Rectal Temperatures of Immobilized, Snare-trapped Black Bears in Great Dismal Swamp

Authors: Hellgren, Eric C., and Vaughan, Michael R.

Source: Journal of Wildlife Diseases, 25(3) : 440-443

Published By: Wildlife Disease Association

URL: https://doi.org/10.7589/0090-3558-25.3.440

Journal of Wildlife Diseases, 25(3), 1989, pp. 440–443

Rectal Temperatures of Immobilized, Snare-trapped Black Bears in Great Dismal Swamp

Eric C. Hellgren[1,3] **and Michael R. Vaughan,**[2] [1] Department of Fisheries and Wildlife Sciences, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061, USA; [2] Virginia Cooperative Fish and Wildlife Research Unit, U.S. Fish and Wildlife Service, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061, USA. [3] Present address: Campus Box 218, Caesar Kleberg Wildlife Research Institute, Texas A&I University, Kingsville, Texas 78363, USA

ABSTRACT: Rectal temperature was determined for 84 black bears (*Ursus americanus*) during 99 handlings in Great Dismal Swamp, Virginia and North Carolina (USA). All bears had been trapped with cable snares and immobilized with a 2:1 ketamine hydrochloride-xylazine hydrochloride mixture. Temperatures were significantly greater in males and varied significantly by season. Immobilized bears began panting at rectal temperatures >42.0 C. One death occurred at 43.0 C. We recommended cooling measures on black bears at rectal temperatures of ≥40.0 C.

Key words: Black bear, ketamine hydrochloride, rectal temperature, snare, *Ursus americanus*, xylazine hydrochloride, chemical immobilization.

Monitoring physiologic functions of captured wild animals is necessary to assess the effects of capture and handling techniques and to maximize safety for both the researcher and the animal. Body temperature, heart rate and respiratory rate are probably the three major characteristics of animals monitored by biologists during immobilization (Franzmann et al., 1984). Data on these functions in wild black bears (*Ursus americanus*) are rare (Addison and Kolenosky, 1979; Stewart et al., 1980). Trapped bears may be particularly susceptible to hyperthermia in hot, humid climates, such as in the southeastern United States, because of their bulky body form and black fur. Our objectives in the present study were to measure rectal temperatures throughout the year in immobilized, snare-trapped black bears and to determine temperatures at which bears became hyperthermic.

Field work was conducted on the Great Dismal Swamp National Wildlife Refuge (440 km^2), Dismal Swamp State Park, North Carolina (57.5 km^2), and adjacent privately owned land, from May 1984 to August 1986. The entire study area (36°30′ to 36°45′N, 76°22′ to 76°37′W) was 555 km^2. Great Dismal Swamp is a forested wetland on the Virginia-North Carolina border in the mid-Atlantic Coastal Plain (Hellgren, 1988). Mean ambient temperatures for January and July are 5.1 C and 26.0 C, respectively (Lichtler and Walker, 1979).

Bears were captured using spring-activated cable snares checked daily from April to December during the years of the study. Trapped bears were immobilized with a 2:1 mixture of ketamine hydrochloride (Parke-Davis, Warner-Lambert Co., Morris Plains, New Jersey 07950, USA) and xylazine hydrochloride (Mobay Corporation, Animal Health Division, Shawnee, Kansas 66201, USA) at an initial dosage rate of 6.6 mg/kg estimated body weight (4.4 mg/kg ketamine and 2.2 mg/kg xylazine). Supplemental doses were necessary in 29 handlings. Drugs were administered intramuscularly by dart rifle, blow-gun dart syringe (Lochmiller and Grant, 1983) or jabstick. All bears were sexed, weighed and the first premolar extracted for aging (Willey, 1974). Rectal temperature was determined to the nearest 0.5 C at 3 to 60 min ($\bar{x}$ = 22.0 ± 1.5) after immobilization with a standard mercury bulb rectal thermometer. Ambient temperatures during handlings ranged from −2 to 35 C. At the conclusion of handling procedures, each bear received an intramuscular injection of 2 to 5 cc penicillin-streptomycin (Combiotic, Pfizer, New York, New York 10017, USA).

Rectal temperature data were analyzed by two-way analysis of variance with in-

TABLE 1. Rectal temperatures (mean ± SE) of black bears in Great Dismal Swamp, Virginia and North Carolina, 1984–1986.

Sex	Spring			Early summer			Late summer			Early fall			Late fall			Denning		
	n	$\bar{x}$	SE	n	$\bar{x}$	SE	n	$\bar{x}$	SE	n	$\bar{x}$	SE	n	$\bar{x}$	SE	n	$\bar{x}$	SE
Male	23	40.1	0.3	18	39.5	0.2	8	40.1	0.4	10	40.1	0.3	4	38.5	0.6	—	—	—
Female	2	39.2	0.7	10	39.6	0.3	9	39.6	0.4	6	39.7	0.3	5	37.8	0.7	4	37.4	0.7

teraction with sex and season as the main effects. Tukey's studentized range test was used for means comparisons. Rectal temperature was also regressed on mean ambient temperature on the day of capture (National Oceanic and Atmospheric Administration, 1984, 1985), bear weight, bear age and postinduction time. Seasons were separated using changes in plant phenology and bear food habits: spring, 1 April to 15 June; early summer, 16 June to 31 July; late summer, 1 August to 15 September; early fall, 16 September to 15 November; late fall, 16 November to 15 January; and denning, any denned bears.

Rectal temperatures were determined during 99 immobilizations of 84 bears. Temperatures were greater for males ($F = 10.89$; df = 1, 88; $P = 0.001$) than for females and varied among seasons ($F = 6.18$; df = 5, 88; $P < 0.001$) (Table 1). Rectal temperatures during spring, early summer, late summer, and early fall were greater ($P < 0.05$) than during late fall and denning (Table 1). Temperatures ranged from 35.5 C to 43.0 C. Panting appeared to be a sign of heat stress. All of five bears (4 males, 1 female) that panted during handling had rectal temperatures ≥42.0 C except the female, whose temperature was not monitored. Water was used to cool these animals to prevent temperatures from rising. Only one male bear with a rectal temperature ≥42.0 C did not pant. Animals with rectal temperatures <42.0 C did not pant.

Two bears died of heat-related causes during the study. A 30 kg yearling female captured on 11 August 1984 died after handling. She was panting during the handling process, but her rectal temperature was not monitored. She was found dead two days after handling 200 m from the trapsite. A 118 kg, 4-year-old male bear captured on 22 April 1988 had a temperature of 43 C, the highest recorded during the study. Ambient temperature was 35 C. After immobilization, this animal began panting. We left the trapsite at 1600 hours with the bear still panting. It was found dead at the trapsite at 0730 hours the next morning. Necropsy suggested that death occurred because of hyperthermia (Southeastern Cooperative Wildlife Disease Study, pers. comm.).

A significant ($P = 0.034$) positive relationship existed between bear weight and rectal temperature. However, only 4.9% of the variation in temperature could be accounted for by weight. There was no significant ($P > 0.05$) relationship between rectal temperature and age, or rectal temperature and postinduction time. In 67 cases, a second rectal temperature determination was taken during a bear handling. A paired t-test indicated no difference ($P = 0.28$) between first and second rectal temperature. Apparently, during the handling process, there was no tendency for temperature to change as postinduction time increased.

Seasonal variation in rectal temperatures probably was due to cooler ambient temperatures in late fall and hibernation in winter. There was a significant ($P = 0.003$) positive relationship with low predictive power ($r^2 = 0.12$) between rectal temperature and mean daily ambient temperature. Body temperatures of hibernating bears are reported to range from 31 to 36 C (Hock, 1957; Erickson and Youatt, 1961; Folk, 1967; Craighead et al., 1976;

Watts et al., 1981). Temperatures of hibernating bears in this study were high in comparison, perhaps because of arousal associated with disturbance or because of mild ambient temperatures.

Rectal temperatures of trap-stressed black bears were much higher than reported temperatures of captives. Body temperatures of captive black bears, regardless of anesthesia used, generally range between 37 and 38 C (Hock, 1957; Erickson and Youatt, 1961; Folk, 1967; Craighead et al., 1976; Bush et al., 1980). Addison and Kolenosky (1979) reported a mean rectal temperature of 38.3 C (range 36.5 to 41.0 C) for 17 captive black bears immobilized with xylazine and ketamine. Mean rectal temperatures of captive bears ($n = 6$ bears, 108 samples) in Virginia were 38.0 C in fall and 36.8 C during hibernation in winter (Hellgren, 1988). To our knowledge, there are no previously published data on rectal temperatures in wild black bears immobilized with a mixture of xylazine and ketamine.

Stirling et al. (1985) recommended tiletamine hydrochloride and zolazepam hydrochloride (Telazol, Warner Lambert Co., 2800 Plymouth Rd., Ann Arbor, Michigan 48105, USA) for immobilization of polar bears (*Ursus maritimus*) because animals can maintain thermoregulatory ability while immobilized. Hyperthermia (>40 C body temperature) has been commonly observed in polar bears immobilized with ketamine-xylazine mixtures in warm weather (Stirling et al., 1985). Mean rectal temperature of 37 black bears immobilized in the field in California with tiletamine and zolazepam was 38.1 ± 0.1 C (Stewart et al., 1980). This drug combination may be indicated for immobilization of black bears in hot, humid weather.

Physiologic functions of immobilized black bears should be monitored carefully, especially in the hot summer months. At body temperatures above 41 C in dogs, a breakdown in thermal equilibrium is possible; collapse and severe nervous symptoms can occur at 42.5 C (Andersson, 1970). In ketamine-xylazine anesthetized black bears, panting began at 42.0 C and death occurred in the one animal with a rectal temperature of 43.0 C. Body temperature of 43.0 C is a "point of no return" in moose (*Alces alces*) (Franzmann et al., 1984). We recommend that measures to cool immobilized black bears commence at a rectal temperature of 40.0 C. These measures include use of yohimbine as an antagonist to xylazine to reduce time of immobilization and compromised thermoregulation (Ramsay et al., 1985; Garshelis et al., 1987). If yohimbine is not available, prophylactic measures include sheltering immobilized animals from direct sunlight and wetting down. Future studies should monitor heart rate and respiratory rate to develop critical values for these functions.

We acknowledge the cooperation of the U.S. Fish and Wildlife Service, Virginia Department of Game and Inland Fisheries, North Carolina Wildlife Resource Commission, and the Department of Fisheries and Wildlife Science, Virginia Polytechnic Institute and State University. Particularly helpful were D. J. Schwab, R. D. McClanahan, and the entire staff of Great Dismal Swamp National Wildlife Refuge (GDSNWR). Technical assistance was provided by W. M. Lane, J. Polisar, and K. Meddleton. R. L. Kirkpatrick and two anonymous reviewers critiqued the manuscript. This project was funded by the U.S. Fish and Wildlife Service. Use of trade names does not imply endorsement of commercial products by the U.S. Fish and Wildlife Service.

LITERATURE CITED

ADDISON, E. M., AND G. B. KOLENOSKY. 1979. Use of ketamine hydrochloride and xylazine hydrochloride to immobilize black bears (*Ursus americanus*). Journal of Wildlife Diseases 15: 253–258.

ANDERSSON, B. E. 1970. Temperature regulation and environmental physiology. *In* Duke's physiology of domestic animals, 8th ed., M. J. Sweeney (ed.). Cornell University Press, Ithaca, New York, pp. 1119–1134.

BUSH, M., R. S. CUSTER, AND E. E. SMITH. 1980. Use of dissociative anesthetics for the immobilization of captive bears: Blood gas, hematology, and biochemistry. Journal of Wildlife Diseases 16: 481–489.

CRAIGHEAD, J. J., J. R. VARNEY, F. C. CRAIGHEAD, JR., AND J. S. SUMNER. 1976. Telemetry experiments with a hibernating black bear. International Conference on Bear Research and Management 3: 357–369.

ERICKSON, A. W., AND W. G. YOUATT. 1961. Seasonal variations in the hematology and physiology of black bears. Journal of Mammalogy 42: 198–203.

FOLK, G. E., JR. 1967. Physiological observations of subarctic bears under winter den conditions. *In* Mammalian hibernation, K. Fisher (ed.). American Elsevier Publishing Company, New York, New York, pp. 75–85.

FRANZMANN, A. W., C. C. SCHWARTZ, AND D. C. JOHNSON. 1984. Baseline body temperatures, heart rates and respiratory rates of moose in Alaska. Journal of Wildlife Diseases 20: 333–337.

GARSHELIS, D. L., K. V. NOYCE, AND P. D. KARNS. 1987. Yohimbine as an antagonist to ketamine-xylazine immobilization in black bears. International Conference on Bear Research and Management 7: 323–327.

HELLGREN, E. C. 1988. Ecology and physiology of a black bear (*Ursus americanus*) population in Great Dismal Swamp and reproductive physiology in the captive female black bear. Ph.D. Dissertation. Virginia Polytechnic Institute and State University, Blacksburg, Virginia, 231 pp.

HOCK, R. J. 1957. Metabolic rates and rectal temperatures of active and "hibernating" black bears. Federation Proceedings 16: 440 (abstr.).

LICHTLER, W. F., AND P. N. WALKER. 1979. Hydrology of the Dismal Swamp. *In* The Great Dismal Swamp, P. W. Kirk, Jr. (ed.). University of Virginia Press, Charlottesville, Virginia, pp. 140–168.

LOCHMILLER, R. L., AND W. E. GRANT. 1983. A sodium bicarbonate-acid powered blow-gun syringe for remote injection of wildlife. Journal of Wildlife Diseases 19: 48–51.

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION. 1984. Climatological data: Virginia, annual summary. National Climatic Center, Asheville, North Carolina, 28 pp.

———. 1985. Climatological data: Virginia, annual summary. National Climatic Center, Asheville, North Carolina, 20 pp.

RAMSAY, M. A., I. STIRLING, L. O. KNUTSEN, AND E. BROUGHTON. 1985. Use of yohimbine hydrochloride to reverse immobilization of polar bears by ketamine hydrochloride and xylazine hydrochloride. Journal of Wildlife Diseases 21: 396–400.

STEWART, G. R., J. M. SIPEREK, AND V. R. WHEELER. 1980. Use of the cataleptoid anesthetic CI-744 for chemical restraint of black bears. International Conference on Bear Research and Management 4: 57–61.

STIRLING, I., E. L. BROUGHTON, L. O. KNUTSON, M. A. RAMSAY, AND D. S. ANDRIASHAK. 1985. Immobilization of polar bears with Telazol on the western coast of Hudson Bay during summer 1984. Canadian Wildlife Service Progress Note 157, National Wildlife Research Center, Ottawa, Ontario, Canada, 7 pp.

WATTS, P. D., N. A. ORITSLAND, C. JONKEL, AND K. RONALD. 1981. Mammalian hibernation and the oxygen consumption of a denning black bear (*Ursus americanus*). Comparative Biochemistry and Physiology 69A: 121–123.

WILLEY, C. H. 1974. Aging black bears from first premolar tooth sections. The Journal of Wildlife Management 38: 97–100.

Received for publication 21 November 1988.