RECTAL TEMPERATURES OF 2 FREE-RANGING WHITE-TAILED DEER FAWNS

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Abstract: Rectal temperatures ($N = 249$) of 2 free-ranging white-tailed deer (*Odocoileus virginianus*) fawns were measured in all seasons in northeastern Minnesota while the animals were normally resting, standing, walking, feeding, and running. Rectal temperatures remained between 38.2 and 40.1 C despite ambient temperatures of −38 to 34 C. Deer were free to select habitats and activities and showed a narrower range of body temperatures (1.9 C) than has been reported for confined individuals (5.6 C). Seasonal and activity-related variations in rectal temperatures were slight but significant.

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Body temperatures of 37.2–42.8 C have been reported for captive or freshly captured white-tailed (Holter et al. 1975, Seal et al. 1978), mule (*O. hemionus*) (Thorne 1975, Parker and Robbins 1984), and Columbian black-tailed deer (*O. h. columbianus*) (Leopold et al. 1951, Cowan and Wood 1955). A narrower range would be expected for body temperatures of free-ranging deer if deer select habitats and activity levels that facilitate homeothermy (Verme 1965; Moen 1968*b*, 1985; Ozoga and Gysel 1972). Published data on body temperatures of free-ranging deer do not exist (Anderson 1981). In this study we measured rectal temperatures of free-ranging deer during various activities not prompted by man or other predators in open and forested habitats.

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METHODS

Rectal temperatures of 2 tame, female white-tailed deer that shared a home range of 2–3 km^2 in a mixed coniferous-deciduous area of the Superior National Forest, Minnesota (47°48′N, 91°45′W), were measured. Deer were obtained at 1 day of age and bottle-fed goat's milk. They were released when they began to forage at 1 month of age. They returned periodically for milk until they were weaned and radiocollared in fall. Measurements of rectal temperature began at 46 days of age on 16 July 1977 and ended at 341 days of age on 17 May 1978. Measurements were made during the extremes of ambient temperatures that occurred during the 10-month period (from −38 to 33.9 C). The deer ranged free during most measurements but in some cases were in a 2-ha pen with forested habitat similar to that in their surrounding home range. Measurements were made with mercury-bulb rectal thermometers inserted 8–12 cm for 3–5 minutes.

To obtain temperatures a researcher located the deer by telemetry and joined them. Bedded deer usually remained bedded when joined, but active deer usually paused briefly to lick the researcher before resuming their activities (Rogers 1981). Up to 6 rectal temperatures were taken/day, depending upon the activities observed. Measurements typically were >1 hour apart. The deer remained bedded or stood unrestrained for insertion of the thermometers, having been conditioned from birth to accept attention to the rectal area, and appeared to ignore the inserted thermometers. They bedded, fed, played, or ran with the thermometers in place, or they stood for measurements immediately after these activities. The running was voluntary (apparently playful) chases among the deer rather than running prompted by predators or man. Deer behavior, ambient temperature, sky condition, and whether the deer were in sunlight or shade were recorded. Data were tested for differences among individuals, activities, and months, using paired and unpaired *t*-tests and 2-way analysis of variance. Data were grouped into 2 periods (Jan–Mar and Apr–Dec), the 1st of which has been shown to be characterized by metabolic depression (Silver et al. 1969; Thompson et al. 1973; Moen 1976, 1978).

Table 1. Seasonal and activity-related changes in rectal temperatures (C) of white-tailed deer in northeastern Minnesota, 1977–78.

Period Activity	$\bar{x}$	SD	Range	*N*
Jan–Mar				
Bedded	38.3	0.1	38.2–38.4	5
Active[a]	38.7	0.3	38.2–39.2	9
Intermittent running	39.1	0.5	38.6–39.8	8
Apr–Dec				
Bedded	38.9	0.3	38.6–39.4	18
Active[a]	39.1	0.2	38.7–39.8	87
Intermittent running	39.3	0.3	38.8–40.1	44
Prolonged running[b]	39.6	0.3	39.1–40.1	9

[a] Includes standing, walking, and foraging.
[b] Running near full speed for >50 m.

RESULTS AND DISCUSSION

Effects of Activity and Season

Rectal temperatures ($N = 249$) did not differ significantly between individuals ($P > 0.05$) and ranged from 38.2 to 40.1 C during all unforced activities (excluding a high temp of 40.3 C for a deer that ran from a vehicle on 2 Aug). The temperatures showed a normal curve with a mean of 39.2 ± 0.4 (SD) C. Two-way analysis of variance showed highly significant ($P < 0.005$) differences between the 2 groups of months and among 4 activity levels (bedding; standing, walking, or feeding; intermittent running; and prolonged running) (Table 1). Rectal temperatures averaged lowest during January–March, when metabolic rates (Silver et al. 1969; Thompson et al. 1973; Moen 1976, 1978), ambient temperatures, and deer activity were depressed (Table 1). Although the data were grouped for statistical purposes into the 2 periods, temperature changes between those periods were gradual, peaking in July–September. The effects of activity level on body temperatures are clear (Table 1), with further effects expected due to posture, wind, sunlight, and ambient temperature (Moen 1968*a*, 1985).

Effects of Ambient Temperature and Sunlight

No strong relationship was established between ambient and rectal temperatures for deer bedded in habitats of their choosing. Ambient temperatures between 9 and 26 C had no obvious effect on rectal temperatures in summer and early fall; resting rectal temperatures were all between 38.6 and 39.3 C. On an unusually hot (33.9 C), humid day (19 Jul), the 2 deer showed rectal temperatures of 39.0 and 39.4 C while resting in shade, with the latter temperature being slightly higher than the other resting temperatures recorded. During late fall and early winter, resting rectal temperatures from 39.2 to 38.2 C ($N = 12$) varied with ambient temperatures between 8 and −29 C, but the same data, when viewed chronologically, showed a consistent decline in rectal temperatures that coincided with the reported decline in metabolic rate during that period (Silver et al. 1969; Thompson et al. 1973; Moen 1976, 1978).

The coldest period during the study was 9–17 January 1978. Eleven rectal temperatures of 38.2–38.8 C were recorded during that period at ambient temperatures between −21 and −38 C. The 3 lowest (38.2, 38.3, and 38.4 C) were recorded at −29 C from deer bedded or standing under mostly cloudy skies. The 8 highest (38.5–38.8 C) were from deer standing or feeding in full sunlight. On warmer (−4 to −19 C) winter days the deer were found in full sunlight on 1 of 18 occasions. Data collection was not dependent upon weather conditions, deer location, or habitat so we believe the deer increased their use of full sunlight at ambient temperatures <−20 C. The deer also remained bedded longer at the lower temperatures than at other times, typically lying with legs tucked under the body and nose tucked into the flank. This posture, noted also by Holter et al. (1975) for cold-stressed deer in a calorimetric chamber, reduces heat loss to a minimum (Moen 1985). It was used for most recumbent activities, including ruminating, in very cold weather. In summer, it was rarely used except for sleep.

Use of sunlight and prolonged bedding in the tucked position apparently are 2 behaviors used on very cold days to minimize heat loss. Shivering was not seen, even at night when the deer were bedded or walking at temperatures ≥−38 C. The only observed shivering by the 2 subjects was on 2 November after a deer was startled, ran into a lake, and stood for 10 minutes under conditions of moderate wind, clear sky, and 12.2 C ambient temperature. She stopped shivering after leaving the lake and shaking the water off. Rectal temperatures 10 minutes and 35 minutes later were 38.6 and 38.9 C, respectively.

Deer may incur excessive heat loads during exertion in winter as well as in summer (Silver et al. 1971:45). Rectal temperatures during exertion did not show significant seasonal differences (Table 1). Strenuous activity in winter, when the winter coat is an effective insulator (Moen 1968*a*, Moen and Severinghaus 1984), elevated rectal temperatures beyond expected seasonal differences. The highest rectal temperature recorded in winter (39.8 C) was 30 minutes after a deer panted from brief exertion at −8 C. Deer did no prolonged running in winter, except when forced, as also has been reported from previous studies (Moen 1976, 1978). Heat buildup, as well as depressed metabolism, may discourage exertion. Seal et al. (1978) found that 4 of 6 whitetail does, with rectal temperatures elevated above 40 C at the time of capture, died during subsequent radio tracking, but 18 with lower temperatures survived. In the present study the 2 tame deer selected habitats and behavior such that rectal temperatures did not exceed 39.8 C in winter and did not exceed 40.1 C in any season.

In summer, deer spent little time in full sunlight. Only 2 of 74 summer rectal temperatures were from deer in full sunlight, and 1 of those was obtained by luring the deer into the sun. In that case, at 32.5 C ambient temperature, rectal temperature rose from 39.3 C to ≥39.6 C in 5 minutes, whereupon the deer returned to the shade and panted, reducing rectal temperature to 39.2 C during the next 5–10 minutes. All other observations of panting were associated with exertion. The deer appeared to prevent excessive heat loads primarily through selecting shade and minimizing exertion rather than by panting. When ambient temperature was >26 C, the deer bedded for unusually long periods during the day, as was reported by Holter et al. (1975) for deer in a calorimetric chamber. At 32 C, 1 Minnesota deer kneeled in a lake in an apparent attempt to cool off. Bauer (1977: 45) reported avoidance of direct sunlight in summer by deer in the Upper Peninsula of Michigan.

Habitat Considerations

Deer that were free to select activities and habitats maintained rectal temperatures within a 1.9 C range in all seasons, compared with the 5.6 C range reported for deer without this freedom (Leopold et al. 1951, Seal et al. 1978). This indicates the importance of behavior, including habitat selection, in thermoregulation. Shade was an important habitat component in summer and on the warmer days of winter. Forest openings with direct sunlight were used on the colder winter days.

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