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BASELINE BODY TEMPERATURES, HEART RATES, AND RESPIRATORY RATES OF MOOSE IN ALASKA

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ABSTRACT: Baseline body temperatures (BT), heart rates (HR) and respiratory rates (RR) were obtained from Alaskan moose (*Alces alces gigas* Miller) at the Moose Research Center (MRC), Alaska. Excitability, seasons and drugs influenced the values to varying degrees. Excitability was the most influential factor. Safe expected ranges were: BT 38.4 to 38.9 C, HR 70 to 91 beats/min (b/min), and RR 13 to 40 respirations/min (r/min). These ranges incorporated all seasons, a central nervous system depressant drug and a paralyzing drug. Values which may be considered critical and an indication that corrective action should be taken include: BT 40.2 C, HR 102 b/min, and RR 40 r/min. It is recommended that persons trained in monitoring vital signs be on hand during moose capture and immobilization procedures.

INTRODUCTION

Body temperatures, heart rates and respiratory rates of mammals may be affected by many factors (Andersson, 1970; Smith and Hamlin, 1970; Tenney, 1970; Kirk and Bistner, 1975). Most biologists handling and capturing wild animals utilize one or more of these criteria to assess the effects of their procedures because they represent and reflect vital functions in the animal. Published BT, HR and RR data for moose were used to relate to specific influences. Classes of BT were used to sort blood chemistry values in moose (Franzmann and LeResche, 1978) and were suggested for excitability evaluation (Franzmann et al., 1975). Roussel and Patenaude (1975) used BT to compare responses between moose restrained with etorphine hydrochloride (EHC) (M-99, Lemmon Co., Sellersville, Pennsylvania 18960, USA) and hand-held moose calves. Haigh et al. (1977) reported mean temperatures for a group of moose captured with fentanyl (Fentanyl, McNeil Laboratories, Don Mills, Ontario L3T 3X7, Canada) and xylazine hydrochloride (Rompun, Bayvet Haver-Lockhart Laboratories, Shawnee, Kansas 66201, USA). Winter energy budgets were assessed using HR (Reneker and Hudson, 1983). Data are essentially lacking for moose which provide baseline points or expected values for BT, HR and RR through seasons from animals expressing no or minimum excitability with and without drugs. The data we present should assist persons monitoring moose vital functions, particularly during capture and handling.

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MATERIALS AND METHODS

Data were obtained from moose at the Moose Research Center (MRC), Alaska which were either trapped (LeResche and Lynch, 1973) or observed free-ranging. Drugs used to immobilize moose were succinylcholine chloride (SCC) (Anectine, Burroughs Wellcome and Co., Research Triangle Park, North Carolina 27607, USA) and EHC. Moose immobilized with EHC received the antagonist diprenorphin hydrochloride (M50-50, Lemmon Co., Sellersville, Pennsylvania 18960, USA).

Body temperatures were recorded using a standard mercury bulb large animal thermometer inserted in the rectum. Heart rates were obtained by auscultation using a standard medical stethoscope. Respiratory rates were obtained by either auscultation with a stethoscope or by observing thoracic expansion and contraction.

Each moose captured was classified on an excitability scale of 1 to 5 based on activity, excitability and response prior to and during handling and/or observation (1—none, 2—slight, 3—moderate, 4—excited, 5—highly excited).

TABLE 1. Body temperatures, heart rates and respiratory rates of free-ranging, captured and immobilized moose in Alaska by season and immobilizing drug (excitability classes 1 and 2).[a]

	Succinylcholine immobilized				Etorphine immobilized				Observed
	Jun Jul Aug	Sep Oct Nov	Dec Jan Feb	Mar Apr May	Jun Jul Aug	Sep Oct Nov	Dec Jan Feb	Mar Apr May	Apr–May
Body temperature (C)	38.9 ± 0.3 (n = 55)	38.6 ± 0.3 (n = 54)	38.4 ± 0.3 (n = 38)	38.7 ± 0.3 (n = 12)	38.8 ± 0.3 (n = 12)	38.8 ± 0.2 (n = 6)	38.5 ± 0.3 (n = 12)	38.7 ± 4 (n = 7)	
Heart rate (beats/min)	91 ± 15 (n = 52)	79 ± 15 (n = 54)	75 ± 13 (n = 28)	76 ± 13 (n = 5)	70 ± 11 (n = 11)	74 ± 11 (n = 5)	76 ± 22 (n = 5)		
Respiratory rate (respirations/min)	40 ± 16 (n = 15)	28 ± 10 (n = 17)	19 ± 5 (n = 3)		19 ± 6 (n = 7)	13 ± 6 (n = 4)			19 ± 8[b] (n = 19)

[a] Only moose classified as not excited or slightly excited at capture are considered.
[b] Two moose not included were standing in the sun and had RR of 56 and 50.

Only moose from excitability classes 1 and 2 were used to establish baseline values by season and drug used.

RESULTS

Body temperature

Mean body temperature obtained from adult moose of both sexes in excitability classes 1 or 2 was 38.7 ± 0.3 C (n = 196); One hundred fifty-nine were immobilized with SCC and 37 with EHC (Table 1). Body temperatures by seasons were nearly the same for both drugs. Seasonal variation was also small to negligible; BT were slightly lower during the December through February period than the June through August period (Table 1).

Body temperatures from 140 moose in excitability classes 3, 4 and 5 were obtained (Table 2). Mean BT for class 3 was 39.4 C (n = 80), 40.2 C for class 4 (n = 35), and 41.0 C for class 5 (n = 25). The mean BT of these classes was 39.9 C. Body temperatures increased with excitability classes and classes 3, 4, and 5 means were each significantly higher (P = 0.01) than the mean BT for classes 1 and 2 moose (38.7 C). Excitability had the greatest influence on BT. Two moose in excitability class 5 had temperatures ≥43 C and died from hyperthermia.

Heart rate

Heart rates were obtained from 160 adult moose of both sexes in excitability classes 1 and 2. One hundred thirty-nine were immobilized with SCC and 21 with EHC (Table 1). Heart rates ranged from 70 to 79 b/min for both drugs and all seasons except the June through August period when the mean rate increased to 91 b/min for moose immobilized with SCC. This period was the only one significantly different (P = 0.01) from the other season and drug influences on HR. The mean heart rate for both drugs and all seasons excluding the June through August SCC immobilized period was 76.5 ± 14 b/min (n = 108).

Mean HR from moose in excitability

TABLE 2. Body temperatures, heart rates, and respiratory rates of moderately to highly excited adult moose in Alaska (excitability classes 3, 4 and 5).

Parameter	Excitability class	Sample size	Values	
			$\bar{x}$	SD
Body temperature (C)	3 (moderate)	80	39.4	0.9
	4 (excited)	35	40.2	0.9
	5 (highly excited)	25	41.0	2.1
	Combined	140	39.9	1.1
Heart rate (beats/min)	3 (moderate)	79	90	21
	4 (excited)	35	102	22
	5 (highly excited)	25	110	20
	Combined	139	97	21
Respiratory rate (respirations/min)	3 (moderate)	30	34	14
	4 (excited)	16	42	18
	5 (highly excited)	10	67	27
	Combined	56	42	17

class 3 was 90 ± 21 b/min (n = 79), 102 ± 22 (n = 35) for class 4, and 110 ± 20 (n = 25) for class 5. The combined mean was 97 ± 21 b/min (n = 139) (Table 2). As with BT, the mean HR increased with increase in excitability, and class 3, 4 and 5 means were each significantly higher (P = 0.01) than the mean HR for class 1 and 2 moose (76.5 b/min).

Respiratory rate

Respiratory rates were obtained from 46 adult moose of both sexes in excitability classes 1 and 2. Thirty-five were immobilized with SCC and 11 with EHC (Table 1). Respiratory rates varied from 13 ± 6 (n = 4) to 19 ± 6 (n = 7) r/min for EHC immobilized moose and from 19 ± 5 (n = 3) to 40 ± 16 (n = 15) r/min for SCC immobilized moose (Table 1). The differences between SCC and EHC immobilized moose within the same season were significant (P = 0.01) and were primarily influenced by the narcotic effects of EHC. Highest rates were detected during the June to August period for moose immobilized with SCC (40 ± 16 r/min) (Table 1). Greater variability was noted for RR than BT or HR. This was partly due to smaller sample sizes, but mostly it was the nature of the parameter.

During April and May 1983 we observed 19 undisturbed moose standing in the shade and counted RR. We obtained a mean RR of 19 ± 8 r/min from these animals, and considered these as our best baseline data. Similar or lower rates were obtained during winter for moose immobilized with SCC (19 r/min) and moose immobilized with EHC during June to August (19 r/min), and September through November (13 r/min). Higher rates were detected during summer and fall for moose immobilized with SCC (40 and 28 r/min, respectively). We also recorded RR from two moose standing in the sun; in April and May, their rates were 56 and 50 r/min. The warmer temperature in the sun more than doubled the RR.

Mean RR from moose in excitability class 3 was 34 ± 14 r/min (n = 30), 42 ± 18 (n = 16) for class 4, and 67 ± 27 (n = 10) for class 5. The combined mean was 42 ± 17 r/min (n = 56) (Table 2). As with BT and HR, we observed an increase in RR with increased excitability.

DISCUSSION

An obvious conclusion was that excitability greatly influences BT, HR, and RR. This was assumed prior to collecting the data and was the reason for establishing

excitability classes for the moose. However, the extent of the excitability influence was unknown until these data were assembled.

Both drug and season influenced HR and RR. SCC acts upon myoneural junctions and causes paralysis. The animal is mentally aware through all sensory systems, but cannot physically respond. EHC, a morphine derivative, depresses the central nervous system and sensory systems are likewise depressed. The impact most evident from the effect of this narcotic drug when monitoring moose was the reduced RR. Moose immobilized with SCC are capable of responding physiologically to sensory impulses resulting in increased HR and RR. With prolonged monitoring of an animal under SCC we would expect a rise in BT as well. When excitability was not an important factor, influence of the seasonal impact on BT, HR and RR was primarily due to ambient temperature. The factorial increase in RR of moose standing in the sun over moose standing in the shade supported this conclusion.

Season, excitability and drug used cannot be considered as separate or unrelated criteria and we need not dwell on which is more important. What is important is that persons handling moose recognize the potential problems each may impart into the process. Our best measures of these influences are the vital signs monitored with BT, HR and RR.

Table 1 provides base-line data on BT, HR and RR for moose which should be useful in monitoring captured and immobilized animals. These values may be considered the safe expected ranges when all is going well, which for moose, in general, appear to be 38.4 to 38.9 C for BT, 70 to 91 b/min for HR, from 13 to 40 r/min for RR. These values incorporate all seasons and both a CNS depressant and a paralyzing drug.

Of most importance, are the points at which each of these vital functions indicate a problem necessitating action. We were not able to establish BT, HR and RR critical points for a hypothermic moose. However, for a hyperthermic moose in the excitability class 4 and BT 40.2 C, HR 102 b/min, or RR 40 r/min, corrective measures to cool the animal, eliminate excitability or drug influence should be initiated (Table 2). For each degree C rise in BT, basal metabolism increases 10 to 20% (Andersson, 1970). When BT reaches 41 C in mammals, oxygen utilization exceeds oxygen supplied by normal respiration and cellular damage begins to occur. When a canine BT reaches 41 C the potential for breakdown of thermal equilibrium occurs, and at 42.5 C severe nervous symptoms develop with danger of collapse possible (Andersson, 1970). Body temperature is less responsive than either HR or RR, but more meaningful when changes occur (Andersson, 1970). A point of no return in respect to BT for moose is 43 C. Three moose attained this BT and died from hyperthermia in spite of all efforts to lower the BT.

Hopefully, the guidelines provided will assist those monitoring captured moose by providing some expected values under various major influences. During major capture projects, it is essential that someone experienced at monitoring vital signs be present.

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