Population Parameters for the Allegheny Woodrat (Neotoma magister Baird) at Two Sites in Eastern Kentucky—The historical range of the Allegheny woodrat (Neotoma magister Baird) extended from southeastern New York and western Connecticut to the Tennessee River in northern Alabama (Newcombe 1930). Over the last three decades there have been major population declines in the northern portion of the animal’s range (Hicks 1989; Hayes 1990; Beans 1992; Sciascia 1993). Numerous reasons have been offered for the apparent decline, e.g., habitat loss (Balcom and Yahner 1996), reduced winter food supply (Beans 1992), and parasitic infection (Beans 1992; Sciascia 1993; LoGiudice 2000). The uncertainty surrounding the range-wide stability of the species has prompted population monitoring studies in a number of states, e.g., Indiana (Johnson 2002), Pennsylvania (Balcom and Yahner 1996; Hassinger et al. 1996), Kentucky (Thomas 2003), West Virginia (Castleberry 2000; Wood 2001), and Maryland and Virginia (Ford et al. 2006). Some have assumed the woodrat population is stable in Kentucky (Hicks 1989; Beans 1992), but prior to the initiation of this and other studies the question had not been addressed. The goal of our study was to provide baseline population information concerning two colonies of the Allegheny woodrat in eastern Kentucky.

The Daniel Boone National Forest (DBNF) is located in eastern Kentucky along the western edge of the Cumberland Plateau (Martin et al. 1993). Two colonies of Neotoma magister in the Morehead Ranger District, DBNF, Menifee County, KY, were chosen for monitoring based on U.S. Forest Service records of woodrat presence. The Murder Branch and Ratliff study sites consisted of broken clifflines and rocky outcrops typical of Allegheny woodrat habitat (Rhoads 1903; Newcombe 1930; Gottschang 1981; Balcom and Yahner 1996). Sandstone formations dominated each site and were characterized by shallow caves, rock houses, ledges, and extensive areas of breakdown. Both study sites were accessible by Forest Service roads and separated from public use areas by 1–2 km.

Trap locations in each woodrat study colony were defined as one of 20 pre-chosen locations along the cliffline and rock outcrop habitat. The minimum distance between trap locations at a study site was determined based on the average approximate radius of woodrat home range size, i.e., 28 m (Thomas 2003). Random values between 14 and 28 m were chosen to serve as minimum distances between trap locations within a site. Actual distances between trap locations were greater than 56 m in some instances because the cliffline habitat was intermittent and specific trap locations were selected based on the presence of woodrat sign.

Monthly two-night mark and recapture sessions were conducted at each woodrat study site between May 1997 and April 1998. Tomahawk live traps (two per trap location) baited with apple slices were covered with boards, supplied with polyester batting during inclement weather, and placed near identifiable woodrat sign (order of sign preference from high to low: fresh cut green vegetation, nest, latrine, stick midden, food cache). Specific placement of two traps per trap location was determined based on the location of sign.

Captured woodrats were assigned to size classes based on mass: 175 g for juveniles, 175–224 g for subadults, ≥225 g for adults. Reproductive condition (scrotal vs. nonscrotal testes for males, and perforate vs. imperforate vaginal opening and enlarged mammae for females) was recorded for each captured individual. Captured individuals had numbered aluminum Monel #1 cartags placed in each ear. Animals were released near the point of capture; an attempt was made to keep handling time to a minimum.

A chi-square contingency table procedure (McClave and Dietrich 1991) was used to test for independence between Allegheny woodrat sex ratio and site. Average mass for adult males and females at each site was determined using the first mass recorded for each individual for every month it was captured as an adult. Monthly age-class structure was derived from data for each captured individual in each month of the study period.

Two criteria were used to estimate the duration of the breeding season for Allegheny woodrats in eastern Kentucky. The first was reproductive condition of captured woodrats. Male and female woodrats were considered reproductively active if they had scrotal testes or a perforate vaginal opening. External characteristics of the genitalia have been used by other researchers to determine woodrat reproductive activity (Patterson 1933; Fitch and Rainey 1956; Monty 1997). The second factor used to suggest breeding season was derived from the mass of juvenile woodrats captured; taking into account when they appeared in the population, growth rate, average mass at birth (Poole 1940), and gestation period (Poole 1940; Zambernardi 1956).

Each Allegheny woodrat study site was monitored monthly between May 1997 and April 1998 (January 1998 was omitted at Murder Branch and February 1998 at Ratliff due to inaccessibility to trap sites). Annual trap success for 580 trap-nights was 22% at Murder Branch and 16% at Ratliff. A total of 42 and 27 individual woodrats were marked at Murder Branch and Ratliff, respectively.

Male:female sex ratios of the two marked woodrat populations differed from equilibrium at both sites (1:1.4 at Murder Branch, 1.4:1 at Ratliff). Sex ratio and site were independent of each other (X² = 3.84); hence the sex ratio of a colony was not dependent on the location of the colony. Recruitment varied markedly between sites. Of the 12 juveniles marked at Murder Branch, only 4 reappeared in one or more months following initial
capture (recruitment = 33%), while all 7 juveniles marked at Ratliff reappeared in the months following initial capture (recruitment = 100%). The male:female juvenile sex ratio was skewed toward females at Murder Branch (1:3), and near equilibrium at Ratliff (1.0:1.1).

Mean mass of adult male Allegheny woodrats at the Murder Branch and Ratliff sites was 286 ± 24 g and 279 ± 41 g, respectively; adult females, 269 ± 27 g and 262 ± 28 g, respectively. In general, males and females at Ratliff weighed least in winter (Dec.–Feb.) and were heaviest in spring (March–May). At Murder Branch, both sexes weighed least in spring; mass of females peaked in summer (June–Aug.), and males peaked in fall (Nov.). Due to small sample sizes, mean daily increase in mass was calculated over the entire trapping period (rather than within each month or season) for juveniles and subadults. Juvenile and subadult woodrats in this study grew at an average rate of 1.0 g/day (n = 12) and 0.6 g/day (n = 11), respectively.

Allegheny woodrat age class structure within each colony was determined for each month of the study period (Table 1). Juveniles were present only in late spring and early summer at Murder Branch but were present from early summer to mid-winter at Ratliff. Some transient woodrats became residents (immigration) at both study sites. At Murder Branch, the immigrants included 5 males (4 adults, 1 subadult); while at Ratliff there were 8 total immigrants [6 males (4 adults, 2 subadults) and 2 females (1 adult, 1 subadult)].

Based on external characteristics, Allegheny woodrats in this study were reproductively active at least from March to October and in December. The animals appeared to be sexually reproductive at a minimum of 6 to 7 months of age. Utilizing the determined growth rate of 1.0 g/day for juveniles, an average mass at birth of 15 g, and average gestation of 30–36 days, conception occurred during breeding bouts from January to June (and possibly in part of December). Woodrats in the area encompassed by this study demonstrated the potential to breed year-round. Both adult and subadult females were perforate in March in both colonies. Perforate subadult females were captured in April, May, August, and September. Reproductively active females captured late in the fall and winter were all adults. Three adult females showed evidence of being polyoestrus within the breeding season (alternating states of vaginal perforation in consecutive months). No females captured in January, February, or November showed signs of reproductive activity. There was a single perforate adult female captured at Ratliff in December. One subadult male had scrotal testes in March at Ratliff. All other scrotal males captured at both colonies in all months were in the adult age class. There were no reproductively active males captured at either study site in October, November, January, or February. There was a single male with partially scrotal testes captured at Ratliff in December.

Allegheny woodrat populations whose sex ratios differed from equilibrium have been observed in other parts of the species’ range (Cudmore 1984; Myers 1997; Poole 2001; Thomas 2003). Rainey (1956) described a cycle in male body weight of Neotoma floridana in Kansas. In contrast to the trend noted in this study, Rainey (1956) found male weights peaked in early spring, declined during the summer, and increased again during fall and winter. Thomas (2003) reported male Allegheny woodrats in Kentucky exhibit a biennial cycle in mean body weight; with winter weights alternating between high point and low point from one year to the next. Fitch and Rainey (1956) stated adult N. floridana weight is influenced largely by season and individual differences, and seasonal trends vary from year-to-year. Although the calculated juvenile growth rate was based on a small sample size (n = 12), the authors felt it was more meaningful to use data from these colonies rather than published growth rates for different species in different geographical localities. Therefore a juvenile growth rate of 1.0 g/day was used to extrapolate time to sexual maturity and months of breeding activity.

Poole (1940) reported captive Allegheny woodrats in Pennsylvania produced 2 or 3 litters per year. Males in West Virginia had sperm in the tubules of the epididymis in February and December (Patterson 1933). Myers (1997) suggested that N. magister in West Virginia produced 3 or 4 litters per year between early January and late August (breeding occurred from December to late July). Zambonardi (1956) noted woodrats in Alabama produced 2 or 3 litters per year, between March and September (breeding occurred from February to August). Barbour and Davis (1974) indicated woodrats in Kentucky probably have multiple litters per year which are born beginning in March (conception as early as February). In subsequent monitoring at one of the sites surveyed in this study (i.e., Murder Branch), Thomas (2003) reported capturing two juvenile woodrats, and having a female give

---

Table 1. Monthly age class structure at two Allegheny woodrat study sites in the Daniel Boone National Forest, Menifee County, KY, May 1997–April 1998.

<table>
<thead>
<tr>
<th></th>
<th>Murder Branch study site</th>
<th>Ratliff study site</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Adults</td>
<td>Subadults</td>
</tr>
<tr>
<td>May</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>June</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>July</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>August</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>Sept.</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>Oct.</td>
<td>14</td>
<td>3</td>
</tr>
<tr>
<td>Nov.</td>
<td>14</td>
<td>2</td>
</tr>
<tr>
<td>Dec.</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Jan.</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Feb.</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>March</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>April</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

* trap sites inaccessible due to weather.
birth to 3 pups in a live trap, in March. These studies support our findings that the Allegheny woodrats monitored in this study may be polyestrous and capable of breeding year-round.

The determination of breeding season and related population parameters for Allegheny woodrats in eastern Kentucky cannot be arrived at definitively based on a single year of sampling. Time to sexual maturity in *N. magister* should be explored to much greater depths than in the current study. Our results offer suggestive, but not conclusive, indicators of the potential duration of the breeding season and possible age of initial reproductive activity. Perhaps determining if *N. magister* females have year-round estrous cycles, as determined for *N. floridana* in Kansas (Chapman 1951), would bring researchers closer to determining the factors that influence the duration and onset of the breeding season in Kentucky. With the decline or disappearance of *Neotoma magister* in portions of its historic range (Castleberry 2000), it becomes paramount that the dynamics of still viable populations be understood. The results of this study represent baseline data for use in monitoring Allegheny woodrat populations in eastern Kentucky.

Financial support for this project was provided by the Kentucky Department of Fish and Wildlife Resources, U.S. Forest Service — Daniel Boone National Forest, and Eastern Kentucky University’s Department of Biological Sciences.

### LITERATURE CITED

mental Unit-Design Division, Missouri Department of Transportation, P.O. Box 270, Jefferson City, MO 65102; Steven C. Thomas, National Park Service, Cumberland Piedmont Network, P.O. Box 8, Mammoth Cave, KY 42259; and Charles L. Elliott, Department of Biological Sciences, Eastern Kentucky University, Richmond, KY 40475. Corresponding author email: Charles.Elliott@eku.edu

**View This Item Online:** https://www.biodiversitylibrary.org/item/175714  
**DOI:** https://doi.org/10.3101/1098-7096-70.1.98  
**Permalink:** https://www.biodiversitylibrary.org/partpdf/335775

**Holding Institution**  
Smithsonian Libraries

**Sponsored by**  
Biodiversity Heritage Library

**Copyright & Reuse**  
Copyright Status: In Copyright. Digitized with the permission of the rights holder  
Rights Holder: Kentucky Academy of Science  
License: http://creativecommons.org/licenses/by-nc-sa/3.0/  
Rights: https://www.biodiversitylibrary.org/permissions/

This document was created from content at the Biodiversity Heritage Library, the world's largest open access digital library for biodiversity literature and archives. Visit BHL at https://www.biodiversitylibrary.org.

This file was generated 15 August 2023 at 01:34 UTC