

NATAL BURROWS AND NESTS OF FREE-RANGING PYGMY RABBITS (*BRACHYLAGUS IDAHOENSIS*)

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Pygmy rabbits (*Brachylagus idahoensis*) are a sagebrush obligate species of conservation concern. The Columbia Basin population in Washington is listed as federally endangered (Federal Register 2003), and in April 2003 the U.S. Fish and Wildlife Service received a petition for rangewide endangered status for the species. Although studies investigating the ecology of the pygmy rabbit date back to the 1940s (Orr 1940, Janson 1946, Severaid 1950), many aspects of the species' natural history remain poorly understood, especially with respect to reproduction. Locations of parturition and nests have not been documented for this species. Pygmy rabbits are 1 of 2 North American leporids that dig extensive burrow systems (Green and Flinders 1980). However, neither nesting materials nor neonates have been found in residential burrow systems that were either excavated or examined with a burrow camera (Bradfield 1975, Rauscher 1997). Wilde (1978) observed 2 isolated juveniles weighing 90 g under separate sagebrush plants. Based on growth curves of captive pygmy rabbits, those juveniles would have been approximately 3 weeks of age (Lamson and Shipley 2002). From this observation Wilde (1978) speculated that females give birth aboveground and scatter young to avoid loss of entire litters to predation.

Observations during captive breeding have provided the most detailed information on reproductive behaviors of pygmy rabbits. Pregnant females were observed digging single-entrance natal burrows that terminated in a nest chamber. Females excavated the natal burrows from 7 to 10 days before parturition and lined the nest chamber with grass and hair; although branches of sagebrush (*Artemisia*

spp.) and other shrubs were provided, those materials were not incorporated into the nests (Oregon Zoo 2001, Lamson and Shipley 2002). In captivity, females constructed nests during daylight hours, back-filled the entrances of natal burrows with soil, and camouflaged the entrances so well that keepers often were unable to identify the location of natal burrows (L. Shipley, Washington State University, Pullman, personal communication). Juvenile pygmy rabbits remained in the nest for 13–21 days, after which the females left the entrance to the natal burrows open and the young vacated the nests (Oregon Zoo 2001, Lamson and Shipley 2002).

We studied pygmy rabbits at 2 sites in the Lemhi Valley in south central Idaho. The study areas consist of shrubsteppe habitat dominated by big sagebrush (*Artemisia tridentata*) and green rabbitbrush (*Chrysothamnus viscidiflorus*) with a sparse understory of grasses and forbs. Both study sites are located at the base of a ridge of low foothills dominated by earth-mounded microtopography known as "mima mounds." While investigating reproductive patterns in pygmy rabbits during April–July 2003, we located 7 natal burrows representing the 1st documentation of natal burrows for free-ranging pygmy rabbits. Our objective in this paper is to characterize natal burrows and nests for this species in their natural habitat.

We measured dimensions of the tunnel and nest chamber of the 7 vacated natal burrows. Using a compass, we recorded aspect of the entrance and angle at which the burrow tunnel declined. Additionally, we measured maximum height of the 10 nearest shrubs to the natal burrow entrance. We estimated that the natal

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TABLE 1. Dimensions of 7 natal burrows and nest chambers of pygmy rabbits measured in the Lemhi Valley, Idaho, during May–July 2003.

ID #	Natal burrow tunnel				Nest chamber					Total depth (cm)
	Entrance (cm)		Angle (degrees)	Aspect (degrees)	Entrance (cm)		Dimensions (cm)			
	Height	Width			Height	Width	Height	Width	Length	
1	14.0	17.0	20	256	10.0	11.0	14.5	16.0	13.0	29.0
2	17.0	9.0	30	130	7.0	6.5	14.5	16.0	22.0	45.0
3	15.0	8.5	25	80	10.0	8.0	13.0	17.0	20.0	43.0
4	13.0	14.0	30	170	9.0	10.5	13.0	16.0	12.0	43.0
5 ^a	7.5	10.0	25	25	10.5	9.5	18.0	19.0	21.0	74.0
6	10.0	8.5	25	108	9.5	10.5	14.0	12.0	16.0	45.0
7	10.0	10.5	35	186	5.0	15.0	12.0	16.0	11.0	30.0
Mean	12.4	11.1	27		10.1	10.1	14.1	16.0	16.4	44.1
s	3.3	3.2	4.9		2.4	2.7	1.9	2.1	4.6	14.9

^aNest construction not completed.

burrows had been vacant for 1 to 3 weeks when we conducted these measurements. Remaining nesting materials were collected, air-dried, weighed, and examined for content. Pygmy rabbits use residential burrow systems throughout the year, and these systems are characterized by multiple entrances, substantial buildup of excavated soil and rocks, and a surrounding carpet of fecal pellets. We evaluated spatial relationships between natal burrows and residential burrow systems by searching the area within a 50-m radius of each natal burrow for currently active or recently active residential burrow systems.

We observed 2 female pygmy rabbits digging and subsequently back-filling burrows with soil during midmorning (1030 and 0815 hours) on 6 May and 15 June 2003. Those behaviors were consistent with natal burrow construction observed in captive pygmy rabbits. Examination of the site dug in May revealed an area of loose soil covered with plant debris at the base of rabbitbrush. On May 13 we opened the burrow entrance and found a single tunnel approximately 30 cm deep. However, on May 26 we found a natal burrow that had been vacated by the juvenile rabbits approximately 20 cm away from the dead-end tunnel at the base of a sagebrush. Despite repeated visits to the area during May, the real natal burrow remained undetected until the nest was vacated and the tunnel entrance left open. At the site where we observed digging in June, we found 2 dead-end tunnels and what

appeared to be a natal burrow in which nest construction was initiated but not completed. These 3 diggings were about 15 cm apart at the base of sagebrush shrubs. Subsequent visits revealed limited evidence of further digging, and nest construction was not completed. Cottontail rabbits (*Sylvilagus floridanus*) have been observed to initiate more than one nest prior to reproduction (Beule and Studholme 1942, Rongstad 1966). Our observations suggest that female pygmy rabbits may exhibit similar behaviors.

We located 5 additional natal burrows that had been vacated, and on one occasion we observed a juvenile pygmy rabbit run into an open natal burrow when disturbed. The 6 completed natal burrows had similar construction. Each consisted of a tunnel with a single entrance ranging in length from 17 cm to 30 cm that ended in a single, spherical chamber (Table 1). The uncompleted natal burrow was longer, more curved, and declined at a steeper angle, perhaps to avoid roots of sagebrush. At each of the 6 completed natal burrows, we found nesting material containing hair within the nest chamber and occasionally outside the burrow entrance. Examination indicated that the hair morphology was consistent with pygmy rabbit hair. Because cottontail rabbits were rare in our study areas and we observed pygmy rabbits in association with 3 of the natal burrows, we assumed that the hair was from maternal pygmy rabbits. This conclusion is consistent with observations of nest construction by captive pygmy rabbits (Lamson and Shipley 2002).

Fine grasses, shredded bark from sagebrush (*Artemisia* spp.), and hair were the primary components of nesting materials. We also found fleas and mites in some nests; these are common parasites of both adult and juvenile pygmy rabbits. The dry mass of nesting materials recovered from each natal burrow ranged from 30 g to 75 g (mean = 58.4, $s = 16.1$, $n = 6$). These values likely underestimate the total mass of nesting materials because some may have blown away or been removed. The uncompleted nest contained 45 g of shredded bark. Observations of captive pygmy rabbits indicated that females began lining nests with fresh grass from 8 to 3 days before parturition, and that hair was pulled from the body and added to the nest shortly before birth (Lamson and Shipley 2002). Nests of the captive pygmy rabbits did not contain shredded bark; however, this may have been influenced by a lack of live shrubs within their enclosures.

Pygmy rabbits appeared to establish natal burrows away from their residential burrow systems. Three of the natal burrows we examined had no active or recently active residential burrow systems within 50 m. Mean distances to active residential burrow systems for the remaining nests were 34 m ($n = 3$; range = 22–44), 47 m ($n = 1$), 28 m ($n = 6$; range = 8–40), and 37 m ($n = 2$; range = 35–38). Overall average distance to active residential burrow systems was >35 m. “Active” burrow systems were defined as having open entrances free of debris in association with fresh pellets, and “recently active” burrow systems were associated with weathered pellets. Additionally, signs of rabbit activity (pellets, digging, and dust baths) were not observed in the vicinity of nests, suggesting that females excavate natal burrows away from areas of general activity. This behavior may avoid attracting predators to the location of nests and neonates.

Vegetation structure and composition around the natal burrows was typical for mima mounds in shrubsteppe habitats. Shrubs tend to be taller and denser on the mounds, with little or lower shrub cover in the areas between mounds (Tullis 1995). Six of the natal burrows were associated with mima mounds, and the burrow entrances were located at the base of shrubs (5 under sagebrush and 1 under rabbitbrush). Average shrub height around the 6 natal burrows located on mima mounds was 59.7 cm (range = 41–86 cm). One natal bur-

row was located in the open between mounds, but the burrow entrance was located under a weathered sagebrush stump. Based on these observations, rabbits appeared to place natal burrows under relatively dense shrub cover.

Nests of rabbit species in North America exhibit a graded variation in depth. Swamp rabbits (*Sylvilagus aquaticus*) construct nests of woven vegetation at the surface of the ground or in shallow depressions, which may be an adaptation to wet habitats (Holler et al. 1963, Sorensen et al. 1972). Mountain cottontails (*S. nuttallii*) have been described as constructing similar cuplike nests (Chapman 1975). Several other members of the genus *Sylvilagus* dig nest chambers below the ground surface and camouflage the opening with vegetation (Orr 1940, Ingles 1941, Skeels 1962, Casteel 1966). In contrast, pygmy rabbits in this study and in captivity (Oregon Zoo 2001) placed nest chambers deeper into the ground at the base of a tunnel and then back-filled the burrow entrances with soil.

We revisited natal burrows 1 to 4 weeks after recording nest measurements. Most burrow entrances were partially collapsed and filled with debris or soil. If nesting materials were removed by wind or rodents after nests were vacated, it would be difficult to recognize the holes as natal burrows. These conditions and the apparent isolation of natal burrows from areas of general rabbit activity have likely contributed to the lack of documentation of pygmy rabbit nests before this study. Given the inconspicuous nature of pygmy rabbit natal burrows, researchers may need to focus on observations of nest-building behaviors (digging natal burrows, gathering vegetation, and pulling hair) to locate nests of this species.

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