 |

a/Includes acorns, hickory nuts, locust pods, and Kentucky coffee tree pods (see Table 1).
b/Includes primarily herbaceous material every season