GEOGRAPHIC VARIATION IN MOOSE ANTLER CHARACTERISTICS, YUKON

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ABSTRACT: Yukon has been identified as the transition zone between Alces alces gigas and Alces alces andersoni. Peterson (1955) suggested the demarcation was a north-south line through central Yukon, with A.a. andersoni to the east, and A.a. gigas to the west. If antler size reflects subspecies differences, our data suggest that the northern boundary of a transition zone between the two subspecies lies in an east-west orientation through central Yukon with A.a. gigas to the north and A.a. andersoni or a mix of the two subspecies to the south. These conclusions are based on four measures of moose antler characteristics taken from samples throughout Yukon. Statistically significant differences were found in all measures between samples taken from regions classed according to a north-south split. No differences were found in measures of antler characteristics between samples classed according to the east-west split proposed by Peterson (1955).

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Yukon has been identified as a transition zone between Alces alces andersoni, 'woodland' moose, and Alces alces gigas, 'tundra' moose. Peterson (1955) hypothesized that the boundary between the two subspecies could best be represented as a north-south line through central Yukon with the larger subspecies, A.a. gigas, to the west of the line and A.a. andersoni to the east. This hypothesis has been commonly

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reported in the literature as something of a truism, for example Franzmann (1978). Observations reported by Yukon hunters over a number of years, however, indicated that larger-size moose occurred in the north rather than south Yukon, suggesting to us that the northern boundary of a transition zone between the two subspecies might more likely lie in an east-west orientation through central Yukon with A.a. gigas to the north and A.a. andersoni to the south.

We test the competing east-west and north-south hypotheses to determine which is the more likely location of the northern boundary of a transition zone between the two subspecies using differences in four antler measurements among regions in Yukon. Gasaway et al. (1985) used moose antler characteristics to evaluate differences among subspecies classified by Peterson (1955). We assume a population of large-sized antlered moose in Yukon to likely represent A.a. gigas while a population of smaller-sized antlered moose represents A.a. andersoni or a mix of the two stocks.

STUDY AREA AND METHODS

Antler data were taken from moose harvested by resident and non-resident hunters between 1979 and 1981 throughout Yukon (Fig.1). Four measurements were recorded (Fig.2). All technicians were calibrated in recording antler measurements for the following techniques (analysis of variance among technicians for each antler characteristic revealed no statistically significant differences at p=0.05). The greatest antler spread was measured in a straight line at right angles to the centre line of the skull, to the outer most points of the antler. The

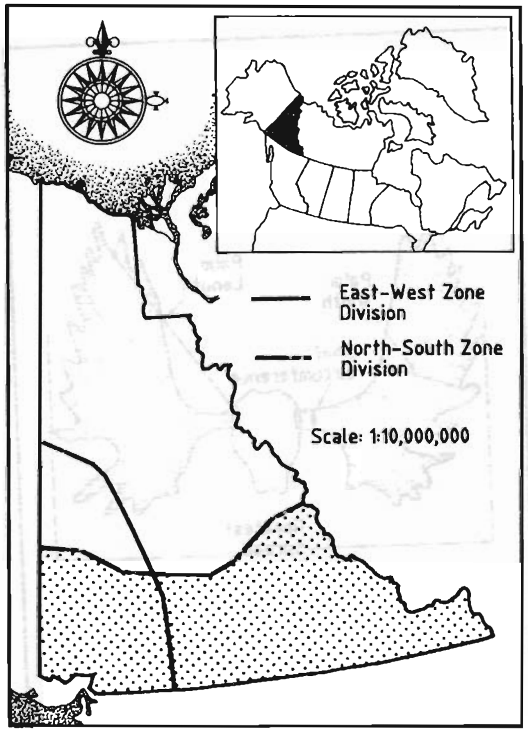

FIGURE 1. Delineation of Yukon into north-south and east-west groupings of data based on moose antler characteristics.

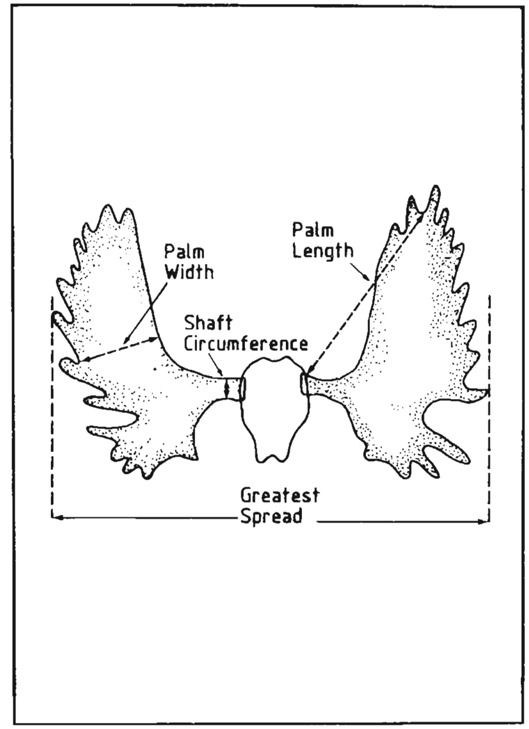

FIGURE 2. Measurements of moose antler characteristics.

minimum shaft circumference of both left and right antlers was taken and the largest minimum shaft measurement recorded. The remaining measurements were taken from the antler with the largest minimum shaft. Total palm length was measured in a straight line from the top or ridge of the coronet to the lowest point of the trough between points at the greatest distance from the coronet. Palm width was measured in contact with the surface across the underside (back) of the palm to the lowest point of the trough between points at the greatest width of the palm. Palm width was measured perpendicular to the long axis of the palm.

The age of each moose was estimated from a first incisor. Teeth were stored in a solution of 70% ethanol, 29% water, and 1% glycerine. Six to eight serial cross sections (0.3 mm thickness) of an incisor were taken beginning six mm from the root tip. Cementum layers of all sections were counted following techniques described by Sergeant and Pimlott (1959). The greatest number of cementum lines counted among sections from an incisor was used to estimate ages (Gasaway et al. 1978). All technicians were calibrated in the cementum sectioning and line count techniques. Low sample sizes for individual ages prompted grouping of data into seven age categories (1-2, 3-4, 5-6, 7-8, 9-10, 11-12 and ≥13 years) for purposes of analyses.

To approximate the east-west split proposed by Peterson (1955), we grouped antler data into 'east' and 'west' regions as shown on Fig.1. We were not able to separate moose antler data from northern Yukon into 'east' and 'west' categories, and therefore rely on data from central and southern Yukon for those groupings. We reason that if there is a difference in antler characteristics using an east-west split, that

difference should be manifested in central and southern populations. Data were also grouped into 'north' and 'south' regions, shown on Fig.1. Tests of normality of antler characteristics showed no significant deviations from normality and an unbalanced analysis of variance design was used to test for significant differences between regional groupings for each antler characteristic. An a posteriori test (GT2) was used to assess differences in antler characteristics among regional groupings and age classes.

RESULTS AND DISCUSSION

Table 1 shows the mean, confidence limits, and test statistic results for comparisons of east-west and north-south groupings of antler characteristics regardless of age. No significant differences were found between 'east' and 'west' regional groupings for any antler characteristics. We conclude that the data represent information from the same population and reject Peterson's hypothesis of an east-west transition zone.

When grouped into north-south categories, the data show statistically significant differences between north and south regions for each antler characteristic. We conclude that the data represent information from two different populations of antler characteristics.

Significant correlations were found between age and each antler characteristic ($p < 0.01$), and we therefore discuss antler characteristics relative to age classes. Table 2 and Figure 3 show the mean and confidence limits for each antler characteristic according to 'north'

Table 1. Descriptive and test statistic results of regional grouping comparisons of antler characteristics regardless of age.

Antler Characteristic	Groupings: East	West	North	South
Spread				
Mean[1]	1206.8±76.8	1194.0±83.7	1348.3±99.4	1152.0±59.9
(n, p values)	(399, 0.66)		(433, 0.01)	
Palm Length				
Mean[1]	630.6±52.5	648.6±53.8	725.7±68.1	610.1±40.8
(n, p values)	(402, 0.36)		(439, 0.01)	
Shaft Circumference				
Mean[1]	173.8± 7.9	176.4± 9.8	189.8± 9.2	170.4± 6.7
(n, p values)	(399, 0.41)		(435, 0.01)	
Palm Width				
Mean[1]	257.3±21.8	264.2±25.4	292.9±27.9	247.2±17.9
(n, p values)	(389, 0.41)		(439, 0.01)	

[1] mean plus or minus 95% confidence limit

Table 2. Antler characteristics according to age classes for northern and southern Yukon.

Region	Antler Characteristics		Age Class: 1-2	3-4	5-6	7-8	9-10	11-12	>=13
North	Spread-	mean	766.9	1152.1	1360.1	1486.2	1480.4	1496.5	1450.0
	95% conf.	limit	97.2	109.0	73.5	68.7	50.4	77.5	125.5
		n	13	14	19	27	21	18	9
	Length-	mean	352.4	573.1	755.2	814.7	801.9	795.7	759.6
	95% conf.	limit	75.1	80.6	72.2	70.1	39.5	33.4	24.5
		n	12	13	23	29	22	18	8
	Shaft-	mean	149.5	163.2	188.3	201.8	200.4	202.5	193.8
	95% conf.	limit	26.7	10.5	8.0	6.3	7.6	6.0	8.7
		n	12	12	23	29	22	18	9
	Palm Width-	mean	153.2	237.6	286.6	329.8	323.8	303.7	331.7
	95% conf.	limit	48.3	57.2	26.0	22.1	22.2	23.8	43.7
		n	10	13	23	29	22	18	8
South	Spread-	mean	718.9	988.2	1236.4	1295.3	1332.3	1374.6	1401.5
	95% conf.	limit	49.3	36.9	48.4	39.7	42.8	58.7	107.7
		n	40	77	61	46	40	37	11
	Length-	mean	317.1	493.5	660.9	730.3	747.2	763.7	688.6
	95% conf.	limit	41.7	24.8	33.1	31.0	19.5	31.6	52.8
		n	40	78	61	46	41	37	11
	Shaft-	mean	127.5	150.6	177.2	182.8	195.2	201.4	185.6
	95% conf.	limit	6.3	4.0	5.9	4.9	4.8	7.3	7.6
		n	41	76	60	45	41	36	11
	Palm Width-	mean	143.1	184.2	274.0	282.0	290.7	308.8	302.9
	95% conf.	limit	20.7	12.9	14.2	15.3	16.6	21.7	46.1
		n	30	76	61	46	41	37	11

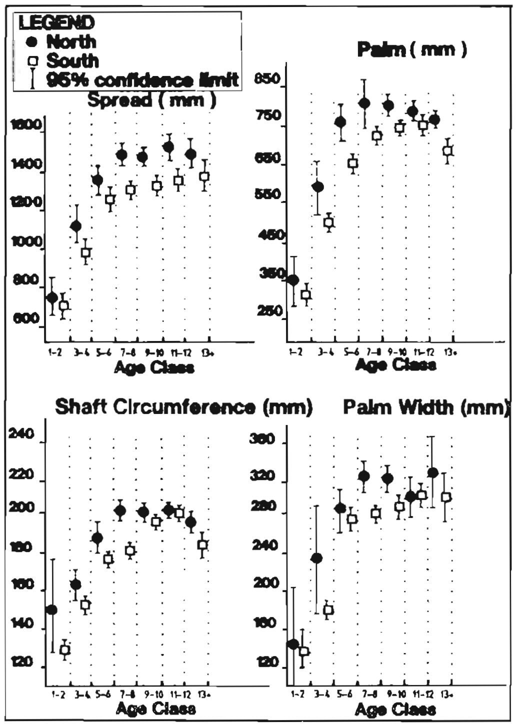

FIGURE 3. Mean antler characteristics with 95% confidence limits for north and south regional groupings.

and 'south' regional grouping and age class. The average values for each age class for each antler characteristic were consistently larger in the north than in the south. We interpret the higher northern values as indicative of a population of A.a. gigas, while the lower southern values likely represent an area where antlers change in size, ie. a transitional area between big and little antlered moose, or moose of hybrid status.

Spread, which is generally regarded as a good indicator of antler size, showed significant differences between north and south for age classes 3 through 12. Antler length, which was significantly correlated ($p < 0.01$) with antler spread for both north-south groupings and according to age class, showed significant differences between north and south for age classes ≥ 3. Shaft circumference showed significant differences for age classes 1 through 8, while palm width showed significant differences for age classes 3-4, and 7 through 10. All antler characteristics were significantly different between north and south for age classes 3-4 and 7-8, and three out of four antler characteristics were different for ages 5-6 and 9-10. The declining trend in the size of antlers in animals ≥ 13 years suggests the possibility of antler regression.

We conclude that the east-west transition zone proposed by Peterson (1955) is unsupported by the available data, and that the northern boundary of a transition zone between A.a. gigas and A.a. andersoni likely lies north-south. This zone lies south of the edge of the tundra region defined by Rowe (1972) and Oswald and Senyk (1977), suggesting that moose classified as A.a. gigas, according to antler characteristics, inhabit both tundra and boreal forest habitats.

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