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HEMATOLOGY AND SERUM CHEMISTRY OF BOBCATS IN NORTHCENTRAL MINNESOTA

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ABSTRACT: Hematology and serum chemistry values were determined for 27 (18 male, 9 female) wild-caught bobcats (*Felis rufus* Schreber) ≥1.0 yr old from northcentral Minnesota. Most blood parameters were similar to normal values for both captive bobcats and domestic cats. Deviations from these normals were likely the result of capture stress, nutritional status, and/or reproductive condition.

INTRODUCTION

Blood parameters of numerous species of wildlife have been examined to determine the physical condition of individual animals in relation to factors such as habitat (Seal et al., 1978) and growth (Seal et al., 1975). For many species, sufficient analyses have been conducted so that age- and season-specific values can be compared with normal values. Currier and Russell (1982) presented blood values for captive and wild-caught mountain lions (*Felis concolor* L.) but we found no information published on wild-caught bobcats. This paper presents baseline blood chemistry and hematology data from 27 bobcats ≥1.0 yr old captured in northcentral Minnesota during 1974–1981 and evaluates potential differences in these values due to sex and season.

METHODS AND MATERIALS

Blood samples were obtained from bobcats in two areas of northcentral Minnesota. Vegetation of both the Hill City area, located 35 km south of Grand Rapids, and the Bearville area, 50 km northeast of Grand Rapids, is mostly boreal coniferous/hardwood forest (Maycock and Curtis, 1960). Mean January temperature at Grand Rapids is −14 C, and the July mean is 19 C (U.S. Dept. Commerce, unpubl. data). During winters 1971–1972 through 1982–1983, the mean January–March snow depth was 44 cm.

Bobcats were captured in No. 3, 4, or 14 double long-spring steel traps during April–May and August–October 1974–1981; traps were checked daily. Animals at Hill City were immobilized with a combination of phencyclidine hydrochloride (2.2 mg/kg) and promazine hydrochloride (2.2 mg/kg), while those at Bearville were immobilized with a combination of ketamine hydrochloride (10 mg/kg) and xylazine hydrochloride (1.5 mg/kg). After a radiocollar and/or eartags were attached, blood samples were taken via the femoral vein.

Blood was handled initially as described by Karns and Crichton (1978). Red and white blood cells were counted using a Fisher autocytometer (No. 6-246V1); hematocrit values were determined as in Guest and Silek (1934), and hemoglobin as in Eilers (1967). Chemical and enzyme analyses included glutamic oxalacetic transaminase (GOT, Karmen units/ml, assayed at 25 C; Karmen, 1955), glutamic pyruvic transaminase (GPT, Wroblewski-LaDue units/ml, 25 C; Wroblewski and LaDue, 1956), creatine phosphokinase (CPK, Sigma units, 25 C; Oliver, 1955; Rosalki, 1967), lactic dehydrogenase (LDH, Wroblewski-LaDue units/ml, 25 C; Wroblewski and LaDue, 1955), alkaline phosphatase (Sigma units or Bessey-Lowry-Brock units/ml, 37 C; Bessey et al., 1946), total lipids (Frings et al., 1972), cholesterol (Huang et al., 1961), glucose (Hyvärinen and Nikkilä, 1962; Feteris, 1965), blood urea nitrogen (BUN; Wybenga et al., 1971), creatinine (Heinegard and Tiderstrom, 1973), total protein (Henry et al., 1957), albumin and globulins (cellulose acetate electrophoresis, barbital buffer, pH 8.6 using Gelman "Sepratek" system), calcium (Anonymous, 1981), phosphorus (Henry et al., 1974), and magnesium (Gindler and Heth, 1971; Pierce Magnesium Rapid Stat Kit, Pierce Chem. Co., P.O. Box 117, Rockford, Illinois 61105, USA). Sodium and potassium values were determined with a flame photometer (Instrumentation Laboratory Model 143 with IL dilutor Model 144).

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TABLE 1. Hematologic values for adult (≥1.0 yr old) bobcats from northcentral Minnesota.

Value	Mean ± 1 SD	n	Normal range for domestic cats[a]
HGB (g/dl)	13.30 ± 1.57	25	8.0–15.0
HCT (vol %)	38.72 ± 4.37	25	24.0–45.0
RBC ($10^6/\mu l$)	7.98 ± 1.46	17	5.0–10.0
MCH (pg)	17.40 ± 4.07	15	13.0–17.0
MCV (fl)	49.35 ± 10.49	17	39.0–55.0
MCHC (%)	34.52 ± 2.43	25	30.0–36.0
WBC ($10^3/\mu l$)	15.81 ± 5.04	15	5.5–19.5
Neutrophils	14.04 ± 1.02	6	2.5–12.5
Lymphocytes	1.77 ± 1.02	6	1.5–7.0
Monocytes	0.00 ± 0.00	6	0.0–0.9
Eosinophils	0.00 ± 0.00	6	0.0–1.5
Basophils	0.00 ± 0.00	6	rare

[a] From Schalm (1965).

Blood parameters were tested for differences between sexes or seasons (spring vs. fall) with Student's t-tests; we assumed P-values <0.01 indicated statistical significance. Mean values are given ±1 SD. For a given test, bobcats were included in one category or the other because small sample sizes precluded more detailed analyses. Potential differences due to location and immobilizing drug were not tested statistically because different drugs were used at different locations. Results were compared with normal values of domestic cats, for which there is an abundance of information (Schalm, 1965; Kaneko, 1980), and with limited data (n = 3–12) from captive bobcats (Flesness, pers. comm.). We converted our values for SGOT, SGPT, CPK, LDH, and alkaline phosphatase to IU/liter using the correction factors in Sigma Chemical Co. Technical Bulletins (Table 2). These conversions do not necessarily make the values directly comparable to those for domestic cats and bobcats because assay conditions were likely not identical, and thus any conclusions drawn from such comparisons must be viewed with caution.

RESULTS AND DISCUSSION

Twenty-seven bobcats (18 males, 9 females) ≥1.0 yr old were captured at Hill City and Bearville and subsequently blood-sampled. Only five bobcats (2 males, 3 females) were sampled in the spring vs. 22 (16 males, 6 females) in the fall.

Most hematological values for bobcats in Minnesota (Table 1) were similar to normal values of domestic cats. Hemoglobin values were slightly higher than for domestic cats, but similar to those for captive bobcats ($\bar{x}$ = 13.8 ± 2.0; n = 10). Low, possibly erroneous, RBC counts of two wild bobcats resulted in mean MCH values slightly higher than for domestic cats, but again, were similar to values for captive bobcats ($\bar{x}$ = 16.6 ± 2.4; n = 10). Neutrophil counts were elevated compared to normal values for both domestic cats (Table 1) and captive bobcats ($\bar{x}$ = 59% ± 42%; n = 12), probably due to the physical damage of, and struggle after, capture (Schalm, 1965).

Serum GOT values of captured bobcats averaged slightly higher than the upper limits of normal values for domestic cats (Table 2), though values for 20 of 22 animals were <90 IU/liter. SGOT values were similar to normal values, but mean CPK and LDH values were extraordinarily high (Table 2). SGOT, CPK and LDH values were all positively correlated (r = 0.759, 12 df, P < 0.01). Significantly higher CPK and LDH levels were found in wild-caught vs. captive mountain lions, and were attributed to more strenuous exercise and muscle damage from the dart (Currier and Russell, 1982). Values for bobcats likely reflect muscle damage due to capture in the trap itself, subsequent struggling before handling (Kaneko, 1980), and possibly the result of the anesthetic injection. Though these levels may also have been the result of previous injury, it is unlikely that this would apply to all trapped bobcats. In addition, low values do not necessarily indicate low stress, as animals may show delayed onset of high values if sampled immediately after capture and handling. All alkaline phosphatase values were within the normal range published for domestic cats. The two highest values (30.0 and 36.7 IU/liter) were from adult female bobcats sampled in spring that were likely pregnant, and thus the elevated levels (Kaneko, 1980;

TABLE 2. Clinical chemistry values for adult (≥1.0 yr old) bobcats from northcentral Minnesota.

Value	Mean ± 1 SD	n	Normal range for domestic cats[a]
GOT (IU/liter)	66.0 ± 31.8[b]	22	10–60
GPT (IU/liter)	27.1 ± 8.7[b]	23	6–83
CPK (IU/liter)	3,710 ± 3,094[b]	15	62–262
LDH (IU/liter)	1,568 ± 1,173[b]	16	10–273
Alk. phos. (IU/liter)	12.5 ± 7.5[b]	22	10–93
Total lipids (mg/dl)	368.0 ± 59.6	16	145–607
Cholesterol (mg/dl)	121.8 ± 19.6	25	95–130
Glucose (mg/dl)	157.2 ± 54.4	25	70–150
BUN (mg/dl)	34.4 ± 7.9	25	5–30
Creatinine (mg/dl)	0.90 ± 0.31	20	0.8–2.1
Total protein (g/dl)	6.68 ± 0.73	25	5.4–7.8
Albumin (g/dl)	3.59 ± 0.58	24	2.1–3.5
Globulin (g/dl)	3.19 ± 0.78	24	2.6–5.1
Albumin/globulin ratio	1.22 ± 0.42	24	0.45–1.19
Sodium (mEq/liter)	148.6 ± 10.3	22	147–161
Potassium (mEq/liter)	4.00 ± 0.59	22	3.7–4.9
Calcium (mg/dl)	9.43 ± 1.11	25	6.2–11.0
Phosphorus (mg/dl)	4.73 ± 1.34	24	3.2–8.1
Magnesium (mg/dl)	2.29 ± 0.41	25	1.92–2.28

[a] From Kaneko (1980) and Bentinck-Smith (1983).
[b] Converted to IU/liter by the following equations: GOT = Karmen units/ml × 0.48, GPT = Wroblewski-LaDue units/ml × 0.48, CPK = Sigma units/ml × 5.0, LDH = Wroblewski-LaDue units/ml × 0.48, and alkaline phosphatase = Sigma units/ml × 16.7 (from Sigma Tech. Bull. 55-UV, 45-UV, 340-UV, and 104, Sigma Chem. Co., St. Louis, Missouri 63178, USA).

Bentinck-Smith, 1983). Glucose values for 12 of 25 bobcats were higher than normals for both domestic cats (Table 2) and captive bobcats ($\bar{x} = 124 \pm 30$; $n = 11$), and may have been the result of the immobilizing drugs (Seal, pers. comm.), or handling stress; liver glycogen output increases with stress and thus elevates glucose levels (White et al., 1959). Urea nitrogen levels were higher than normals of domestic cats for 17 of 25 bobcats, but similar to values for captive bobcats (30 ± 6, $n = 11$). Diets of both captive and wild bobcats were likely higher in protein than for domestic cats, and Currier and Russell (1982) also found high BUN levels in mountain lions. Other mean blood chemistry values were within normal ranges for domestic cats and similar to those of captive bobcats.

Alkaline phosphatase levels were significantly greater ($t = 3.02$, 20 df, $P < 0.007$) for females (19.2 ± 11.5, $n = 6$) than for males (10.0 ± 3.0, $n = 16$). Again, three females were captured in spring, and two of these were likely pregnant. This also resulted in higher ($t = 3.42$, 20 df, $P < 0.003$) alkaline phosphatase levels in five spring-caught bobcats (20.7 ± 12.4 vs. 10.0 ± 2.8 in fall, $n = 22$). Magnesium levels in these spring-caught animals were significantly lower ($t = 2.83$, 20 df, $P < 0.009$) than for those in fall (1.88 ± 0.29 vs. 2.40 ± 0.38). This may be related to lower nutritional status in spring (Kaneko, 1980), or seasonal variability in mineral metabolism (Flynn and Franzmann, 1984).

Most blood parameters for wild-caught bobcats fall into the normal range for both captive bobcats and domestic cats. Deviations from these normals are likely the result of capture stress, nutritional status, and/or reproductive condition. Consideration of these aspects should allow researchers to better evaluate the physical condition of captured bobcats.

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