Proceedings of the Iowa Academy of Science

Volume 75 | Annual Issue Article 41

1968

Physiological Observations on Raccoons in Winter

G. Edgar Folk Jr.

Karen B. Coady

Mary A. Folk

Physiological Observations on Raccoons in Winter[1]

G. Edgar Folk, Jr., Karen B. Coady, and Mary A. Folk

Abstract. Body temperatures were recorded earlier from raccoons tethered outdoors in extreme cold. There was no suppression in body temperature. Later, two events suggested a new study, this time on heart rates: (1) the development of implantable radio-capsules for heart rate and EKG, and (2) the information that bears develop a bradycardia in the winter den, slowing sleeping heart rates from 40 b/m to 8-15 b/m. Three raccoons were studied periodically in outdoor dens in midwinter with Iowa implanted radio-capsules. Unlike the bears, when the raccoons stayed indoors for several days due to severe weather, their sleeping heart rates went up instead of down. The explanations may be: (1) they were yearling raccoons, and (2) the winter was unusually mild. The experiment will be repeated with older animals.

This paper concerns the physiological status of raccoons during cold weather in wintertime. We had previously compared the body temperature of three Northern raccoons when exposed in a warm room and when exposed to severe cold. These animals were maintained on long chains with collars. It had seemed reasonable to expect that some body temperatures during sleep in the cold might be lower than control temperatures; this would be an indication of semi-dormancy. There was no reduction in body temperature in the cold (Folk et al., 1957).

After these results were reported, we studied bears and demonstrated a bradycardia during prolonged sleep in the winter den (Folk, 1967). This heart rate was low enough to justify the use of the term "semi-dormancy" for these animals, in spite of the fact that the body temperature did not drop appreciably. The bears' summer *sleeping* heart rates of 40 to 50 beats per minute lowered during sleep in the winter to 8 to 12 beats per minute. Because of these observations, we repeated our studies on three more raccoons to determine whether they too show a reduced heart beat during sleep in the wintertime without a reduction in body temperature.

Methods

Three yearling raccoons were maintained in an outdour enclosure (four meters on all sides). In each upper corner of the enclosure was a nest box (45 cm. by 30 cm. by 33 cm.). Each animal carried internally a physiological radio-capsule to record heart rate and EKG (Folk, 1964). Separate antennae around each nest box, and another around the entire enclosure led to an instrument building where the heart rates of each animal were programmed and recorded every half hour for one minute. The radio-capsules in each animal were designed

[1]Supported by National Science Foundation.

for a long life (one year), for short range, and were implanted in the abdominal cavity. A hopper for pellet food was fastened to the floor of the enclosure. By several techniques it was possible to determine when the animals left the nest boxes at night: they always deposited droppings in a pan in one corner of the cage, and on the coldest nights none of the animals used this litter pan. Secondly, the radio signal changed when the animals left the nest boxes. A third technique concerned the use of the food hopper because the animals invariably scattered food on the floor. Simple meteorological records were kept with a maximum-minimum thermometer beside the enclosure. The control readings were taken from these animals during mild weather or in the laboratory. Each animal was recorded for periods varying from one to two weeks in the months of January, February, March, and May. There was some cold weather in January with eight nights which ranged from —2° F. to —11° F. February was exceptionally warm, although there were two nights below 0° F. (average maximum, 35° F.; average minimum, 16° F.; with 0.71 inch precipitation). March environmental temperatures ranged from 10° F. to 72° F.

Results

Results from experiments using radio-capsules can include behavioral information as well as physiological information. One can

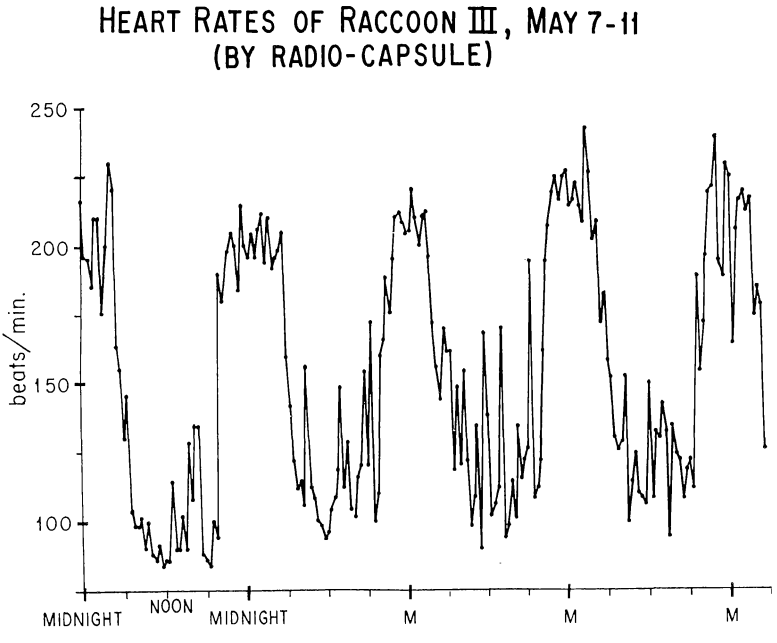

Figure 1. Heart rates recorded automatically for one-half minute every 30 minutes for five days. Similar samples were taken periodically while this raccoon was maintained outdoors for three months.

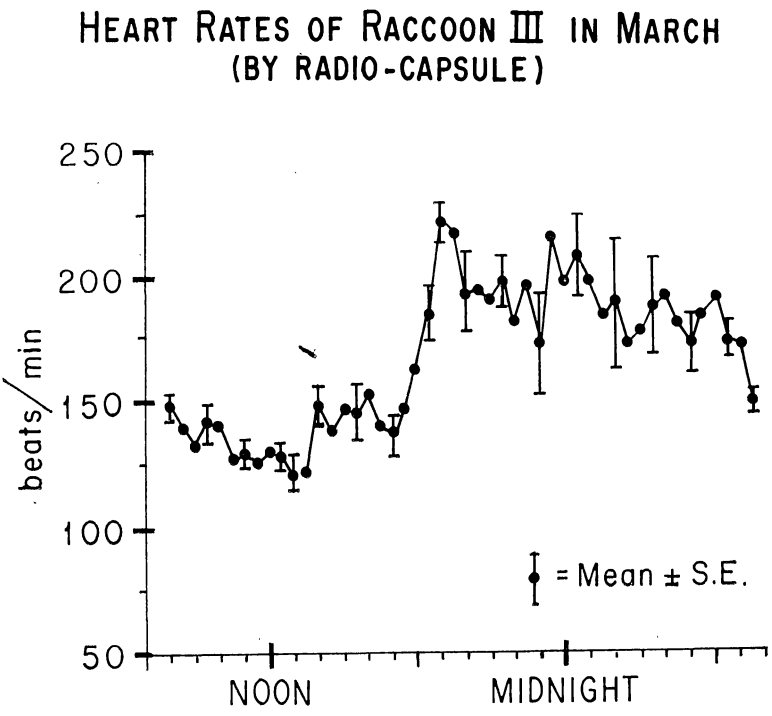

Figure 2. Mean heart rate for each half hour for a one-week period in March, to show the daily time of change from resting condition to activity.

determine whether a mammal has a nocturnal or a day-active behavior pattern; the 24-hour daily rhythm of activity and physiological function can be recorded. This last type of measurement is described as studying the "biological clock." Cardiac physiology is studied by recording first the basal resting heart rate of the unexcited animal and then the response of the heart to exercise or excitement. For example, some species regularly double or triple their resting heart rate due to spontaneous activity like feeding. In this paper we will report only on the day-night behavior pattern and the sleeping heart rates of the raccoons when the air temperature became cold. The first conspicuous behavioral observation concerned the use of nesting boxes. The raccoons often remained during cold spells in their nest boxes for 48 hours without coming out for food or water. Four boxes were provided; we assumed that each animal would select one and claim this as its territory or den. Instead, on most nights all three raccoons jammed themselves into one box. This is surprising when their weights are considered: 5.3 kilo; 3.3 kilo; and 3.0 kilo. The animals consistently ignored two of the nest boxes; during one 32-day period which included a moderate number of cold days, on 17 days two of

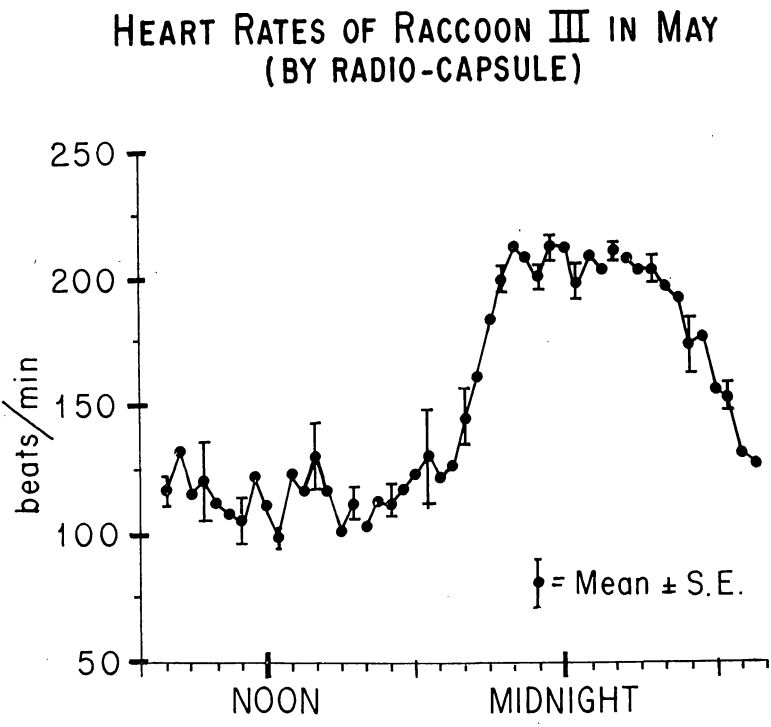

Figure 3. Mean heart rate for each half hour for a one-week period in May, to show the lower sleeping heart rates which were found in the warmer month.

the animals were together in one box; but on 15 days, all three were in the same box.

Perhaps this crowding behavior explains an observation from the heart rate data that raccoons seem to be nervous sleepers. This is only a partial explanation because restless sleep was also observed when single animals spent 24-hour periods alone in a nest. If we take a mean of resting heart rates (the inactive period), some species show a heart rate variation from this mean (during the inactive period) of approximately 10 percent, while the raccoon showed a very high percent—at times exceeding 25 percent (Figure 1). The time of day for sleep and wakefulness of these animals was regular and predictable: invariably, the lowest heart rates of each sleep period came between 12:30 and 1:00 PM (Figures 1, 2, 3). The time of emergence from the nest boxes varied with the time of sunset. Late in spring, emergence was usually around 8:00 PM and the animals frequently returned to the nest box and became quiet at about 3:00 AM. The heart rates during sleep were characteristic of each animal. A common range for sleep will be presented for two of the specimens, and the

standard error will be presented for the third specimen which was studied the most extensively (Table 1).

Table 1

Sleeping Heart Rates (b/m)

	January	February	March
Raccoon I	100-112	68-97	100-120
Raccoon II	62- 88	62-70	——
Raccoon III	(Laboratory 98 ± 5 SE)	(May 99 ± 3 SE)	121 ± 5 SE

Complete data for animal III for two weeks in March and two weeks in May are presented in Figures 2 and 3.

Discussion

This study showed that the sleeping heart rates of raccoons, which often remained during cold spells in their nest boxes, were not reduced in response to unpleasant or severe weather. In fact, in every case, when they prolonged their stay inside, apparently due to severe weather, the sleeping heart rates went up instead of down. These animals in this particular winter showed the reverse of the physiological response of the bears in their winter dens. This observation on the raccoons may have two explanations: these were yearling raccoons; our observations from other animals indicate that the first year animal may have a different response to winter climate from that of older specimens. Secondly, the winter of this study was unusually mild. The study will be repeated with older animals, and we hope with more severe meteorological conditions.

Literature Cited

Folk, G. E., Jr., C. H. Dodge, and M. A. Folk. 1957. Resting body temperatures of raccoons and domestic rabbits. Proc. Animal Care Panel 7:253-258.

Folk, G. E., Jr. 1964. Electrodes for use with implanted radio-capsules. *Biomedical Science Instrumentation II,* 235-264. Plenum Press, New York.

Folk, G. E., Jr. 1967. Physiological observations of bears under winter den conditions. *Mammalian Hibernation III,* 75-85. K. C. Fisher et al., Ed. Oliver and Boyd, Edinburgh.